October/November 2018

traffic
TECHNOLOGY INTERNATIONAL

The end of sensors
Just how much detail can floating car data deliver?

Smarter intersections
How connected technologies are radically improving traffic flows

WWW.TRAFFICTECHNOLOGYTODAY.COM

EXCLUSIVE INTERVIEW!
Greg Winfree on his new role as director of Texas A&M Transportation Institute

FEATURING

comtrans
Your essential guide to the future of transportation communications

Road weather V2X
Effective rural traffic management requires accurate road weather information. Can V2X help?

Cellular RSUs launched
Road managers wishing to deploy connected technologies have a new cellular option

JENOPTIK

We care for global safety.

Jenoptik's Civil Security is making the world safer with advanced security solutions. We capture, analyse and act against public safety threats such as serious organised crime and border control violations through the use of real-time predictive data analysis.

Visit us at booth Z1.B19 at Gulf Traffic and find out more about Civil Security solutions.

We turn data into knowledge.
www.jenoptik.com/traffic-solutions

We specialize in:
- Vehicle Identification
- Person Identification
- Driver Behaviour Detection
- Big Data Analysis
- Data Processing

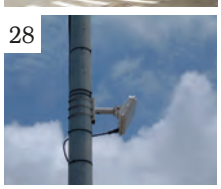
See you at
Gulf Traffic in Dubai
04. - 06. December
Booth Z1.B19

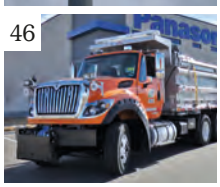
Cover story

36 'Future SCOOT' gets green light

Transport for London is rebuilding its traffic management platform

Saul Wordsworth reports on the Real Time Optimizer (RTO) system that will replace TfL's Urban Traffic Control (UTC) and run 'Future SCOOT'





54


60


62


Technology Profiles

Editor's letter

Denmark's capital, Copenhagen, which hosted the ITS World Congress in September, is a city of contrasts: proudly Danish and yet connected by an international road and rail bridge to Sweden; full of beautiful historical buildings and yet also home to cutting-edge architecture. The contrasts continue when getting around the city. Anyone who visited the Congress will doubtless remember the autonomous metro. It's a well-designed, reasonably priced mass transit system that operates reliably, 24/7, without any drivers. The city is justifiably proud of the metro and I was not surprised to record five mentions of it during speeches on the opening day of the Congress. I was actually slightly miffed, as it meant I narrowly lost my bet that I would hear at least six.

Rather less predictable were the taxis. Operating in an Uber-free bubble, they serve as a stark reminder of what passed for adequate service in this sector in the days before ridesharing and smart-hailing apps began the revolution that has now engulfed most major western metropolises. In Copenhagen the experience of traveling by taxi is as retro as the metro is futuristic. Our hotel was a short, seven-minute car ride from the Bella Center where the Congress took place and yet, even though the fare was US$10-15, drivers routinely refused to take us there because it was 'too close'. Some would agree to do it only if you paid in cash. Others – even on longer journeys – would claim halfway through a ride that their card machine had broken, so cash was the only way. They'd even prefer euros over a card, despite the local currency being Danish krone.

And so one evening we found ourselves in the slightly absurd situation of performing currency conversions on our phones and fumbling around with notes and coins of two different currencies to pay a driver with a glowing and, to all appearances, fully functional card machine attached to his dashboard. So much for Mobility as a Service. It was more like Mobility as a Nightmare. But of course the Congress exists partly to attempt to make inconveniences like this a thing of the past.

On page 16 you can find out what happened when I bumped into an old friend – Greg Winfree – in Copenhagen. His days at USDOT may be a fading memory, but he remains very much at the forefront of transportation research in his new role as director of the Texas A&M Transportation Institute. Elsewhere in this issue you can read about some of the traffic management revolutions that are taking place wherever you are in the world, including the ongoing march of floating car data (p28), the birth of truly smart intersections (p20), rural road weather via V2X (p46), plus the brand-new SCOOT now being developed in London and soon to be rolled out around the world (p36). But before you really get stuck in, don't miss our quick roundup of some of our top stories from the ITS World Congress on page 10, including news of the launch of the city of Copenhagen's first Mobility as a Service app. Taxi drivers take note.

Tom Stone, Editor

traffic TECHNOLOGY INTERNATIONAL
comtrans

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, Bethany Gill, 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

Editorial director
Anthony James

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

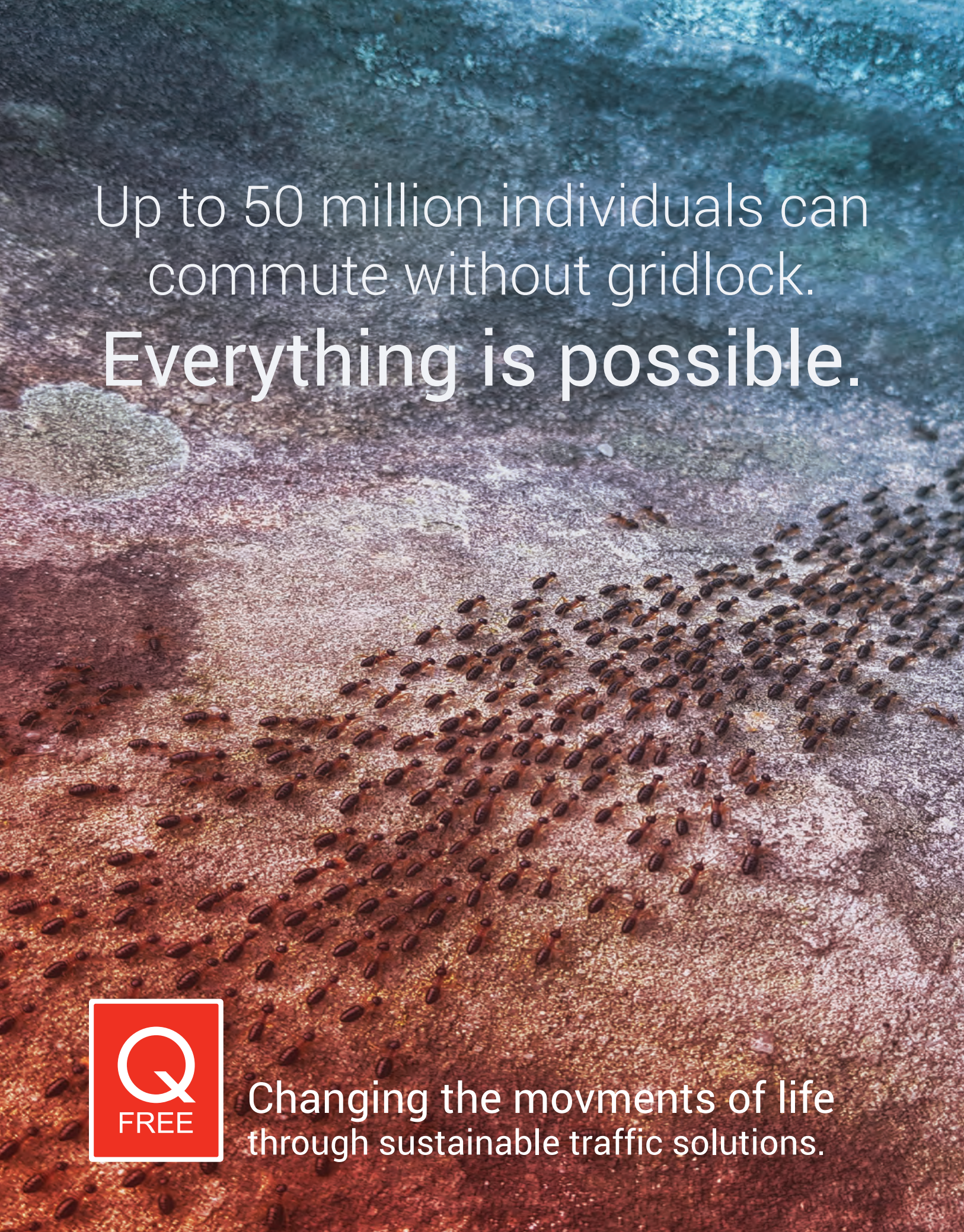
Published by UKi Media & Events, a division of UKIP Media & Events Ltd

Member of the Audit Bureau of Circulations

Average net circulation per issue for the period January 1 to December 31, 2017, was 17,411
Annual subscription US$110/£85
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


Up to 50 million individuals can commute without gridlock.
Everything is possible.
Q
FREE
Changing the movments of life
through sustainable traffic solutions.

UK horizons

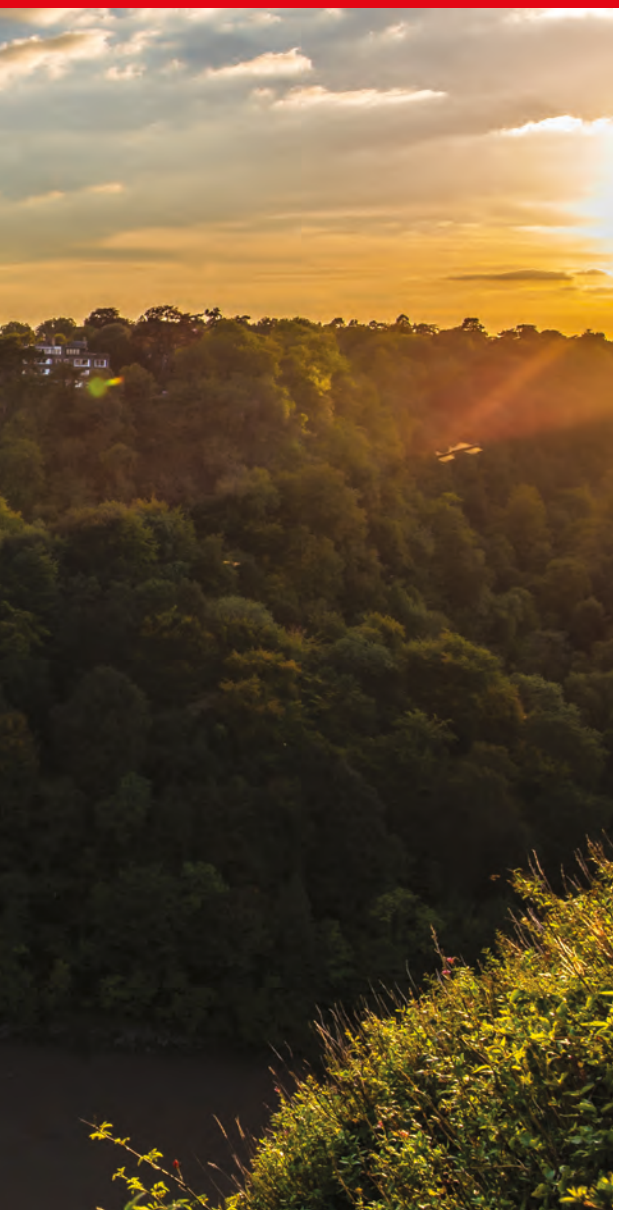
For the first time ever, ITS (UK) is hosting an industry summit. One of the event's founding principles is not simply to discuss new technological solutions within transportation, but also to attempt to establish practical paths toward implementation

November 27, 2018, will see ITS (UK) host its inaugural annual Summit, at the Harbour Hotel in the historic city of Bristol, 110 miles (180km) west of London. Here, attendees will be able to meet with leading industry figures, both from the UK and from around the world, to debate some of the pressing issues facing transportation today.

One of the USA's leading ITS experts, Kirk Steudle, director of Michigan DOT and CEO of the American Center of Mobility, will be a keynote speaker at the event. He will be joined by such luminaries as RAC Foundation director Steve Gooding; ITS (UK) Connected Vehicle Interest Group chair Andy Graham; and Giles Perkins, future mobility technical director at global consultancy WSP.

The one-day thought-leadership summit will also bring together ITS operatives, suppliers, contractors and consultants from the public and private sector, alongside those responsible for managing the country's road network, including representatives from the Department for Transport (DfT), Transport for London (TfL), Highways England (HE), Transport Scotland, Northern Ireland's Department for Infrastructure, and Traffic Wales.

"When we decided to introduce a new annual meeting for ITS (UK) members, I wanted it to be different from the long list of conferences that already crowd our working life," says ITS (UK) secretary general Jennie Martin. "We see great solutions week in, week out that don't actually reach implementation, not because they are not



excellent, but because funding or understanding does not exist. This summit will be looking at how we can change this. I promise it'll be a lively, thought-provoking day and not 'death by PowerPoint'!"

Autonomous vehicle debate

A key debate at the event will chaired by Andy Graham, and kicked off with the statement, "This House believes that driverless vehicles are the biggest opportunity for a step change in mobility and therefore it is right that resources and investment are channeled toward them."

Already setting himself up in favor of AVs, WSP's Giles Perkins says, "Automated vehicles provide us with a real opportunity to reinvent our long-established relationship with motorized transportation. They could help us redefine places, improve mobility and enable equitable access for all. As part of a balanced mobility ecosystem, refocused on people and their needs, self-driving vehicles could help us build better communities."

But Christian Wolmar, author of a new book, *Driverless cars: On a road to nowhere*, counters, "The logical outcome [of AVs] is that there will be many more vehicles on the road exacerbating the problems of congestion, pollution and parking." He cites the obstacles to carsharing, such as the need to carry child seats, golf clubs, or to simply make a personal statement, and warns against the real risk of hackers gaining control over braking and steering systems.

The two speakers will continue the discussion in Bristol, where audience input will also be invited.

The event will follow ITS (UK)'s annual dinner and awards ceremony, which will take place at the Bristol Harbour Hotel the night before, hosted by the organization's president, Steven Norris.

For more details of both events visit www.its-uk.org.uk

Left: **Bristol's iconic Clifton Suspension Bridge**

Above: **The city's vibrant harbor area, where the summit will take place**

£28bn

The predicted size of the market for connected and autonomous vehicles in the UK by 2035 (US$37bn)

Source: Transport Systems Catapult

> "We see great solutions week in, week out that don't reach implementation, not because they are not excellent, but because funding or understanding does not exist. This summit will be looking at how we can change this
>
> ***Jennie Martin, secretary general, ITS (UK)***

Bristol in brief

The largest city in the southwest of England is the setting for the inaugural ITS UK Summit in November. Here are its key transportation facts and figures

Infographics by Anna Davie

4,874,943

people flew into or out of **Bristol Airport** in the first six months of 2018

More hot-air balloons are manufactured in Bristol than anywhere else in the world

With more than **9,900** cycle parking spaces, Bristol was named as one of the world's **Top 10** bicycle-friendly cities and was also awarded money from the UK's Department for Transport to improve cycling provisions further

Vehicles traveled

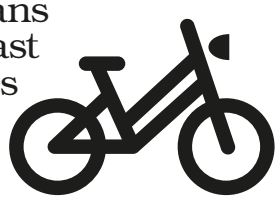
27.8m miles

(44.8m km)

on Bristol's roads in 2016

11.9%

of Bristolians cycle at least three times a week



2,503 miles

(4,028 km) of roads make up the city's network

A hydrogen-powered ferry provides harbor cruises

Peak hour traffic adds

148

hours a year an average drivers' travel

In 2016 Bristol's roads were most congested on Friday, September 23

SEPTEMBER

23

The 154-year-old, Grade 1-listed Clifton suspension toll bridge carries more than

4m

vehicles every year

Source: www.cliftonbridge.org.uk

Bristol has the highest combined levels of walking and cycling to work of any local authority area in England and Wales

Source: Good transport plan for Bristol

Crown Commercial Service

Save money on technology solutions with CCS

In a constantly evolving technology market, it's vital for public sector organisations to make the right procurement decisions. CCS is here to help you get the best transport technology solutions at the very best price.

WE HELPED TRANSPORT SCOTLAND REDUCE CASUALTIES BY 62% ON ONE OF THE MOST DANGEROUS ROADS IN THE UK

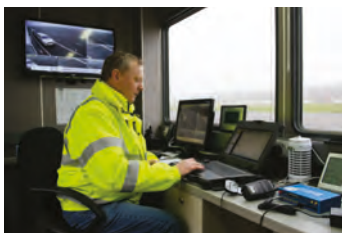
Our Traffic Management Technology framework has everything you need to make cities smarter, from traffic monitoring and enforcement to electric vehicle charging infrastructures and solutions to improve air quality.

Find out how we can help you transform your transport technology procurement

ccsheretohelp.uk/transporttech

Measure up

Road Safety Support's camera testing facility in the UK is now an official, international calibration laboratory. **James Gordon** gets the inside story



The RSS laboratory is certified to calibrate traffic speed measurement devices according to the ISO 17025 standard

A UK-based road safety firm, which is using cutting-edge technology to help reduce road casualties, has been officially recognized as an international calibration laboratory.

Road Safety Support (RSS), a not-for-profit company that is headquartered in Essex in the southeast of the UK, was recently awarded ISO 17025, meaning it is one of only a few laboratories in the world certified to calibrate and test road traffic speed measurement devices to this higher and much more exacting standard.

The facility has been approved by the United Kingdom Accreditation Service (UKAS) to test the accuracy of speed cameras and other devices, either at its dedicated testing track or on any road across the world.

Two
The number of years it took RSS to achieve the new ISO 17025 standard, through multiple inspections of processes and facilities

RSS's managing director, Trevor Hall, says, "Receiving accreditation is a significant achievement, one that recognizes our facility for calibrating and testing road traffic speed measurement devices."

He continues, "We are extremely pleased to have achieved this designation. Accreditation is a rigorous process, but one that we welcome as a continual quality improvement mechanism. Earning UKAS accreditation is another measure of our excellence as a test laboratory to perform tests on any road, anywhere in the world that is covered by GPS satellite service. It sets us apart, as very few organizations in the world have obtained accreditation for this specific use."

> "Legal teams representing those accused of breaking the law will find it much harder to query the reading on a camera, or wriggle free on a technicality, as the new standard leaves no room for error"
> ***Trevor Hall, managing director, RSS***

For a number of years, RSS has been responsible for testing the reliability and accuracy of new road traffic enforcement technologies in the Type Approval process, on behalf of the Home Office. RSS adds value to the calibration of devices by also checking the integrity of devices in an operational setting.

RSS said that the new standard, which took two years to achieve and included inspections of its processes and facilities, "will use its new accreditation to strengthen that process".

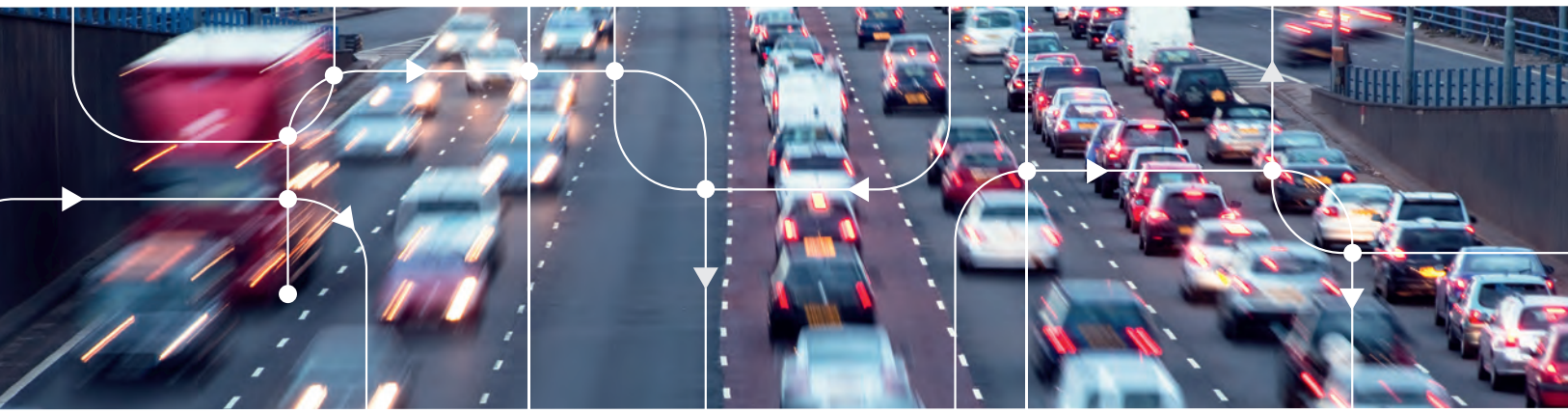
Hall adds, "Achieving the new standard gives confidence that the validity of the results provided and the accuracy of the measurements undertaken can be relied upon and are traceable to national standards. It will mean that the legal teams representing those accused of breaking the law will find it much harder to query the reading on a camera, or wriggle free on a technicality, as the new standard leaves no room for error. On the flip side too, it will provide defendants with an even greater level of confidence that the camera used to record their speed is operating at a well-established accuracy."

Now an accredited laboratory for speed measurement, RSS will offer services to camera providers worldwide, as well as offering services to the motoring industry and other related organizations.

