June/July 2017

traffic
TECHNOLOGY INTERNATIONAL

Worst-ever event jams
How to manage heavy traffic on minor roads during festivals

The new weigh-in-motion
Virtual scales and big data are revolutionizing enforcement

WWW.TRAFFICTECHNOLOGYTODAY.COM

NEWS & VIEWS
Connected vehicle roll-outs around the world
A look ahead to the ITS World Congress 2017
Exclusive opinion from industry insiders

Avoiding detection

The criminals who use high-tech devices to fool traffic cameras, and how manufacturers are fighting back

FEATURING
comtrans
Your essential guide to the future of transportation communications

World's first smart state
How the state of Nevada is encouraging uptake of its advanced connected vehicle technology

Making maps with cars
The probe data that is able to build near-real-time, high-definition traffic maps of Toronto, Canada

Brian Ness
The director of Idaho's Transportation Department explains how to harness new technology and reduce costs

ANPR REVOLUTION

graphics: donaldecompany.com

Tattile
Custom ANPR Solutions

Vega Smart

- 2 different OCR on board
- Vehicles Brand and Color recognition
- Full HD video also in low light conditions
- Optical vehicles classification
- Speed estimation using image analysis
- Sophisticated Auto trigger sw
- Multivehicle per second

Vega Basic

- POE
- Multicore processor on board
- New generation sensor
- For reflective and no reflective plates
- No external IR lighting requested
- Very compact size & easy installation

www.tattile.com

Cover story

14 Confusing the cameras

The war being waged over illegal, speed-camera-avoiding technology

James Gordon reports on criminal hardware devices that allow drivers to go undetected by enforcement cameras

Technology Profiles

Editor's letter

Planned special events are problematic enough for traffic managers when they take place in large stadia, served by modern, dedicated, multimodal infrastructure. But what about when they happen in the middle of nowhere? The modern phenomenon of the pop festival is a case in point. Often these gatherings of tens, if not hundreds of thousands of revelers are situated in remote locations served only by rural roads. And everyone wants to arrive and leave at roughly the same time… It's the stuff that traffic managers' nightmares are made of, but a challenge that they must rise to with increasing regularity.

Back in 1997, I attended the Glastonbury Festival for my second time. After what can only be described as a dangerous drive home after my first visit to the event, I decided to leave the driving to someone else and take the coach when I went again. Certainly, the decision made me feel much safer. However, what I had not banked on was the rudimentary method in which coach traffic was managed that year at the event. In order to relieve pressure on the rural roads close to the festival site, organizers had decided to make the coach drop-off point over a mile from the gates. Hopefully this did help reduce traffic chaos in some way, because, as far as everyone on the coach was concerned, the solution was somewhat brutal. It meant all the passengers were forced to get off the coach and trudge along hilly, country lanes (in the rain, of course) carrying heavy camping equipment. It was an exhausting ordeal simply to reach the gates.

Thankfully, in recent years, the traffic management at such events around the world has become vastly more sophisticated. As we go to press the 2017 Glastonbury Festival has just closed its gates, with traffic jams significantly down on previous years. Find out how this was achieved on page 28, along with insights into the traffic challenges facing other festivals, including the USA's legendary Burning Man.

My experience in 1997 illustrates well one of the traps that traffic managers can fall into – managing the vehicles, without properly considering the people inside the vehicles. People have a habit of getting in the way. Sometimes deliberately…

On page 14 we take a look at the criminals who fit 'jamming' devices to their cars, which prevent their speed being recorded by laser enforcement cameras. With recent, high-profile convictions for the use of such equipment, police and camera manufacturers alike are now fighting back, both through camera design and by changing the way in which such equipment is used in the field.

Elsewhere in this issue you'll find technical developments at the cutting edge of weigh-in-motion (p36), some of the latest updates being made to tunnel ITS across Europe (p20) and the connected vehicle advances that will change roads right around the globe (p45) – hopefully always alive to the fact that if people in vehicles aren't safe and happy, traffic management has failed.

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 editor
Alasdair Morton

Design team
Andy Bass, Anna Davie, Louise Green, Andrew Locke, Craig Marshall, James Sutcliffe, Nicola Turner, Julie Welby, Ben White

Head of production and logistics
Ian Donovan
Deputy production manager
Cassie Inns
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 UKIP Media & Events Ltd, 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.

Published by UKi

Member of the Audit Bureau of Circulations
Average net circulation per issue for the period January 1-December 31, 2016, was 17,413
Annual subscription US$104/£80
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

ortana

ORTANA Offers METEOS, a New Line of Weather Station Solutions

METEOS is a new line of meteorological sensors within the ORTANA family which can be integrated into ITS systems to detect and measure functional microclimate conditions on the roads.

www.ortana.com info@ortana.com

Intertraffic

The leading traffic technology events connecting traffic professionals worldwide

INFRASTRUCTURE • TRAFFIC MANAGEMENT • SMART MOBILITY • SAFETY • PARKING

Save the dates for our upcoming events

MEXICO CITY - MX
15.16.17 NOV **2017**

AMSTERDAM - NL
20.21.22.23 MAR **2018**

BEIJING - CN
28.29.30 MAY **2018**

ISTANBUL - TR
SPRING **2019**

Organised by:

rai AMSTERDAM

In partnership with:

TTEC

UBM NTSR
UBM NTSR FUAR VE GÖSTERİ HİZMETLERİ A.Ş.

EJK®

www.intertraffic.com

Driving ahead

From cybersecurity to advanced mapping, **James Allen** rounds up the latest autonomous vehicle headlines and video reports

Coping in the cold

The ability of autonomous vehicles to function in cold conditions, when road markings can be obscured by snow and ice, is often called into question. That's why Minnesota Department of Transportation (MnDOT) has announced that it is hoping to begin trials on autonomous buses during winter weather at its MnROAD test track near Albertville. With this in mind it has issued a Request for Proposals (RFP) seeking technology partners to help in carrying out these tests.

Find out more at:
trafficTechnologyToday.com/coldbus

Blocking the hackers

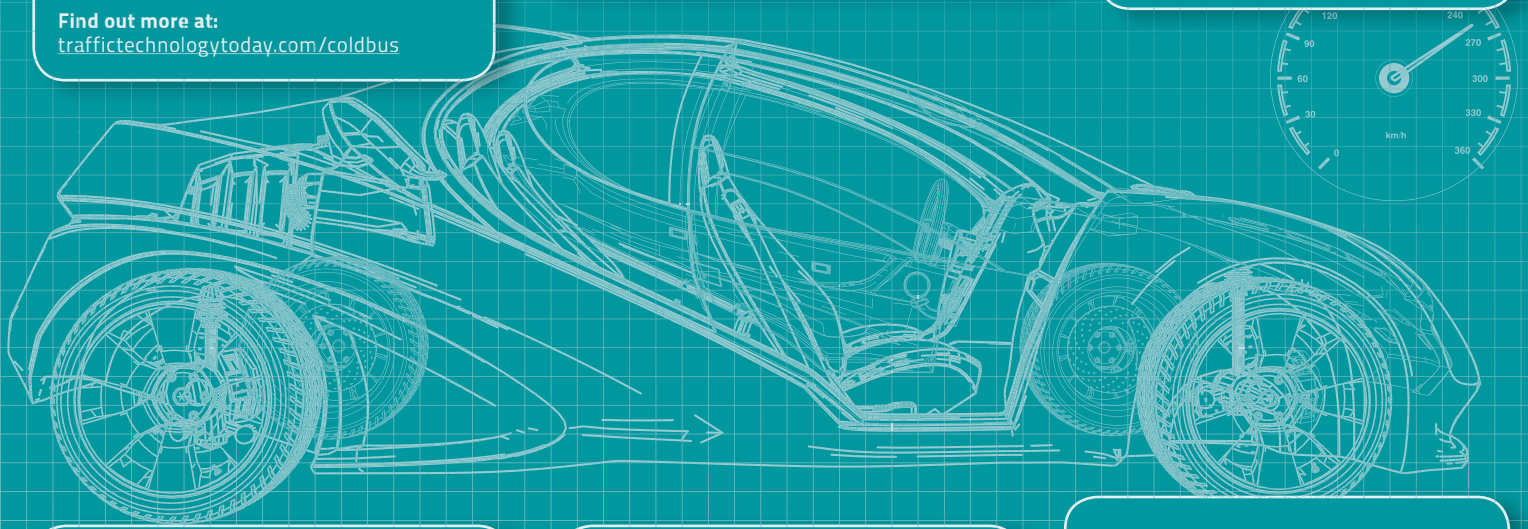
Researchers at Texas A&M College of Engineering are addressing the possible threat of cyberattacks on autonomous vehicles. In this video, the team illustrate how dynamic watermarking technology could prevent the system's onboard sensors from being manipulated for malicious purposes.

Watch the video:
trafficTechnologyToday.com/texas

Student support

A trial of autonomous vehicles in Victoria, Australia, will explore the benefits of driverless shuttle technology for meeting student mobility requirements. Starting in August, it is the first proof of concept project to address first- and last-mile connectivity in Australia.

Find out more at:
trafficTechnologyToday.com/student



Superior mapping

Civil Maps is developing a '6D' mapping system for autonomous vehicles. Going beyond current 3D systems, the six degrees of freedom – roll, pitch, yaw, x-axis, y-axis and z-axis – enables more accurate identification and locating of the autonomous vehicle. With selective attention capabilities, anticipation of the vehicle's surroundings is increased, for smoother navigation along public roads – including avoiding potential hazards.

Find out more at:
trafficTechnologyToday.com/6D

Optimus primed

Optimus Ride has been approved by the Massachusetts Department of Transport (MassDOT) to test automated vehicles in the state. A pilot project will start shortly as the company develops a fully autonomous (level 4) system for electric vehicles. Although new to the self-driving industry, the Optimus Ride team brings over 30 years of shared experience in self-driving technologies, electric vehicles and mobility-on-demand.

Find out more at:
trafficTechnologyToday.com/goahead

Target setting

Honda is targeting 2025 for when it expects to introduce commercially available vehicles incorporating highly automated driving systems (SAE level 4). In a recent demonstration the company revealed its current autonomous capabilities on multiple lane freeways, including artificial intelligence with 'deep learning' functionality. Level 4 means that the vehicle can operate without a driver in most situations.

Watch the video:
trafficTechnologyToday.com/goals

Montreal's moment

The annual ITS World Congress is being held in the Canadian city of Montreal from October 29 to November 2. **James Allen** takes a look at what can be expected at this year's show

Leaders in transportation management will, in a few months, be coming together once again for the annual ITS World Congress, this year produced by ITS Canada in conjunction with ITS America. A mix of academics, policy makers, investors and traffic authorities will converge on the city of Montreal from October 29 to November 2.

The event will coincide with the celebrations taking place to commemorate the country's 150th anniversary and the 375th anniversary of Montreal itself.

This year the World Congress will be held at the Palais des congrès, right in the heart of the city. "It's a beautiful, huge facility with lots of hotels nearby and a great vibrant area for nightlife and social activities that are going to be held all around the same time," said Chris Philp, chairman and CEO of ITS Canada, recently. "It's going to be a wonderful celebration of a number of things coming together."

Wide-ranging program

There will be a wide-ranging educational program of presentations covering institutional, business and economic aspects of ITS delivered by experts in their field from all over the world.

Robotics, autonomous and connected vehicles, artificial intelligence, data and privacy, cybersecurity, wireless communications and operations

in the cloud are inspiring new technologies that will all be discussed and debated at the show.

A virtual testbed on the streets of Montreal will provide practical illustrations of innovative ITS technologies. An arterial loop circling the Palais and a nearby section of a limited-access highway equipped with dedicated short-range communications roadside units with local signal controllers will offer live connected vehicle demonstrations.

Smart city pavilion

The centerpiece of the event will be the smart city pavilion, featuring solutions implemented from not just the host city, but also from Singapore, Copenhagen, Christchurch in New Zealand and Columbus, Ohio.

Philp added, "We're looking forward to a lot of great presentations, technical sessions and discussions regarding the latest in ITS. Connected and autonomous vehicle technology probably leads the list in the interest of a lot of people and members because of how quickly it is coming along."

> "Connected and autonomous vehicle technology probably leads the list in the interest of a lot of people and members because of how quickly it is coming along"
>
> *Chris Philp, chairman and CEO, ITS Canada*

The exhibition hall running alongside the congress will showcase the latest advances and solutions in an ITS market that is projected to reach US$143bn by 2020. The event will offer participants and companies – representing the entire spectrum of an ever-growing ITS world – unparalleled opportunities for networking and business growth.

ITS WORLD CONGRESS 2017
Montréal | OCTOBER 29 - NOVEMBER 2

For more in-depth coverage of what will be taking place at ITS World Congress 2017, don't miss the August/September 2017 issue of Traffic Technology International.

Top 3 technical tours at the ITS World Congress 2017

1. Motor Vehicle Test and Research Center

PMG Technologies has been operating Transport Canada's Motor Vehicle Test and Research Center (MVTC) for the past 20 years. It has developed a vast array of test methods to evaluate the performance, efficiency and autonomy of eco-energy, electric and autonomous vehicles. The MVTC has more than US$1.5m of equipment, including 25km of test tracks, environmental chambers and an indoor crash lab to test advanced driver assistance systems. It is the only test facility of its kind in Canada and the most state-of-the-art facility in North America. A tour of the entire site will include the crash test facilities and test tracks as well as an in-depth briefing on some of the areas of research and testing on connected vehicles.

2. New Champlain Bridge project

The New Champlain Bridge is one of North America's busiest spans, with 50 million vehicles crossing it every year. It is also one of the continent's biggest worksites, with a construction project designed to make the bridge a new symbol for the metropolis of Montreal. Scheduled to be completed by December 2018, the work includes a new 3.4km Chaplain bridge, an additional 470m bridge, widening of Highway 15 leading to the new bridge and improvement of the ramps leading to the South Shore. Visitors will be able to witness the ITS used during the project and the systems that will be in place permanently.

3. Urban Mobility Management Center

The City of Montreal centrally manages traffic signal prioritization for the metropolis's bus network to ensure interoperability of its pre-emption systems. It means signal priority is managed by the Urban Mobility Management Center rather than by the traffic signal controller at the intersection. The tour will include a demonstration and detailed explanation of the interaction between the centralized system and the buses.

Connected news

There are a number of partnerships in place, and projects underway, that are working to speed up the development and enhance the benefits of connected automotive technologies

Streetlight traffic counter

A traffic counting system forms the basis for connected data collection

Echelon Corporation has produced a new streetlight-based, low-cost solution for counting traffic. The InSight Cognitive Vision System, which was piloted in Spokane, Washington, uses intelligent cameras to both accurately and inexpensively count traffic on city streets. During the pilot, the InSight Cognitive Vision System captured data that matched or exceeded the accuracy of conventional automatic and manual counters. Spokane's InSight system also included an adaptive learning capability to accommodate differences in light levels, shadows and reflections for each camera.

The traffic-counting system communicates over

existing lighting networks and can be deployed on any streetlight, not just those at intersections adjacent to traffic control boxes.

By using a city's existing connected lighting platform, Echelon's traffic counting application offers smart cities a cheaper alternative in managing energy use, as well as a platform to collect traffic data.

Data-sharing benefits

Intersection data being made public to enhance the development of V2I technologies

Connected Signals has announced the public release of digital intersection stop line data – a move that demonstrates its commitment to making connected vehicles safer and more efficient. The vehicle-to-infrastructure (V2I) systems developer and connected vehicle data analytics company

provides real-time traffic signal information using infrastructure that is already in place.

"We hope our decision to contribute this data to the public domain ultimately enhances intersection safety for both autonomous and connected vehicles," commented Matt Ginsberg, Connected Signals CEO.

A connected team

A V2X provider has joined the 5G Automotive Association

Savari Inc., a provider of automotive V2X (vehicle-to-everything) communications technology, is the first V2X provider to join the 5G Automotive Association (5GAA), a group of leading automotive OEMs, Tier 1 system and component suppliers and technology vendors.

By joining the group, Savari has committed to contributing to the development of V2X standards across the automotive and mobile industries that will accelerate its commercial availability, and the global market penetration of this life-saving technology.

"We believe cellular-V2X technology plays a very important role in the

widespread adoption of V2X. Our hardware, safety applications and data services support either DSRC or cellular-V2X standards," noted Savari CEO Ravi Puvvala.

"We're pleased to join and collaborate with 5GAA's members on developing the standards for cellular-V2X communications, promoting interoperability across the industry for connected and autonomous car applications."