Intertraffic

The leading traffic technology events connecting traffic professionals worldwide

INFRASTRUCTURE • TRAFFIC MANAGEMENT • SMART MOBILITY • SAFETY • PARKING



Save the dates for our upcoming events

JAKARTA - ID
31 OCT - 2 NOV **2018**

MEXICO CITY - MX
13 - 15 NOV **2018**

ISTANBUL - TR
10 - 12 APR **2019**

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

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

Organised by: rai AMSTERDAM

In partnership with: TTEC, ITS CHINA 中国智能交通协会, UBM, EJK Tarsus E.J. Krause Tarsus de México, Tarsus INDONESIA

www.intertraffic.com

Congress crunch

The transportation world turned its attention to Copenhagen recently for the ITS World Congress. **James Allen** rounds up some of the big stories to come out of the show, from all corners of the globe

Big Apple, big data

NYC DOT moves forward with advanced data processing program

The New York City Department of Transportation's (NYC DOT) chief technology officer, Cordell Schachter, revealed how the organization is investing in the processing of big data to save money in the future and reduce traffic congestion.

Schachter – who is also on the ITS America board of directors – explained how NYC DOT had to recognize its limitations in data processing in order to move forward with the large amounts of data the DOT collects. He said, "We have learned the importance of supporting both public and private development tools, as

well as the importance of supporting young people to become data scientists."

Proper processing of collected information enabled NYC DOT to share meaningful data sets with the public as part of its data share program.

"Unless you have the right data analysts or scientists working for or with you, then it won't be easy to unlock the value of your data," said Schachter.

8,000

The number of vehicles equipped with V2X hardware as part of the USDOT's Connected Vehicle Pilot Program in New York City

MaaS for the Danes

Updated Copenhagen journey planner app launched for immediate use

A new Mobility as a Service (MaaS) app for Copenhagen was launched at the ITS World Congress.

MinRejseplan is a new generation of the Rejseplanen journey planner and was made available for use in the Danish capital.

Before developing the app, certain critical elements had to be considered: access to transportation data to improve mobility; interoperability of transportation service platforms; a connected, automated, service-based and electric (CASE) ecosystem; and public-private partnerships.

"I often get asked who is responsible for setting up MaaS. The answer is: the organization is in the best position to do it, in terms of inviting different stakeholders," Piia Karjalainen of the MaaS Alliance told Congress attendees.

C-ITS live

Dutch university demonstrates eight V2I technologies being tested across Europe

Eindhoven University of Technology demonstrated eight C-ITS applications that are all currently live in sites across Europe.

During a 20-minute drive, visitors were shown vehicle-to-infrastructure (V2I) technologies operating in a number of theoretical applications.

The systems demonstrated on the modified Toyota Prius

included pedestrian warning, green-light optimal speed advisory, road hazard and traffic manager notifications.

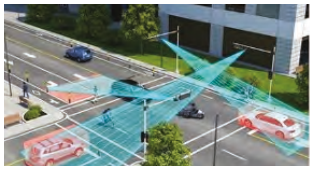
Solid-state vision

LeddarTech unveils two new lidar sensors for ITS applications

Canadian firm LeddarTech launched two new solid-state lidar (SSL) sensors for ITS at the Congress. The SSL 2D sensing units are capable of both object identification and distance measurement, making them suitable for a variety of electronic tolling and traffic management deployments.

The T16 and M16-LSR units aim to improve the performance, reliability and cost efficiency of various ITS applications that rely vehicle detection, profiling and velocity measurements.

The M16-LSR uses highly efficient laser flash illumination with various field-of-view options and measurement



rates of up to 100Hz, making it the ideal sensor for city-speed applications and detecting vehicles passing through highway toll plazas.

The unit can differentiate between bicycles, pedestrians, and multiple types and classes of vehicle, so it can also be used for free-flow electronic tolling classification, gated access control systems and height warning systems.

GULF TRAFFIC

TECHNOLOGY FOR SMARTER CITIES

ZA'ABEEL HALLS 1 & 2
DUBAI WORLD TRADE CENTRE

04 06 DEC 2018

Technology For smarter cities

Connect and think smarter with influencers and peers from the traffic technology industry who make a difference only at Gulf Traffic 2018.

REGISTER FOR FREE

www.gulftraffic.com/en/register

AI in Dubai

This year Gulf Traffic (which will take place in Dubai from December 4-6) is evolving – not only will there be a host of new exhibitors and an expanded conference program, there's also a whole new sector being showcased: artificial intelligence. **Rachelle Harry** reports

One of the key features of Gulf Traffic is its exhibition at which 150 companies from 55 countries will be showcasing their latest innovations. Exhibited products will be reflective of the event's theme – Technology for smarter cities – as well as its increased focus on the future of transportation.

"With product sectors including ITS, traffic technology, infrastructure, road safety, parking and now artificial intelligence [AI], there really will be something there for everyone in the industry," says Claudia Konieczna, exhibition director at Informa, the company that is organizing the event.

"Around 40% of this year's exhibitors are completely new to Gulf Traffic," says Konieczna. "We welcome companies such as Miovision, Ride with Via, ScanSmart, TEC Engineering, Tioman, Fleeture and Captels – all of whom are showcasing new products and innovations.

"Such products include speed sensors, smart parking systems, navigation and mapping solutions, traffic detection and monitoring systems, vehicle tracking devices, connected technologies and ridesharing apps," continues Konieczna. "We have also extended our product sectors to include artificial intelligence and I am excited that we are going to see these products on the show floor."

Left: **Dubai is the glittering host city for Gulf Traffic**

GULF TRAFFIC PREVIEW

by giving parking wardens the option to issue parking tickets from the comfort of their office."

Conference program

Other highlights for the 3,000 expected visitors include themed conferences and presentations from industry experts.

"This year, we are pleased to welcome the Saudi Ministry of Transport which, for the first time ever, is officially supporting and exhibiting at the event," says Konieczna. "The organization will discuss how it is developing transportation in order to achieve the goals of Saudi Vision 2030. In addition, we will hear about how it plans to keep the world's longest straight road [Highway 10] safe – with no traffic signals.

"We are also excited to announce that we have partnered with Road Safety UAE to host Gulf Traffic's first Road Safety Conference," continues Konieczna. "The Road Safety Conference will see speakers from Volvo, TomTom and Continental discussing how cities around the world are making their roads safer. Attendees will also hear about what technologies Dubai's Roads and Transport Authority is using to reduce traffic fatalities."

At the forward-thinking Future Infrastructure Conference, both the UAE Ministry of Infrastructure Development and Saudi Ministry of Transport will reveal their infrastructure and transportation plans. The conference will also involve presentations from US-based Via Transpiration, which will reveal how its technology can help transit planners to quickly adapt to sprawling cities. "In addition, Virgin Hyperloop One will give an update on the pending launch of their Hyperloop in the UAE, as well as discussing

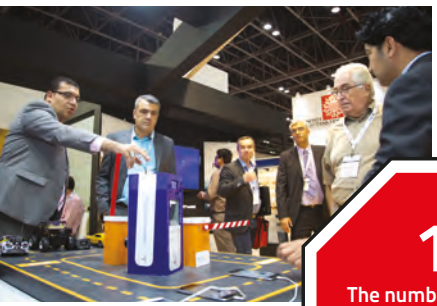
55
The number of countries that will be represented at this year's Gulf Traffic event

The exhibition will display the latest transportation technologies from organizations such as Tesla, which will be showcasing its self-driving Model X; Siemens, which will be promoting its most advanced intelligent transportation systems to date; and Sensys Gatso, which will launch a new generation of enforcement technology known as the X Series.

"In addition, we are very excited to welcome ScanSmart and Arvoo, which are exhibiting at Gulf Traffic for the first time," says Konieczna. "ScanSmart and Arvoo will showcase an innovative automatic license plate recognition [ALPR] parking enforcement system that eliminates the need for on-street enforcement

> "This year, we are pleased to welcome the Saudi Ministry of Transport which, for the first time ever, is officially supporting and exhibiting at the event
>
> ***Claudia Konieczna, Gulf Traffic exhibition director, Informa***

GULF TRAFFIC PREVIEW



13
The number of winners that will be chosen in this year's hotly contested Gulf Traffic Awards

Above: **Attendees at Gulf Traffic 2018 will get to see the industry's latest innovations first hand, as well as being able to take part in the growing conference program**

the benefits that it will bring," says Konieczna.

The all-new Artificial Intelligence in Transportation conference will see speakers such as Tarek Saeed, chief AI officer at IBM; Dr Jorge Dias, professor of electrical and computer engineering/robotics at Khalifa University, Abu Dhabi; and Jorge Sebastiao, chief transportation officer at Eco-System, presenting their latest findings and solutions. Other key topics of discussion will include how AI will help to reduce traffic congestion and emissions in Dubai to make it a smarter state, and how emerging ethical AI guidelines and government regulations will impact AI usage.

Developments in technology

"Next-generation technologies are changing the way that we travel," says Konieczna. "As our cities continue to grow, more people are traveling than ever before. The industry therefore needs to become more sustainable.

> "In logistics and transportation, blockchain will reduce the middleman and administrative costs
>
> ***Claudia Konieczna, Gulf Traffic exhibition director, Informa***

"Blockchain technology, although in its very early stages, will change the industry in many ways," says Konieczna. "For example, in logistics and transportation, blockchain will reduce the middleman and administrative costs, and the risk of lost shipments and incorrect documents could be eradicated. We are still in the early stages of discussions for Gulf Traffic next year [2019], but I believe blockchain will be a key talking point for our visitors, exhibitors, and us as the organizer."

Find out more and book your pass at gulftraffic.com

Awards and competitions at Gulf Traffic 2018

The Gulf Traffic Awards will return at this year's event to honor companies and individuals who have shown commitment toward developing projects, products or initiatives that benefit the public and region.

"I am especially excited to see who wins this year as we have introduced new categories including Best Road Project and Best Bridge and Tunnel Project," says Claudia Konieczna. "Our judging panel, made up of 10 industry experts, will go through a number of thorough review stages to select 13 winning submissions. And having personally reviewed all entries, I can say that they certainly have a tough job on their hands."

For the first time ever, Gulf Traffic is running a Driving Innovation competition for students. Designed for undergraduate and postgraduate students from all disciplines, project entries will need to address solutions around smart technologies and can cover – but are not limited to – the following areas: road safety, smart mobility, AI in transportation, ITS (including telecoms), transportation systems (including logistics) and renewable energy.

"The competition offers students a fantastic opportunity to meet potential employers, as well as providing a great experience for them to add to their resumés," says Konieczna.

The winning project will be presented with a Gulf Traffic Award and will also be promoted across various social media platforms, as well as in an email to Informa's database of over 50,000 industry professionals.

The winner will be selected by Informa's expert panel of judges and will be announced on the show floor on December 6. "Who knows, one of our student entrants could be the next Elon Musk," says Konieczna.

From USDOT to Texas A&M Transportation Institute, **Gregory D Winfree** remains one of today's leading figures in mobility research

Interviewed by Tom Stone

Greg Winfree is a highly recognizable and well-respected figure at the ITS World Congress and, when I met him at the latest edition of the annual event, which took place in Copenhagen in September, he was as open, genial and enthusiastic as ever about the potential of transportation to create a better world. Last time I interviewed Winfree, in 2015, he was serving in the Obama administration as assistant secretary for research and technology at USDOT. In December 2016, as Washington prepared for a political changing of the guard, Winfree shipped out, taking up his current role as director of the Texas A&M Transportation Institute (TTI), which he sees as a logical progression from his role in government.

"At USDOT I had responsibility for a multidisciplinary, multimodal research portfolio stretching across the entire department," he says. "The opportunity which presented itself at TTI was in perfect alignment, a continuation of the same mission – same communities, same issues. TTI has a long history in transportation infrastructure – pavement materials, roads and bridges. We're involved in all facets of transportation – from policy research to data science. Those areas are always important, especially as we begin to grapple with what we called the 'data tsunami' at USDOT. As all this electronic wizardry hits our roadways, a tremendous amount of information will be generated; managing and mining it will be a significant task."

Winfree has no wish to dwell in the past, but rather seeks to position TTI in a forward-looking role. Ideas that may now seem far-fetched, such as airborne urban

> A tremendous amount of information will be generated on our roadways; managing and mining it will be a significant task

transit via 'drone-taxis', may be deployed quicker than people think, he suspects. Soon research could be turned to developing the solutions these new modes will demand – such as three-dimensional traffic management systems.

Winfree is proud of the many institutions with which TTI is affiliated, including Safe-D, CARTEEH and the Center for Infrastructure Renewal (see *How the Institute is growing*, below right). But the conversation seems to circle back to a subject that has long been central to Winfree's vision: connected autonomous vehicles (CAVs).

Planning a connected future

"Two areas I took a great interest in at USDOT were connected vehicles and managing the civil equities in GPS," he recalls. "Those two technologies will be critically important as AVs become more of a reality and less of a test scenario. Global satellite systems providing that navigation – whether it's GPS, Galileo in Europe, BeiDou in China, or even the GLONASS signal provided by the Russians – will be key as self-driving technologies roll out. You can't navigate if you don't know where you've been or where you're going. Those components are right at the heart of what we do in the World Congress community."

As a big fan of two-wheeled motorized transportation, Winfree was once dubbed 'President Obama's man on a motorbike', and flashes a broad grin at the mention of motorcycles. "We're renowned for our crash-test program; many safety innovations you see on roadsides were developed at TTI," he says. "One recent crash test concerned how to prevent motorcyclists being ejected over Jersey barriers and what mitigation technologies can be put in place." Warming to the subject he remembers the connected motorcycle initiative launched by BMW, Honda and Yamaha at the 2015 Bordeaux ITS World Congress. "That's still near and dear," he says. "I've engaged with Honda about how it can remain impactful; I don't want to see those issues tabled until the back-end of integration. Two-wheeled transportation is usually forgotten until the last moment, then everyone's scurrying around to accommodate it. We have a green field with connected vehicles, so let's get motorcycles in now and make sure they're safe."

Left: **TTI's new headquarters at the Texas A&M University System's RELLIS Campus**

How the Institute is growing

Founded in 1950, Texas A&M Transportation Institute (TTI) has conducted research in all 50 US states and more than 40 countries. With 700 projects each year covering every conceivable aspect of transportation, it has provided breakthroughs that have saved billions of dollars and thousands of lives. Since the start of 2017, it has had a new director – Greg Winfree, formerly of USDOT – who is brimming with enthusiasm.

"One of the most exciting things is our new corporate headquarters," Winfree says. "We're a state agency affiliated with Texas A&M University, College Station. There's a portion of the campus, formerly a World War II military base, now called RELLIS – standing for our core values of Respect, Excellence, Leadership, Loyalty, Integrity and Selfless Service. Situated there is our new Center for Infrastructure Renewal. That's where our pavement materials laboratories are; a sensor lab for automated vehicle work will be commissioned; we've got a smart grid, where we can look at issues impacting the electrical grid. It's an extraordinarily exciting facility.

"Our CAV work is moving apace and we're working on truck platooning with Texas DOT," he continues. "We also have two USDOT-sponsored transportation centers. One is Safe-D – that's Safety through Disruption; the other is CARTEEH, focused on the confluence of public health and transportation, so very forward-thinking. There's a lot going on that's positive – it's a great place to be."

During the World Congress, we had both seen a demonstration of connected vehicles from Las Vegas, combining technologies from Cohda Wireless, Cisco Systems, NXP and Esri. The setup, relying on dedicated short-range communication (DSRC) technology, was impressive in its functionality and robustness. When I ask Winfree about the ongoing debate as to whether DSRC or potentially cheaper cellular technologies provide the best medium for CAV communication, it taps into a strong vein of conviction. He points to recent developments involving General Motors, Mercedes and Toyota fitting vehicles with DSRC as evidence that corporate enterprises are increasingly convinced of the benefits of DSRC for both shareholders and potential customers. DSRC also has the advantage of technological readiness which, for Winfree, carries with it a strong moral imperative.

"DSRC is the one technology that's mature and ready to be rolled out – that can start saving lives tomorrow," he says. "We lose 100 people each day on US roadways. That's measurable: every day that we don't have affirmative support for DSRC means 100 more families grieving loved ones." For Winfree, safety provides the fundamental

Right: **A computer-generated fly over of the Texas A&M RELLIS Campus**

> DSRC is now being installed in GM, Mercedes and Toyota vehicles. Corporate enterprises are about returning value to shareholders, so they don't take these decisions lightly

raison d'être for connected vehicles and the immediate, human dimension overrides arguments for ongoing 'technology agnosticism' professed in some quarters. "If 5G becomes the next wave of technology, then fine. But I've been sitting on panels where we've recognized that they're already talking about 6G and C-V2X. These technologies are promising; they should be investigated and, as they come down the line, implemented if appropriate. But they're not ready to be implemented tomorrow."

Beyond the safety imperative, Winfree sees other compelling arguments favoring DSRC. For one, it can enable the ITS community to begin convincing the public of the benefits of connectivity. "It gets us out of the ideation of what connected vehicles are about and allows us to say, 'From this point on, the technology is going to be available to start improving efficiency and saving lives'." He also emphasizes the collaborative nature of CAV development, involving both governments and corporate partners worldwide. "It would be a disservice to all parties not to have an affirmative move regarding DSRC," he says. "They can't operate in an uncertain environment."

Spectrum sharing

The same argument applies to debates that are still ongoing surrounding sharing or splitting the 75MHz spectrum range allocated for ITS DSRC communications with other commercial non-transportation industry players. Winfree believes dividing the available bandwidth would undercut the potential benefits of DSRC connected vehicles by congesting the spectrum. He also finds hypothesized solutions for sharing the spectrum that involve 'sense, detect and avoid' mechanisms unconvincing, being liable to result in denial of service situations. However, he is hopeful such debates will soon be settled and returns to his earlier point about GM, Mercedes and Toyota backing DSRC as evidence that the technology is really now beginning to gain traction. "Corporate enterprises are about returning value to shareholders, so they don't take these decisions lightly," he notes.

For now, Greg Winfree is relaxed and avuncular, very much at ease amid his peers in Copenhagen "Having been leader of the USDOT delegation means a lot of folks at the World Congress know who I am," he says. "I think I built a good reputation at DOT for being an advocate, but a responsible advocate – not a firebrand. Those who remember Orlando 2011 may recall a wide-eyed gentleman, only in the job two weeks, having to address 8,500 people! It's an organization and a mission that I hold near and dear, as we look at roadway safety, increasing efficiency, congestion mitigation, and all those topics that bedevil us now."

US$350m

The price tag on building Texas A&M's new RELLIS Campus, which includes a test track and proving ground for connected and autonomous vehicles

RELLIS world

The US$80m Center for Infrastructure Renewal was the first new facility to open on the redeveloped RELLIS Campus in April 2018. Authorized by the Texas Legislature, the center will develop new methods and better materials for the nation's ailing infrastructure and train the private sector in how to apply new techniques and materials. Other major transportation-related research and testing facilities located at the RELLIS Campus are TTI's Environmental and Emissions Research Facility, Sediment and Erosion Control Laboratory and Roadside Safety and Physical Security program.

VITRONIC
the machine vision people

POLISCAN RED+SPEED

FOR SAFER ROADS

Meet us at Gulf Traffic 2018
04-06 Dec 2018
GULF TRAFFIC
Za'abeel Halls 1 & 2 –
Dubai World Trade Centre
Booth Z1.A30.

Maximizing safety at intersections

Intersections and crossings are high risk areas especially for vulnerable road users. By combining red light and speed enforcement, POLISCAN RED+SPEED helps authorities address two of the most dangerous driving habits in these busy zones. POLISCAN RED+SPEED maximizes safety at intersections and ultimately saves lives.

www.vitronic.com

Watch POLISCAN RED+SPEED
in immersive 360-degree

Intersection of ideas

In Detroit there's a new way to manage intersections, using smart systems for fault reporting, signal priority and dynamic safety enhancements. Plus, open architecture means the foundations are now being laid for a whole new traffic ecosystem. **David Smith** reports from Motor City

Back in 2013, the City of Detroit was struggling to maintain the lights and signals at its intersections and the roads were getting more dangerous. The City had filed for the USA's largest-ever municipal bankruptcy, around US$19bn, and was too cash-strapped to spend huge sums on monitoring and replacing faulty equipment. To address the problem, the traffic department brought in camera and sensor technology to monitor intersections remotely. But that was just the beginning of Detroit's infrastructure enhancements. It turned out the technology offered a huge number of additional benefits, such as smart monitoring of cyclists; fast, sophisticated data gathering; sending alerts to connected cars and Waze users that jaywalkers are ahead; and providing priority access for emergency and freight vehicles.

> When we were going through bankruptcy, signals kept going out. It was using up a huge part of our budget. We wanted a cheaper solution
>
> **Mark de la Vergne, chief of mobility innovation, City of Detroit**

What started out as the need to solve very basic functionality problems in Detroit has developed into one of the world's most advanced systems for monitoring intersections.

Open for business

The system's open architecture was inspired by the iPhone's multitude of apps, according to Miovision, the Canadian supplier. It means new software applications can be added easily to the existing hardware, enabling the city to constantly innovate and improve services. At this summer's ITS America Annual Meeting in Detroit, Miovision and the city set up a demonstration of the technology's capabilities. They equipped five intersections along Larned Street, which runs in front of Detroit City Hall, with systems in use at other city intersections. However, they also added new software applications to demonstrate the value of the open approach. Miovision dubbed the corridor 'the world's smartest intersection', which, while it may be marketing spin, is not far from the truth.

Rising from the ashes

The intelligent intersections on Larned Street are the result of years of work, says Mark de la Vergne, Detroit's chief of mobility innovation. "When we were going through bankruptcy, the signals kept going out," he says. "We had to send crews out every time to find out what wasn't working. It was using up a huge part of the transport budget and we wanted a cheaper solution that involved remote monitoring. But once we started, we began asking how we could use it to make the city safer, more affordable and easier to get around. We've already seen emergency vehicle response times improve by 20%, travel times by 30% and there's more we can do with the data," he says.

20%

The improvement in emergency response times since the installation of smart intersection technology in Detroit

Back in the dark days of 2013, staff relied on citizen complaints to alert them to traffic signal fails. Now the city has remote monitoring via Miovision's TrafficLink technology, which includes a 360° fisheye camera, an array of smart sensors and an IoT-connected hub. It was a godsend to the Detroit traffic teams. Miovision then coupled video analytics with deep learning so it could monitor intersections more accurately and gain more insights from data.

Advanced recognition

The company has trained the system's AI using data from more than seven billion vehicles and 770 million cyclists and pedestrians. It can recognize the movement of vehicles, cyclists and pedestrians, and is able extract insights, such as travel times at rush hour and jaywalking hot spots. The AI provides the "eyes and brains of an intersection", says Dave Bullock, vice president of product strategy for Miovision.

There are already about 400 smart intersections in Detroit, with plans for more.

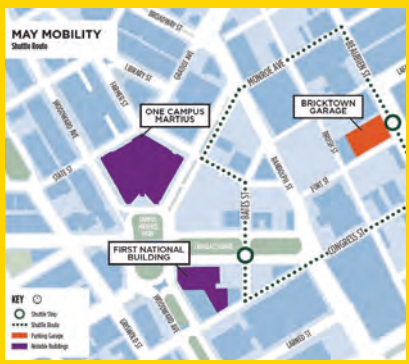
AV uptake to Quicken

A first-of-its-kind autonomous shuttle service aims to reduce pollution and congestion in the center of Detroit

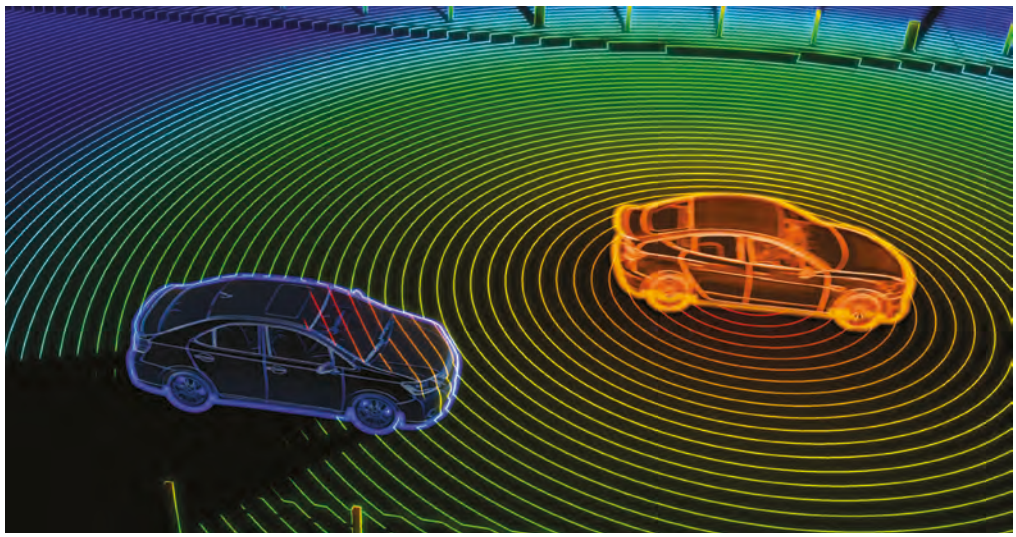
June 2018 saw Detroit become the first urban center in the USA to deploy a permanent, self-driving shuttle route on public streets alongside cars, cyclists and pedestrians. The automated vehicles (AVs) were made by the Michigan startup May Mobility and are being used to transport close to 18,000 employees of the Quicken Loans company, the largest mortgage lender in the USA, between its different offices and parking lots in the city.

Previously, Quicken Loans' property management firm, Bedrock, had to hire a fleet of three dozen private shuttle buses to deliver the employees to its many downtown office buildings. The packed buses spewed out diesel exhaust fumes 18 hours a day on the congested streets. All have been replaced by electric AVs, which steer through the traffic on a mapped, closed loop with a top speed of 25mph (40km/h).

The AVs rely on lidar, radar and camera sensors, and also use radio frequency signals implanted in signs and streetlights on the route. For now, May Mobility has a human driver to take control if necessary. Earlier this year May Mobility raised US$11.6m in seed funding from BMW iVentures, Toyota AI and others.



The Quicken AV shuttle travels on a closed loop on public roads



Intersection technology allows traffic managers to predict potential accidents

Much of the focus, driven by the requirements of the city, has been on safety. In 2015, Detroit had the highest pedestrian fatality rate in the USA, at 6.79 per 100,000 people. This had improved to 4.31 by 2016, but Detroit was still one of the five worst US cities for pedestrian deaths. The intersection technology provides more accurate and faster predictive safety analytics, which means traffic managers can react immediately to problems, or even predict them. "It used to take years to collect crash and fatality data and see what happened, then make changes, but we can now analyze near misses, as well as accidents, which gives us a lot more data," says de la Vergne. The technology can spot a multitude of other changes, such as worn markings on bike paths, malfunctioning streetlights, jaywalking and cars reversing dangerously.

Vulnerable road users

Cyclists are particularly vulnerable, but the cameras in Detroit monitor the 'dilemma zone', an area in which a rider may face a tricky decision when a signal turns yellow. Signals are timed for cars, but cyclists move more slowly. Riders can face a dilemma about whether to slam on their brakes and risk being shunted in the back or to proceed into the intersection and be vulnerable to a collision. But Miovision's SmartView 360 cameras are connected to the AI system, which detects cyclists in the dilemma zone and instructs the controller to hold the green signal for two seconds extra.

Two seconds

The extra green time automatically given to cyclists detected in a 'dilemma zone' at Detroit's smart intersections

Funding the future

Michigan has long been a center for automotive innovation in the USA – a tradition that is continuing with automated and connected vehicles

The Michigan Translational Research and Commercialization (MTRAC) Innovation Hub for Advanced Transportation (overseen by the University of Michigan [UM]) has awarded a total of US$700,000 in startup funding to 10 new technologies addressing transportation issues and opportunities. Three of the 10 projects were autonomous driving technologies.

The projects were selected – from 26 proposals submitted by six universities – by a 15-member committee comprising venture capital professionals, industry experts from leading transportation firms and experienced entrepreneurs.

Projects were selected for their "capability to identify opportunities in the transportation space and propose effective solutions, in tandem with researcher team strength and commercialization plans". The MTRAC program is a partnership with the Michigan Economic Development Corporation's Entrepreneurship and Innovation initiative.

AV technologies received the most attention. The maximum award of US$100,000 went to UM's wireless technology system for "long coverage range and high data rate connectivity for autonomous vehicle data flow". Also from UM, the "all-weather lidar system for autonomous vehicles that improves object recognition in inclement weather" received US$86,957. Meanwhile, Michigan State University received US$93,478 for its "high-resolution radar imaging for autonomous vehicles that is less costly than existing lidar systems".

Other winning technologies include a vehicle noise control product, a high-speed 3D printer system and a process for weldability analysis.

MTRAC programs have so far funded 169 projects and helped establish 32 startups. Technology has been licensed to 22 companies and more than US$132m follow-on funding has been secured.

The Canadian connection

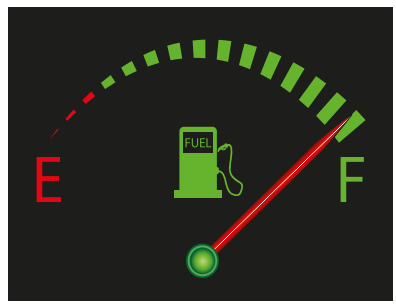
Detroit's infrastructure improvements aren't limited to intersections – soon there will be a new crossing to Canada

The longest cable-stayed bridge in North America is being built, which will link Detroit and Windsor, Ontario, in Canada. Bridging North America, a partnership between the Fluor Corporation and ACS Infrastructure Canada, overseen by the Windsor-Detroit Bridge Authority (WDBA), is constructing the Gordie Howe International Bridge. The project broke ground on July 17, 2018, and is due for completion by the end of 2022.

The finished crossing will include new ports of entry (POEs) on both the US and Canadian sides, as well as bringing improvements to existing infrastructure in both Michigan and Ontario. It will have an 'A' shape, six lanes and will be 1.6 miles long (2.5km), with a main span of 2,799ft (853m).

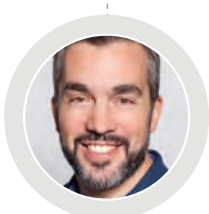
25%

The average reduction in fuel use in heavy trucks achieved with freight priority at signals



Using the same technology, the city can manipulate traffic signals to clear the way for emergency vehicles. The Detroit police department had already invested in wireless modems for vehicles, and because of the open architecture, their technology was compatible with Miovision's monitoring equipment. The police modem engages the siren, which automatically sends the vehicle's location wirelessly to the cloud, where TrafficLink triggers signals at every intersection in its path. "Normally it's expensive to buy new equipment for police cars, but the open approach allows the two data systems of the police and Miovision to be integrated for a low cost," says Bullock.

> It's expensive to buy new equipment for police cars, but the open approach allows two data systems to be integrated for a low cost
>
> **Dave Bullock, vice president of product strategy, Miovision**



Related to emergency pre-emption, Miovision has introduced freight signal priority in certain corridors in Detroit. The system provides real-time tracking of freight vehicles. When loaded with cargo, they get green light priority at certain times. Bullock says it has resulted in a roughly 25% reduction in fuel use for heavy 18-wheel trucks, which consume lots of fuel as they get moving again after having come to a halt.

Sharing is caring

A further advantage of the open architecture is the ability to share information about Detroit's streets with anyone. Students at Wayne State University's engineering department, for example, performed a hackathon on the data, coming up with ideas to enable school bus priority. Another innovative suggestion came from a young entrepreneur, who used the data to build a mobile app for the visually impaired. "It was tied into real-time data coming from the intersections and had audio cues about whether it was safe to cross. The city can provide this valuable service for no money," says Bullock. Meanwhile, de la Vergne says he is looking into what else could be done with its data. It can be shared with other cities, for example, and Detroit might even charge for the insights. For the public, de la Vergne wants to build an online dashboard, so people can view and interpret city traffic data. There is still some way to go before that happens. The end goal is not to be reactive but to "use technology to be predictive", he says.

With millions in revenue on the line every day, OSI LaserScan's AutoSense products can deliver the level of accuracy you require. Vehicle Detection, classification, separation and camera triggering is provided via our advanced laser scanning technology, field proven since the 1990's. Non-invasive and deployable most anywhere, the AutoSense series can help consolidate the traffic and classification data in your toll collection system.

AutoSense™

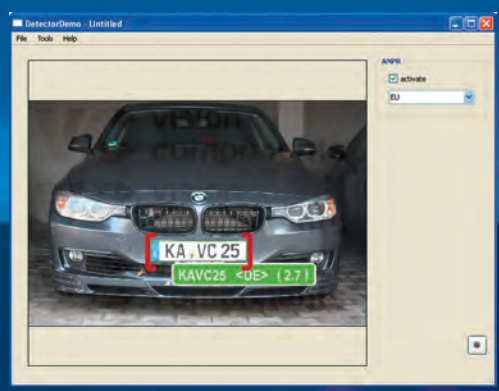
OSI LaserScan

Visit our web-site www.osilaserscan.com or send us a quote request on sales@osilaserscan.com

---

CARRIDA

Your ALPR/ANPR Software Engine



Typical Applications
- Access Control
- Law Enforcement
- Urban Planning & Traffiic
- Management of Transport Fleets and others

Features
- Typical reading accuracy >96% including damaged plates, angle correction etc.
- Hardware platform independent: Windows, Linux & Linux embedded
- Processing time: 30 ms (platform dependent)
- Quick & easy configuration

www.carrida-technologies.com

The wisdom of crowds

Can traffic managers now gain valuable congestion information simply by using the anonymously crowd-sourced, floating car data provided by Google Maps? **Jack Roper** takes a look at the software that is enabling just that, and explores its limitations

Floating – or fixed? That is the question now occupying traffic agencies in respect of sourcing data for traffic flow and density measurement, incident detection, or even targeting violation enforcement. Traditionally, traffic measurement has depended on a fixed-sensor infrastructure consisting of induction loop detectors buried in the asphalt, as densely as one every 500m (1,640ft) in the Netherlands. More recently, radar, infrared, microwave, sonic and ultrasound technologies, as well as cameras with associated video analytics, have all formed part of roadside monitoring systems. These sensors are expensive and require ongoing, costly and sometimes disruptive maintenance.

But for a while now, a potentially much cheaper type of data has been floating through the network. "With the advent of smartphones – and particularly GPS chips in smartphones – it's becoming much easier to get data from cars," says Shawn Turner, senior research engineer at Texas A&M Transportation Institute. "It's eliminating the need for data collection involving authorities installing and maintaining dense sensor networks. With floating car data, the sensor is on the car or phone and the consumer is the one who's updating and maintaining it. Penetration rates vary, but once you get around 5% of the traffic stream, you can infer lots of information about traffic speed and movement.

> Penetration rates vary, but once you get around 5% of the traffic stream, you can infer lots of information about traffic speed and movement
>
> **Shawn Turner, senior research engineer, Texas A&M Transportation Institute (TTI)**

20%

The reduction in the density of loop sensor deployment possible through the introduction of floating car data in traffic management

Source: TNO

What's already happening is that road agencies are rethinking the density of roadside sensors."

Saving costs

Floating car data from Google is sufficiently accurate for Dutch road authorities to reduce the density of induction loop sensors by 20% without a significant loss of accuracy in measuring traffic speeds, according to a TNO study (see *Matching up*, page 33). This data forms the basis of ODIQ, a cloud-based traffic monitoring solution built on top of the Google Maps Platform by Belgian firm Localyse. "A typical use case would be a road segment requiring maintenance," says international business development manager for Localyse, Olav Adami. "Pre-works, you can analyze traffic volumes using the road segment and begin simulating the impact of diversions; post-works, you can see whether traffic flow has been improved."

> The problem with floating data is that if drivers are not involved in an accident and can use unblocked lanes to drive around it, you won't see it
>
> **Taoufik Bakri, senior data scientist and mathematician, TNO**

When PSV Eindhoven host Barcelona in the Champions League, Dutch traffic coordinator Ron Phaff will be using ODIQ to manage the influx of traffic. "The highways have

Top: **Traditional induction loops, embedded in road surfaces, are reliable, but expensive and time-consuming to install**

Above: **Floating car data is generated automatically from smart devices in vehicles, providing a virtually free sensor network, as shown on this map of the Netherlands**

5%

The lower limit of floating car data penetration in any vehicle fleet in order to infer useful traffic flow information

Source: TTI

traditional loops, but the roads inside the city of Eindhoven don't," he explains. "We used to send people into the city; then we didn't know what was happening after that. But floating car data is everywhere; every street gives us information; if an incident occurs, we can divert the traffic."

Phaff believes floating data is sufficiently reliable for providing traffic information, but would hesitate to use it instead of induction loops for traffic safety functions, such as sending information to variable message signs. "We know that traditional loops are always working, every day. But what is floating data doing at night?"

Limitations of floating data

"With floating data, relevancy depends on quality, which you get through a high sample," says Adami. When there are fewer cars with devices on the roads, the accuracy of data tends to decrease – for instance, at night or on minor roads. It is therefore most reliable on busier roads – where the need for traffic management is most pressing. Moreover, ODIQ's sample, based on Google data from both Android-based devices and Google apps, may promise a disruptive level of penetration. "It's difficult to advance numbers," says Adami, "but I think the vast majority of mobile devices worldwide either run on Android or have a Google application installed."

Hidden depths

We delve beneath the surface of the phrase 'floating car data' to find out what it really means, and exactly where such information comes from

The earliest form of floating car data consisted of the basic and imprecise location data, which a flip-phone communicates to a cell tower. But with the rapid evolution of cell phone and automotive technology, the data itself, and the means by which it is communicated, has become more complex and varied.

"There are a number of different ways a car or truck can report," explains Texas A&M Transportation Institute's Shawn Turner. "You can have an untethered phone, which isn't connected to the vehicle but is still moving on the highway, or a connected phone, which gives richer information about what's going on in the vehicle, but is still essentially getting information from the phone. Then a third variation, in newer cars, is that the car itself has a cell phone modem, reporting to a provider periodically. As smartphones become integrated into vehicles and vehicles have more intelligence, we're getting more than just consecutive location reports."

A tidal wave of data from vehicles' onboard sensors could become available to traffic managers, providing a new level of precision in detecting and diagnosing problems on roads. "As vehicle sensors are becoming more integrated into cloud-based functions," Turner continues, "we're getting things like windshield wiper activation, or indications of when anti-lock brakes have been activated. You might get indications of sudden changes in vertical acceleration, telling you that there's a big pothole in the road."

Navigation apps are a key source of floating data. Some give end users free information, like Google and Waze, while others operate a subscription model, like Apple, TomTom and Inrix, but these companies all have APIs for reselling information to road authorities. Many automotive manufacturers have contracts with navigation suppliers so as to offer in-dash integration of the navigation system and traffic feed. Meanwhile, providers such as TomTom investigate ways of gathering data directly from vehicle sensors – for instance, using dashboard or smartphone camera data to update the high-definition maps that will be needed for automated driving.

Above: **Ubiquitous in-car smart devices represent a potential data gold mine for traffic managers**

> We know that traditional loops are always working, every day. But what is floating data doing at night?
>
> **Ron Phaff, manager of traffic operations, Eindhoven area, RWS**

While navigation apps such as Google Maps and Waze provide a rich seam of floating data, they also give rise to the problematic 'Waze Effect', whereby apps reroute shoals of drivers through sleepy residential areas, bringing unwanted noise and disruption. However, providers are now beginning to offer solutions based on data from the same apps that are causing the problem, enabling authorities to anticipate Waze-induced through-cutting and divert traffic away from smaller communities. According to Shawn Turner, Waze is also beginning to reduce the need for roadside sensors as a means of incident detection.

"Traditionally the road authority installed roadside surveillance cameras for incident detection," he says. "With floating car data, the first thing they'd know is that there's a slow-down, based on speeds and travel times. But the other element is that apps like Waze are self-reporting. In some cases, people stuck in traffic are reporting incidents faster than it's showing up by traditional means." However,

Matching up

How well does floating car data match up with what's coming off traditional sensors? And how good a representation is it of the real world?

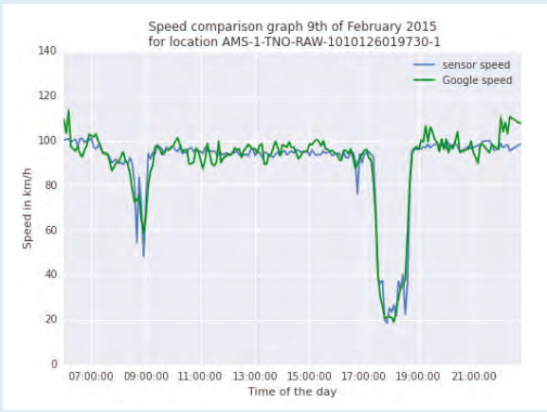
Floating car data from Google-enabled devices carried in vehicles is sufficiently reliable to replace 20% of existing induction loop detectors on the A12 in the Netherlands with only a 3% diminution in data quality, according to a 2016 study. The quality of traffic state indicators derived from Google data was considered adequate for analyzing traffic scenarios and signaling road users, but is not, as yet, deemed sufficiently reliable for tactical applications and operational traffic applications, such as controlling traffic lights. Replacing 20% of sensors over a 30km (19-mile) stretch of the A12 could reduce costs by €364,000 (US$428,000), while not installing 20% of sensors in a greenfield situation could save as much as €700,000 (US$823,000), researchers concluded.

The study, conducted by Dutch applied scientific research organization TNO, focused on speed as the main indicator of traffic states on roads. It sought to validate aggregated and anonymized Google data against ground-truth induction loop measurements from over 2,200 sensor locations on highways in the Netherlands during a four-month period, yielding a database containing some 58 million records.

As well as establishing an interesting business case for replacing a percentage of sensors, TNO researchers gained insights into the challenges involved in preparing floating data for traffic analysis.

"This information is floating everywhere," explains senior data scientist and mathematician Taoufik Bakri. "The first problem is map-matching: establishing exactly where the car is when it gives information and snapping it to the network. If a highway has a parallel exit road, there's a considerable speed difference and you must be sure at which level a car is driving.