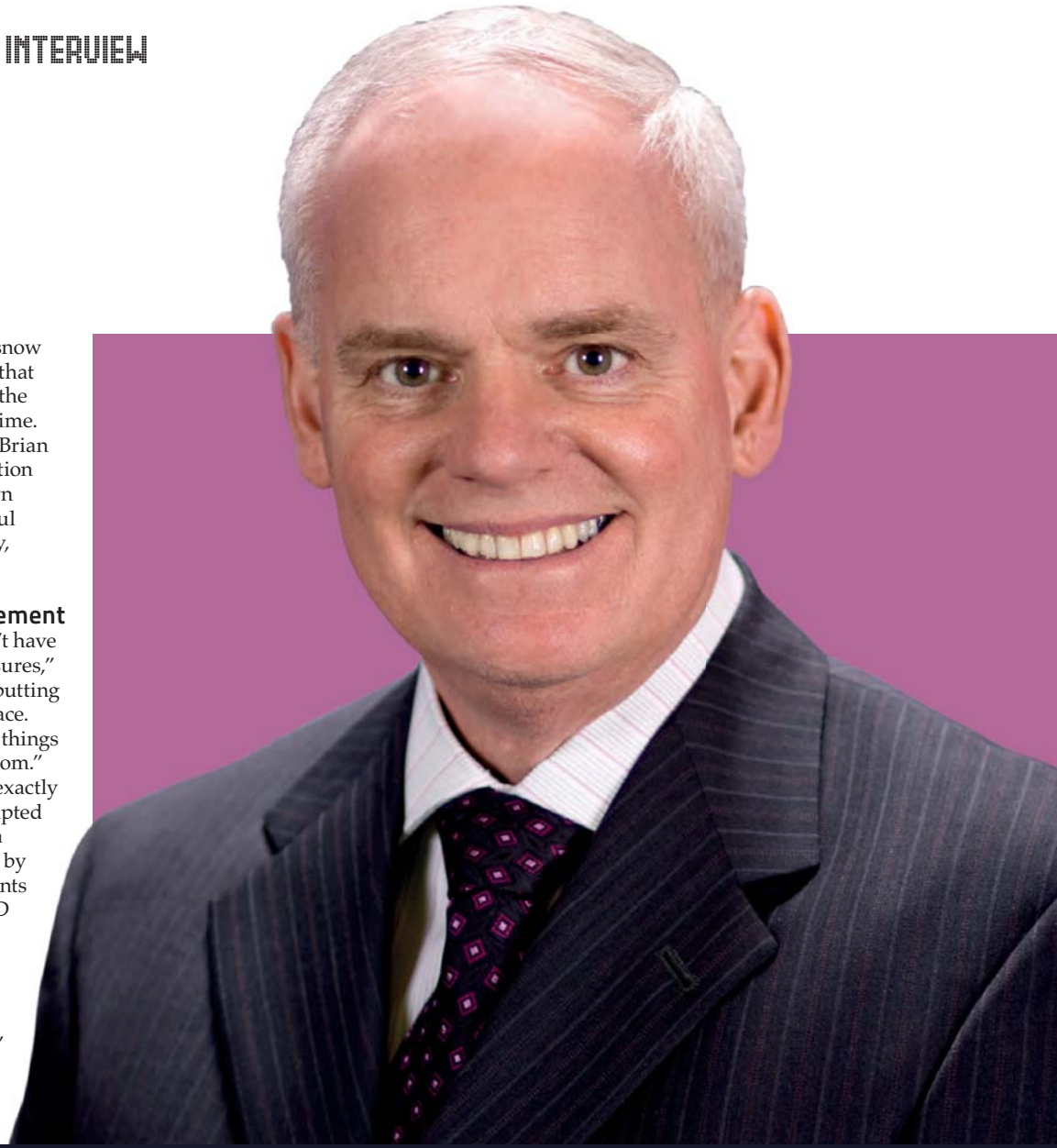
5G collaboration

Continental and NTT DOCOMO are developing 5G connectivity for use in future car systems

5G vehicle-to-everything (V2X) communications is being explored in a research project run by the automotive company Continental and Japanese telecommunications company NTT DOCOMO Inc.

The high-performance wireless communication technology is designed to enable an increase in the speed of wireless data transmission quality and speed of response (latency time). The partners will use

it to enhance connected infotainment functions and build the foundation for cellular-based vehicle-to-everything (C-V2X) wireless communications systems.



Idaho Transportation Department director **Brian Ness** talks technology, data, progress in ITS – and why none of it is possible without a talented, well-managed team

Interviewed by Rachelle Harry

In winter 2010, in the state of Idaho, snow and ice disrupted roads so severely that vehicles were permitted to travel at the posted speed limit only 28% of the time. Thankfully, over the past seven years, Brian Ness, director of the Idaho Transportation Department (ITD), has managed to turn the situation around with the successful implementation of ITS and, specifically, the state's winter operations program.

Advanced road weather management

"When I joined in 2010, we really didn't have any outcome-based performance measures," says Ness, speaking of the reasons for putting the winter operations program into place. "We wanted to focus on improving the things that the public could see and benefit from."

The first step involved finding out exactly when and how much roads were disrupted by winter weather. ITD implemented a network of 130 sensors (manufactured by Finnish company Vaisala) onto pavements across the state. The sensors enable ITD to collect accurate data, at 15-minute intervals, on: road surface and air temperatures; the presence or absence of ice, snow and water; precipitation rates; and windspeed. "From that data, our engineers are able to work out if people can safely drive on the roads," says Ness.

> "For three-quarters of the time during storms, you could drive at the speed limit and not worry about sliding off the road

Left: **Roadside weather stations communicate traveling conditions to traffic managers**

"I also wanted my maintenance employees, who were out there plowing snow, to be able to make decisions according to the conditions that they saw," says Ness. "But they couldn't make good decisions if they didn't have good outcome-based performance measures to base those on."

Data collection from road sensors is a continual process within the winter operations program. Other continual processes include a winter mobility index, which tracks the amount of time that snow settles on pavements without freezing. In addition, a winter performance index tracks the duration of ice on roads, per unit of storm severity – with more severe storms being 'allowed' to have ice on the roads for longer.

Since the program was implemented, Ness and his team have managed to keep roads clear for 75% of the time during extreme winter weather. "This year, we had the worst winter that the state had seen in 30 years," says Ness. "But our roads were free of snow and ice 75% of the time. That's pretty phenomenal. For three-quarters of the time during storms, you could drive at the speed limit and not worry about sliding off the road."

Connected vehicle technology

ITD has also started to incorporate vehicle-to-infrastructure (V2I) technology into its ITS. "When our [salt/de-icing] trucks pull into their garages, data – including average speed and how much material was deposited – is downloaded from sensors," says Ness. "The next generation of this is: can the road sensors talk to the truck sensors? With that data, the truck sensors will be able to say, 'Do we need to put down more or less salt?' We'll be able to carry out these processes according to live data, rather than having to download it and analyze it as we do at present."

ITD also takes care to share relevant data with the public, so that people can make better decisions when planning their travel routes. One element of ITS that has been hugely popular is Idaho's roadside cameras – the first of which was implemented in 1998, but 50 have been added since. "During the winter, people look at those cameras to check the conditions on some of the roads that they are about to drive on," says Ness. "The cameras have been very successful."

ITD also shares its achievements with the public through its online dashboard.

> By having fewer staff, we are able to pay our employees more, which translates to better retention and performance

Fewer staff, bigger results

Ness has managed to increase the quality of service that ITD provides, with fewer staff – therefore demonstrating that successful ITS implementation comes down to quality, not quantity, and that a good team is, arguably, equally as important as good technology.

"When I first joined, we were losing 50% of our snowplow drivers each year because they were going to other places for better pay," says Ness. "We've since reduced our staff numbers by 10%. By having fewer staff, we are able to pay our employees more, which translates to better retention and performance.

"We've also eliminated layers of supervision and have given people more ownership over their jobs. When you survey our employees, they are more satisfied and are happier in their jobs than they've ever been. You wouldn't think you'd get that result when you're cutting staff, but they realize that cuts translate into higher wages."

With their newfound responsibilities, Ness's team decided that their work would be most effective if they adjusted their schedules to coincide with winter storms. "They came up with the idea of 'swarm the storm', which involves them meeting with the National Weather Service twice a week and adjusting their work schedules accordingly," Ness explains.

"For example, if we're going to get storms over the weekend, they'll take their 'weekend' on Tuesday and Wednesday, so that they're available during the storm. And when the storm arrives, all of our employees are out there with every piece of equipment we have. They have taken the initiative to do this by themselves." ○

Idaho Transportation Department state transportation system consists of roughly…

12,300
road lane miles (19,600km)

31
rest areas

1,800
bridges

2,500
miles (4,023km) of Scenic Byways

126
public-use airports

The Port of Lewiston

12
ports of entry

Autonomous Vehicle SAFETY REGULATION WORLD CONGRESS 2017

*The world's only **conference** exclusively dedicated to discussing the rules, regulations and legal issues of autonomous vehicles*

OCTOBER 23-24, 2017

THE SUBURBAN COLLECTION SHOWPLACE, **NOVI, MI, USA**

Over the course of the two days, the conference will address a number of key unresolved issues such as:

- Adapting current safety standards and regulations to allow further testing of autonomous vehicles on public roads
- Assessing liability in accidents involving autonomous vehicles
- Establishing an international agreement on rules and regulations for autonomous vehicles
- Safely integrating autonomous vehicles with other road users
- Code of ethics for autonomous vehicles in the event of an unavoidable accident
- Authorising police and law enforcement agencies to intercept and remotely stop self-driving vehicles
- Allocating civil and criminal liability in the event of a cyberattack, vehicle hacking or deliberate interference with an automated vehicle

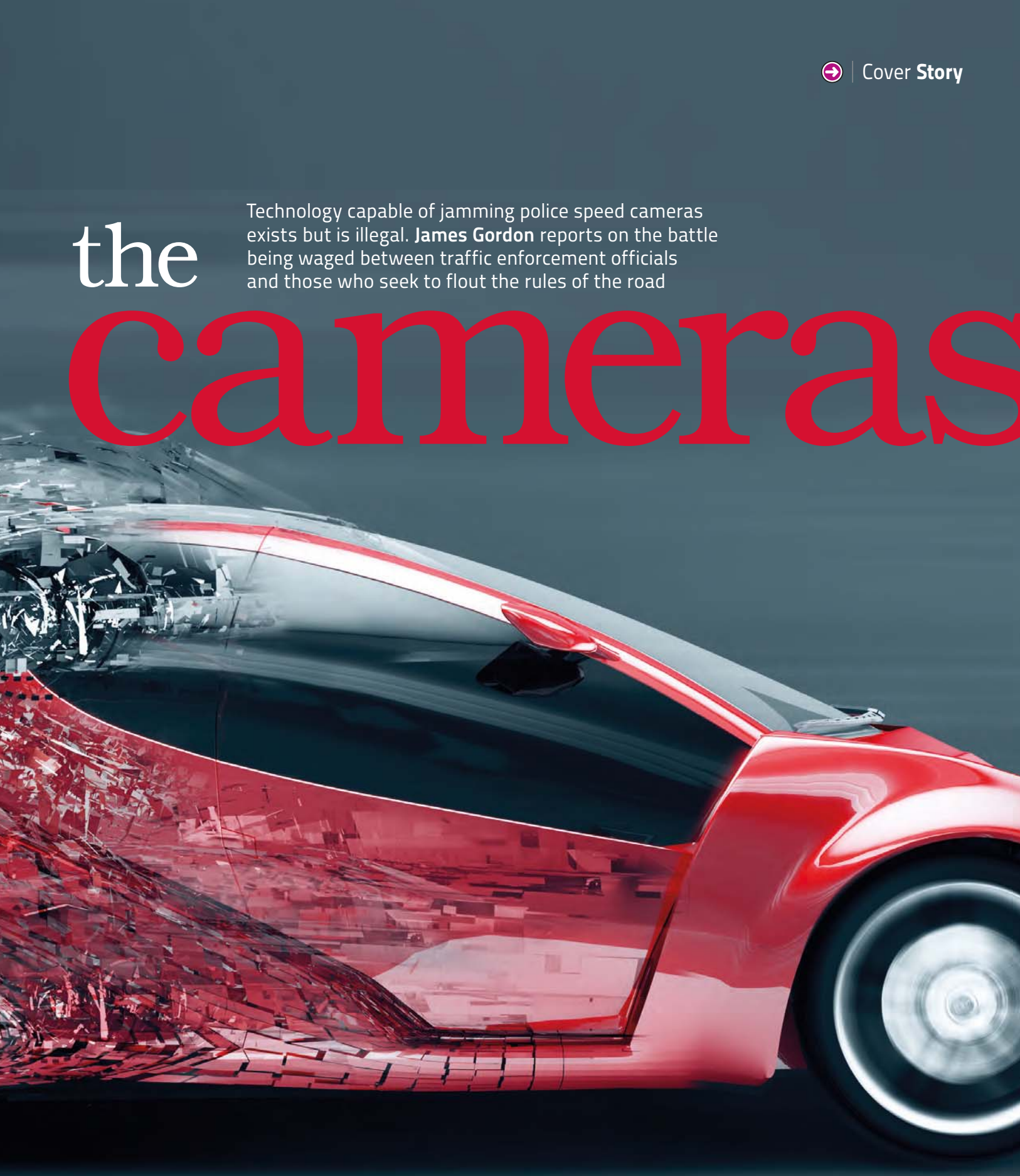
40+ speakers + Expert Panel Discussions!

www.autonomousregulationscongress.com

Confusing

the cameras

Technology capable of jamming police speed cameras exists but is illegal. **James Gordon** reports on the battle being waged between traffic enforcement officials and those who seek to flout the rules of the road



He raised thousands of pounds for charity, but earlier this year, Ben Kitto, a sales executive from Scarborough, northeast England, made national headlines for very different reasons.

In early February he pleaded guilty to perverting the course of justice when he installed a laser jamming device on his black BMW 6 series. The US$380 (£300) Laser Elite jammer, which Kitto purchased on the internet, not only warned him whenever a laser speed camera was tracking his vehicle, but had also been designed and assembled specifically to prevent traffic officers from recording his speed. Kitto received a two-month suspended sentence and a hefty fine.

How widespread is this crime? And how many drivers have installed the technology in their vehicles? *Traffic Technology International* has discovered that UK data is hard to come by. The National Police Chief's Council (NPCC) has not produced any figures, nor has the Department for Transport (DfT). In mainland Europe the picture is no clearer, with TISPOL, the European Traffic Police Network, yet to compile any statistics on the subject.

> When a jammer encounters light waves from a speed enforcement laser, it uses short flashes of invisible light to jam the signal and prevent a reading
>
> **Steve Callaghan, technical manager, Road Safety Support**

Below right: **Handheld enforcement cameras from Jenoptik in action**

One man who is perhaps best placed to offer an answer is Road Safety Support's technical support manager, Steve Callaghan. In fact, there is very little that he does not know about jamming devices. Callaghan, an expert in road traffic enforcement technology testing, heads a team that ensures that all police speed safety camera devices adhere to stringent Home Office Type Approval Standards (HOTA).

A widespread problem?

Callaghan, who supplied technical analysis to police in the Kitto case, says, "There are no statistics that shine a light on the number of cases

£100

The minimum possible speeding fine in the UK (US$130)

Patrolling the skies

Can drone technology support traffic enforcement operations?

Over 100,000 commercial drones were sold across the globe in 2016 and staggeringly, according to US research giant Gartner, that figure is set to increase by over 35% this year. Could these unmanned aerial vehicles (UAVs) help police forces around the world bring speeding drivers to book?

In the UK, the USA and the EU, where strict legislation decrees that drones must always be flown within the operator's sight and not deployed in densely populated urban areas, the challenges ahead are legion. Paul Garratt, managing director of Tele-Traffic, believes that this technology has yet to prove itself for this application.

"I cannot see drones being used in the UK or the EU for traffic enforcement purposes in the foreseeable future," he says. "The UK has one of the most stringent civil aviation regulatory environments in the world. It would take several years and hundreds of hours of testing in controlled circumstances before a drone could be deployed, and even then there would probably be a number of restrictions on where the UAVs could be flown. Flights over built-up areas or crowded motorways, for example, where many speeding offenses occur, might not ever be permitted."

It is a view shared by Steve Callaghan, who adds, "I can see no potential for the widespread use of drones to aid speed enforcement technology. Fixed-wing aircraft have been used to a small degree to measure the speed of motorcycles on country roads, but the use of drones in this area was found to be very expensive and not particularly effective. The future, instead, is in the development of multi-use systems and passive video analysis techniques, coupled with harnessing the ability of speedometers to measure and record multivehicle scenarios."