"One major problem occurs if a highway runs beside a railway. People in the train also have phones! Are they sitting in the train, or driving very fast on the highway? If you get a zero speed, is that a problem on the highway – or someone stopping at a gas station? Processing the data adequately and fusing it with induction loop data is not a trivial task."



Below: **Google Maps traffic speed data compares favorably with that gleaned from in-road sensors**

authorities may be reluctant to rely on this method of incident detection in safety-critical applications, such as stopped-vehicle detection.

"When you need a tactical level of information to quickly detect an accident, loop detectors do it instantly," says TNO senior data scientist and mathematician Taoufik Bakri. "The problem with floating data is that you're only following people who are clients of your provider. If they're not involved and can use unblocked lanes to drive around the accident, you won't see it. Another problem is that when traffic information providers have a gap in their data, they put in the most likely value for that time and location, based on a huge historical data set. For serious things like giving priority to emergency vehicles, you cannot rely on expected values: you need real information. An induction loop lies there waiting for information and detects anything passing it."

Along with traffic management and incident detection, another key function of roadside infrastructure is enforcement, often involving cameras and video analytics. Clearly, gathering periodic location reports from cell phones carries the potential to calculate a driver's average speed and to use this data for enforcement – but floating data is currently anonymized and aggregated so that individual drivers cannot be identified. "ODIQ doesn't say how many cars are on the road at any moment," says Adami. "It gives densities and relative numbers; traffic managers are learning how to work with those densities."

Preserving driver anonymity

Since providers like Google rely on the passive consent of road users to gather data, it may be against their interests to ever contemplate de-anonymizing data for direct enforcement. "When people install apps on their phone they don't look at their privacy settings," says Turner. "They don't realize that this app they're not using, that's not even in the foreground, is sending location

US$823k

The potential saving achieved by reducing the number of in-road sensors by 20% on a 19-mile stretch of new road, and instead using floating car data

Source: TNO

reports every few minutes. Bad publicity from a privacy blow-up could torpedo some floating car data collection." For this reason, some authorities may remain cautious about depending entirely on private companies, rather than their own sensors, for data.

Instead of replacing camera enforcement, a more probable scenario is that floating data could be used to identify road stretches where people consistently exceed speed limits, facilitating more targeted deployment of mobile cameras. But even here, providers may be wary, after stories surfaced in 2011 about Dutch police using TomTom data to target speed traps, giving the company a PR headache.

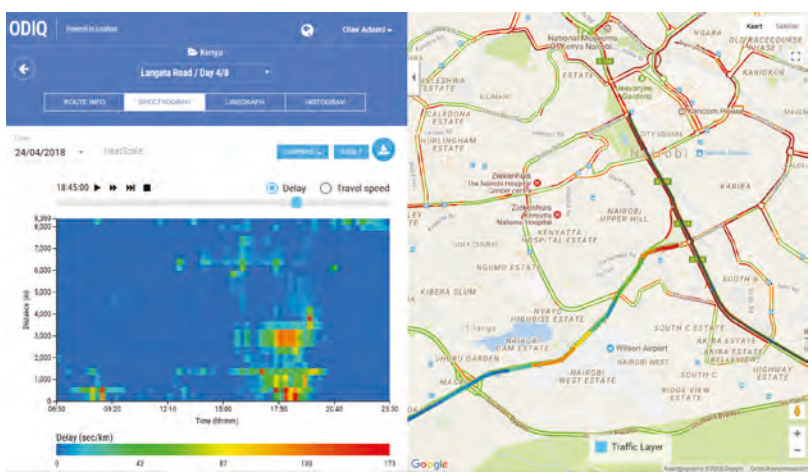
"The negative public reaction made TomTom rethink its license agreement, about how authorities could use their data," says Turner. "Tolling is another area where you need really accurate sensors to know what cars are going by, with what axle configuration. Enforcement and tolling are probably the tail-end of the floating car data adoption curve."

> We're talking to cities like Cairo, Lagos and Nairobi, which lack elaborate roadside infrastructure. They can start using floating data to get insight into traffic flows
>
> **Olav Adami, international business development manager, Localyse**

Floating into the future

While floating data plays a growing role in complementing traditional fixed-sensor data, allowing costly induction loops to be deployed at wider intervals, the need for existing sensors is likely to remain, especially for safety-critical and enforcement applications. But floating data has exciting potential for nascent ITS implementation in developing nations. "We're talking to cities like Cairo and Lagos and Nairobi, which lack elaborate roadside infrastructure," says Adami. "They can start using floating data to get insight into traffic flows and how to manage them. It's a real opportunity for them to get a low-cost, high-value source of data."

"I really fell in love with this type of data for poorer countries, like Indonesia," adds Taoufik Bakri. "They don't have the means to install induction loop sensors – but everyone has a cell phone. Using and analyzing this data would open up a universe they have never seen before. These really are free sensors and the impact would be great in these countries, where traffic is a huge problem."



Right: **Smart software systems can interpret Google data to make it even more useful for traffic managers**

READ *anywhere* WITHOUT WI-FI!

download now!

Available on the App Store

ANDROID APP ON Google play

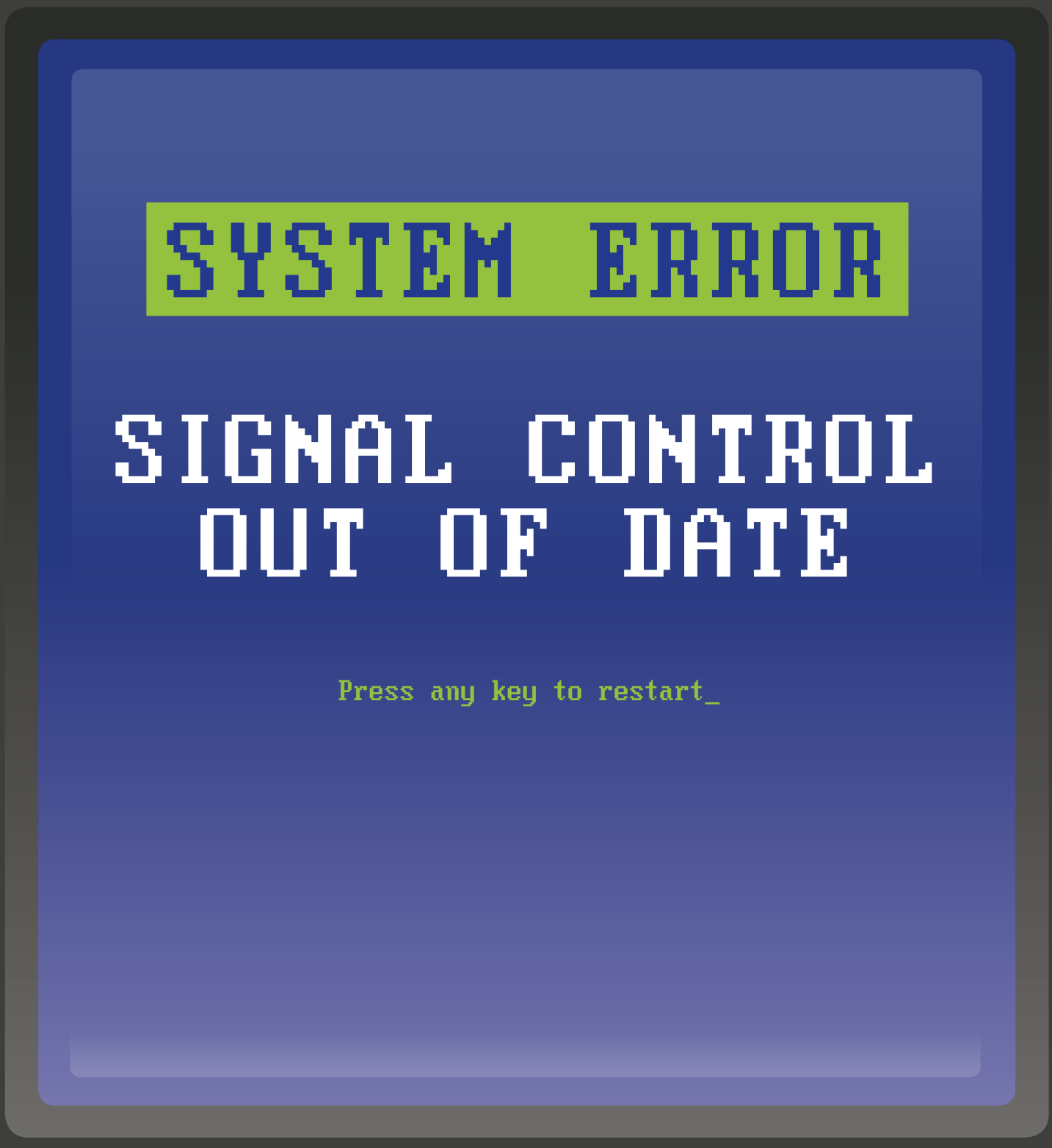
SEARCH TRAFFIC TECHNOLOGY INTERNATIONAL IN YOUR APP STORE NOW

FREE APP

Receive the latest issue weeks before the hard copy is available

---

Includes the latest news & Free Magazine archive


SYSTEM ERROR
SIGNAL CONTROL
OUT OF DATE
Press any key to restart_

A new era in ITS is dawning. London's Urban Traffic Control (UTC) system, the backbone for SCOOT, is reaching the end of its useful life. Its replacement will be revolutionary. **Saul Wordsworth** finds out more

SCOOT, or Split Cycle Offset Optimisation Technique, was developed in 1979 by the UK's Transport Research Laboratory (TRL) for the Department for Transport in an attempt to create an adaptive system for managing complex flows of people around London. SCOOT has been in operation in London ever since, using traffic sensors to optimize signal timings. Its latest incarnation – prioritizing buses if they are running late – keeps traffic delays 13% lower than they might be otherwise. Transport for London (TfL) has a problem, however: SCOOT is running out of time.

"Our Urban Traffic Control [UTC] system, which is the backbone for SCOOT, is coming to the end of its lifetime," says Glynn Barton, director of network management for surface transport at TfL. "The platform is becoming obsolete and will be out of support by 2019. The agreement between the people who market and develop SCOOT has also come to an end, so we thought it was the right time to step in and really move things forward for London."

TfL decided to offer up its UTC system and the intelligence behind it to the market, and work with whoever could best assist them in developing a solution fit for the future demands of London and its roads.

"We needed something that really looked at all the ways people use our streets, at how to optimize our signals for pedestrians and cyclists, and at adaptive and selective control for buses, but also with an eye on connected and autonomous vehicles in the future," says Barton.

> We thought it was the right time to step in and really move things forward for London
>
> **Glynn Barton, director of network management for surface transport, TfL**

A short history of SCOOT

London's SCOOT – and its Australian cousin SCATS – spread out to dominate the world of signal control

1973 SCOOT predecessor developed. It selects most appropriate signal timing plan from library of plans. Outcome: network jumpy.

1979 SCOOT software first developed by Transport Research Laboratory (TRL), a British government entity. Designed to monitor traffic flow over whole network and make small but frequent adjustments to signal timings to reduce delays and improve traffic flow. First test site established in Glasgow.

1980 First commercial use in Maidstone, Kent.

1980-1983 SCOOT rolled out across London.

1990 Siemens and Dynniq given rights to sell SCOOT all over the world. Alongside SCATS (Sydney Coordinated Adaptive Traffic System), it becomes one of the top-two dynamic traffic solutions worldwide and is sold across the USA, Europe, Asia and China.

1990 SOFT (Saturation On-line Flow Techniques) introduced to improve modeling, particularly under abnormal circumstances.

1993 SCOOT demonstration in Toronto shows average reduction in delays of 14%, along with 61% during unusual conditions (for example, a baseball game).

1995 Active priority to buses integrated.

1997 São Paolo survey shows SCOOT reduces delays by an average of 20% in one area; 39% in another.

1999 Emissions modeling adds new formulae, including noxious emission data, to SCOOT to better estimate total emissions of vehicles.

2003 Supplementary Detection designed to allow improved modeling of 'difficult' links.

2006 Congestion Supervisor – Online version of earlier tool to monitor SCOOT looking for unusual, regularly occurring data which might indicate an inefficiency in performance.

2010 Mayoral SCOOT program deploys extra signals in London, taking count from 2,000 to 3,000.

2015 Road space management SCOOT program in London. Number of signals rises to 4,500.

Right: **SCOOT is one of the key tools used by traffic managers in London, and around the world**

12%
Reduction in delays in London thanks to SCOOT

After an extensive competitive process where Siemens Mobility Limited, Dynniq and TRL made the shortlist, it was Siemens that was awarded the 10-year contract in May. The company was well known to TfL as one of the major resellers of SCOOT around the world. However, this time a partnership rather than client-customer relationship was established whereby together they would set out a strategy for future solutions required to upgrade London's road network management system, and market that solution jointly as a suite of tools.

"Siemens aligned to our development pathway with a product we felt would work well with our existing UTC system, as well as enable us to have something that would roll out into the control center," says Barton.

Siemens' development team for the project is based in Poole, Dorset, on the UK's south coast, with a further, separate team located within

1st

SCOOT was voted most transformative network management tool at Traffex 2011 by the transportation community

250

Number of cities that use SCOOT around the world

TfL's central London headquarters.

"For closer integration and collaboration, the Siemens project specialist is based a few desks from the TfL team in London," says Wilke Reints, Siemens' managing director for Intelligent Traffic Systems.

New technology

The first step for TfL and Siemens is to get the existing system onto a sustainable platform. Over the next couple of years the two companies will work in tandem to migrate the UTC to a new product that will replicate the existing one, albeit hosted in the cloud and with an enhanced user interface.

"If you are currently a control center employee, what you're looking at is an old MS-DOS screen," says Barton. "Our bright new graduates arrive and say, 'What is this?' They're the touchscreen generation, so it's important we give them a system they can use and interact with."

Not just a pretty face

Aside from the user-friendly interface, this initial phase means the development of a new, cloud-hosted traffic control system, replacing the existing UTC with a brand-new, Real-Time Optimizer (RTO) solution. The second phase sees the development of new adaptive control algorithms in a program currently known as Future SCOOT, for delivery in 2022, while the final phase sees TfL and Siemens further honing the system, and Siemens managing it through to 2028.

TfL and Siemens believe that RTO – which replaces TfL's existing system of servers across data centers with a cloud-host environment – will revolutionize the current traffic light control system, enabling more people and goods to move on the city's road network with fewer delays. When the road network is disrupted by planned and unplanned incidents, or events, TfL will have a more refined tool to help return the network back to normal service at speed.

"RTO is designed to optimize traffic flow in London," says Reints. "Obviously there is already a SCOOT algorithm known to the market. What we will be doing differently is to consider every single journey and mode of transportation. Rather than relying only on loops and sensors triggering the traffic signals, we want to take in a range of new data sources and connect to new types of sensors and innovation, including shared data with connected vehicles, and in the future autonomous vehicles. We are aiming for the kind of adaptive control mechanism already recognized within the ITS community, but as far as I know no one has gone as far as

Above: **Siemens' Wilke Reints (left) and TfL commissioner Mike Brown, with the signed contract to build RTO and 'Future Scoot'**

US$1.3bn
Potential economic benefit of RTO over the next 10 years, through reduced traffic delays (£1bn)

we will with RTO, which could become a true adaptive traffic management solution for TfL."

"Future SCOOT is designed in a way allowing it to take data from things that we don't know even exist yet to accompany future technological input," adds Brett Graves, program manager for Siemens.

Priorities

For Barton, RTO also means factoring in mayoral priorities such as the Healthy Streets for London agenda, which requires optimizing the network for sustainable transportation. There is also Vision Zero to consider: TfL is committed to the elimination of all fatalities on the road network by 2041.

"The new system has a key part to play in this and we'll need to develop and innovate," says Barton. "That's what the final eight years of this partnership are about – developing a control system that is really fit for the future of the network."

Aside from streamlining car journeys, this will mean improved signals for pedestrians and cyclists, with improved prioritization for riders possible in the future, reducing their delays at traffic signals. The bus network will also be adaptively and selectively controlled in a more efficient way than currently. The business case for RTO is said to be £1bn (US$1.3bn) of benefits through reduced delays over the next 10 years, from an initial cost of £19m (US$25m).

"RTO will enable operation of the network with much greater efficiency by allowing a pathway to identify incidents on the network more quickly and alleviating their effects in a much more rapid and efficient way," says Barton. "We have our internal delivery mechanism for ensuring RTO is harmonized into our system, and the right change control and change management for individuals who'll operate it on a daily basis. TfL is adept and proven at doing innovative things with big software such as our ticketing platform, which is already renowned. We have systems that are top class and enable us to interact with our customers. This is just another step in that journey for TfL and we are not overawed in any way."

> Rather than just an isolated solution for London, our approach is to place RTO into other megacities. I think there is huge scope for this system
>
> **Wilke Reints, managing director, Siemens Intelligent Traffic Systems**

Modeling and scalability

An interesting element of RTO is Siemens' purchase of simulation and modeling company Aimsun during its negotiation with TfL. Ownership of Aimsun bolsters Siemens' modeling expertise – TfL already regularly deploys its own modeling know-how – and enhances a further arm of RTO, all of which plays into TfL and Siemens' drive for global scalability. The RTO system is being designed as a traffic management system initially for London and cities in the UK, but in time, it will be available for export worldwide.

"This is our clear ambition," says Reints. "Rather than just an isolated solution for London, our approach is to place RTO into other megacities. I think there is huge scope for a system that is really capable of analyzing the traffic, and making the proper and right decisions."

Left: **The famous Traffic Light Tree sculpture situated on a roundabout in the City of London. Thankfully no signal control system is required for this**

2021

The year that the first phase of new adaptive control algorithms (currently known as Future SCOOT) will be delivered

US$1.5m

Estimated economic benefit to São Paulo in 1997 as a result of SCOOT (£1.1m)

Both TfL and Siemens will benefit financially from any future commercial roll-out, with TfL pledging to reinvest the profits back into London's roads.

A big step forward

For now, the architecture of Future SCOOT remains in development, strictly classified and under lock and key. Over the coming months it will take shape and announcements will follow. However, the process of getting there, one of pure collaboration between Siemens and TfL, is energizing both parties.

This kind of collaboration may be new, certainly between Siemens and TfL, but the desire for teamwork is strong.

"TfL has a lot of very clever switched-on people when it comes to traffic systems and the expectation is that over time they will come to us with some really great ideas that could move RTO forward as a product and sell it all over the globe," says Reints. "Similarly, London can be used as testbed for a system, when we want to trial features on small parts of London that can grow out across the city. The basis of the relationship is intended to be different."

"I don't think there's been a realistic development in this world that's taken it a step forward in a long time," reflects Barton. "I'm hoping this will stimulate that and we can start that step change which is desperately needed. This new traffic management system will be a game-changer for us in London and I believe RTO will become the leading system in the world. If you look at the network we have to operate in, considering the constraints and demands on our signals, we're an extremely demanding operator. Any new system will need to be fit for purpose for us and by its very nature that will make it the leading product."

A formidable partnership

Glynn Barton joined TfL as a traffic control engineer 17 years ago, has worked his way up, knows the system inside out, and has sat on the SCOOT steering committee for the past nine years. Wilke Reints, meanwhile, is an expert in his field, and also an ambitious cave diver, including two extraordinary dives of 15 hours' duration. After speaking with these two level-headed gentlemen, one gets the impression that through a combination of vision and endurance, the new solution will be a worthwhile replacement for the original SCOOT system.

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

comtrans

Your essential guide to the future of transportation communications

Huawei launches first C-V2X RSU

The intelligent roadside device can support low-latency connected vehicle data broadcasting and exchange over Uu and PC5 interfaces

Chinese telecommunications giant Huawei Technologies has launched the world's first commercial C-V2X (cellular vehicle-to-everything) roadside unit (RSU).

Based on 3GPP R14 LTE-V2X, Huawei's RSU network device can support low-latency V2X data broadcasting, enabling intelligent traffic management and automated driving. The technology aims to help road operators, government transportation and public safety departments, industry and consumers to improve road traffic efficiency and highway safety.

As the world's first such device, it supports data exchange over Uu and PC5 interfaces to ensure safe communications. Wired and wireless access modes are used to flexibly connect road facilities, such as traffic signal controllers, facilitating project deployment. Huawei's RSU also supports the USA-based GPS and China's BeiDou Navigation Satellite System.

The latency over PC5 is less than 20ms, and it supports 20MHz bandwidth of the 5.9GHz waveband, which is the frequency deployed by most countries for intelligent transportation systems.

Veni Shone, president of Huawei's LTE and C-V2X product line, says, "Currently few road facilities are connected. We want to facilitate road digitization by connecting more road facilities.

"For this ecosystem to truly thrive, it requires the efforts of all parties, from both ITS and ICT sectors, as well as all related organizations and companies. We welcome partners to join our collaborative efforts and help bring intelligent transportation and connected vehicles to reality."