The price of 'anonymity'

2 months
The jail term British salesman Ben Kitto was given for using a speed camera jammer on his car, suspended for 12 months due to his 'good character'

5
The number of penalty points Kitto received on his license

£2,200
The total fine Kitto had to pay, including court costs (US$2,860)

91mph
The speed at which Kitto was traveling when the jamming device on his car was detected – 31mph over the speed limit

100
The number of hours of community service Kitto was sentenced to carry out after his conviction

tried in the UK. We don't have conclusive evidence that reveals that laser jammer use is on the rise. I can say with certainty, however, that detection rates are increasing thanks to better training for camera operators. So surveillance and monitoring has probably improved, rather than more people installing more devices on their cars."

How do the sensors in laser jammers, which are often mounted next to a license plate or installed behind it, defeat speed enforcement laser equipment?

Callaghan, who says that jammers often masquerade as parking sensors or garage door openers, and are sold by small or independent retailers often on the internet, explains: "Laser speed cameras work by firing short flashes of light to a speeding vehicle. However, let's imagine a scenario in which a traffic enforcement officer attempts to measure the speed of a vehicle where a laser jamming device has been fitted.

"When a jammer encounters light waves from a speed enforcement laser that it recognizes, it redirects short flashes of invisible light back to the laser safety camera at a much higher intensity. This jams the signal and prevents a reading.

"Different speed cameras operate on different wavelengths. The most

Levent Konuk/Shutterstock.com

elaborate laser jammers, however, have been programmed to distinguish between the different frequencies used by safety cameras and many also contain a database of all known police speedometers."

Paul Garratt, whose company Tele-Traffic supplies handheld safety cameras and van-mounted cameras to 98% of the police forces in the UK and Ireland, says that his company provides cutting-edge technology that negates the effects of jamming technology.

Speaking from his Warkwickshire workshop, where his 20 employees also repair camera enforcement equipment, Garratt does not wish to go into detail but states that the commercially sensitive patented systems that his company provides to nullify jamming equipment have been tested and approved by the UK Home Office.

Callaghan also does not wish to delve too deeply into the subject: "It would be inappropriate to reveal this information," he says. However, he believes that education is the most powerful tool available to police forces wishing to circumvent laser jamming devices.

"Some safety camera manufacturers already incorporate anti-jamming software," he says, "which not only alerts the traffic officer when a jammer is being used, but enables him or her to still obtain a valid speed reading. But the simplest way to neutralize a jammer is for the operator to point the safety camera at a part of the vehicle where there is no jammer. After a short and simple training session, which Road Safety Support delivers to police forces throughout the UK, this simple but highly effective countermeasure defeats the jammers every time."

> The most elaborate laser jammers have been programmed to distinguish between different frequencies used by cameras
>
> **Steve Callaghan, technical manager, Road Safety Support**

Flawed defense

As for the excuse commonly offered up in court or to the police – that the jammer was installed as a parking sensor and not a defeat device – Callaghan, who regularly provides expert witness reports and has appeared in hundreds of speeding cases over the last decade, some of which have included the use of jammers, says that this explanation simply does not hold water.

"The defense does not stand up to scrutiny for four reasons," he says. "First, as opposed to laser jammers, bona fide parking sensors use ultrasonic radiation, not light. Second, parking sensors can be constructed in such a way that they do not interfere with a laser speedometer. Third, genuine parking sensors do not carry databases containing the myriad of flash rates and wavelengths required to render a safety camera ineffective. And finally, when a so-called parking sensor does interfere with laser speed camera equipment, it cannot be put down to mere coincidence. Any parking sensor that replicates reflected laser light signals has been deliberately constructed to do so and can therefore be confirmed as a jamming device."

Below left and right: **Handheld laser cameras are typically pointed at license plates to get a speed reading, however pointing at other points on a car can defeat jammers**

"Light is not just at the end of the tunnel!"

From art installations to smart LEDs, lighting plays an essential role in helping to make tunnels safer and less stressful. But it's far from being the only bright idea that's helping with traffic management in these confined spaces, as **Jack Roper** discovers

Photographs: Mikael Ullén

Whether it be improving the urban environment, traversing a body of water without disrupting navigation, bypassing miles of treacherous mountain passes, or diverting traffic beneath a site of ecological or cultural importance, tunnels around Europe provide the subterranean solution to a range of road network challenges. But their cavernous stretches also create confined and claustrophobic spaces wherein the danger to life from fire or toxic fumes is magnified, necessitating a bewildering array of escape routes, emergency power and communications systems, fixed fire systems and ventilation systems. And with new projects in the pipeline and older tunnels undergoing wholesale renovation to meet stringent new EU directives with a 2019 deadline, increasingly sophisticated tunnel management systems require a concentrated deployment of technology.

> We have about 12km of single-tube tunnels with cameras every 50m. In total we have at least 400 cameras
>
> **Tor Thomassen, installations project manager, Norra Länken, Stockholm, Sweden**

Failsafe early detection of any incident in a tunnel is imperative to safety – which means cameras, and lots of them. The Norra Länken (Northern Link) is a new section of Stockholm ring road consisting largely of tunnels. "Each tube contains only traffic in one direction

Artwork helps improve the ambience and aids navigation in Stockholm's Norra Länken tunnel

– that's a safety feature," explains installations project manager Tor Thomassen. "It's a two- or three-lane highway with lots of intersections. We have about 12km of single-tube tunnels with cameras every 50m. In total we have at least 400 cameras. If there's an alarm – for instance from a smoke detector – it's stamped with the best camera position and we'll automatically get a view of that area. Of course, we have image-analyzing systems in the cameras; we use them for detecting incidents, stopped vehicles, lost loads, or anything that shouldn't be there."

Speed awareness

Average speed enforcement cameras were installed in the UK's Hindhead Tunnel following problems with wealthy young drivers making recreational 'tunnel runs' in high-performance sports cars. But in tunnels, where traffic queues cannot be allowed to form because of the potential build-up and inhalation of fumes, detecting slow vehicles is the crucial thing. In the Norra Länken, an MTM2 sign system is used whereby infrared detectors measure average speed every four seconds; if this falls below 50km/h, systems are activated and VMS signs display warnings upstream. "Infrared detectors can't detect stopped vehicles with any precision, so we have two detection systems – one for queues and one for stopped vehicles," Thomassen explains. "Trafik Stockholm is one of the Swedish Transport Administration's four traffic management centers and surveys all roads in the Stockholm region. The system architecture means that contractors can deliver several different systems in different tunnels with a common functionality. As long as there's an interface with the monitoring system, the subsystem could use any technology to fulfill functional requirements."

Light and magic

Light in tunnels can help to relax drivers, aid navigation and improve safety, as projects in Stockholm, Austria and Norway prove

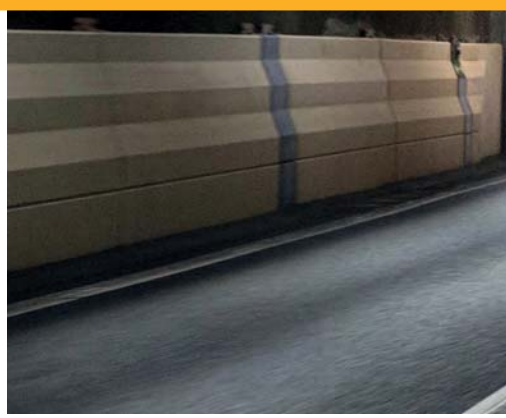
Six junctions within Stockholm's Norra Länken are embellished with art installations combining lighting, sculpture, photos and video to represent nature and the changing seasons. "If you build a tunnel in one of Sweden's most valuable environments, you have to build something pretty, for sure!" says Tor Thomassen, who is installations project manager for the facility.

But can art actually contribute to tunnel safety? "I don't have data to show this," Thomassen concedes, "but, when it's discussed among experts, we think it's better when environments are not so cold and sterile and black. Some people fear entering tunnels, so this lighting and expression shows this is a human environment after all."

The installations also orientate road users by lending a visible geography to a complex system. "You have the choice of making several exits during your ride through and this artistic expression helps you to recognize where you are," says Thomassen.

Lighting also plays a role in improving safety and softening the driving environment upon entry and exit, when drivers transition between natural and artificial light. "Light is not just at the end of the tunnel!" quips Christoph Wanker, project manager for Austria's Arlberg Tunnel. "Brightness sensors in the Arlberg Tunnel ensure optimum lighting for human vision at all times. Lights are situated closer together near the tunnel portals, ensuring the difference isn't too extreme and allowing the eyes time to adjust to the new conditions. Integrated sensors regulate the lighting throughout the tunnel."

The shared concern with creating a benign driving environment echoes the radical design of Norway's 24km Lærdal Tunnel – the world's longest road tunnel. The Lærdal is punctuated by large caverns at 6km intervals, illuminated in blue and gold to mimic sunrise and give drivers the impression of emerging into daylight between four shorter tunnels.



Left: **A range of new technology is being installed in Austria's Arlberg Tunnel**

Right: **Another dramatic view of the artwork on display in Stockholm's Norra Länken tunnel**

Under the mountains

Austria's Arlberg Tunnel – a 14km, single-bore bidirectional tunnel providing a vital road link under mountainous country – is undergoing a US$180m (€160m) refurbishment, encompassing new escape routes, breakdown bays and a high-pressure mist-sprinkling system, to meet new laws. This upgrade will see multiple technologies working together to detect potential incidents. "A range of high-tech systems such as video image evaluation, thermal scanners and audio tunnel monitoring will enable quick responses to any disruptions," explains Alberg Tunnel project manager Christoph Wanker. "Microphones and cameras transmit data to a database. Software is able to

differentiate between the normal sound of traffic and unusual noises such as collisions or brakes."

Thermal scanners at the tunnel entrances are intended to avert potential tunnel fires before they happen. "All heavy vehicles are guided through a special portal with five scanners and two infrared cameras," he says "and, in case of over-heating, diverted in order to cool down."

The Arlberg Tunnel is monitored from a regional traffic management center at St Jakob, one of nine such centers around Austria monitoring 1,367 miles (2,200km) of road and 158 tunnels with over 4,900 cameras. "Every tunnel is monitored 24 hours a day," Wanker continues. "Data collected from around the network is displayed on a large wall of monitors. Every alarm is activated in the management center, where ASFINAG [Austrian road agency] operators check the situation and decide on further moves." They can then coordinate with local emergency response teams and drivers can be directed via VMS signs, loudspeakers and static-free radio transmission within the tunnel.

> Microphones and cameras transmit data to a database. Software is able to differentiate between normal traffic sounds and unusual noises such as collisions or screeching brakes
>
> **Christoph Wanker, project manager, Arlberg Tunnel, Austria**

Man versus machine

Even when incorporating autonomous elements, tunnel systems are always likely to require human oversight given the catastrophic risks if things go wrong. And there are other considerations. "Personally, I think there will always be the need for a human element," says Thomassen. "Image-analyzing systems have not always been stable and can give false alarms. For instance, if it rains, cars carry water with them into the tunnel, making a wet spot. The camera sees a difference in the environment and thinks the wet spot

Christoph Wanker photograph: ASFINAG

Underground route

A new tunnel in central Singapore will ease jams created by traffic coming from nearby Sentosa Island

The Sentosa Gateway Tunnel is a 1.4km, one-way tunnel carrying outbound traffic from Sentosa Island to Lower Delta Road and Keppel Road in Singapore. It was built to relieve congestion in the area and opened in April 2017.

The Singapore Land Transport Authority (LTA) utilizes an Integrated Traffic and Plant Management System (ITPMS) as a common control platform for multiple detection and response systems in the Sentosa Gateway Tunnel and other road tunnels. This is part of the LTA's 24-hour monitoring of island-wide traffic from a single control center.

Linear heat detectors and automatic incident detection (AID) cameras monitor the tunnel and, if an incident such as fire or abnormal traffic flow is detected, the control center operator is alerted and must verify the incident before making the decision to execute a specific response plan recommended by the ITPMS. In the event of fire, the ITPMS response plan will aim to provide a smoke-clear path to facilitate evacuation, firefighting and rescue operations.

Variable message signs (VMS) upon entering the tunnel keep motorists informed of traffic conditions, while lane-use signs operate inside. In the event of an emergency, an entrance ramp barrier system can prevent vehicles from entering the tunnel and FM radio re-broadcast and break-in facilities can be used to convey messages to drivers. If fire occurs, the fixed water-based firefighting system will be activated and the tunnel ventilation system will provide a tenable evacuation route by preventing back-layering of smoke.

According to an LTA spokesperson, traffic in the Sentosa Gateway Tunnel has been smooth-flowing since its recent opening and it has fulfilled its purpose of easing traffic problems at Sentosa Gateway.

Singapore's newest tunnel, the Sentosa Gateway, is keeping traffic flowing in the city center

is a stopped car. Around 90,000 vehicles use the Norra Länken each day and, if you close the tunnel on a false alarm, it has a huge impact."

Verification is essential – but, once an alarm is confirmed, the complexity of interconnected systems involved means response must be pre-programmed. "The system has action plans for every possible event – stopped vehicle, accident, car fire, and so on. In theory, the operator shouldn't do more than accept there is a car fire and the location is correct. Then they push a button, messages are sent to systems, managers and assistance crews. A pre-programmed series of actions takes place."

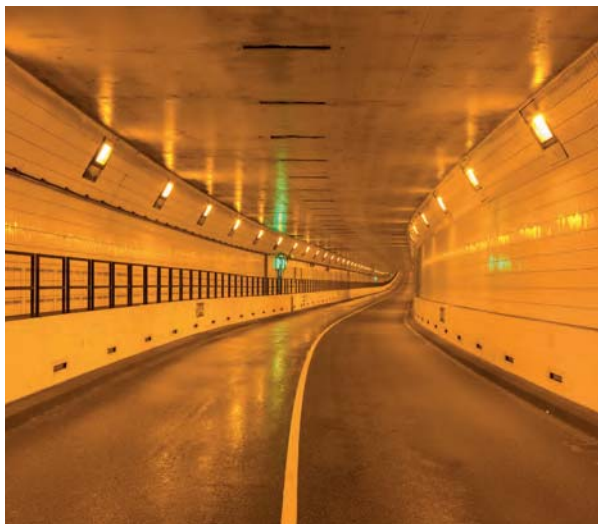
> The speed within the tunnel should be at least 15km/h because that's the speed at which fumes and exhaust gases are ventilated in the direction of the traffic
>
> **Erik-Sander Smits, consultant, Arane**

Adaptive flow management

Rotterdam's 0.6-mile (1km) Maastunnel – taking traffic beneath the Nieuwe Maas shipping channel – was opened in 1942 and now requires renovation to meet new European rules. Part of the challenge is preventing queues since the tunnel forms part of a busy urban network. Alongside conventional tunnel management systems, the City of Rotterdam is working with Arane Consulting to provide an innovative solution known as adaptive flow management (AFM).

The challenges are threefold. "First, the speed within the tunnel should be at least 15km/h because that's the speed at which fumes and exhaust gases are ventilated in the direction of the traffic," explains Arane consultant Erik-Sander Smits. "Secondly, there cannot be any spillback toward the tunnel; downstream of the tunnel are traffic lights and intersections; queues here can spill back into the tunnel. Thirdly, it should be possible to evacuate the tunnel, so we must always ensure sufficient space is available downstream."

The proposed system is an integrated network management solution aiming to satisfy all three imperatives – while also being fully automated. "Within the tunnel there



Right and below: **The interior and entry/exit of the Maastunnel in Rotterdam, which is now undergoing refurbishment**

Go with the flow

From July 2017, at any one time, most of the Maastunnel in Rotterdam will be closed for a two-year refurbishment. It will include the installation of an adaptive flow management (AFM) system. Here's how it will work...

will be detector loops that measure speed and count vehicles; outside there will be more than 80 radar installations – a new way to measure queue length at intersections," Smits continues. "We continuously measure available space downstream and speed within the tunnel. Before a situation becomes problematic, the AFM system increases throughput by giving more green-time at traffic lights downstream. It can also hold vehicles upstream."
For an outline of how the system works see *Go with the flow*, box, above.

Data from the detection systems is processed by proportional-integral-derivative (PID) controllers, which calculate the green-time variations needed to maintain appropriate network outflow. This is transmitted to the surrounding signalized intersections, where green-time is adjusted accordingly. In this way, tunnel traffic flow is smoothly maintained without the inefficient tunnel closures and vehicle metering currently needed to avert queuing in some Dutch tunnels at peak times.

> Our goal is to finish the AFM system in 2018. We then have a year to test whether it is a stable, working system before the tunnel is ready
>
> **Robert Kooijman, traffic management advisor, City of Rotterdam**

"We are building the central system and placing radars outside the tunnel," says City of Rotterdam traffic management advisor Robert Kooijman. "Our goal is to finish the AFM system in 2018. We then have a year to test whether it is a stable, working system before the tunnel is ready. It will improve throughput on the whole network and liveability in Rotterdam." And further innovation is envisaged, with Kooijman already speculating that radar detection may eventually be superseded by floating car data.

15% discount for USDOT and federal transportation administrations

Autonomous Vehicle TEST & DEVELOPMENT Symposium Novi. Michigan

OCTOBER 25/26, 2017

THE SUBURBAN COLLECTION SHOWPLACE, NOVI, MI, USA

Testing, Validation & Development of Autonomous Vehicles

The **Autonomous Vehicle Test & Development Symposium 2017** is North America's only conference exclusively dedicated to discussing the complex challenges of testing, validation, verification and development of ultra-dependable system operation of autonomous vehicles. The conference will be held alongside Automotive Testing Expo North America, the largest exhibition dedicated to new vehicle development and testing in North America, and in conjunction with Traffic Technology International magazine, the world's leading magazine for advanced highway and traffic management technologies.

Hosted at:

automotive testing expo 2017
★ NOVI ★ ★ MICHIGAN ★

Over 50 of the world's **leading experts** in driverless vehicle testing will be presenting papers!

Book your delegate pass now!

2-DAY PASS $1,595

www.autonomousvehiclesymposium.com/detroit

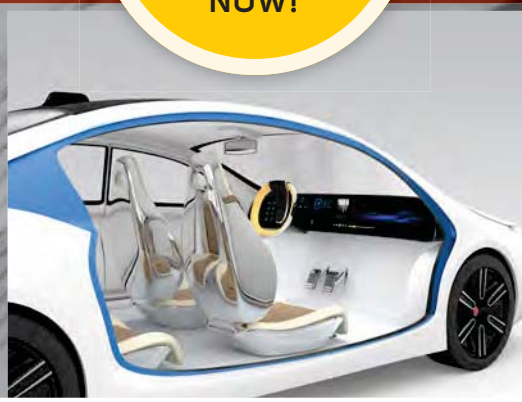
*Prices correct at time of going to press

Brought to you by the publisher of:

traffic TECHNOLOGY INTERNATIONAL

Go online to view the program and **REGISTER NOW!**

© UTAC Ceram



Bringing together the world's leading engineers in the field of autonomous vehicle research, testing, validation and development

Held alongside:

Autonomous Vehicle INTERIOR DESIGN & TECHNOLOGY SYMPOSIUM 2017 NOVI, MICHIGAN

Autonomous Vehicle SAFETY REGULATION WORLD CONGRESS 2017

For more information about the Autonomous Vehicle Test & Development Symposium 2017,
please contact Andrew Boakes: andrew.boakes@ukimediaevents.com
Tel: +44 1306 743744 | www.autonomousvehiclesymposium.com/detroit

11.5 hours

Reported time it took one festival-goer to travel the last 3.3 miles to the Glastonbury Festival in 2016

Big events small roads

The growing popularity of outdoor music festivals presents unique challenges for road authorities attempting to ease temporary but severe congestion, often on minor roads. **James Gordon** talks to traffic managers with innovative solutions

Spare a thought for some of the 200,000 people who each year descend on Pilton, Somerset, UK, to attend Glastonbury, the world's largest greenfield festival. In 2016 the typical long traffic jams, spanning several miles, were exacerbated as monsoon-like conditions caused flash floods. In just 12 hours nearly one month's worth of rain fell on the venue.

On Wednesday, June 22 – the first day of the festival – one person even tweeted that the last 3.3 miles of her journey had taken 11.5 hours. Thankfully by 1:30pm the weather had eased, as did the jams, enabling relieved Glastonbury officials to publish a statement declaring the festival "open for business".

Although last year's torrential rainfall was a freak event, the festival organizers, Glastonbury Festival Events Limited (GFEL), and Somerset County Council reworked their strategy this year to maintain traffic flow should bad weather return.

Steve Russell-Yarde, off-site traffic manager at GFEL, says, "From our on-site control center, we not only employ CCTV to monitor traffic in the six car parks and on adjoining roads, but also have access to helicopters, which are able to paint an accurate real-time picture of

> We are in communication with Somerset Council's traffic management center, and Highways England's, too… collectively we possess split-second visibility
>
> **Steve Russell-Yarde, off-site traffic manager, Glastonbury Festival Events Limited**

The Glastonbury Festival in Somerset, UK, attracts more than 200,000 people, most of whom arrive by car

congestion on key arteries several miles away from the venue.

"We are also in constant communication with Somerset Council's traffic management center, and Highways England's, too. The collaborative relationships that we have forged mean that collectively we possess split-second visibility. Variable message signs [VMS] mean we can redirect traffic flows when required. We can also remotely change the sequencing of traffic lights. But at peak times, when human intervention is required, the Police Accredited Traffic Officers (PATOs) we employ are on hand to manually coordinate busy junctions with the assistance of information from the control room."

Going multimodal

But the safe management of this 40,000-vehicle-strong mechanical migration is only half the battle. For the past decade GFEL has strongly encouraged motorists to leave their cars at home – a campaign that is now bearing green fruit.

"A third fewer cars use our parking areas today than they did 15 years ago. This meant that we were almost able to eliminate queuing traffic in 2013 and 2015. Over the past decade we have forged close links with local and national bus operators, who now transport 50,000 people to and from the festival – that's double the number deployed 10 years ago."

How has this been achieved? Russell-Yarde says that GFEL has adopted a two-pronged approach encouraging people to adopt more sustainable patterns of travel.

"For festival-goers who live close to the venue, we have a dedicated service for them to cycle to the site and have their bags picked up and dropped off outside the gates. For those traveling from further afield, we have worked closely with large coach companies to put on services to and from the busiest population centers. These associations have also helped facilitate coach bookings for private parties."

Burning ambitions

How do you manage the influx (and departure) of 30,000 vehicles to an event in the middle of the desert, where there aren't even any roads?

Ensuring a smooth and efficient flow of traffic to and from a venue is always a massive challenge for any event management team.

However, the traffic operations team at Burning Man have discovered an ingenious way of coping with the mass exodus of vehicles leaving the gathering, which can exceed 30,000 vehicles.

Jim Graham from the festival team explains, "During departure from the event, after communicating with our traffic management center and coordinating with agencies, we can initiate 'pulsing'.

"During a phase of pulsing we ask all drivers to switch off their engines for an hour. We encourage vehicle occupants to have a rest and many take the opportunity to hang out with other participants. When the hour is up, we notify motorists through the site radio station, and also via Twitter, that their vehicles will be simultaneously pulsed forward a mile. We continue pulsing until all the external agencies are satisfied that traffic levels have eased. That's the extent of what is required to make this work."

PHOTOGRAPH: FRANK SPINELLI

30,000

The number of vehicles that help form the temporary desert town of Black Rock City, for the Burning Man Festival

Desert storm

Five thousand miles west of Glastonbury, in the searing heat of northwest Nevada, finding space for the 30,000 vehicles that attend the annual Burning Man gathering in late August is not difficult.

That's because the eight-day event, which attracts over 60,000 people each year, is in the middle of the Black Rock desert. Jim Graham, who is in charge of strategic projects, reveals the traffic management challenges faced by the wider team.

He says that vehicle traffic "is a top priority every year for event organizers" as the vast majority of the 30,000 vehicles travel on Highway 447, which is a 75-mile two-lane road.

Prior to each event, Graham and his team coordinate with local law enforcement agencies, other emergency responders, and state and local road departments. They analyze potential scenarios that could slow or stop traffic on Highway 447 and, most importantly, draw up an effective response strategy.

> We installed a high-resolution camera on Poito Peak that enables us to monitor a 20-mile stretch of 447 in real time
>
> **Jim Graham, senior advisor, special projects, Burning Man Festival**

"In past years we have deployed a Bluetooth-based traffic monitoring system along 447 that has allowed us to monitor drive times between key staging posts," says Graham. "This system allows us to generate hourly traffic reports and identify traffic issues in areas with no cell phone service.

"Second, we installed a high-resolution camera on Poito Peak that enables us to monitor a 20-mile stretch of 447 in real time. We also deploy counters and radios to relay data to our operations center. Third, we are also in communication with local law enforcement and road crews driving 447, and with flagging teams that are deployed in the nearby towns of Empire and Gerlach for traffic reports. All this information, plus weather updates, is funneled into a traffic operations center in Black Rock City [the temporary 'town' that springs up in the desert for the event]."

However, for Graham, "while planning with technology is important and interesting, the action on the ground inevitably comes down to relying on experienced, knowledgeable leadership, coordinating with participants and relying on their goodwill and civic engagement with Black Rock City. That more than anything is the key."

Heading for Reading

Back in the south of England, Simon Beasley, Reading Borough Council's network and parking services manager, agrees that multimodality

Below: **Burning Man's systems of 'pulsing' means drivers are required to stop for an hour, during which time they can relax, while they wait for roads ahead to clear**

Traffic Technology International

FREE APP

now available!

Available on the App Store

ANDROID APP ON Google play

DOWNLOAD NOW!

> Read anywhere, **without wi-fi!**

> Receive the latest issue weeks before the hard copy is available

PLUS

The latest news & Free Magazine archive

Island mentality

When you have a large special event taking place on an island, it creates its own unique traffic management challenges

It is England's smallest county, measuring just 23 miles by 13, but the Isle of Wight, which sits in the English Channel three miles off the mainland, is home to one of the country's most prestigious music festivals, with 90,000 tickets on sale each year.

The island is normally home to just 130,000 people, so how do organizers ensure the weekend doesn't create gridlock?

Peter Hayward, from Island Highway & Transport Consultants (IHTC), who has been involved in managing the festival's traffic strategy for the past nine years, says, "The traffic management plan is integrated into the broader event management plan involving 10 separate agencies including the council, the emergency services and transport operators. The great challenge we face is how to predict the number of vehicles, most of which arrive and leave the island in the space of 48 hours.

"We work closely with the event promoters and local transport operators – ferries and buses. The operators share data regarding passenger numbers and vehicle arrivals, so we know the exact numbers that are due to attend, with arrival rates controlled by ferry capacities. Depending on the arrival port, traffic is directed to different car parks by both conventional signage and VMS. Diversion routes with enhanced stacking capacity are established, to which traffic can be directed should difficulties arise on the road network."

At the festival itself, Hayward and up to 25 colleagues base themselves in an on-site event management center incorporating a traffic management cell, where they have access to CCTV at the festival and on surrounding roads.

"With the representatives from the emergency services and council in the room, we can quickly gain a shared understanding of issues as they develop, deliver a coordinated response and communicate real-time messages to drivers through VMS boards should we need to divert traffic," Hayward adds.

25

The maximum number of staff working in the Isle of Wight Festival event management center at any one time

and civic engagement is essential to managing traffic for major public events. He created and currently oversees the council's traffic management plan for the Reading Festival – England's second-largest music event – which takes place from August 24-27 this year.

Beasley believes that there is little point in relying solely on a brand-new network of roads to alleviate congestion without putting in place a "clearly defined, multistakeholder strategy" in the first instance.

Beasley and his team learned that lesson the hard way. "In the late 1990s a new section of dual carriageway [two-lane freeway] was constructed, linking the city's major ring road with the town center, the M4 and the festival site. We envisaged that the new road, which opened in time for the 2000 festival, would not only reduce journey times but would also substantially alleviate traffic."

Above: **The Isle of Wight festival in full swing**

Right: **Red Funnel ferries bring vehicles to the Island. Operators share data to help coordinate arrivals**

Several thousand vehicles, directed by VMS, headed for this strategically placed cut-through. Unfortunately the new road simply couldn't handle the huge volume of traffic and there were tailbacks for several miles on surrounding roads.

A new traffic plan

Following a comprehensive review, Beasley and his team set to work replacing the old plan with one better able to cope with the 90,000 daily visitors to the four-day festival.

Explains Beasley, "Think of our traffic management plan as a pyramid. At its base are car parking facilities. Pre-2000, while there was no shortage of car parks available to the public, the vast majority were within the festival site and town center, which caused traffic chaos."

Beasley and his colleagues realized that the key was to create two new giant parking areas – one to serve festival-goers from London and the southeast, and the other for those traveling from the rest of the UK. Each parking lot is color-coded. The 'green' lot in the center of Reading holds 4,000 cars, while the 'white' lot to the north of the city houses over 5,000 vehicles.

"Sixty thousand people buy weekend tickets," says Beasley. "By matching postal addresses to tickets

20

The number of permanent VMS used to inform locals about traffic arrangements for the Reading Festival in the weeks beforehand

we are able to use big data to map the location of attendees and the number of cars likely to be at the event. In terms of mapping traffic, by using powerful analytical tools, not only do we know months in advance if we need to create extra car parking capacity, but we are also able to liaise with Highways England to advise them of the likeliest busiest routes."

But not everything is so straightforward. Take tickets, for example. Not all the 90,000 tickets sell out far in advance – 30,000 are allocated as day tickets, which makes it more challenging to anticipate traffic volumes.

So how is the Reading Council traffic control room using technology overcome this logistics hurdle?

"Four weeks before the festival begins we start our VMS and social media campaigns. We begin by using our 20 permanent VMS, which notify the 318,000 local residents of the days and times the traffic restrictions for the festival come into force. Thankfully we do not need to warn drivers of roadworks, because any that would have been due to take place are postponed until after the festival.

Above: **Crowds at the Reading Festival, which has an urban setting on the outskirts of the Berkshire town**

"A fortnight before the festival begins, we employ all our VMS, which extend all the way from the city center to the M4. We reinforce the message by posting regular updates to our 16,700 followers on social media. As the festival opens, our social media team regularly posts important traffic updates, which are also published on our website."

> State-of-the-art technology enables us to accurately assess journey times and, crucially, it is dynamic. If we identify a potential bottleneck we can notify motorists
>
> **Simon Beasley, network and parking services manager, Reading Borough Council**

But for Beasley, the real test is whether the plan creates a platform for "seamless interoperability between traffic managers, their systems and the most important link in the chain – the general public. So how do humans and technology inter-link in real time?

"A week before the August bank [public] holiday weekend [when the festival is always held], our traffic control room is fully staffed with a team of the most experienced traffic managers, and representatives from the emergency services and Highways England," says Beasley. "Everyone has access to our Siemens Stratos strategy tool, which in November 2014 was integrated and harmonized with our traffic roadside infrastructure systems at a cost of £1.5m [US$1.9m]. The technology, using Bluetooth, is capable of building a real-time digital picture of not just Reading's urban traffic environment, but also the surrounding motorway networks that feed into the city.

"The state-of-the-art technology enables us to accurately monitor and assess journey times and, most crucially, is dynamic in that if our experts identify a potential bottleneck we can notify motorists through our VMS and even re-route traffic if necessary. Finally, Stratos provides us with real-time data regarding parking capacity."

The new weigh

Weigh-in-motion technology is rapidly becoming about much more than just scales in roads. **David W Smith** takes a look at some of the latest innovations that are helping authorities to screen trucks and protect infrastructure more effectively

There is a raft of modern technologies that are helping DOTs to monitor for overweight trucks, including advanced ALPR, geofencing and virtual weigh stations. It means US state DOTs have more data at their fingertips than ever before, so could these new technologies one day replace weigh-in-motion (WIM) as a sorting tool to root out overweight trucks? Such a scenario currently seems a distant possibility. Instead, new technologies are today being integrated with WIM – which uses scales embedded in the pavement to automatically weigh vehicles – to make it more efficient. DOTs broadly agree that WIM remains the best sorting tool available, rewarding truck operators for best practice by permitting them to bypass scales, as well as protecting infrastructure from overweight vehicles.

"Until we get x-ray vision, we need WIM to tell us what's inside the trucks. The alternative is for every truck to stop on a static scale, which creates congestion and is costly," says Captain John Broers, district commander of the South Dakota Highway Patrol Motor Carrier Division.

WIM allows Broers and his team to concentrate on the trucks that

> Until we get x-ray vision, we need WIM to tell us what's inside trucks. The alternative is for every truck to stop on a static scale
>
> **Captain John Broers, district commander, South Dakota Highway Patrol Motor Carrier Division**

require the most attention and could be dangerous. "We focus on drivers who don't maintain trucks and drive too many hours. There's no point weighing trucks belonging to companies with excellent credentials as we waste our time and theirs," he says. "We prefer to take the 'junk' off the roads when it has bad brakes, bad tires, is overloaded and has a driver that's done 20 hours straight and could crash."