46: Weather intelligence

Colorado DOT is testing the V2X technology in order to address the challenges of harsh weather conditions on remote roads

50: Fastest ever 5G comms

A team from the UK has set a new record for V2X 5G communications speed, which will help to define future systems architecture

Weather intelligence

In Colorado, a new US$72m V2X corridor is being equipped with DSRC roadside units. The aim is to keep road users safe with a constant stream of up-to-the-second information about weather events, road conditions and crashes. **James Gordon** reports

The city of Golden and the town of Vail in Colorado couldn't be more different. One is a modern-day gateway to world-class ski slopes, the other a pioneering outpost made famous by the Gold Rush, and now a center for industry and learning. They may be only 100 miles (160km) apart by road, but they are geographically distinct too. Golden is located in the foothills of the Rocky Mountains, and enjoys a temperate climate, while Vail is in the heart of the Rockies and is subject to much more extreme weather conditions.

For many, driving between the two has become routine. But with weather systems as unpredictable as they are severe in the Rockies, negotiating the I-70 Mountain Corridor can be extremely challenging – even for the most experienced of motorists.

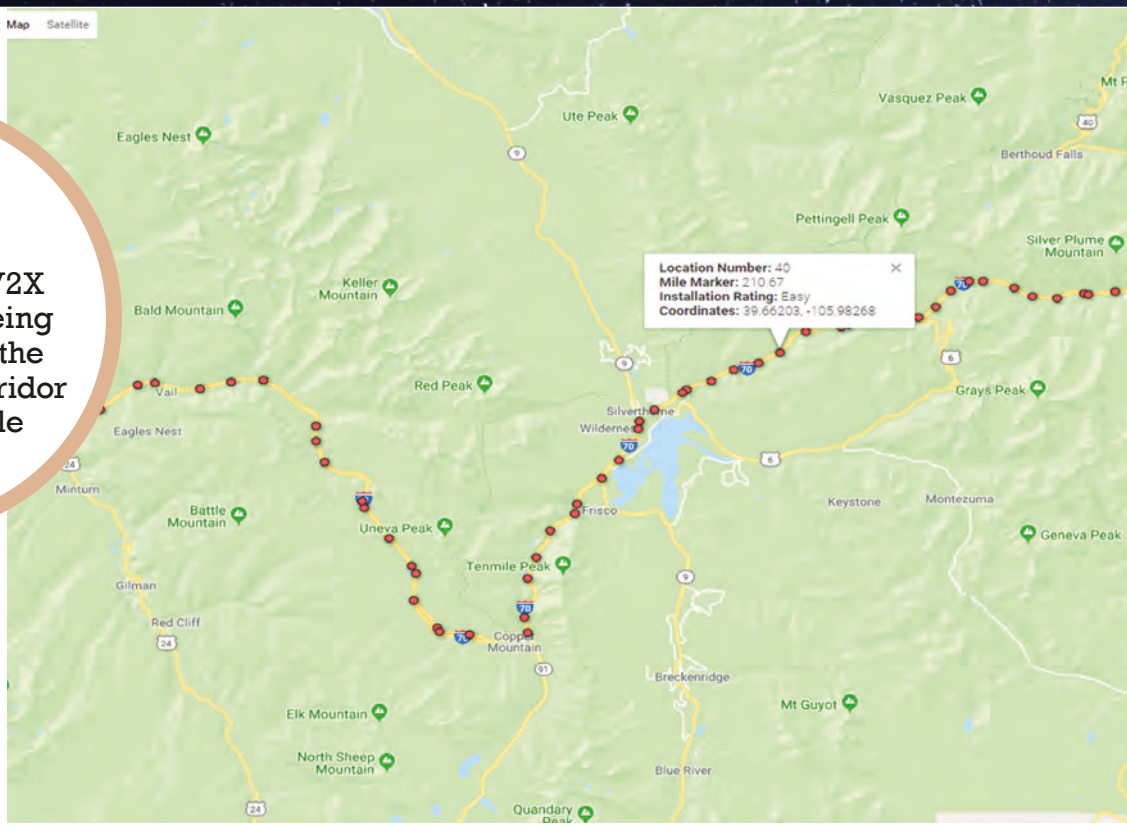
At least this is the story that the statistics tell. Between 2011 and 2016, for example, there were 3,900 property damage crashes, 1,800 injuries and 14 fatalities – many of which were caused by the inclement weather conditions on the corridor.

The Colorado Department of Transportation (CDOT) believes that "data-driven technology can save lives" and it is using next-generation vehicle-to-everything (V2X) technology and the help of technology giant Panasonic America to prove its point.

Amy Ford, CDOT's chief of advanced mobility, explains, "Having undergone a successful pilot, we will deploy 100 roadside units (RSU) – each one a mile apart – on the I-70 Mountain Corridor between Vail and Golden. Essentially, the V2X technology, which links connected vehicles to the roadside

100

The number of V2X roadside units being deployed along the I-70 Mountain Corridor – one every mile



infrastructure will enable drivers of connected vehicles to receive basic safety messages (BSM), 10 times a second, on any part of the corridor where the roadside units have been installed."

But on an icy stretch of road, for example, how does the technology ensure that not just one equipped vehicle, but all of them, receive real-time alerts when conditions are hazardous? Ford explains, "In a severe weather event, the driver of an equipped vehicle would receive an alert from the vehicle ahead that it has applied its brakes. And in the worst-case scenario, if there is a multicar collision, all the vehicles involved will send back real-time messages to the traffic control center, which once received, will contact the emergency services and send warnings to all of the equipped vehicles nearby."

Counting the cost

The five-year project, which is set to go live at the end of 2021, has a price tag of US$72m. Is this good use of US tax dollars? With many OEMs (including Ford, Toyota and Volvo) already developing V2V systems, what benefits can V2X technology bring that a V2V system or APIs (application programming interfaces) – such as Google Maps and Waze – can't?

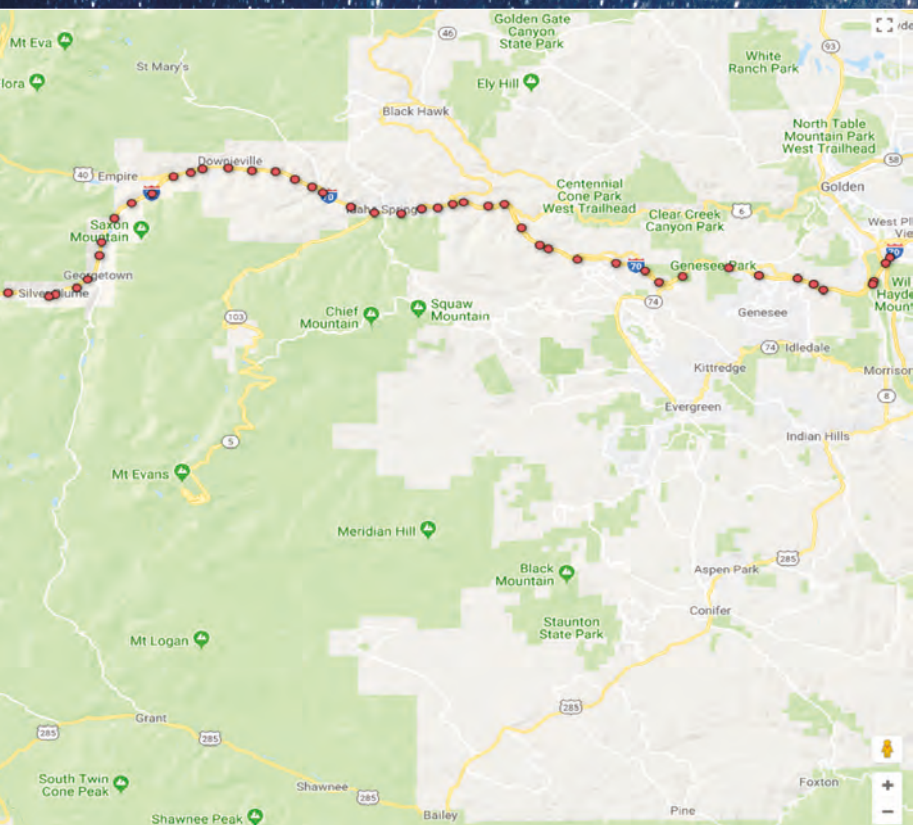
Says Ford, "On rural roads, where weather is a constant challenge, the collaborative nature of V2X, which combines V2V and V2I, will, we believe, prove much more effective than technology systems working independently of each other. Why? Because, with the help of Panasonic America, we are building a data ecosystem that will manage more than two billion datapoints per hour when connected vehicles are fully deployed in Colorado. To give that some context – globally, Twitter sends out 150 million tweets an hour. Clearly there are many web mapping services on the market today, but they don't work in instant, real time. There's some latency, which means that those who solely rely on them might not receive adequate warning of a sudden weather event like a flash flood. But with V2X technology in place, it's much more likely that they will."

> This digital treasure trove of data – the first of its kind – will take our situational awareness to a new and unprecedented level
>
> **Amy Ford, chief of advanced mobility, Colorado DOT**

Continues Ford, "For drivers of equipped and connected vehicles using this stretch of road, this digital treasure trove of data that is generated, which is the first of its kind, will take our situational awareness to a new and unprecedented level. It will do this by collecting information from every road and vehicle sensor, making sense of that data, and acting upon it by sending a BSM to the driver. What's more, it will do all this instantaneously.

"So let's say a small and isolated section of road is affected by black ice. Without V2X it would take much longer for us to pick this up. We might have to wait for a motorist to call in and even when the traffic management center [TMC] has been made aware of the problem, there may not be a VMS board in the area to warn drivers of the weather hazard. But with V2X, we have access to a rich, highly nuanced and detailed level of data – including tire differentials and braking information. If both are flagged by the TMC, we can send out a maintenance team to tend to the road, which could save lives."

Colorado DOT believes that V2X can reduce the number of



Left: **The V2X project will take place in the 100-mile I-70 Mountain Corridor**

unimpaired multivehicle collisions – many of them caused by inclement weather – by an astonishing 80%. For this to happen, Ford says that in the interim period before connected vehicles become commonplace, it must first "equip 2,500 vehicles belonging to the state with onboard units so that they can receive the V2X alerts, before then making the technology available to the general public".

Having a critical mass of equipped vehicles is important, particularly in rural areas, as Tyler Svitak, Colorado DOT's connected and autonomous technology program manager, points out: "In areas where infrastructure or V2I isn't connected, the V2V technology will still share data and information between vehicles."

But what about the many thousands of vehicles that won't be connected? For example, the drivers who can't afford the cost of the new technology or don't wish to use it? Can they still benefit?

Says Ford, "The beauty of this technology is that not everyone has to be equipped with it in order to make rural roads, which are prone to unpredictable weather fronts,

Above and left: **The RSUs will manage more datapoints than Twitter does globally**

2021

The year the I-70 Mountain Corridor V2X project is planned to go live

safer. As long as some cars have it, other drivers will also gain. Why? Because when there's thick snow, unequipped drivers will not only see the connected cars in front of them braking more, but if there is a crash, they'll also be able to follow those connected vehicles, which are acting on real-time BSMs, and re-route their journeys."

DSRC vs cellular

With V2X already being rolled out, it is somewhat surprising that there is still some doubt about the future of the technology that will underpin it. Some believe that wi-fi based dedicated short-range communications (DSRC) technology, which was created two decades ago, could be left behind.

Ford Motor Company, for example, is pioneering cellular vehicle-to-everything technology (C-V2X) in its vehicles, using cellular signals instead of wi-fi ones to connect them to other vehicles and to infrastructure.

Where in the world?

There is growing confidence that V2X communications networks will be robust, but what about accurate positioning via GPS?

Larry Head, professor of systems and engineering at the University of Arizona Transportation Research Institute, has worked with DSRC and connected vehicle systems for the past eight years and has been pleasantly surprised by its capabilities.

Initially RSUs were predicted to have a range of around 300m (985ft), and require line-of-sight to ensure connectivity. But he can now reckon on them reaching closer to 1km (0.6 miles) and has found line-of-sight is not needed. Therefore it is hoped that such systems will continue to perform well in rural areas in extreme weather.

However, Head believes that in remote hinterland roads such as the ones found on the I-70, it won't be getting DSRC signals through but ensuring accurate GPS data that could prove to be the greatest challenge.

"Drivers traveling on mountain roads often receive poor GPS data," he says. "But for V2X to save lives, it is absolutely crucial that GPS is accurate to a meter. The question, therefore, is how will this be achieved? Certainly the RSUs will help with position and direction. It is therefore vital that they are deployed at safety-crucial locations, to provide positioning accuracy. And there will be locations where the positioning data is inaccurate."

So what is the best solution? Says Head, "The technology will undoubtedly benefit from next-generation positioning, navigation and timing [PNT] systems – which will process information from cellular towers, take data from satellites, and absorb floating vehicle data, too."

Below: **The RSUs will enable connected vehicles to receive safety messages 10 times a second**

1km

The upper range limit of DSRC transmitters used in V2X (0.6 miles)

For Colorado DOT, there is no way of knowing which technology will win out, and so rather than pick a winner, the road operator has hedged its bets by enabling its RSUs to work with both technologies. But which technology is likely to prove more accurate on weather-affected corridors such as I-70?

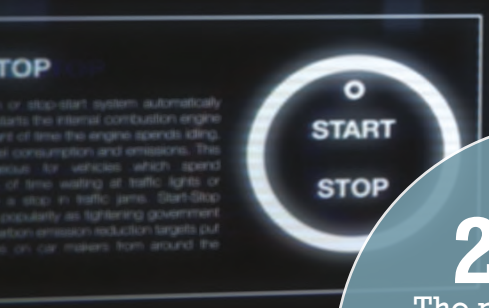
Says Ford, "At this point, it is difficult to say because the project is in its infancy. And this is also why we are working with Ford to test C-V2X. In general, they ought to provide drivers with the same benefits. They will both have the capability to feed off V2V and V2I, issuing safety alerts in real time. They'll also be able to tap into the myriad local weather apps and databases that we've created, to give drivers in remote locations the most complete weather picture possible."

> V2X systems can save lives – especially in rural locales where bad weather makes driving conditions dangerous
>
> **Larry Head, professor of systems and engineering, University of Arizona Transportation Research Institute**

Larry Head, professor of systems and engineering at the University of Arizona Transportation Research Institute, believes that while both technologies are viable, regulators and road operators cannot afford to wait for C-V2X networks to develop and mature. "V2X systems can save lives – especially in rural locales where bad weather makes driving conditions dangerous," he says. "C-V2X is much more complex than DSRC. It will involve experimenting with different channel layouts, and spectrum sharing, and right now there is no definitive knowledge in place as to how it will work. Therefore, it could take another eight years for C-V2X to be road ready and a lot of needless road fatalities. DSRC is already a mature technology and so it should be the cornerstone of V2X right now."

The need for speed

Researchers at the University of Warwick in the UK have set a 5G communications speed record that will help to define the scope of future V2X technology



2.867

The new 5G record in gigabytes per second. Enough to transmit an entire satellite navigation map of the UK in a single second

> These controlled trials are critical to better understanding of the capabilities of 5G in millimeter wave bands, and to how infrastructure providers and vehicle manufacturers must carefully plan and deploy their 5G service and application roll-out over the next few years
>
> **Dr Matthew Higgins, associate professor, WMG, University of Warwick**

WMG's 3xD Simulator for intelligent vehicles

A 5G record of 2.867Gbps has been set at Warwick University in the UK. The transmission was made to an SAE Level 4 low-speed connected autonomous vehicle (CAV) in the pioneer 28GHz millimeter wave band by the Warwick Manufacturing Group (WMG) research team.

The recorded speed is nearly 40 times faster than current fixed-line broadband and equivalent to sending a detailed satellite navigation map of the UK within a single second, or a full HD movie in under 10 seconds.

Such communications will allow vehicles to rapidly share data with each other and with traffic managers. For an autonomous vehicle this could include precise 3D road maps created by lidar and high-definition video images of the vehicle's surroundings.

WMG's team of associate professor Dr Matthew Higgins and senior research fellow Dr Erik Kampert used their new 5G mmWave test facility to set the record. Working with an autonomous pod built by RDM, a Coventry-based AV manufacturer, the team optimized antenna placement inside the pod and on roadside infrastructure.

Supported by the UK government's HVM (High Value Manufacturing) Catapult, WMG's test facility includes some of Europe's most advanced 5G mmWave testing equipment, which has been provided by an equipment collaboration with National Instruments (NI) for its mmWave technology platform.

"This is an exciting step toward the realization of future CAV 5G applications, which will be enabled by fiber-connected wireless infrastructure that supports high data rates and ultra-low latency mobile broadband," said Bob Slorach, CTO of Wireless Infrastructure Group (WIG), an independent wireless infrastructure operator also involved in the project.

Will floating car data help solve our global congestion challenge?

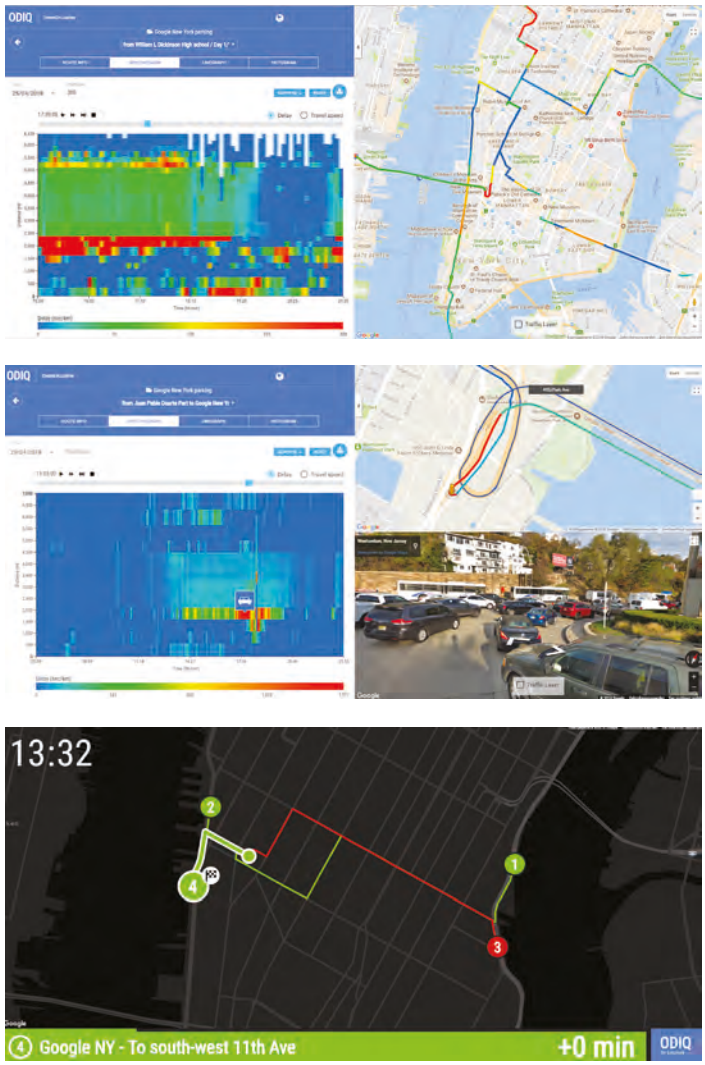
According to Karen Vancluysen, secretary general of Polis, "Air pollution, congestion and road safety are the top three priorities for our cities. Reliable data is a key resource to enable sound management in these three areas."

Over the past year, Localyse, a Belgium-based technology company, has been engaging with the ITS community by means of its traffic management tool Odiq. "The idea for Odiq came through our focus on mobility," says Chris Hoogwys, managing partner of Localyse. "As a Premier Google Cloud partner with a focus on Google Maps, we are interested in leveraging Google technology to help solve complex problems. Traffic congestion, reachability analysis and multimodal route planning are examples of the problems Localyse helps to solve."

Need to know

Benefits of using Odiq software for traffic management

- Gives detailed real-time traffic information every 50m (164ft)
- Allows cities to visualize and interpret traffic flows based on Google Maps FCD
- Reduces the need for additional sensors to be installed
- Supports decisions to improve safety, reduce pollution and cut costs



Above: **The Odiq dashboard enables the use of Google Maps data for traffic management**

Using Google Maps

Reducing congestion has a direct positive impact on air quality and road safety. "By engaging with traffic experts, we realized the potential of Google Maps' floating car data [FCD] and the benefits it could bring to the global ITS community. Odiq was born through combining traffic management expertise and Localyse's technical expertise," says Birgit Antonissen, Odiq product manager.

ERTICO – ITS Europe, with its vision of zero delays and fully informed people, advocates the added value that FCD brings to city planners, road authorities and road operators. FCD enables city planners to extend their existing investments to reduce congestion and improve journeys for drivers, saving them time, money and frustration. In particular road authorities save on the expense and time it takes to install and maintain additional road sensors.

Odiq improves accuracy and offers detailed real-time traffic information for every 50m (164ft) on every road type and class, resulting in the insight that transportation agencies and urban planners require to improve a city's road network performance.

Mobility challenge

Belgium and the Netherlands are both densely populated countries with a tremendous mobility challenge. Reducing congestion is high on the agenda for both the government and the private sector. "Among the early adopters of Odiq are cities, including The Hague in the Netherlands and Namur in Belgium, institutions such as Traffic Service Nederland, construction companies such as BAM and mobility consultancies, among them Stratec. Every one of these organizations has a vested interest in improving traffic flows and reducing congestion," says Jeffrey Benning, country manager for Localyse in the Netherlands.