Research has found a correlation between overweight trucks and multiple equipment violations, which highlights the importance of removing the 'junk'. Overweight truck crashes are expensive, damage to roads is severe and there can be hazardous materials to clean up. Casualties are common. Then there's the general question of wear and tear.

Many violators are local or regional contractors. "Truckers going

200
The total estimated number of WIM in California alone
SOURCE: FHWA

600
The total estimated number of WIM sites in the USA
SOURCE: FHWA

from New York to Los Angeles run across so many scales they are unlikely to drive vehicles greatly overweight," Broers says. "Regional and local operators are more likely to be overweight because they may not have the scales to weigh accurately and may think they can avoid law enforcement. More cargo in fewer trips means more money on the bottom line. The USA is big and there are only so many cops checking weights, so some truckers may feel they can risk it."

A tightening net

According to the USDOT Federal Highway Administration (FHWA) the use of mainline, high-speed WIM is increasing. The FHWA estimated that there were close to 600 WIM sites in operation nationwide and the number is rising all the time.

US states deploy different types of WIM. Aside from mainline WIM sites (where trucks are weighed at highway speeds and suspect vehicles flagged down via VMS for more accurate weighing) there are more accurate low-speed WIM systems installed on weigh station ramps. They operate in a similar way, allowing legitimate trucks to return to the highway, but the process is somewhat slower. The FHWA says

Above: **Installation of a new WIM system in Boise, Idaho**

many states have installed, or plan to install, ramp WIM systems. Kentucky, Michigan, Mississippi and Indiana all use ramp WIM at five or more weigh stations.

Data driven

A lot of mainline WIM systems are used to collect data about traffic and its impact on infrastructure and Minnesota and California are both developing data warehouses to manage the data. California in particular has used WIM for decades and the state has many more stations that are simply for data collection than it has for enforcement, according to the FHWA.

> Regional and local operators are more likely to be overweight because they may think they can avoid law enforcement
>
> **Captain John Broers, district commander, South Dakota Highway Patrol Motor Carrier Division**

In North Dakota, Michigan and elsewhere, mainline WIM information is used to assign enforcement resources. Factors such as the level of truck traffic and the frequency of overweight trucks can determine the best locations for mobile enforcement teams. There are, however, mainline WIM systems that serve double duty in pre-selection for static weighing and in planning.

Undoubtedly the use of WIM is growing in the USA, but the way it is being used has become more complicated. The FHWA says some states use no WIM and others, such as California, have a lot. Meanwhile, certain states require WIM for the allocation of a bypass, which allows trucks to skip weigh stations, and others don't. What is certain is that newer technologies are aiding the effectiveness of WIM.

WIM, AVI and ALPR

The state of Idaho, for example, introduced WIM/automatic vehicle identification (AVI) technology at the Inkom Port of Entry on Interstate 15 earlier this year. It was the fourth Idaho weigh station to go wireless and will produce dramatic results, according to state officials. Though a high-speed WIM system, it is accurate enough for sorting purposes. A WIM sensor loop is buried under slow lanes on the north and southbound I-15 and is instantly able to register weight and axle configurations. Loaded trucks can be scanned accurately at cruising speed, whereas previously all trucks had to

PrePassing the test?

A windshield-mounted transponder is all a trucker needs to bypass a weigh station, if enrolled in the PrePass scheme

52%
The proportion of PrePass sites in the USA that also have WIM installed to verify transponder information

US$294m
The total fuel savings derived from PrePass between 1993 and 2016

30
The number of US states in which PrePass is in operation

US$5.4bn
The estimated total benefit to the US economy of the PrePass system between 1993 and 2016

300
The total number of PrePass facilities in the USA

drive over the scales at 5mph to get a usable reading.

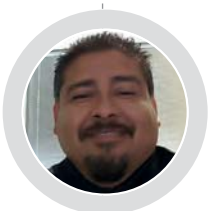
An important dimension of the WIM AVI system is the inclusion of ALPR, which enables computer systems to quickly check credentials from a federal database, even when trucks are not actually equipped with transponders.

"WIM was more basic 20 years ago, but technology has improved," says Reymundo Rodriguez, compliance manager for Idaho Transportation Department (ITD). "The ALPR is an exciting development as it has become more reliable. The new WIM systems allow us to run 'lean and mean' by focusing only on vehicles that have to come in. Rather than disappear, WIM will become more advanced as data becomes more dynamic and we are able to integrate other sensing technologies, such as checking if brakes are overheating."

ALPR is also part of South Dakota's plans for WIM. In March 2017 International Road Dynamics. (IRD) won the contract to install a US$1.1m WIM sorting system at the Blunt Port of Entry on US Highway 14 and US Highway 83 east of Pierre. It will be the fifth Port of Entry WIM system supplied by IRD to South Dakota and installation should be complete by October.

The project includes ALPR technology, single-load-cell (SLC) WIM and an intelligent Roadside Operation Credentialing (iROC) system. Broers says a similar WIM system will be installed next summer just outside Sioux Falls on the South Dakota/Minnesota border. "Then we'll have six fully equipped systems with WIM, transponder readers and ALPR, plus VMS across the WIM scales," he says.

> The new WIM systems allow us to run 'lean and mean' by focusing only on vehicles that have to come in
>
> **Reymundo Rodriguez, compliance manager, Idaho Transportation Department**



The 360 view

In Iowa, the state has integrated WIM stations in Jasper and Dallas with the 360 SmartView system, which uses cameras at the entrance ramp to the scale to take photos of the truck, the license plate, and the USDOT number. The system automatically checks to ensure the license plate is correctly assigned while Iowa's Motor Vehicle Enforcement officers analyze the images and check the carrier's safety rating on computers. Trucks

A bypass sign in operation in Idaho

Jumping the geofence

Virtual 'geofences' allow truckers to gain weigh station bypasses on a smart device, with no need for transponders

Both Idaho and South Dakota are experimenting with geofencing technology, using the Drivewyze tool, which is in operation at more than 600 weigh stations and inspection sites nationwide.

Unlike PrePass and NORPASS, which rely on transponders, Drivewyze uses the same commercial mobile radio service (CMRS) technology that carries voice and data over cellular networks. Available on smartphones and tablets, it provides weigh station bypasses without requiring poles and reader infrastructure on the roadside. In South Dakota there are more than 60 geofencing spots in use and Captain John Broers says there are various places where only a white spot on the road announces its presence.

South Dakota intends to integrate Drivewyze into many of its WIM locations, Broers says. Through real-time integration, Drivewyze is able to read weigh data from a truck as it passes over a scale and transmit the information to a server, requesting a bypass.

In Idaho, Illinois, Maryland, Michigan, Montana, Utah, Virginia and Wisconsin, Drivewyze has already been integrated with a variety of WIM systems made by several WIM manufacturers. Reymundo Rodriguez says that Idaho has the Drivewyze system operating with WIM at two locations and is planning more joint installations. "When they work together you get the best of both worlds," he says.

from carriers with good ratings are signaled to bypass the scale. But if there are questions about the license plate, USDOT number, or safety rating, the system directs the truck up to the scale facility.

"It's an upgraded version of PrePass [see box, page 41]," says Lieutenant Tracy Barker from Iowa Motor Vehicle Enforcement. "Linking license plates and USDOT numbers helps identify carriers using highly rated numbers unlawfully. The system flags up mismatches that could easily have been missed before."

Virtual reality

Barker says that Iowa intends to use virtual weigh stations more in the future to save on infrastructure and manpower costs. Virtual stations work similarly to mobile data operations, but use digital images as well. An enforcement officer studies real-time WIM data and a vehicle photo on a laptop in a patrol vehicle near the virtual station. Suspect vehicles are identified and the officer intercepts the violators. Alternatively the same data and images may be viewed more remotely by enforcement personnel in a fixed facility. They could dispatch nearby enforcement units to intercept and weigh suspect vehicles.

"In the future I can see Iowa as well as other states getting more involved in virtual scales," says Barker.

"Every time a truck is weighed on a static scale, traffic slows and vehicles use more fuel, whereas with virtual operations, vehicles can leave the route more easily and then merge back in."

> In the future I can see Iowa as well as other states getting more involved in virtual scales
>
> **Lieutenant Tracy Barker, Iowa Motor Vehicle Enforcement**

One use for such virtual weigh stations is to patrol areas where vehicles frequently exit the main highways to avoid fixed weigh stations. The FHWA says that an example of this strategy was the virtual weigh station at Punta Gorda, Florida, which evaluated trucks avoiding nearby stations. Two WIM systems and four cameras were installed north and south of the weigh station to monitor trucks leaving Interstate 75, using US Highway 41 and then re-entering the interstate. In fact, wherever you look, the integration of virtual operations and other new technologies is proceeding apace.

"Commodities need to flow and trucks need to get where they want to go as safely and quickly as possible. WIM is one of the best tools for making that happen," says Barker. "It also allows us to measure axle weights and shuffle loads that are not correctly distributed to help protect infrastructure."

World first

OIML R134 Certified Low and High Speed Weigh-In-Motion Enforcement/Tolling System

From 5 km/h to 120 km/h for HGV's (Heavy Goods Vehicles) and from 5 km/h to 140 km/h for LGV's (Light Goods Vehicles)

With only 3 rows of OIML certified Lineas® sensors

Temperature range -30 °C to +75 °C with up to 85 % RH

Rugged design for harsh (hot and cold) environments

Certified by:

Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Federal Institute of Metrology METAS

www.traffic-data-systems.com

Traffic Data Systems
Innovative Technologies

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

Kistler Traffic Data Collection

Optimize public spending on road infrastructure with maintenance planning based on professional WIM (Weigh-In-Motion) traffic data. Thanks to our extremely durable quartz crystal technology, Kistler's Lineas® sensors and the Kistler WIM Data Logger deliver totally reliable traffic data – year after year.

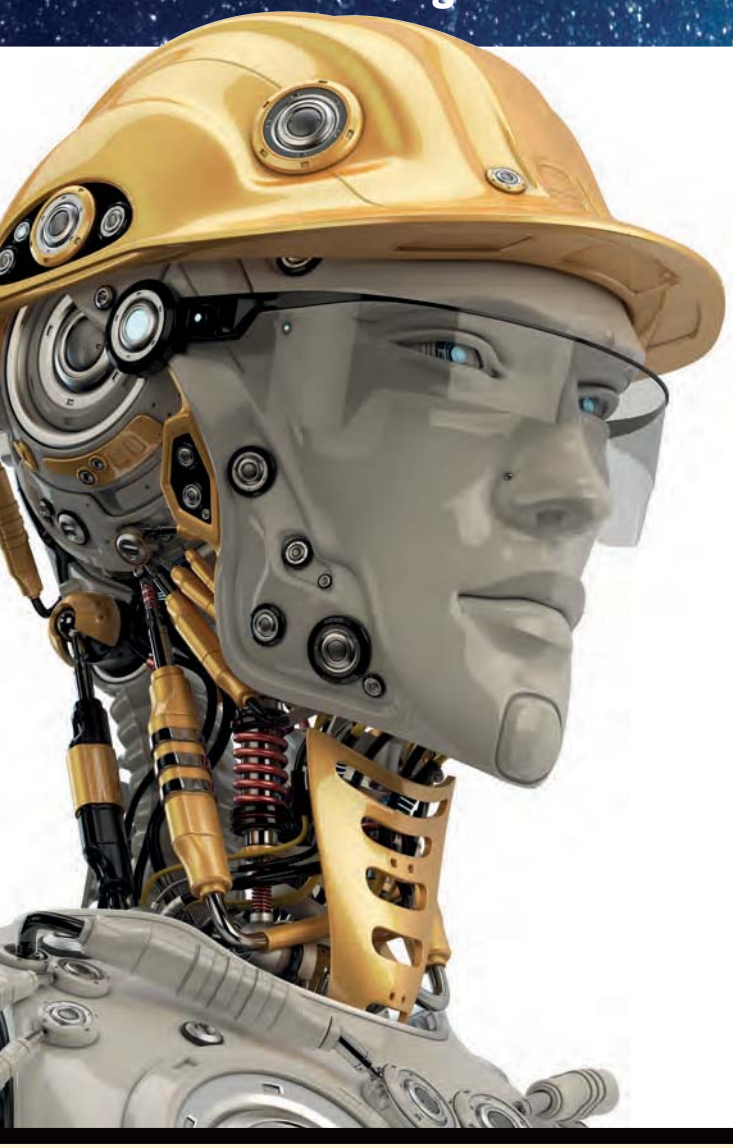
Our experts are at your service worldwide.

www.kistler.com/wim

KISTLER
measure. analyze. innovate.

comtrans

Your essential guide to the future of transportation communications



Smarter workzones

Michigan is building advanced connected vehicle technologies into its I-75 modernization project

Using roadway safety systems from 3M, the Michigan Department of Transportation (MDOT) is creating the USA's first 'connected workzone' on the I-75.

A three-mile stretch of the highway will be transformed in order to improve safety for drivers and to test vehicle-to-infrastructure (V2I) technologies that could be used by connected and autonomous vehicles (CAV) in the future.

Smart signs, pavement markings, temporary traffic controls, and vehicle identification systems are paving the way for the data-driven environment of the cars and roadways of tomorrow.

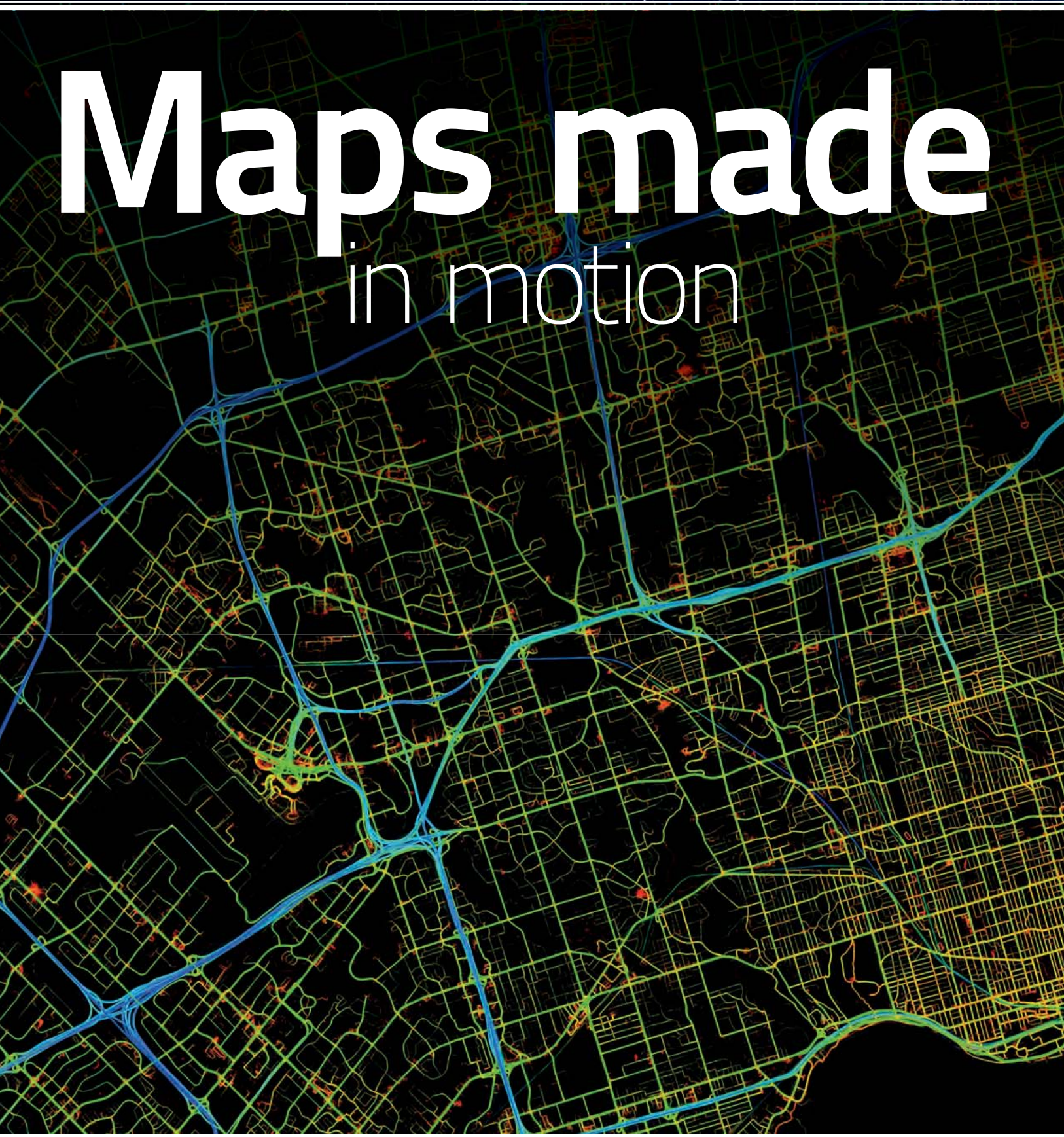
3M will provide MDOT with all-weather lane markings, retro-reflective signs with smart sign technology, and DSRC devices for V2I communications. The updated devices will allow for extra redundancy to help improve driver safety on the roadways.