Jaime Huerta, secretary general of ITS Spain, sees Northern Europe taking the lead in using FCD. "The Benelux, the Nordics and the United Kingdom are leaders in Europe when it comes to understanding the value of floating car data, which helps users to comprehend traffic

flows and patterns and to anticipate congestion, whether spontaneous or structural in origin," he says. "In Spain, institutions such as Dirección General de Tráfico [DGT] and cities like Madrid and Barcelona are slowly but surely following in the footsteps of our Northern European counterparts."

Accurate traffic data

Congestion is a truly global phenomenon and affects all of the world's major cities. Available for more than 110 countries and in 64 languages, Odiq can support traffic decision making in all continents. "Recently, Thierry Geerts, country director for Google Belgium, published his book *Digitalis*, in which he invites all of us to embrace technology to create a better future," says Annik Du Pont, advisor for international entrepreneurship at Flanders Investment and Trade. "I think Localyse did just that – by leveraging and adding value to existing Google Maps technology, it has created a powerful new tool [Odiq]. We look forward to supporting Localyse's international expansion based on its technological innovation."

Odiq is a cloud-based, Software as a Service (SaaS) solution. Traditionally, acquiring accurate traffic data has been heavily reliant on roadside infrastructure and human effort. Today, accurate traffic information is also available via an internet connection.

by **Larry Yermack**

Is the private sector taking control of our entire transportation network?

Who is in charge of the transportation system? I know that this is kind of an odd question, but it got me thinking about the state of play of ITS today. Let me explain.

City street patterns emerged over a long period and many were designed, if you could use that word, for foot and animal traffic. Transportation technology entered the picture with automobiles and trains. Oh, and please don't take this as well-constructed history, but rather as an allegory to illustrate an important point. The introduction of automobiles and urban trains (subways, elevated lines and trolley cars) then helped to define the functional shape of the cities.

After an early attempt at privatization, subways were purchased by local government. The suburban highways and interstate highway system were designed by government. You could say that for most of the 20th century, the transportation network, for good or ill, was a project of government. Just as the Interstate Highway System helped to define the key work and leisure routes of suburban American life, so urban arterial grids helped create the city and the mass transit routes that defined living and working patterns.

We didn't have to like it and starting with Jane Jacobs [who campaigned against some insensitive urban renewal projects], the critics of road and highway building entered the public debate. For this discussion, where you stand on the issues is not important – the point is that the design of the transportation network was the product of a debate. There was the opportunity – through public hearings and votes on bond issues, not to mention elections – to affect the outcome. Local elections have been decided on transportation issues. One mayoral election in Houston revolved around buses versus trains for commuting. Buses won.

Fast-forward to today. We are no longer in the era of building new roads or transit, but, rather, in the age of system management to achieve maximum efficiency. With this shift, I fear, we have ceded control from the public to the private sector.

The levers of control today are real-time traffic and transit information, trip planning and payment. Of these the most effective is real-time information. The 511 helpline was created for government to provide these services, but governmental offerings have now been surpassed by private services. I spoke to the chief engineer of one very large and progressive state who suggested that governments should get out of the traffic information business completely and let private companies run it.

"The levers of control today are real-time traffic information, trip planning and payment"

Beyond information is trip planning, and we are seeing global corporations contemplating building out their capability to offer much more than individual rides. They are offering ridesharing services and can address first and last mile challenges, but have yet to incorporate all the other paid transportation services. If and when they do, they will be the managers of the transportation network. Is this good or bad? I don't know, but I'd sure like to see a public debate on it.

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

Technologies for the connected mobility age

Following extensive laboratory and track testing, UK CITE (Connected and Intelligent Transport Environment), the project to create an advanced environment for connected and automated vehicles (CAVs), has now entered its second phase of trials, with connected cars being tested on public roads.

The trials are being undertaken over 40 miles (65km) of the M40, M42, A45 and A46 over a five-month period. Siemens has supplied and installed ESCoS (Eco System Cooperative System) roadside units (RSUs), which provide the technical platform for real-time data exchange between vehicles and traffic control equipment by communicating with equipped vehicles over short-range communications (ITS-G5).

This phase of the UK CITE trial program will test specific connected features, including emergency electronic brake light warning, roadworks warning, emergency vehicle warning, traffic condition warning and virtual gantry signs. Connecting cars to each other and their environment makes it possible to provide a much higher degree of predictability and safety for both manual and autonomous driving.

The trial covers the installation and verification of the roadside infrastructure in readiness for future V2I communication and represents both a really exciting development and a vitally important one, effectively making the transition from a controlled environment to the real world, testing the connected network's capabilities on the live highway. Representing the largest deployment of its kind in the UK, it will provide a valuable benchmark for the future of the technology.

UK CITE will create the UK's first fully connected infrastructure, using a unique combination of wireless technologies, enabling real-world testing to take place in a safe and managed way. The consortium comprises leading industry, academic and local and national governmental organizations and is jointly led by Visteon Engineering Services Limited and Jaguar Land Rover. The consortium's partners include Siemens, Coventry City Council, Coventry University, Highways England, Horiba Mira, Huawei Technologies (UK), TfWM, Vodafone Group Services and WMG at the University of Warwick.

Dreams become real

Automated vehicles will rely on connectivity to reach their full potential, but much of the technology now being developed (some of which is being trialled under UK CITE) will also deliver benefits for manually driven connected vehicles.

Need to know

Connected vehicle use cases being tested as part of the UK CITE pilot

- Emergency electronic brake light warnings
- Roadworks warning
- Emergency vehicle warnings
- Traffic condition warnings
- Virtual gantry signs
- Installation and verification of V2I-enabling roadside infrastructure

One such technology not utilized for the UK CITE project is GLOSA (Green Light Optimized Speed Advisory), where a vehicle is connected to a traffic signal controlled intersection. Here, the current signal status is broadcast via a SPaT (signal phase and timing) message, which is received by a connected vehicle's onboard GLOSA system. This interprets the message and, based on the vehicle's position, speed and heading, provides advice to the driver via a visual display on how to adjust their driving to ensure they pass through

Above: **Greater connectivity will improve mobility in cities around the world**

the junction on green. The system has the potential to improve driver comfort, safety and economy, and cut emissions by eliminating needless acceleration and braking. However, the success and realization of these benefits depend not only on an accurate prediction by the GLOSA algorithm of the remaining green time for a phase, but also on the driver making the necessary behavioral changes.

The system has been deployed successfully at sites that are switched into fixed-timing mode (enabling communication of an accurate time) but the benefits are less obvious when phase times are variable, which is more common in the UK.

Moving with MOVA

The UK has some of the most advanced traffic control systems in the world, including MOVA (Microprocessor Optimised Vehicle Actuation) control. The system has been proved in applications over decades of use, with an excellent track record of improving capacity at junctions by optimizing signal timings based on live traffic demand. MOVA makes decisions quickly and dynamically, adapting as traffic patterns change and so extending or shortening green times. This dynamic system means that predicting the length of the current green, or predicting the time until changing to green, is difficult – which in turn makes GLOSA's ability to make accurate predictions difficult.

To address this, a system could be developed that can draw on historical data to make a more accurate prediction. While it might be difficult to predict green times from one cycle to the next, it is much less difficult to predict today's pattern based on yesterday's, or last month's. Of course there are anomalies, such as special events and holidays, but it's reasonable to assume daily patterns and to make predictions based on these.

To achieve this, artificial intelligence and machine learning (ML) techniques are being considered. By deploying software at the roadside and leaving it to 'listen' to the controller, all inputs and outputs for a period of time are recorded. This data set could then be used to train an ML algorithm with the specifics of the site.

If the 'taught' algorithm is then deployed at the site and used to generate the SPaT message, a prediction could be made based both on what it has learned and from live traffic. This means a much more accurate message could be broadcast to the connected vehicle – one which is much more reflective of what will actually happen at the intersection. When they consistently receive accurate messages, drivers are more likely to adjust their driving style in response to the message, having a far greater degree of confidence in the result.

This is just one of many potential applications of connected technology. Other applications include, for example, enabling emergency vehicles to communicate with signals to ensure a clear path (which has already been developed using GLOSA), or to enable the system to suspend start/stop functionality (if it can be determined that switching off and starting the engine will produce more pollution than allowing it to idle for a short period) are yet to follow, but there are a huge number of possibilities and potential benefits.

Curb management and new mobility services

Cities are facing several challenges right now: to provide sustainable transport, foster the adoption of shared mobility, improve air quality and alleviate traffic congestion. At the same time, the number of people moving to urban centers is going up, and with it the demand for mobility and logistics services. Whether it's a taxi, an on-demand shuttle or a bus, all vehicles require curb space for their services to work, otherwise they would have to double park on the street, potentially causing traffic jams. Curb space is also important for deliveries, being where vans load and unload goods. Furthermore, many cities generate parking revenue with their curb space.

Urban space is a scarce resource, and curb space is particularly rare, given the competing activities of pedestrians and vehicles that rely on it within a city's mobility ecosystem. As we see an increase in rideshare services offering flexible pick-up and drop-off, even at busy locations, how can cities better manage curb space to reduce delays and improve traffic flow and safety? The behavior in one city can be different from that in another, meaning the issue is very localized and there is no one-size-fits-all policy. Modeling the impact of different curb allocation and management strategies, therefore, helps cities make the best and most flexible use of limited urban space.

Dedicating curb space to shared mobility services can help reduce traffic congestion

Need to know

The competing ways in which curb space can be used in a city

- Traditional parking
- Bus stops
- Drop-off and pick-up spaces for rideshare services and taxis
- Temporary parking for delivery vehicles
- Carshare spaces

Modeling in Lisbon

PTV Group collaborated with the International Transport Forum (ITF) to analyze curb space use in the Portuguese capital's commercial business district (CBD), looking particularly at different rideshare adoption scenarios. The report the group produced was entitled *The Shared-Use City: Managing the Curb*. Shared mobility scenarios were modeled in this high-activity area. The models showed that without management, curb pick-up and drop-off can reduce road capacity by up to 50% due to the effect of double-parked rideshare vehicles causing congestion. Introducing dedicated pick-up and drop-off areas, however, alleviates the problem and reduces delays by up to 20% compared to models with no shared mobility.

Another factor the study considers is the pricing implications that come with more flexible and dynamic use of space. Prioritizing the allocation of curb space to ridesharing activities takes away from existing car parking spaces, which can result in lost car parking revenue for the city. However, analysis with microsimulation demonstrates that pick-up and drop-off spaces have the potential to service over 90 transactions an hour. In the context of Lisbon's CBD, this shows great potential for dynamic multipurpose use of curbs, as a single parking space usually has one transaction per space every five hours.

Implementing dynamic pricing mechanisms is therefore an important aspect to consider, which would mean passengers would pay a premium to be picked up or dropped off at busy locations. This helps manage congestion, but also allows cities to recoup losses in on-street parking revenue.

While allocating dedicated curb space is not feasible in all urban areas, the study highlights how the effective management of curb space

best supports the integration of large-scale rideshare services on urban streets.

360° solutions

Rethinking urban space and therefore also curb space is not only crucial for efficiently integrating rideshare services, but also for reacting to the increased number of single-parcel deliveries and for making mobility services safer for people to use.

To provide an insight into how transitioning to new mobility services may look, the PTV modeling solutions ensure a realistic representation of traffic conditions with rideshare services. For the joint study with the ITF, firstly, rideshare trip requests obtained from the Lisbon mobility data were fed into PTV MaaS Modeller, which optimized the dispatching and routing of the vehicle fleet to individual trip requests. Secondly, PTV Visum was used to simulate the background traffic conditions of private vehicle trips. And thirdly, the detailed simulation of curb-side activities, including individual vehicle behavior and interaction with the background traffic, was then carried out with the microsimulation software PTV Vissim.

As every city has a different mobility ecosystem, individual curb management strategies need to be developed, and they are best planned and analyzed with advanced modeling and simulation software. ○

by **J J Eden**

Why transportation partnerships sometimes fail and how we can prevent it happening

In today's large, complex transportation development projects, partnerships and joint ventures are necessary to spread the risk of failure among multiple organizations and ideally bring the best of professionals and teams to a project to maximize returns. A successful partnership happens when the vision, mission and goals of two or more organizations align in such a way that liabilities and profits are shared, once successful outcomes are met. Too often we have seen that transportation business partnerships are defined by bringing firms together with complementary services or products only. In the tolling industry, this might be firms that provide a back office and roadside service or product offerings, to deliver toll collection systems. In services, this might be specialty services within the engineering or technology area, based on expertise and previous experience. However, even with the emergence of these strategic partnerships designed to provide the best teams to meet a project's goals, we still see projects and initiatives fail, be inefficient or ineffective. Why does this happen? Among the most obvious factors is that many organizations use the same staff in every major pursuit, regardless of its type. Another factor is the lack of a compatible culture within two organizations at the start of the project, something which may continue for its duration. Values relating to how organizations treat their employees, value their customers and execute their missions must be aligned with partner organizations. While organizations with different products and services can provide a complete and preferred technical solution, if the people delivering these products and services are valued and treated differently by executive management, this often results in delays and other project delivery issues and turmoil.

So ask yourself these very simple questions when you are setting up a partnership: 1) Do the partner companies compete with our services? If so, how do we keep the project productive and not a competitive fight that distracts from the project mission and goals? 2) When issues arise, are leadership teams from all organizations committed from the proposal stage and throughout the operating period to identifying, addressing and resolving the issues as a team? 3) Do all organizations have the governance in place to handle staff (executive and project) to maintain the mission and value of this project when people leave? And is there a process to define when the partnership no longer works and should be dissolved, even before the end of the contract?

"Values relating to how organizations treat their employees must be aligned with partner organizations"

If you cannot commit to these three fundamental principles in partnerships, then maybe you are not ready to be in that partnership and should go find another partner or project to pursue.

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

A guide to smarter procurement of transportation technology

The words 'transportation technology' encompass so much – from variable message signs, to electric vehicle charging, to real-time travel information. It seems the move toward a more sustainable sector has led to a bounty of solutions, the variety of which can in itself be problematic.

Some believe the sector has been slow to react to opportunities. Neil Gibson, president of ADEPT (Association of Directors of Environment, Economy, Planning and Transport) and executive director for transport economy environment at Buckinghamshire County Council in the UK, observed that when it comes to capturing and intelligently using data, the UK road industry is "at the foothills in the development of technology".

Speaking at UK road industry event Traffex Seeing Is Believing, Gibson went on to say, "We are not using technology creatively. It's a cultural issue. We are not looking at how technology is used in other sectors and applying that knowledge."

Need to know

A quick checklist for effective procurement of new technology

- Consider engaging potential suppliers with a face-to-face or virtual discovery day
- Publish FAQs
- If estimates are too high, define your objectives more clearly
- Don't draft your final specification and tender document until you have all market feedback

Retail seems to be well attuned to the digital solutions required to solve its problems, but perhaps that has not always been the case in transportation.

How can you possibly select the correct solution? Will your choice be practical? Is it tried and tested? Can you afford it? Is it future-proofed, or will it be out of date by the time you turn it on?

Help is at hand

Crown Commercial Service (CCS), which supports the public sector to achieve maximum commercial benefit when procuring common goods and services, has been helping a number of organizations to solve these worrisome problems more effectively.

CCS advises that commercial arrangements should focus on the destination, not the route. By being too prescriptive to a supplier about what you think you need, you could limit innovation, ending up with a less satisfactory solution than you might otherwise get.

Danielle Carvell, commercial agreement manager at CCS, is clear: "Many public sector buyers I speak with ask how to avoid pitfalls when buying transport technology. Regardless of what they are buying, my recommendation is to take pre-market engagement with suppliers seriously.

"The suppliers are the experts – call them in to help. Explain your aims and be open with what you want the technology to do. In this way, they can tailor their solutions to the task at hand."

Engage for innovation

This engagement process need not be a dry, paper exercise. By being creative, you will enlighten and inspire your prospective suppliers. If you demonstrate to them that you are open to new ways of

Connected, autonomous and electric vehicles are creating new procurement challenges for road authorities

tackling your transportation issues, they may just surprise you with new solutions.

Your approach might include one or more activities dependent upon the scale and complexity of your requirement. You might wish to advertise a supplier engagement event to the market and register supplier interest.

You might publish the engagement presentation material along with questions and answers and, for more complex requirements, you may also wish to hold a discovery day. Discovery days, which are an extension of your pre-market engagement, enable potential suppliers to better understand your organization and objectives.

For example, if you are looking to install electric vehicle charge points, why not arrange to take the suppliers around the proposed sites?

Such events let suppliers see the real-world implications of what you are asking them to do. This will often provide you with more accurate indicative costs and let you know whether you've pitched the bid correctly – if your indicative costs are unexpectedly high, then maybe the requirements need further definition or clarity.

Once the market is tested and you've received feedback, you can draft a more compelling and useful final specification and tender documentation.

Highways England

This is an approach that Highways England found useful when it used CCS's offering in traffic management technology to begin the roll-out of connected and autonomous vehicles (CAVs) across the UK.

Highways England is leading two CAV projects – UK CITE and the A2/M2 Connected Corridor. The projects aim to improve how data is gathered, shared and used, so as to better inform drivers and make journeys smarter.

Both projects are part of the UK Department for Transport's CAV strategy and Highways England's Innovation Fund, to strengthen the UK as a global center for the fast-growing intelligent mobility market, worth an estimated US$1,180bn per year globally by 2025.

Highways England needed a pool of experts in vehicle communications, cybersecurity, in-vehicle systems, traffic data management and business models. It also wanted to ensure the contract could be used by Transport for London, the Department for Transport and Kent County Council to aggregate demand.

So Highways England conducted pre-market engagement with suppliers on the CCS Traffic Management Technology 2 framework, particularly CAV domain experts, to gain feedback on the requirements.

By setting out the goals early on, in a clear way, Highways England's competition resulted in the appointment of engineering professional services company WSP. The four-year contract has an initial value of around £1.5m (US$2m), and its scope resulted in reduced day rates and reduced contract management overheads.

WSP is now working closely with Highways England, the Department for Transport, and other authorities to roll out a world-class ecosystem for CAVs across the UK. Supported by its supply chain partners, WSP will provide services including program management, design of CAV technology solutions, V2X communications, system architecture design, data and cybersecurity solutions, trials evaluation, business case development, road safety case development, and data analysis and modeling.

It was only because Highways England set out its ambitions clearly that the market was able to deliver such a comprehensive and bespoke solution.

The lesson is that those in the transportation sector who are responsible for procuring goods and services need to describe the destination and let suppliers take the wheel, enabling them to advise creatively on the best way to get there. ○

Enabling the World's Smartest Intersection with video detection

Along the Larned Street corridor, in the heart of Detroit, Michigan, lies a groundbreaking technology display coined the World's Smartest Intersection. Created by Miovision – a company specializing in traffic data and smart cities – the World's Smartest Intersection is actually made up of five intersections, all powered by the Miovision TrafficLink platform.

The technology puts safety first, communicates with the world around it, and completely transforms the way traffic engineering teams operate. The successful operation of the five intersections in Detroit will lead to similar technology being deployed at many more, and will ultimately drive the creation of a fully interconnected smart city.

It was the introduction of deep neural networks (DNN) and computer vision processing algorithms that took the intersection from smart, to the smartest in the world. Advances in the DNN and computer vision processing algorithms that power TrafficLink have enabled the collection of data that was not previously possible through traditional detection technologies, including the classification of other modes of traffic, such as pedestrians and cyclists, and real-time incident detection. This advance opens a new opportunity to quantify and observe pedestrian-related behavior on crosswalks.

Need to know

Three pieces of technology make up the World's Smartest Intersection

- **SmartLink data hub** – connects existing controllers and systems to Miovision cloud via the cellular network
- **SmartView 360** – an advanced 4k camera that provides vital visual analysis of intersections
- **SmartSense** – edge computing to process data from the SmartView 360

The technology involved

TrafficLink is built around open architecture principles and is made up of the SmartLink data hub, SmartSense, to enable edge computing, and the SmartView 360 camera. The SmartLink data hub works with existing controllers and systems, securely connecting them to the Miovision cloud through a cellular networks (for example, 3G, 4G/LTE), exchanging information with the controller, and linking to other Miovision elements. SmartSense provides the edge computing to process the SmartView 360 video in real time and execute logic that links conditions to actions. The SmartView 360 enables advanced use cases with live video monitoring and provides a visual confirmation of what's happening at an intersection in real time or in the past. Unlike single-purpose proprietary camera systems, cities can let other departments (for example, local police) use their SmartView 360 network – making much more efficient use of limited municipal funds and keeping intersections free of unnecessary clutter.

SmartLink enables traffic engineers to connect their signals and manage traffic more efficiently by monitoring and managing their signals remotely, so they can prioritize resources and solve issues before they escalate. Together, SmartSense and SmartView 360 facilitate the measurement of intersection performance with ATSPMs (automated traffic signal performance measures) that enable a data-driven approach to traffic management, as well as DNN and computer vision processing algorithms for continuous multimodal detection.

Intelligent intersections

Deep neural networks are computational algorithms that attempt to mimic how a human brain's neurons work together to solve complex problems. One example of a problem that's easy for humans but hard for machines is image processing: we know a vehicle when we

Left: **The World's Smartest Intersection technology showcase is taking place at five intersections in Detroit, Michigan**
Above: **The essential ingredients of the World's Smartest Intersection**

see one, but only advanced algorithms running on powerful hardware can achieve this feat.

In TrafficLink, DNN powers the computer vision processing algorithms in SmartSense that identify the presence, location and movement of vehicles, cyclists and pedestrians from the SmartView 360 camera's video stream.

At the World's Smartest Intersection, Miovision and the City of Detroit explored different methods of combining pedestrian detection at signalized crosswalks with high-resolution signal status data and proposed methods to visualize them to provide a more comprehensive understanding of pedestrian behavior. These metrics aim to quantify and visualize the crosswalk performance in terms of clearance, pedestrian signal compliance, usage profiles and density heat maps.

by **Don Hunt**

How are AV makers addressing safety?

In September 2017, NHTSA issued Automated Driving Systems 2.0, which set out new guidance for the safe development and deployment of Level 3 to Level 5 automated vehicles. The guidance suggested companies developing AVs could submit Voluntary Safety Self-Assessments (VSSAs) to communicate to the public how they were addressing safety. So far, three AV makers have filed VSSAs with NHTSA: Waymo, Ford and GM. What trends can be discerned in these three companies?

From the VSSAs, it's clear that these three manufacturers are taking a very similar path to introducing self-driving vehicles in the USA. Each company is testing a Level 4 vehicle capable of self-driving within a prescribed Operational Design Domain – in each case a geo-fenced area of a city with a detailed 3D map. Each company intends to introduce a driverless ride-hailing or 'robo-taxi' service that will operate within these geo-fenced areas within a few years – or perhaps a few months in the case of Waymo in Phoenix, Arizona.

None of the companies state any immediate plans to implement Level 5 vehicles, nor are they positioning for AV sales to individuals. They see the near-term market as fleet vehicles, with close operational and maintenance oversight from the implementing company. These vehicles won't use highways in the early days, and will stick to city streets with speeds under 40mph (65km/h). And it's likely that snowy northern climates will see robo-taxi service only after a substantial amount of operational experience accumulates in Sun Belt cities.

So what is unique about each company's approach? Waymo is the only one of the three to outfit an existing vehicle, a Chrysler Pacifica, to become a self-driving car. This approach has helped Waymo become the real-world self-driving test leader, with more than eight million roadway miles driven. Both Ford and GM are designing new vehicles from the ground up to build their fleets, resulting in a slower accumulation of road test miles. They anticipate commercial introduction of their purpose-built self-driving vehicles in 2021.

Ford's unique approach includes the transportation not only of people, but also of goods. Ford has developed partnerships with several consumer companies, such as Domino's, and sees a large market for on-demand goods delivery. While all three companies discuss safety operator training for its test vehicles, Ford presents its safety operator training extensively. Clearly these three companies understand the importance of protecting public safety and building consumer trust during their public vehicle test programs.

"So far three AV makers have filed VSSAs with NHTSA: Waymo, Ford and GM"

GM articulates several unique aspects of its self-driving vehicle program. It is dedicated to the development of an electric vehicle for self-driving fleets. It is also ready to build vehicles with no human controls and has petitioned NHTSA for an exemption to the Federal Motor Vehicle Safety Standards to allow production of these vehicles. Another goal unique to GM is congestion reduction through the introduction of self-driving vehicles – although the GM assessment does not present a rationale of how that would happen. Lastly, the GM assessment highlights its road testing in the challenging San Francisco roadway environment.

Don Hunt is a transportation consultant and former director of Colorado DOT; ***dhunt@anteronet.com***

New efficiency-enhancing tools for workzone traffic management

Recently, a study conducted by Inrix found that annual vehicle miles traveled (VMT) in the USA increased to a staggering 3.2 trillion last year. And congestion cost US drivers approximately US$305bn – an increase of US$10bn from 2016. According to the FHWA, workzones account for nearly 24% of non-recurring congestion. Unfortunately workzone and non-workzone crashes have also steadily increased. There were 765 workzone fatalities in 2016.

Although VMT is rising, roadway capacity expansion is not keeping pace. States are spending increasing amounts on roadway preservation rather than on new capacity. With increased VMT, limited capacity and the need to maintain the existing infrastructure, much of the National Highway System may have workzones on it, with an estimated 6,400 in effect at any one time during the summer months. This has tremendous impact on safety, mobility and emissions. Moreover the window to work without severely affecting traffic is getting smaller as rush 'hours' become longer.

Lane closures come in many sizes and shapes (long-term, mobile, shoulder and full closures, for example) with multiple entities having jurisdiction over different roadways. In addition, workzones have significant dependencies on weather and rapidly changing construction schedules. Most DOTs expend significant staff time tracking, de-conflicting, disseminating and managing workzone events with sometimes limited situational awareness as a nearby locality also manages construction events on roadways under its jurisdiction. Due to all these dynamics, providing comprehensive traveler information either through state advanced traveler information systems (ATIS) or through crowd-sourced programs such as Waze is challenging.

How can we reduce staff time involved with information dissemination, de-confliction and workzone management? How can we improve the accuracy of traveler information and improve overall situational awareness? And how can we save road contractor time and resources, and ensure workzones are compliant with roadway time-of-day restrictions?

To address the above needs, sometimes the answer is not to apply a new, underdeveloped and untested solution, but rather to use a proven and effective tool that has confirmed results along with an examination and alignment of internal and external business processes.

Need to know

How can Q-Free's Lane Closure Advisory Management System help in workzones?

- Provides geo-spatial data for conflict resolution
- Enables peer review of planned lane closures
- Enables seamless sharing of information
- Creates workzones compliant with all local and time-based restrictions
- Provides more accurate traveler information
- Enables planning of future projects

Lane-closure management

One such solution, a lane-closure management system, balances plans for road closures against vehicle movement by the use of active data management, enhancement, peer review and information sharing.

Q-Free's Lane Closure Advisory Management System (LCAMS) does just that. It is a web-based application for scheduling and managing workzones and special events. It provides easy-to-use browser-based interfaces for both workstation and mobile devices. Users can submit and manage lane-closure requests, manage the approval workflow process, detect and respond to scheduling conflicts, track the status of approved lane-closure requests, and share data with stakeholders and travelers.

LCAMS provides both a conflict-management system and a planning tool for future projects. Implementing LCAMS alleviates the manual aspect of identifying existing occupancy of a workzone by other organizations, minimizes the chance of human error and duplicate requests, and provides a means to verify and compare multiple lane closures against

Left: **Lane closures around workzones often cause delays congestion**

Above: **Congestion can be even worse at complex junctions. The Q-Free Lane Closure Advisory Management System helps plan for all eventualities**

established policies and business practices. In addition, it uses scalable embedded systems imposed on the life of a planned closure. Each of these embedded systems has a starting point. Multiple starting points allow the same software to handle complex urban areas, where many levels of review are necessary, as well as rural areas, where little to no active management is necessary.

In use in Virginia

A case in point, and one of the early drivers for LCAMS, began in 2008 when the Northern Region of the Virginia Department of Transportation (VDOT) had US$4bn to US$6bn in active construction underway in the heavily congested Washington DC suburbs. For every workzone, VDOT needed a way to detect conflicts, redirect traffic and disseminate accurate and timely information to the public. LCAMS provided the means to do so.

The application has been upgraded several times since 2008 and now Q-Free is integrating its LCAMS solution into the Q-Free ATMS platform, OpenTMS, which is used by VDOT. This scalable system was engineered to work in urban and rural areas and accommodates diverse business rules. Multiphased regional transportation management tools enable a tier-based system to ensure that action plans do not negatively affect other route closures. These tools also provide insights to see who did what, when, where and why.

The Q-Free LCAMS solution was built to interface with, enhance and exchange data with other applications such as 511 and computer aided dispatch systems. This interface for data exchange includes mobile application support for contractors, which increases communication between workzone contractors and DOT operations, reducing accidents in workzones. Public dissemination of real-time traveler information and more accessible shared information empowers road-users to make informed decisions.

CAV future

With the arrival of connected and automated vehicles (CAVs), having accurate and timely information on workzone activities will be even more important to enable congestion management and to ensure safety. Often pavement markings and construction-related signage may not be adequate or may be in flux. Having real-time warnings and accurate information may allow the vehicle to alert the driver and allow for driver control if needed, whether using DSRC or cellular protocols.

Q-Free's LCAMS can be the unified source of reliable workzone information. It uses active geo-spatial data for conflict resolution, peer review and information sharing, and has a planning tool for future projects. Ultimately this saves agency staff and road contractor resources, ensures workzones are compliant with time-of-day restrictions, increases traveler information reliability, and improves overall situational awareness in a multijurisdictional environment.

Making weighing systems legally watertight

The practice of weighing vehicles is necessary for the prevention of damage to road networks caused by overweight vehicles. Over the last few decades, weighing systems have been improved so much that their accuracy is unquestionable. The higher the measurement equipment's accuracy, the stricter the laws are, especially in developed countries. The need to apply tolerance deduction is very low – almost nonexistent – and the obtained weighing data is reliable. Nevertheless, stricter the laws, the greater the chances that the driver or company operating an overweight vehicle will challenge the data in court to try to avoid penalties.

In some countries, the punishments are so harsh that a high percentage of sentenced drivers seek refuge in the laws – or rather, in the failures of the legislation.

Need to know

How to ensure that weighing data is enforceable

- **Get international certification** – awarded by metrology bodies such as OIML
- **Get local certification** – sometimes required, so local knowledge is important
- **Ensure correct usage** – when picking WIM scales always make sure proper operator documents, such as certificates and manuals, are included

In Switzerland and Germany, for instance, the overload must be transferred to another vehicle, which can be costly. In Israel, an overweight truck is forbidden to drive for a month. Their losses are so large that transport companies find it worthwhile to invest time and money in lawyers to try to avoid such a penalty, and the chances of winning are high because there are often circumstances that are not observed by the police or that the weighing equipment does not fullfil.

Certification and usage

When used for enforcement, a weighing system must be certified and approved by a notified metrology body. In many countries, international certifications such as OIML (International Organization of Legal Metrology) are not enough and a local certification is required. The whole chain must be certified, from scales to software data storage. In Brazil there have been so many cases of software hacks that local laws were made even stricter than the OIML requirements for data storage. Nevertheless, the certification given is only for the instrument itself and does not ensure that the case will not fail in court.

Once equipment is certified, it must be approved before being put into service. A weigh-in-motion (WIM) system, even when portable, must be approved in the place where it will be used. For static scales, a first and periodic calibration done at the test bench of a certified metrology body or in the presence of an official is normally enough. In some countries, such as Morocco, Kenya and Israel, the scales must be tested with weigh stones.

Another question is the way the measurement was performed. Did it follow the local code of practice? Were all tolerances deducted? Were the leveling rules obeyed? Some countries don't have a code of practice for vehicle weighing control and the police officers in charge of the weighing must follow the operation manual of the equipment. Again, responsibility for ensuring such manuals are up to date lies with the manufacturer.

In legal metrology and especially in weight enforcement, it is important to provide a reliable product, an application knowledge and legal background.

Choosing the right scales

Haenni Instruments has been producing wheel-load scales for weight enforcement for 44 years and has sold its products to more than 100 countries. The company keeps in close contact with its customers worldwide, ensuring that information flows in both directions.

A Member of the Swiss Weighing Association, the CECIP, the International Road Federation (IRF) and the ISWIM (International Society for Weigh in Motion), swiss manufacturer Haenni has actively participated in issues surrounding weighing control. In Switzerland, for example, the instructions about police weight control in road traffic, known also as the code of practice, were developed in cooperation with Haenni. The company is in constant contact with national institutes and organizations in legal metrology (OIML, WELMEC) and this background is used to benefit its clients, who are always kept updated about new regulations.

Richard Butter

Real-time navigation tools could soon offer predictions

Main: **Haenni portable scales enable reliable weight enforcement**

Below: **Certain jurisdictions require scales to be tested with weigh stones**

One week before my summer holidays in Tuscany, I read the news about the 'black Saturdays' on European roads, caused by heavy congestion. Looking for a way around this problem, I found the Dutch news website NU.nl had some advice. "Try to avoid traveling on a Friday night," it suggested. "It's better to depart on Saturday afternoon. And use Google Maps to get the best alternative route options." This last part was interesting and relatively new advice. So, just how far have we come in recent years with real-time navigation and where are we heading?

Real-time speed data provides a dynamic picture of changing traffic conditions and enables traffic management centers to manage traffic flows. It has also become a very important part of navigation, as it allows drivers to improve on the originally calculated route based on the current traffic situation. The best and fastest route to your destination is optimized while you are driving.

Now even my car navigation predicts the fastest route based on current traffic conditions, but eventually drivers must still make their own choices based on common sense. We're so stubborn, don't say you aren't… So do you follow the advice of your car navigation or not? And if you don't obey, which choice do you make? There are so many route-finding apps available, but simply by checking one you are creating a safety hazard as you will be taking your focus off the road, which is why using a smartphone while driving is illegal in many countries and US states. Nevertheless choices must be made and they are important as they can make a big difference, especially when you are driving long distances as I was a few weeks ago for my holidays – about 1,000 miles (1,600km), in fact.

It was the end of August when we had to leave beautiful Tuscany behind and head back to the Netherlands. We departed around 4:00pm from our picturesque farmhouse; the car navigation predicted us to arrive home at 6:25am the next day without a stop (my wife and I always take shifts at the wheel), but during the trip our estimated time of arrival varied between 6:25am and 11:20am. Eventually we arrived at 9:00am. The estimated time of arrival appeared

"Modeling techniques allow not just reactions to real-time events, but traffic predictions"

,to change because of unexpected congestion around Florence and Milan.

Such real-time route finding is good, but there is still some way to go – a five-hour margin for error can surely be improved upon. Navigation companies are developing new modeling techniques that will enable not just reacting in real-time to traffic events, but being able to predict them before they happen. This could leave you being directed to drive on a route that appears to make no sense at all. Will we trust such predictions? As they become more reliable we almost certainly will. We've already come so far, more often than not leaving our old-fashioned hard copy route maps at home, or even in the trash. As if to prove our newfound trust, as we approach home, our children's mouths fall open when we explain how we used to navigate…

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

Real-time traffic management or short-term prediction?

Short-term prediction, decision support systems and predictive modeling: all familiar concepts to experts in transportation, but given the many real-time adaptive traffic management systems, do we really need them?

When it comes to adaptive traffic management systems, the UK market is the world's most saturated. Most cities and towns face high levels of congestion on a daily basis. A well-configured SCOOT system can handle many of the day-to-day challenges facing such networks.

The best investment an authority can make to manage its network and maximize its physical assets through technology is an adaptive system, be it a highway ATMS (advanced traffic management system) or a city-wide adaptive solution. All carry a high cost/benefit ratio, though they are generally restricted to dealing with immediate traffic situations.

Need to know

Ways in which Aimsun Live can help to augment traditional real-time ITS

- Enables dynamic forecasting based on current state of the road network
- Allows traffic managers to take proactive steps to prevent system breakdown
- Enables evaluation of different strategies for alleviating congestion – before implementation

In the UK, the Transport Technology Forum suggests that transport congestion, safety and emissions add up to a £100bn-a-year (US$130bn) problem.

We are all familiar with the frustrations of the daily commute. The problem is magnified when there is an unplanned incident in the network, whether a lane closure, emergency road works, an accident, or even an ITS failure (it does happen). With air-quality policies starting to influence cities' traffic management strategies, congestion rising, and capacity in the network remaining largely the same, timely intervention could well be the measure of success by which road users judge operators.

Predicting the future

This is where predictive decision support systems (DSS) come in, working together and enhancing these real-time systems by looking past the current situation and assessing, analyzing and predicting the future, normally in 15-, 30-, 45- and 60-minute periods.

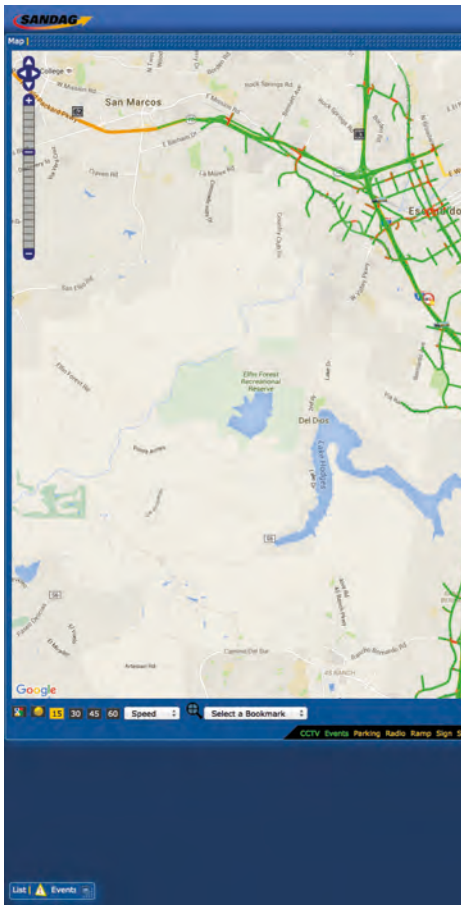
The award-winning San Diego Integrated Corridor Management (ICM) system has now been live for five years. The ICM system deploys innovative solutions designed to coordinate and optimize all infrastructure, routes and modes.

SANDAG (San Diego Association of Governments) has delivered a pioneering DSS that can build on the state-of-the-art systems deployed on the I-15.

The DSS is a smart traffic management system that gives system managers comprehensive insight into the performance of the entire corridor; it also allows them to take proactive steps to prevent system breakdown, using enhanced controls across multijurisdictional devices such as traffic signals, ramp meters and message signs.

Above: **Aimsun Live helps with earlier communication of incident information**

Right: **The Aimsun Live user control panel features live feeds and simulations**



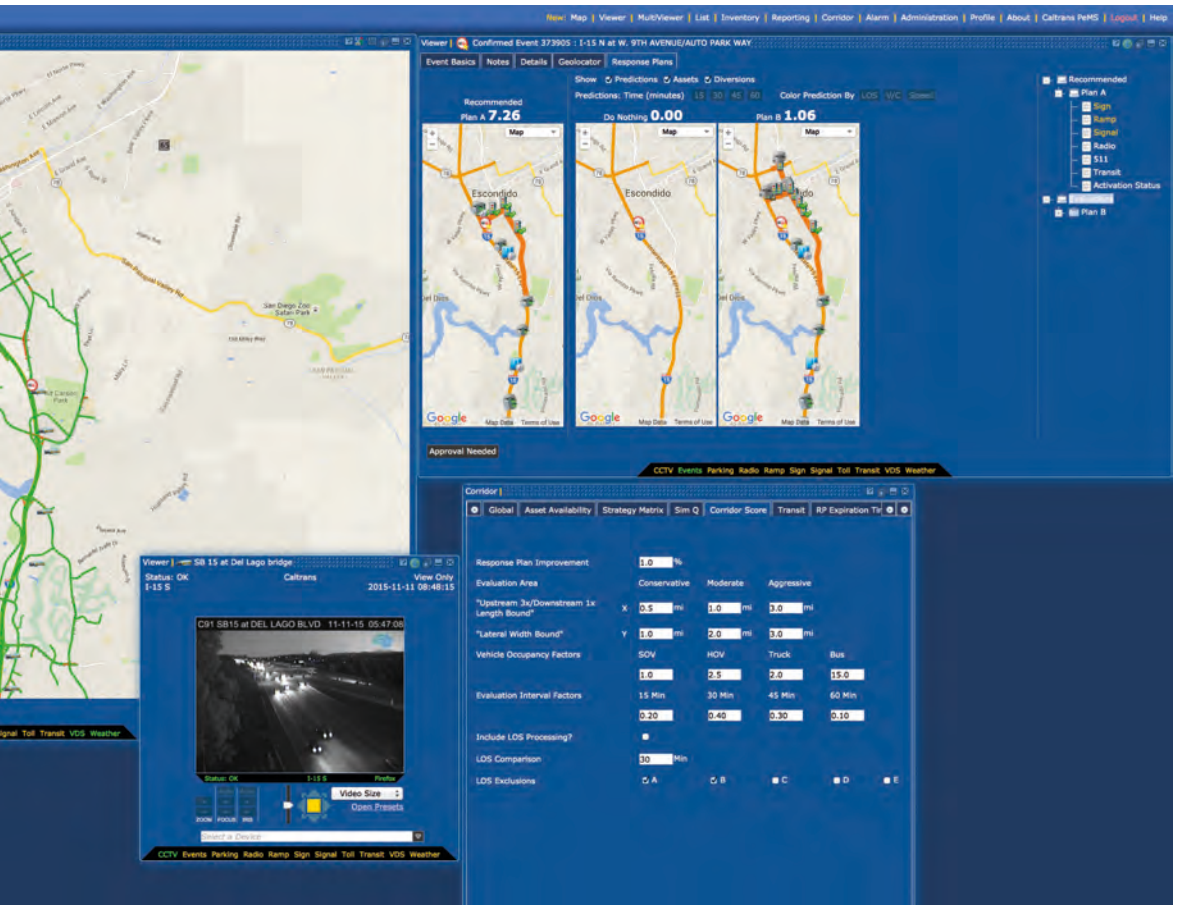
At the heart of the DSS is the Aimsun Live modeling package, configured and integrated with Parsons' iNet system by the SANDAG project team. It uses live traffic data feeds and simulations to dynamically forecast future corridor traffic conditions based on the current state of the network. Aimsun Live enables traffic management center operators to evaluate the impacts of different strategies prior to implementation, then select the best strategy to help tackle future or existing congestion.