John Riccardi, VP at 3M's Traffic Safety and Security Division, says, "The future of mobility requires an open ecosystem in which industry leaders connect and collaborate to create new technologies to improve our roadways. The state of Michigan is leading the charge when it comes to the future of mobility and we are looking forward to seeing where this partnership goes."

46: Maps made in motion
Real-time and historical GPS probe data is helping the Canadian city of Toronto's transport officials ease congestion on its road network

52: Broader horizons
A smartphone app that turns the handheld gadget into a dashcam is allowing Nevada to roll out a state-wide V2V and V2I network

Maps made in motion



Graham Heeps discovers how real-time and historical GPS probe data is being used to build more accurate maps, improve road network operations and inform future transportation planning in the congested Canadian city of Toronto

With 2.8 million people, 5,600km (3,500 miles) of roads and long, cold winters, traffic managers in Toronto, Canada, are turning to new technologies to solve the city's congestion problems. According to figures from TomTom, the typical commuter in the Greater Toronto and Hamilton Area (GTHA) experiences an average of 81 hours of delay each year, or 33 minutes for every hour driven in peak periods.

The city has a Congestion Management Plan for 2016-2020, which is an update of a document originally issued for 2014-2018. One of the principles enshrined within is

81 Hours
The length of time the average Toronto commuter spends stuck in traffic each year

A map of central Toronto made using vehicle probe data

to place "an emphasis on forward-thinking technologies, such as connected vehicle readiness and big data analysis". The approach has been encouraged by Toronto mayor John Tory, and was initiated by Stephen Buckley, former general manager of transportation services.

In July 2015, the city's Transportation Services department established a Big Data Innovation Team, led by Jesse Coleman. The team currently has a staff of five, including two student positions, with plans to expand. And thanks to a new contract with Here to supply real-time GPS probe data from across the city, this department now has plenty of data to work with.

Historical data

"We've always used data to help with our decision making, both in operational and planning contexts," says Roger Browne, manager of the City of Toronto's traffic safety unit. "This included for the management of our traffic signal infrastructure, and conducting before/after evaluations [when improvements were made]. Typically, however, we've collected data on a spot basis. For example, for a travel-time run we would have three or four people driving down the street to collect the information. Instrumentation might also be deployed, but only for a day or two.

"With a city as large and as complex as Toronto, it was a bit of a stretch to try to make the argument that a random spot-check was statistically representative, and adequate to plan from," he continues.

"We wanted to look at new, innovative ways to expand that data set and give us the flexibility and capability to establish a clear, representative baseline of what regular conditions are like. So when it comes to any intervention we're considering – whether from an operational point of view or in a planning context – we have the ability to monitor for a longer duration of time and really see the change."

Above: **Workzones can be added to maps in near real time**

Below: **Data can be used to communicate travel times to road users via VMS**

Updating the data

In the spring of 2016 the city issued an RFP and gathered proposals from a variety of vendors. Following a period of technical and financial evaluation, a partnership between Here (which is supplying GPS probe data) and Iteris (provision of iPeMS [Performance Measurement System] visualization and analytics tools) was selected. With the contract finalized and staff training complete, Here began supplying data on April 1, 2017.

The data includes aspects such as travel time and speed information. Coverage is for minor arterial roads and above, enabling analysts to establish proper baselines from which to monitor current problems and plan improvements. Monali Shah, Here's director of intelligent transportation solutions, says the data is sourced primarily from passenger cars and that a different algorithm is used to process it compared with highway data due to the extra complexity of the city environment.

"You don't want to show someone stopping at a red light as congestion,"

she offers, by way of example. "It's a natural characteristic of an arterial road on which you wouldn't generally expect people to be traveling at the posted speed limit. Determining the normal speed for an arterial road is very different than for a freeway, where a typical speed at a particular time of day might even be higher than the speed limit if the traffic is free-flowing."

A normal speed can be calculated for the time of day, time of year and road conditions, and a baseline established from which congestion can be measured. The city's Transportation Operations Centre (TOC) will use deviations in the typical travel time or speed as a prompt to investigate delays via a network of around 200 traffic monitoring cameras. "The intent in the longer run is to integrate and automate the anomaly detection process," adds Browne. "The machine will have established rules and guidelines on when to flag; the operator only needs to know which camera to look at."

> "You don't want to show someone who is stopping at a red light as congestion. It's a natural characteristic of an arterial road
>
> **Monali Shah, director of intelligent transportation solutions, Here**

Below: **Here uses probe data from cars on busy streets in Toronto to make maps**

Incident detection

Unexpected incident planning will also get a boost from access to the GPS probe data. A hydro vault explosion in May 2017 on King Steet in Toronto's downtown core is one example of an incident whose impact can now be accurately measured in order to inform mitigation strategies for similar events in the future.

"In the past, we would not have been able to establish a baseline prior to the incident and then see what the effects of the street closure were on that and parallel corridors," Browne explains. "But because we no longer have to put instrumentation in the field, we can go backward and establish the baseline after the fact, as opposed to having no data to work from. It's a really cost-effective way to get data from across the network, historically and in real time."

There are already a number of ways in which Browne can envisage

the data contributing to the planning of new road and transportation projects, too, with additional uses expected to arise as the team builds experience of using the data. For example, options for the future of two Toronto expressways, the Don Valley Parkway and the Gardiner Expressway, are under evaluation: tolling, freeway management patrols, intense maintenance and even the demolition of the Gardiner have been proposed.

"Even for the intense maintenance activities [on the Gardiner], there have been many requests for investigations into the impacts of the maintenance, where people go and how it impacts other portions of the network," he says.

> We're being asked to look at the data to help us analyze the impact of not having streetcars…
>
> **Roger Browne, traffic safety unit manager, City of Toronto**

Above: **Streetcars on Queen Street have been traditionally difficult to assess for efficiency**

"We need to know what we can we get away with in terms of closures."

There are hopes that, right across Toronto, being able to call on objective data will help to solve arguments about which option or change will provide the best way forward, backed up by the results of accurate before-and-after analyses.

Streetcars ahead?

Another current debate in Toronto surrounds the use of streetcars (trams) versus buses on another major arterial route through the city center, Queen Street.

Streetcars predate cars on Queen Street, have a high passenger capacity and, with electric power, are perceived as environmentally desirable. On the flipside, they run down the center of the street, which is a safety concern for passengers and other road users alike. Current construction projects on Queen Street have shone a light on the streetcar/bus comparison, with commuters anecdotally claiming they're saving time on their regular commute by using the buses, according to Browne (there are no streetcar services from May to September this year). With the cost of running additional buses to meet the same capacity as the streetcars reportedly costing the city an extra C$1m (US$750,000) per month, the stakes are high.

"It's a contentious issue and people are questioning the need to put the streetcar back," he says. "We're being asked to look at the data to help us analyze the impact of not having streetcars on that run. It wasn't something we anticipated, but now it's another opportunity [to use the data]. A previous project to analyze our historic data from across the city showed us that the key routes we were missing were the streetcar routes, primarily because over the years we couldn't throw a tube [counter] down across streetcar lines. It's very costly from a manual perspective to get that data for those routes, whereas with the Here data we now have records back to 2012, and will have them in real time moving forward."

Two wheels good?

Accurate, real-time mapping data can help to assess whether cycle lanes are successful in reducing congestion

In 2016, Toronto adopted the Ten Year Cycling Network Plan, part of a wider move toward a 'complete streets' philosophy on many of its arterial routes. Some of those routes, such as along Bloor Street, are contentious, thanks to the competing priorities of a connected, viable network for cyclists and convenience for local motorists and businesses. "How will the reality of taking a lane away from traffic to build these bike lanes compare with people's perception?" questions Browne. "We expect the Here data to help us through this huge debate by enabling us to go back to the historical data, and likewise [monitor the situation] moving forward."

FROM THE PUBLISHER OF **TRAFFIC TECHNOLOGY INTERNATIONAL**

EVEN BIGGER THAN EVER!




DISCOVER BETTER FORECASTING AND MEASUREMENT TECHNOLOGIES HERE!

More than 200 exhibitors are expected to participate in the world's largest fair dedicated to meteorological forecasting and measurement technologies and services

200+ EXHIBITORS EXPECTED

FREE TO ATTEND!

Meteorological TECHNOLOGY WORLD EXPO 2017

10, 11, 12 OCTOBER 2017

AMSTERDAM, NETHERLANDS

NEW VENUE FOR 2017!

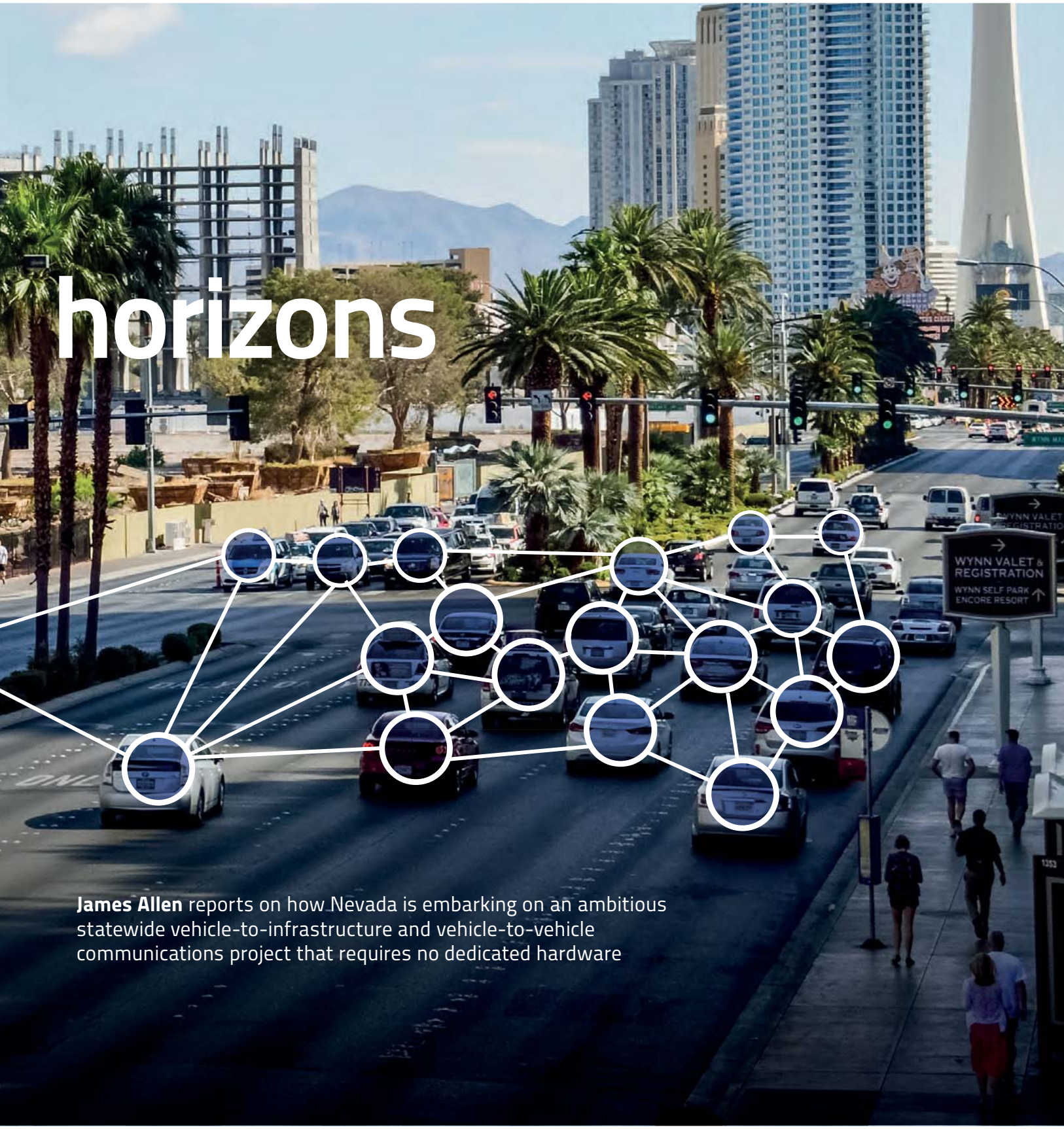
Further information:
Please contact Simon Willard at: UKi Media & Events,
Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK
Tel: +44 1306 743744 • Email: simon.willard@ukimediaevents.com

Register online now!

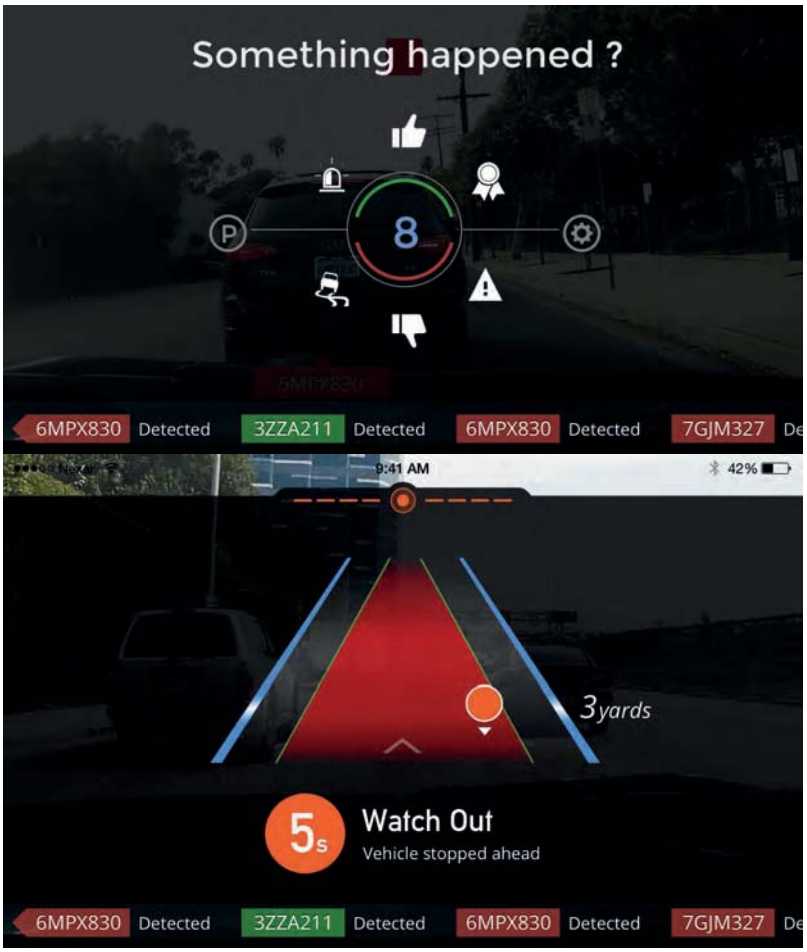
www.meteorologicaltechnologyworldexpo.com

Broader

horizons



James Allen reports on how Nevada is embarking on an ambitious statewide vehicle-to-infrastructure and vehicle-to-vehicle communications project that requires no dedicated hardware



Right: **The Nexar app is able to collect a wide variety of data and provide safety warning to drivers**

The phrase 'smart city' has quickly become part of our vernacular, describing the march of technology in urban environments. In the UK, drivers are also used to hearing about 'smart motorways' – stretches of freeway controlled by the latest ITS. A new phrase might be needed, however, when it comes to a project recently initiated in the US state of Nevada.

The Nevada Center for Advanced Mobility (CAM) is working with the technology company Nexar to build what is being touted as the first-ever statewide vehicle-to-vehicle and vehicle-to-infrastructure (V2V and V2I) network.

Established in 2016, Nevada CAM has one foot in government and the other in academia, with the state's DOT and the University of Nevada, Las Vegas, being strategic partners.

It is perhaps surprising that covering the entire state – which is over 100,000 square miles (259,000km^2) in area – as opposed to focusing only on the road network of a single city, is not something that fazes the project's leader, Dan Langford, innovation director at Nevada CAM.