The project is much more than just a corridor management system, as it takes in a multitude of roads around and alongside the main corridor highway, providing alternative solutions, and complexity, to the systems.

Managed motorways

The Roads and Maritime Services, in Australia, has recently launched a similar project, selecting Tyco as systems integrator for the Sydney M4 Smart Motorway Management System deployment, and Aimsun Live as the provider of the DSS for managing traffic in real time along its corridor and the surrounding roads. This will be the first smart motorway for New South Wales and the first simulation-based predictive system in Australia.

The M4 Smart Motorway will offer a smarter way of traveling, integrating real-time information, traffic management and communication tools, to give motorists a safer, smoother



and more reliable journey.

Unlike traditional analytical forecasting processes, Aimsun Live (which is based on the simulation of individual vehicles) can emulate the M4's intelligent transportation policies, including ramp meters, variable speed limit and variable message signs.

It is also connected to the Sydney Coordinated Adaptive Traffic System (SCATS) for reading detection data and real-time traffic signal controller status, so can accurately emulate the SCATS traffic signal logic.

This system lets traffic control room operators make short-term predictions about congestion, enabling them to choose the best congestion mitigation strategy.

Key planning considerations include:

- **City- or area-wide network:** An integrated modeling approach that covers macro-, meso- and micronetwork models, with a single software interface, is a strong starting point. The base network, origin destination matrices, and traffic patterns are all set up, utilizing Aimsun Next tools, before being deployed in Aimsun Live.
- **Speed:** Predictions need to run in the shortest possible time. If it takes an hour to run a prediction for an hour's time, there is little point. In Lyon, in France, through the Opticities EU research project, Aimsun Live was running 24/7, simulating a full city model in three minutes, giving a predictive scenario of the upcoming 54 minutes (that is, it was 18 times faster than real time).
- **Quality:** At the start of each prediction, Aimsun Live's quality manager checks the previous prediction against the data and makes corrections if necessary. The system learns from this, while ensuring that predictions never deviate too far from the base truth position.
- **Integration:** Data can be integrated natively in the Aimsun Live deployment, or into any existing ITS architecture. There are pros and cons to both approaches, but it's important to remember that a DSS such as Aimsun Live is a key supportive function to existing ITS systems, not a replacement. The success of a DSS rests on its integration into existing systems.

Operators have a complex working environment. There are many systems and subsystems to monitor and operate, so adding a further DSS must be done in a sensitive way. Aimsun Live runs behind the scenes, creating its predictions and scenarios, only exposing its suggestions or outputs to the existing ATMS.

Conclusion

An effective DSS that looks into the short-term future, integrated with real-time traffic management, provides an advanced ITS toolkit that enables traffic managers to deal with unplanned incidents and high-level policies that normal traffic management systems on their own would struggle with.

Whether we call it short-term prediction, DSS or predictive modeling, these systems are being deployed, are working and, most importantly, are here to stay, as part of the traffic management toolkit to enhance existing ITS.

Improving the efficiency of winter road management

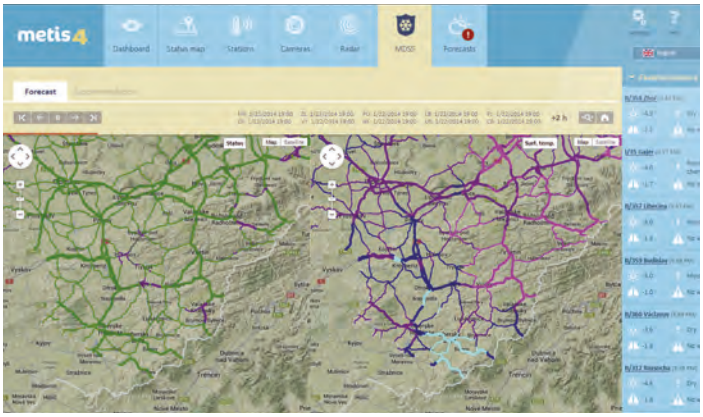
Winter road maintenance is both complex and costly, driving companies to constantly attempt to improve the efficiency of the practices involved. In the Czech Republic since 2003, Cross Zlín has been operating a nationwide road weather support system called Metis. Metis is instrumental in the improvement of maintenance quality as well as cost reduction (26%, according to a 2014 analysis by the Czech Ministry of Transport). What are the key elements of this success story?

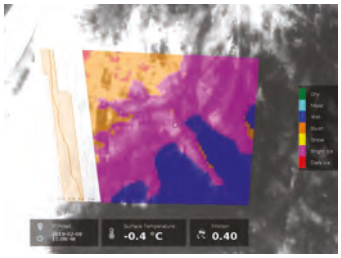
Comprehensive system

With a web interface and an app, Metis caters to the needs of maintenance managers, vehicle personnel and dispatchers. The solution consists of three layers: a road-weather information system (RWIS), a maintenance decision support system (MDSS) and a maintenance information system (MIS).

The RWIS collects, validates, and stores data from road weather stations (RWSs). It then displays them as historical station data, a current status map and a camera list. It also integrates radar and satellite data to overlay cloud cover and precipitation on the status map.

On top of the RWS data layer sits the MDSS layer, which provides road-surface forecasts and treatment recommendations. The road-surface temperature and status are forecast for every 1km- (0.6-mile) stretch of road for 12 hours and shown on an animated color-coded map (Figure 1). This enables efficient maintenance planning and even selective maintenance. Treatment recommendations are presented as a set of graphs, suggesting snow plowing and chemical treatment, including salt dosage.





Left: **Metis delivers road-surface forecasts on color-coded maps (Figure 1)**

Above: **2DRoad, by Cross Zlín partner MetSense, shows multiple road surface statuses (Figure 2)**

Need to know

The constituent parts of Cross Zlín's Metis road-weather support system

- **Road-weather information system (RWIS):** collects and validates data from road-weather stations
- **Maintenance decision support system (MDSS):** provides visual geospatial information on road conditions
- **Maintenance information system (MIS):** enables maintenance reporting and invoicing

The MIS layer offers maintenance reporting and invoicing (largely based on vehicle GPS), and boasts integration of the Cross Winter Maintenance Index (WMi) module – a validation and evaluation tool for comparing maintenance activities with recorded weather conditions. WMi is used to analyze and control the adequacy of maintenance to detect overreactions (i.e. overpricing), and to unify the maintenance standards among regions, to maximize safety, mobility and efficiency across the country.

"We have been refining the system based on feedback from hundreds of users in the Czech Republic. This ensured that all their wishes were incorporated in the system," says David Konečný, the development head for Metis at Cross Zlín.

Technology agnosticism

Currently, Metis seamlessly pools data from more than 600 RWSs from six manufacturers. The recently released fourth version of CrossMet is strongly represented among them. With Metis's RWS agnosticism, CrossMet can operate with tens of third-party sensor types, act as a V2I endpoint, and even control other roadside technologies, like VMS.

Continuous innovation

The very latest addition to Metis is 2DRoad from MetSense. 2DRoad is a near-infrared (NIR) camera sensor that outputs a full multilane (up to 6 x 6m/20 x 20ft) description of road surface condition. Seven statuses (dry, moist, wet, slush, snow, and bright and dark ice) are detected with a resolution of 4,000 pixels and are overlaid on an overview image. Together with a remote point temperature measurement, road friction can be estimated with extreme accuracy.

During a 2017/2018 winter test on three sites across the Czech Republic, 2DRoad changed the paradigm of winter road maintenance. According to Jörgen Bogren, a road climatologist at Klimator, "A road section often exhibits up to three surface statuses, such as icy tracks with slush in between and snow on the roadside (Figure 2). Subject to installation location, a single point detector can report only one of three such statuses, often leading to suboptimal maintenance."

2DRoad in contrast delivers 'proportional surface status information', where the predominant or most dangerous (lowest friction) status is reported and flagged. This, combined with intuitive visual information, leads to better-informed maintenance decisions, thus saving money and delivering safer roads.

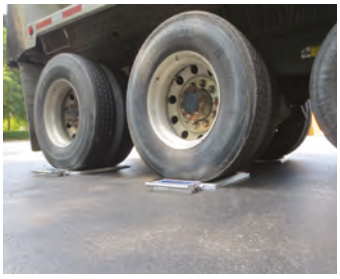
Certified weigh-in-motion scales for multiple applications

Incorporating strain-gauge technology into its fixed and portable scales and sensors for four decades, Intercomp has developed and enhanced its products to surpass testing required for regional and international certification standards. Intercomp's static and weigh-in-motion (WIM) scales and sensors provide users with accurate wheel, axle and gross vehicle weights for static, low and high speeds across a variety of applications. The USA-based manufacturing company supplies its scales worldwide and therefore works to certify performance to several standards.

Portable certification

In the portable scale market, Intercomp's LP788 low-profile wheel-load scale received NTEP certification for enforcement use in the USA. This scale is added to several existing certified scales that Intercomp has available to customers, and with a weight of under 40 lb (18kg) and a height of 0.85in (22mm), the scales are exceptionally easy to transport and use. As they incorporate solar charging and full wireless capability, safely recording weights to indicators and software is simple. As other countries use static weighing for legal weight enforcement but adhere to the OIML standard, this scale is currently undergoing testing for OIML R76 certification.

Another portable product, the LS630-WIM portable weigh-in-motion scale, has had NTEP certification in static mode for several years for enforcement purposes. Building on that experience and leveraging the static and WIM capabilities of the scale systems, Intercomp has completed successful testing for both OIML R76 static and OIML R134 WIM certification for these versatile scales. This will be a unique tool that enables static or WIM weighing possibilities for OIML countries.



Far left: **The LP788 low-profile scale has solar and wireless capability**

Left: **The LS-WIM axle scale has a 12in-deep frame (305mm)**

Need to know

Some of the certified vehicle scales available from Intercomp

- **LP788** low-profile, portable wheel-load scale with solar and wireless capability. NTEP certified
- **LS630-WIM** portable scale. NTEP certified for static, plus OIML R76 and OIML R134 certified for static and WIM
- **LS-WIM** in-ground axle scale. Has passed OIML R134 certification testing
- **Strain-gauge strip sensors** have passed OIML R134 certification testing

From portable to in-ground

Progression of this technology has led to integration of WIM into many countries' resources for acquiring accurate vehicle weights. By generating accurate weights without having to stop traffic, enforcement efforts are made more efficient by minimizing queues and saving time for drivers and enforcement officials.

Above: **Strip sensors are grouted into 3in (75mm) channels**

Above right: **Portable LS630 scales work in static or WIM mode**

For use at low speeds, Intercomp's in-ground LS-WIM axle scale has also successfully passed OIML R134 verification testing. The LS-WIM axle scale provides highly accurate axle and gross vehicle weights for enforcement and industrial applications. The scale frame is installed into the pavement, which involves modest civil works for a 12in (305mm) deep frame. Requiring installation across several days, the scale is incorporated into new or existing systems with a variety of equipment such as gate arms, displays and software.

With a greater operational speed range, Intercomp's in-ground strain-gauge strip sensors have also passed OIML R134 product verification testing. Configurations of these sensors are used in a variety of applications including data collection, screening and direct enforcement, tolling (ETC) and industrial applications at speeds ranging from 2mph (3km/h) up to 80mph (130km/h). Installed and grouted into place into 3in (75mm) channels cut into pavement, it takes a single day with minimal civil works to incorporate sensors into WIM systems.

Intercomp is unique in its position as manufacturer of a wide range of portable and in-ground scales and sensors. For portable scales with static or WIM capabilities, and in-ground WIM products gathering vehicle weights at low and high speeds, the company's global customers can benefit from the efforts being made to provide certified scales to help comply with almost any regional standard.

Free reader inquiry service

Intercomp inquiry no. **510**

To learn more about this advertiser, please visit: www.ukimediaevents.com/info/tfm

The latest solution for toll evasion control

All toll systems have one common goal: to avoid fraudulent activity and achieve secure transactions. Fraud on a toll road occurs when vehicles fail to complete toll payments – a situation known as toll evasion.

Over the past few years, there has been a considerable increase in the number of evasive vehicles. Despite it being a serious violation in any traffic code, many drivers continue to commit this type of fraudulent activity, putting other drivers and workers at risk and generating substantial financial loss for highway concessionaires.

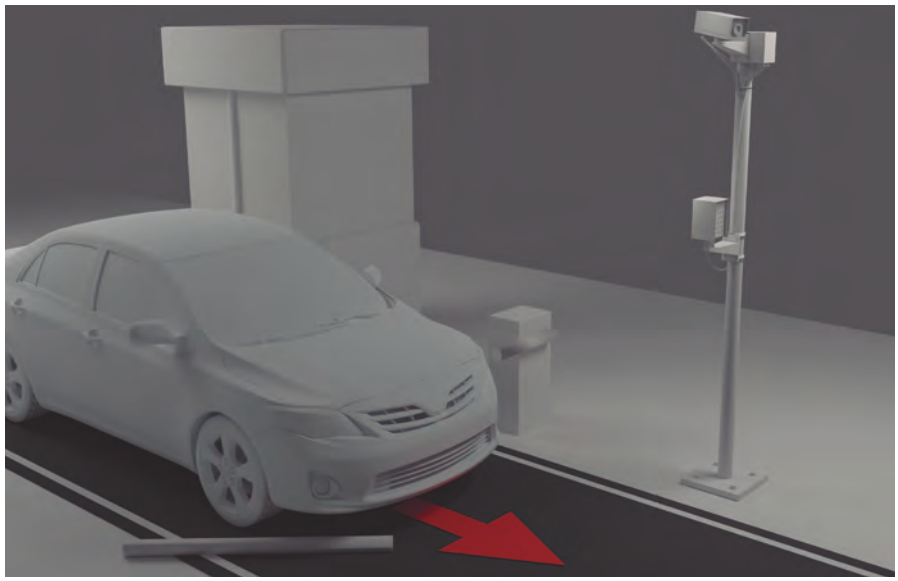
With substantial experience, having carried out projects across four continents, Tecsidel knows that evasion is one of the primary concerns that toll operators face. Brazil, with more than 12,400 miles (20,000km) of highway concessions, is one of the most interesting examples. Tecsidel has been implementing its Stop & Go toll solutions for 25 Brazilian concessions for more than 15 years, including manual, automatic and mixed lanes.

Toll evasion in Brazil

In 2014 almost two million toll evasion offenses were registered on Brazilian roads, causing great economic damage to concessionaires and resulting in a negative effect on work investments and user security. The following year, DENATRAN (Departamento Nacional de Trânsito/National Traffic Department) began to invest in automatic equipment in the hope of controlling fraud.

The Tecsidel team, analyzing the matter and collaborating with the relevant authority, wanted to extend its knowledge to help tackle the issue. The solution studied consists of an advanced registration system, which, when integrated with Tecsidel's toll system, enables the appropriate authority to monitor toll evasions and prosecute violators.

In case of violations (such as a vehicle not stopping at the gate; lacking a toll tag; having a negative-balance tag; being blacklisted), the system automatically generates a report and sends its details to the appropriate authority.



Left: **Tecsidel's toll-evasion detection system consists of a number of sensors and cameras, as well as a fully integrated back-office solution**

Need to know

Tecsidel's toll enforcement systems include the following indicators

- Daily records
- Timestamps of toll evasion incidents
- Identification of the most frequent offenders
- Current status of toll tags as they pass the plaza

This high-tech detection system comprises: an OCR front camera to register the plate; an optional back camera; a panoramic camera to show context (including the state of the stoplight); and a local processing unit. The camera can also record a video. All the hardware and software is integrated into a Tecsidel application.

The software is capable of analyzing the different types of infraction and can issue fines automatically to those involved. The information that the system provides is 100% reliable and is backed up by multiple indicators (listed left).

Real-world deployment

In 2018 Tecsidel implemented its cutting-edge evasion solution for the first time, over 20 lanes of the Planalto Sul Highway in Brazil, which is managed by Arteris. The concessionaire Via Paulista is also soon to implement the system in 66 lanes along the state highway in Ribeirão Preto/São Paulo, Brazil.

To further increase the security, speed and convenience of toll collections in Brazil, Tecsidel is launching a state-of-the-art solution called GToll, which enables users to make toll payments through a mobile application, a card or a bracelet validated by means of near-field communication, which exchanges data between two devices less than 20cm (8in) from each other.

The entire process, from toll payment to validation at the plaza, is very practical and intuitive. Smartphones, which shape consumer behavior so much in the modern world, can also be used to make payments via the GToll app. These payments can be validated in the toll booth with semi-automatic systems.

traffic TECHNOLOGY INTERNATIONAL

Join our LinkedIn group page at
www.TrafficTechnologyToday.com

17,411*

Readers from **100+** countries

*ABC audited circulation

LATEST SUBSCRIBERS INCLUDE...

- Engineer at the Colorado Department of Transportation
- Manager from Vic Roads, Australia
- Senior economist at the World Bank
- Manager from ZF Friedrichschafen, Germany
- Project manager at Mazda Motor Company
- Regulatory engineer from Valeo
- Traffic safety engineer at Turkish phone operator Turkcell
- Project engineer from PTV, Austria
- A Colombian civil engineer
- Engineer at the Norwegian Public Roads Administration

SUBSCRIBE AT:
www.TrafficTechnologyToday.com

GULF TRAFFIC
TECHNOLOGY FOR SMARTER CITIES

GULF TRAFFIC 2018

TTI IN DUBAI!

This issue of *Traffic Technology International* will be distributed at Gulf Traffic 2018, taking place at the Dubai World Trade Centre, December 4-6, 2018

Next issue...

- How to write the perfect VMS message
- How GIS helps transportation planners in an emergency evacuation
- Traffic Management as a Service... and what it means for you
- The latest road weather technology revealed
- Machine vision and smart cameras
- The latest in V2X communications... and much more...

CONTACT OUR SALES TEAM TO GET INVOLVED:
Godfrey Hooper, publication manager
godfrey.hooper@ukimediaevents.com

Index to Advertisers

Express lanes

Your shortcuts to some highlights you will find in this issue – and beyond!

"The continuous flow intersection moves left-turning vehicles before they reach the intersection, so when they do reach it they can turn left, while oncoming vehicles can go straight on"

Watch Utah Department of Transportation's explanation of the clever, continuous flow intersection it is introducing at its Pioneer Crossing on Redwood Road
trafficTechnologyToday.com/redwood

"We've already seen emergency vehicle response times improve by 20%, travel times by 30%, and there's more we can do with the data"

***Mark de la Vergne**, Detroit's chief of mobility innovation, on the advantages of a new approach to managing intersections in the city*

Page 20

"If you meet the technical safety requirements, you can operate without a driver in Denmark and France, but no one has done it so far. For most of the time, you have to start with a safety operator"

***Clément Aubourg**, head of autonomous vehicles for Keolis*

Watch an exclusive video of a demonstration of the Keolis autonomous shuttle 'robotaxi', which is expected to radically transform urban mobility in the future and is now ready for deployment
trafficTechnologyToday.com/robotaxi

"With floating car data, the sensor is on the car or phone and the consumer is the one who's updating and maintaining it. It's eliminating the need for authorities to maintain dense sensor networks"

***Shawn Turner**, senior research engineer, Texas A&M Transportation Institute (TTI)*

Page 28

"They are overhead pedestrian beacons, which, from far away, look like traditional traffic signal lights, but look closely and you'll see that they operate a little differently"

***Vince Jacala**, Caltrans public information officer*

See how the California Department of Transportation (Caltrans) is improving pedestrian safety with intelligent crosswalk beacons
trafficTechnologyToday.com/hawk

"We've heard from hundreds of cities across the world that continue to struggle to manage their curbside assets and create an environment that can handle, or even encourage, new modes of transportation"

***Bob Youakim**, CEO, Passport*

Read more about smart city developer Passport's US$5m investment in transportation systems at
trafficTechnologyToday.com/passport

SIEMENS

Ingenuity for life

At your service

Whenever and wherever you need it

You need to deliver the high levels of service expected by members of the public and network users. You have challenging targets and limited resources. Siemens can help you by providing flexible and bespoke operational service and system support. From route and junction monitoring to full strategic traffic control and network optimisation.

Relieving your pressure and making sure the travelling public enjoys the benefit of a highly efficient road network. That is Ingenuity for life.

siemens.co.uk/operationalservices


PTV GROUP
the mind of movement
You know the benefits of establishing a smart city. We know how to realise it best.
With our traffic software, we help over 2,500 cities model, simulate, plan, analyse, and predict traffic and transport to optimize the flow of movement.
Take a virtual tour of our PTV Mobility Lab at ptv.to/mobilitylab or join the conversation, #MindofMovement.
www.ptvgroup.com