"We wanted to make it a statewide effort rather than just focus on one particular area, and it's actually easier in Nevada because so much of it is desert, plus we don't have a huge number of cities across the state," says Langford. "Also, the fact that people drive a lot helps us because it means we can collect more data."

> The Nexar app turns your phone into a dashcam. You attach it to your windshield… and it monitors what your vehicle is doing
>
> **Dan Langford, innovation director at Nevada CAM**

Simplicity in deployment

One of the beauties of the Nexar project is that it needs no expensive dedicated hardware – all that is required is for drivers to download an app on their smartphones. Using the smartphone's camera and other sensors, such as GPS and gyroscope, it can monitor many aspect of the vehicle's status as it moves around the state's roads.

"The Nexar app turns your phone into a dashcam," explains Langford. "You attach it to your windshield like you would a satnav and it monitors what your vehicle is doing. It can sense you hitting everything from speed bumps, to braking too quickly, to colliding with something, so there's an incredible amount of detail it provides when incidents happen."

The raw data is collected, collated and processed by Nexar before being transmitted to Nevada CAM, where it is used to inform transportation decisions in the state.

"We are understanding our streets so much better, whether it's travel times from one place to another or the speed of traffic in congested areas," says Langford.

Protecting pedestrians

The app is also helping to improve pedestrian safety – which is a big issue in Las Vegas. "You'll be surprised to find it actually isn't all drunken tourists on The Strip!"

laughs Langford. "It has started to help us to understand pedestrian safety better, which is a huge win. Within the first week I saw footage of numerous near misses, including a pedestrian hit by a vehicle, which looked pretty bad at the time but fortunately they are okay."

While the majority of transportation authorities currently investigate vehicle accidents only when serious damage, injuries or fatalities occur, the information provided by the app is allowing Nevada CAM to also look at near misses that would otherwise have gone under the radar – giving a depth of understanding not previously afforded.

Multiple benefits

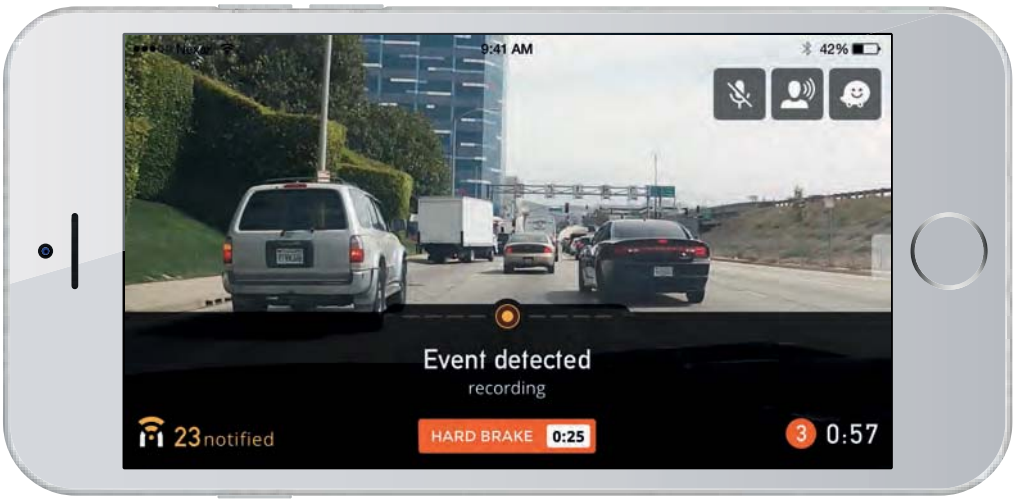
Of course, the information can only be collected where the app has actually been downloaded but, crucially, benefits of the project are not restricted to just Nevada CAM.

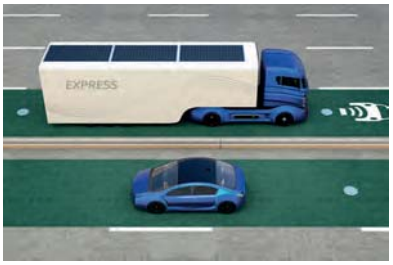
Vehicles with the app can communicate with each other, informing one vehicle of the need to slow down if another has had to brake sharply further up the road, giving an obvious safety benefit to drivers using the technology.

"Anyone can download it and use it right now, but we're targeting professional drivers because they are on the road more than anyone else, so they are going to add far more value than just someone who drives to and from work every day."

An important part of the project is increasing uptake of the technology by making sure drivers are aware of the benefits.

"If you have a crash, it'll record the impact, provide footage, give you details about the incident for your insurer and potentially prove your innocence, which is really helpful," says Langford. "But the added indirect benefit is that the data generated can be used to make the streets safer, save taxpayer dollars and generate new tools to make navigating and selecting transportation options a lot easier."





> Vehicles with the app can communicate with each other, informing of the need to slow down if another has had to brake further up the road, giving a safety benefit to drivers using the technology

Above: **A screen view of the Nexar dashcam app**

Left: **Nevada CAM technology**

Although several fleets of taxi cabs have been piloting the technology for several months, the full project officially only started at the end of May 2017, so any discussion about long-term results is premature, but the early signs are certainly positive.

"We were over the moon about the results of the pilot," says Langford. "And now the range of projects we've been talking about with Nexar has increased. Nexar is just one piece of the puzzle, though, as there are many ways of collecting data from vehicles and various sensors on the roads."

As for the future, Nevada CAM envisages the Nexar project as merely the start of what is possible for V2I and V2X, so don't be surprised if the phrase 'smart states' gains traction.

Ensuring necessary road maintenance costs are covered

Data on traffic loads is an essential element of the design, construction and maintenance of road networks. Traffic load is the sum of all individual vehicle loads, which causes fatigue of the carriageway, resulting in the onset and progression of road damage.

In Slovenia, the Slovenian Infrastructure Agency, along with Dars, the company responsible for managing the country's highways, monitor the actual traffic loads. They do so with Cestel's portable bridge weigh-in-motion system, SiWIM, which measures real traffic loads and weighs vehicles in freeflow traffic. With this system it is also possible to determine the overloading of commercial vehicles and to evaluate additional traffic due to the construction of major infrastructure facilities.

Collect and process

The SiWIM can be installed onto the bridge's superstructure without damaging it. The system analyzes bridge behavior in response to traffic weight loads, transforming the collected raw and aggregated data into information road authorities can use for a variety of purposes.

Based on SiWIM measurement assessments, the impacts and consequences of overloaded commercial vehicles and increased traffic are:

- Higher investment costs;
- Higher maintenance and renewal costs;
- Shortened durability of the pavement;
- Faster onset and progression of damage to the road surfaces.

Roadway construction is based on the assumption that all these cost impacts are similar or will not change.

During the construction of major infrastructure or other objects, it is necessary to shift large amounts of material from one location to another. These works cause higher traffic on roads with construction site vehicles, causing more damage and more rapid deterioration of the roads, which are not built to withstand that kind of load.

Maintenance and restoration costs of these roads are very high and are not usually provided in planning documents.

A possible solution to the problem is the sharing of rehabilitation costs among owners of the road, investors in the construction projects and the contractors of these projects. For this reason, a methodology was developed to determine corrective measures.

Calculating the difference

The increased volume of truck traffic due to construction works is calculated against the normal volume of the trucks on a measured road section.

It is important to compare not only traffic volume but traffic loads. The methodology includes interlocked activities, where all parties involved cooperate.

The first stage of the includes preparation and preliminary estimates of the necessary measures and costs.

Following the adoption of solutions and signing a contract to implement the necessary measures, operators begin with the construction of the facility. During the second stage, the road owner should perform periodic checks on the state of the roads and take appropriate action in the event of any major damage. At the same time, the SiWIM system is implemented to measure traffic counts and traffic loads, separately for construction and other vehicles.

The final stage involves activity at the end of construction. During this period the owner again organizes a review of previously excessively used roads and assesses the damage caused during construction.

Based on the projected remedial measures, costs are calculated using a valid price list.

Sharing the costs

The aim of the agreement between the owners of national roads and investors/operators is to determine remedial actions, as well as sharing the cost of these measures among the signatories to the contract.

The condition of the road will begin to deteriorate once the

Need to know

The Slovenian situation

- The Slovenian Infrastructure Agency and Dars, the Slovenian motorway company, monitor traffic loads
- Cestel's portable bridge weigh-in-motion system SiWIM is used to measure loads and weigh vehicles in freeflow traffic

by **Neil Hoose**

IoT-based data management is risky but does create opportunities

I have previously pointed out how supply chains for data are an increasingly important aspect of ITS and C-ITS delivery. They are also important for autonomous vehicles because the onboard systems require access to up-to-date mapping and other data, even though this access may not need to be in real time.

There are several possible architectures for data collection and management. The most obvious is for some form of large, central repository – such as a data warehouse – that collects data from a variety of sources. It then manages the storage, curation and perhaps validation of the data and reformats it so that a number of output channels are available for data consumers.

The Internet of Things (IoT) approach is different. Streams of data from devices or primary data collection systems are available through an internet platform and consumers can select the set of streams they need for their purpose. In this case, the consumers may add value to the data by combining disparate data streams, or performing analytical tasks including estimating future data. They may then make their output available as an IoT stream that can be accessed by other consumers or provide a service direct to a specific user base.

While different, both approaches have common issues regarding ownership of data and, more pertinently, responsibility for the data availability, accuracy and validity. There is also the question of metadata. To be able to consume a data stream usefully, you need to understand the nature of that stream. There is a whole host of fixed, or slowly changing, information needed to interpret a dynamic data source. This metadata needs to be owned and maintained, and responsibility for its veracity clearly identified.

In a data warehouse the operator of the facility, which may be a physical entity or a cloud-based arrangement, takes on much of the responsibility. It can be selective about sources of data, provide verification and data cleansing, and perform data curation and formatting. The IoT is more diffuse and open ended. Any owner of data can make it available as a source stream. However, this places consumers of data streams in a *caveat emptor* situation, having to work out if the metadata is adequate to allow the data stream to be understood, and they are reliant on the supplier for accuracy, reliability and availability of both.

> "Metadata needs to be owned and maintained, and responsibility for its veracity identified"

One of the key opportunities is claimed for IoT is the ability to bring together disparate data to create new streams of information that provide value to new, untapped customer bases. Those creating this new value may not be experts in every data stream they access and so are reliant on that stream being fit for their purpose. At present this is a considerable risk, but it does create an opportunity for a brokerage service to act as data manager. Currently reaching a specified data quality seems to be a problem for public sector bodies and the private sector is still reluctant to share data by itself. There are technical challenges in IoT, but they are soluble if there is a business, organizational and contractual infrastructure to match. This should become the immediate focus of government support and needs the involvement of risk capital players before the technology heads off in a different, more commercially attractive, direction.

Neil Hoose is an independent ITS consultant and owner/director of Bittern Consulting Limited ***info@bittern-its.com***

Cestel hardware turns bridges into weigh-in-motion scales

project is completed and is opened up for public use. Therefore, when only appropriate traffic loads are on the road, the cost of remedial measures is the sole responsibility of the road authority.

However, when, due to local construction, large additional loads are on the road and cause deterioration, the operator may be unable to cover the relatively large financial resources for rehabilitation.

In this case the investor/contractors responsible for the increase in construction site vehicles should undertake to settle part of the costs for the fixing of any damage done to the roads.

OIML R134 certification for a low- and high-speed WIM system

In December last year, Traffic Data Systems reported on the successful conclusion of extensive test runs for OIML R134 compliance testing with its weigh-in-motion (WIM) system, the WIM-DSP 32/TMCS-U.

In the meantime, successful and extensive laboratory measurements have also been carried out in temperatures ranging from -30°C to 75°C with relative humidity up to 85%, and a certificate has been issued by the Swiss Federal Institute of Metrology (METAS).

Traffic Data Systems is the world's first and only manufacturer capable of providing an OIML R134-certified low-speed and high-speed WIM system – the WIM-DSP 32/TMCS-U – with only three rows of OIML-certified Lineas sensors for a speed range of 5-120km/h for heavy goods vehicles and for 5-140km/h for light goods vehicles.

Accuracies of ±5% for initial verification and ±10% for in-service inspection, in accordance with OIML R134, have been achieved. Traffic Data Systems points out that although these results appear at first glance to be less accurate than those of most competitors, these other systems have not been tested in accordance with OIML R134, and certainly not in the speed range 5-140km/h.

For customers, the OIML certificate is a sign of quality at the highest level. Only documents of this kind are accepted by local government authorities for calibrating WIM systems before they can be used for enforcement or tolling.

Failsafe design

The WIM-DSP 32WIM system supports up to 32 inputs from Kistler 5163A10x charge amplifiers and is supplied in a lead-sealable aluminum housing with IP67/EN60529 protection for use under severe environmental conditions. The pin assignment of the four D-sub connectors on the WIM-DSP 32 is compatible with the D-sub connectors of Kistler 5163A10x charge amplifiers.

WIM-DSP 32 is the first weigh-in-motion system that has Piezo Sensor Health Care (PSHC) long-term sensor monitoring. The new design has an integral color graphics display and touch keys for easy configuration and functional control.

The TMCS-U is a complete TLS remote monitoring station with control module, integral function groups FG1, FG2 and FG6 (TLS 2012 standard of the Federal Highway Research Institute, BASt, Germany), integral UPS, 3G/UMTS modem and 16 inductive loop detectors/classifiers.

The data and power supply cables between WIM-DSP 32, TMCS-U and the inductive loop connections can be up to 300m (985ft) long. WIM-DSP 32 and TMCS-U have a high integration density with outstanding performance features and low power consumption. The TMCS-U and WIM-DSP 32 assemblies ensure precise time synchronization with optional data signature.

For statistical types of applications, two rows of Lineas

Need to know

Traffic Data Systems was the first company to develop WIM enforcement systems

- WIM-DSP 32 is the first weigh-in-motion system that has long-term sensor monitoring – Piezo Sensor Health Care (PSHC).
- The WIM-DSP 32 supports an array of up to 32 Lineas sensors that can be arranged in any configuration
- The TMCS-U is a complete TLS remote monitoring station. The data and power supply cables between WIM-DSP 32 and TMCS-U and the inductive loop connections can be up to 300m (985ft) long

Right: **WIM-DSP 32/TMCS-U is the world's first and only OIML R134-certified low- and high-speed WIM system**

Above: **In WIM enforcement, ALPR and overview cameras are required to automatically filter out overloaded vehicles for checks**

sensors, together with one sensor installed at an angle to check the wheel position within the lane and the type of tires fitted (single or twin tires), are sufficient.

Three rows of Lineas sensors are required for WIM enforcement (WIM-E) and tolling systems to satisfy a higher accuracy class in accordance with OIML R134. The sensors that are installed at an angle are used to preserve evidence of the position of the vehicle in enforcement systems, and to distinguish between single and twin tires.

A second angled sensor can be used to calculate the tread surface of the tire and therefore, also indirectly calculate the inflation pressure.

WIM-E also requires a road weather information system (RWIS) to suspend measurements in weather conditions/situations with impacted snow covering, slush or icy roads.

The system in action

In addition, automatic license plate recognition (ALPR) and overview cameras are required to document correct traversals and the number of rolling and raised axles, and to automatically filter out overloaded vehicles for checks.

The improved time and spatial resolution of the overall system enables adjacent wheel tracks to be used in the evaluation. Distances between axles can be determined with high accuracy thanks to the precise time synchronization.

The WIM-DSP 32 supports an array of up to 32 Lineas sensors that can be arranged in any configuration. Known sensor geometries enable different wheel tracks to be combined – in the simplest case, the left and right neighboring tracks.

The WIM-DSP 32 also helps to simplify the installation and operation of WIM systems. The reduced number of cable connections and terminations alone makes a major contribution to the reliability and performance of the overall system. An RJ45 cable in protection class IP67 is used for the extended temperature range for data communication and supplying power.

The vehicles' speed and weight can be displayed on variable message signs, or transmitted to a central office or control station in an encrypted form.

Traffic Data Systems has already obtained type approval for Switzerland and is the first company to implement the requirements for WIM systems, which have for many years been demanded by customers and local government authorities.

Weigh-in-motion sensors for enforcement at high speeds

Weigh-in-motion (WIM) technology has been used for decades to gather gross vehicle weights (GVW) and axle weights at both low and high speeds. This yielded weights- and axle-based commercial vehicle configurations to quantify traffic, and to identify probable overweight conditions as a first line of defense for weight-based vehicle enforcement. The challenge then, as it is now, is to supply accurate data from WIM sites for enforcement efforts.

Both low- and high-speed WIM technology is used in enforcement applications, but use at higher speeds minimizes interruptions to traffic flow, and is more desirable to allow for mainline installations to be used in enforcement. Screening and pre-selection for enforcement are established and are commonly used at high speeds, with direct enforcement increasingly being investigated and implemented in different locales around the world.

Vehicle screening

In many countries, legal metrology only allows for WIM use in screening or pre-selection applications. Screening involves a WIM site sending weight information downstream to a mobile enforcement unit that stops the vehicle for potential violations and performs vehicle axle measurements on portable static scales. Citations are then issued based on the portable scale static weights.

Pre-selection is similar in that it involves identifying potential weight violations, but the vehicles are then diverted to permanent weighing stations for static weighing and given citations for violations. These two methods both benefit from WIM technology to allow rule-compliant vehicles to continue uninterrupted, while identifying only the most probable offenders.

Need to know

Intercomp strip sensors are being used for pre-selection screenings by US states

- For pre-selection screenings, Intercomp strip sensors can effectively weigh vehicles traveling at speeds of up to 80mph (10km/h)
- WIM technology is being improved, enhanced and developed for use in direct enforcement
- Testing for use of WIM in direct legal weight enforcement is currently underway in Tawain, France and Czech Republic

In the USA, improved WIM performance has outpaced the development of legal metrology requirements for the use of these systems in direct enforcement. Standard practice for vehicle enforcement officials follows the WIM screening/static weighing model of enforcement. Intercomp, which provides portable static scales for vehicle enforcement, has taken the proven performance of strain gauge sensor technology to create WIM strip sensors that are installed for fixed, in-ground, high-speed applications.

Integrated into mainline WIM systems, Intercomp strip sensors are being used by multiple US states with excellent performance at high speeds of up to 80mph (130km/h). Errors of less than 5% for GVW and 10% for single axle are common, and there are examples of some states using WIM sites designed for data collection being used successfully for identifying weight violations.

This illustrates advances in technology that have incrementally closed the gap between historic WIM performance and the requirements for direct enforcement applications that are based on static weighing capabilities. Furthermore, legal metrology requirements have been modified in some countries to use WIM technology for enforcement. This highlights the two obstacles for using WIM for direct enforcement: sites' historic performance; and legal requirements for certification

Left: **Pre-screening of vehicles in the USA**

and operation for using WIM technology.

Direct enforcement

Several countries have used WIM in direct legal weight enforcement due to the steady improvement of the accuracy of WIM systems.

Testing for, or actual direct enforcement with WIM, has already taken place in countries such as Taiwan, Czech Republic and France, for example, with many other countries actively working on implementing systems and legal regulations to make the application a reality.

To meet these requirements, Intercomp has developed WIM sensor configurations that are coupled with automatic license plate recognition (ALPR) and scene view cameras to give WIM systems capabilities of conducting real-time registration, permit and weight-based enforcement of commercial vehicles. This enables the creation of systems for effective screening, pre-selection, and future direct enforcement, where allowed.

The challenges that WIM sensor technologies now face for use in direct enforcement are: adjusting to inherent vehicle factors that contribute to measurement error, which will always exist to some extent; and establishment of local legal metrology requirements that can be met by these systems.

by **J J Eden**

Toll roads must to serve unbanked customers far into the future

Financial success with all-electronic tolling (AET) becomes easier to achieve as electronic toll collection (ETC) participation increases. When toll operators contemplate AET operations, they work to understand what the ETC participation rate is expected to be, and then they work to understand how to increase it further.

Toll operators also have to understand the customers. They include infrequent and temporary customers on work travel or vacation. There are video-based strategies for these customers: billing-by-mail, of course, rental car agreements, and temporary pay-as-you-go credit-card based accounts, all with the backstop of the threat of descent into violation enforcement hell if tolls are not paid.

And then there are the unbanked and underbanked customers – the people who go to check cashers and pay day lenders for alternate financial services, and generally run their lives on a cash basis without credit or debit cards.

Some toll operators have made provisions in urban areas to provide payment channels such as cash cards or payment center kiosks for unbanked customers, but these have not yet been widely adopted.

Tolling used to be considered an elective choice, paying a premium toll for a premium product. If a driver has no choice but to use a toll facility, and no choice but to have an ETC account, then this does not feel very elective. The specter of a large violation fine is not attractive to anyone, but it is particularly worrisome for the unbanked/underbanked and those with limited resources, who need to drive for their livelihood.

According to research by Lisa Servon presented in her new book, *The Unbanking of America*, it appears that this market segment is not going away soon. In her book, Servon states: "In 1990, check cashers processed US$45bn in check-cashing transactions. In 2010, that number was US$58bn. Payday lenders handled US$10bn in 2001, and in 2012 that number increased to nearly US$30bn.

As more toll highways become a mandatory part of work life, this market segment must be accommodated.

The Central Florida Expressway Authority (CFX) in Orlando is experimenting with E-Pass Reload Lanes to accommodate these customers.

> "If a driver has no choice but to use a toll facility, then this does not feel very elective"

E-Pass is the CFX home agency brand name for electronic toll accounts. Reload lanes are former cash toll lanes in which a driver can pull up and make a payment on an account or acquire a new transponder.

Cash toll collection lanes are not very busy these days, as over 85% of traffic is paid with electronic tolls. They generally sit idle, out of the way, and represent real estate waiting to be repurposed. Reload lanes might be that best repurposing.

The public response has been favorable and the lanes are well used so far. If CFX ultimately decides to discontinue cash toll collection, it would be able to recycle some legacy toll plazas into drive-up customer service center lanes. These would be ideal for underbanked/unbanked customers as a convenient location to top up accounts with cash, enabling these drivers to maintain their E-Pass accounts and gain the advantages of E-Pass discounts, but without having a credit card on file.

I will watch this experiment and report on the results.

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

Pushing the limits of ALPR cameras with a new ITS suite

As vision systems continue to become more advanced, there is a trend toward embedded systems being used within tolling, free-flow, and speeding and red light control applications. ITS users are continuously looking to improve the intelligence of IP cameras, to provide wireless camera control, and to offer additional functionalities with easy access and installation.

Tattile has achieved a breakthrough in machine vision technology with the design and development of an entirely new Vega Smart range of camera systems. The new ITS camera systems go beyond ALPR and offer functions and a level of integration that cannot be found elsewhere on the market.

Next-gen ALPR

An integral part of the new product line is the Vega Smart 2HD, a camera specifically designed for free-flow toll collection, traffic monitoring and security. The system is able to cover two lanes measuring up to 25ft (7.5m) each in width and detects vehicles at speeds of up to 155mph (250km/h). Standard functions include embedded ALPR, capturing monochrome vehicle images and color contextual vehicle images, optical speed evaluations, and the ability to read reflective and non-reflective license plates. An extra-sensitive sensor mounted to the Smart 2HD's contextual camera ensures high-quality images even in low light. The modular system architecture enables the hardware platform to be easily customized according to the complexity of each application.

These standard features are complemented by optional functionalities that transform the camera from a standard plate reader into a truly smart vehicle recognition and security system. First, a system can be added to recognize a vehicle's brand, class and color, and to offer HD streaming for video surveillance. Additionally, the Smart camera can be equipped to simultaneously run two different optical character recognition (OCR) systems on board. Real-time license plate identification is then performed by two independent software tools inside the system that provide maximum accuracy. Validated license plate data is a direct output from the camera, from the double OCR.

Above: **A front view of the Vega Smart 2HD camera**

Need to know

Tattile's Vega Smart 2HD ALPR system marks the next generation of scalable smart cameras

- The system is suitable for applications including toll collection, traffic monitoring and security
- The system can monitor two lanes across a width of 25ft (7.5m)
- Cameras that can be used in the system include the Vega Smart HD, the Vega Smart 2HD, the Vega Smart HD Color and the Vega Smart 2HD Color

Additional third-party analysis software is not necessary and this reduces the complexity of the system for the user, as well as operating costs.

In all, the new Tattile Vega Smart 2HD ALPR system marks the next generation of highly scalable smart cameras. Its embedded intelligence provides maximum output at low cost because all of its algorithms run inside the system to deliver an output ready to be interpreted by the user.

Remote configuration app

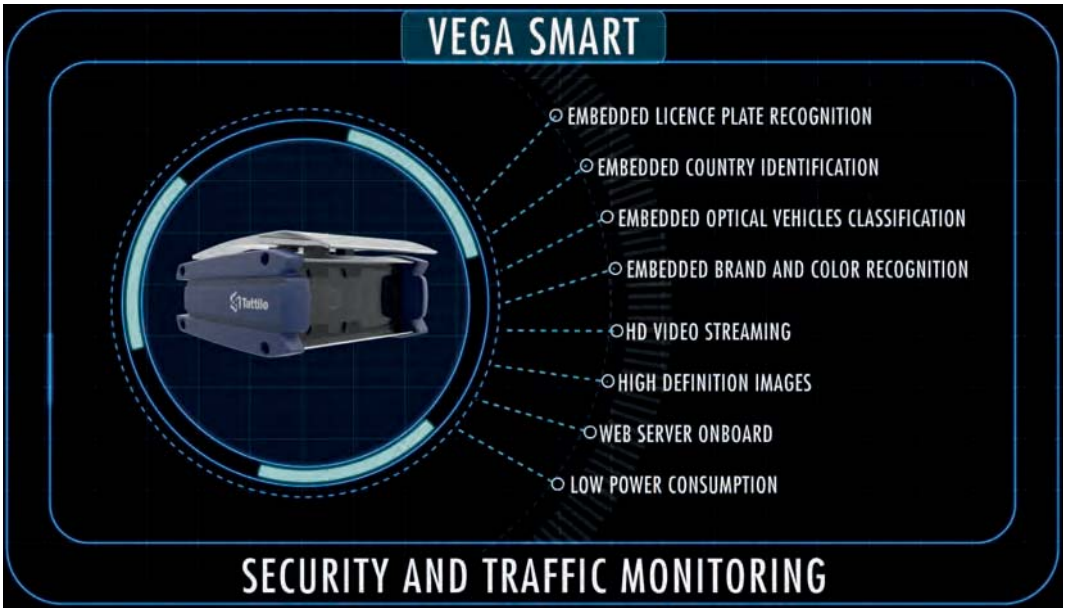
For its new ALPR systems line, the ITS specialist has developed the Easinstall app, a solution that facilitates the installation and maintenance of new ALPR cameras. The installation pack and optional camera functions

Below: **Tattile's Easinstall app**

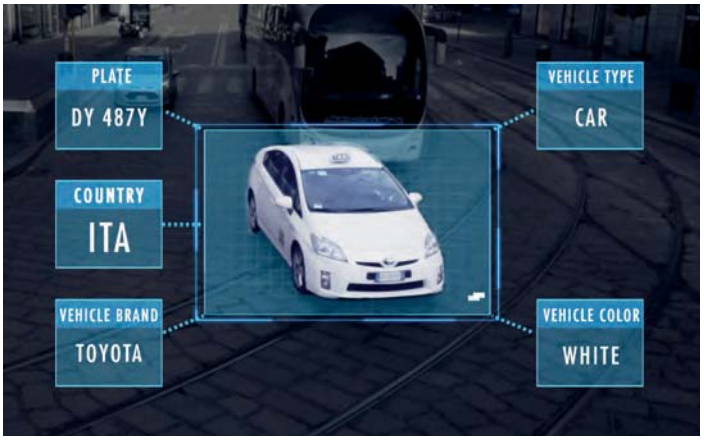
can be uploaded to the camera via remote connection, even when the system is already in operation.

This new app represents not only an essential time-saving tool for camera installers, but it also increases safety because on-site staff will no longer need to use gantries to carry out routine maintenance on the cameras. The app allows any authorized user to access a camera device without being physically connected to it. Thanks to Easinstall, road lines no longer need to be closed for maintenance, adjustment processes or to check the status of camera devices. Instead, the operator can carry out these checks remotely.

Once installed on an Android or iOS device, Easinstall can wirelessly detect all available cameras in the vicinity and automatically connect to them via service set identifier (SSID). The app then creates a hotspot connection to allow the control room to access the camera without any physical connection. In addition, a user who is on-site with the mobile device can reconstruct an ALPR camera's history by scanning its QR code (affixed to the device) and sending this data directly to the technical support team in the control room.



Above: **Tattile's new Vega Smart 2HD camera and its functions**



Above: **The camera can capture vehicles' license plates, color, brand and country of residence**

Another feature of Easinstall is that it supports Web view (video calling from the on-site worker), allowing technical support teams in the control room to have a live view of the scene. Technicians can also provide remote updates to the cameras.

With its new app and ALPR camera range, Tattile is redefining the way ITS systems are being handled.

How to integrate tunnel management systems to make them most effective

With there being more than 1,800 fatalities per year on UK roads, safety is of the utmost importance for both road users and road maintenance staff. Although road tunnels cover a very small part of the road network, they carry a much higher risk in terms of road user safety, plus incidents can have a major impact on the wider network and so need to be responded to robustly and efficiently to limit disruption.

Intelligent transport systems (ITS) play an essential role in enabling control rooms to efficiently manage operations and quickly respond to any incidents that may affect traffic flow or road safety. For a successful outcome, these factors need to be considered at every stage of a tunnel management system project, from design and implementation (on a robust and proven platform), through extensive testing and live operation.

With the correct ITS in place, road tunnels can be made safer and more efficient

Broad range specialist

From a design and implementation perspective, the safe and efficient operation of integrated tunnel management systems by its very nature necessitates the understanding and ability to manage a broad range of specialist safety subsystems. In the wider context, these systems must integrate and share data with regional control centers and urban traffic management centers.

Traditionally, subsystems were provided by separate suppliers each using their own disparate user interfaces, presented in an inconsistent and incoherent format. This could have a critical impact on the response times to a potentially life-critical emergency situation, bringing confusion when a fast, effective response is required.

Robust Internet Protocol (IP)-based system architectures can now deliver the high-integrity solutions necessary in safety-critical applications, providing the resilience needed with which to manage such ITS systems. Other operational safety benefits available include an opportunity to build-in the recommended operator procedures to emergency situations for a more consistent approach to emergency event management.

Also, there is the opportunity to improve integration with asset-management systems, including the coordination and standardization of maintenance management activities, reporting and diagnostic facilities, including predictive failure, all of which are empowered through an integrated system approach. An integrated ITS system can provide a one-stop workstation optimized for efficient management of routine and emergency situations and asset management.

Need to know

Points to consider for effective control room operations

- ITS plays an important role in efficient control room operations
- Safety-critical applications can be managed with robust IP-based systems
- Risks from cyberthreats come with IP systems
- All-lane running on smart motorways is an example of cost-effective solutions to reducing accidents

Cybersecurity risks

The benefits of IP systems and remote accessibility have also opened up new challenges over cybersecurity risks (well publicized in the recent Windows and 'WannaCry' vulnerabilities). Rather than the traditional 'fit and forget' approach, platforms need to be regularly updated and fully maintained, ensuring that operational safety and availability is not compromised. P Ducker Systems (PDS)

continues to evolve, taking its expertise developed over the past 28 years within tunnels to deploy similar technologies on the wider road network, providing end-to-end solutions from the roadside to the control room and even up to management level.

Infrastructure expansion

PDS has focused on expanding its resilient and widely skilled infrastructure support teams, upskilling engineers to provide a comprehensive response, and providing factory-accredited maintenance and roadside installation work, so offering an attractive proposition. With a change of management some five years ago and now a new brand to reflect a new direction, PDS is well placed for the future.

National constraints on infrastructure spend and operational expenditure continue to create pressure on delivering appropriate solutions, technology can help provide a means to streamline operations as well as reduce risk. A good example is with all-lane running on smart motorways, where PDS is helping to deploy proven technologies and solutions to help mitigate the safety risks.

PDS delivers and maintains high-integrity infrastructure control systems with traffic management systems and SCADA. Its projects range from small installations through to complete upgrades and refurbishments, from the control room to the road surface. ○

by **Larry Yermack**

It's always 'us' that pays for infrastructure projects, it's just a case of how?

For the past several months, it seems that all we have heard is about how to pay for transportation infrastructure and very little about what it ought to be. I'm willing to play along with the game of 'who pays' and 'how', recognizing that the 'who' is always 'us'. After all, there are no free roads and even repatriated foreign balances originally came from 'us'.

There are three broad categories for funding: direct user payments, indirect user payments and general government revenue. Let's take a look at all three and see if we can learn something to guide our thinking.

The traditional gas tax is a more indirect form of payment, with both state and federal levies added to the per gallon price and paid at the pump. It is a proxy for usage, hitting less fuel-efficient vehicles harder and exempting plug-in electrics entirely. It is less visible and most people, when asked, think they pay much more in fuel taxes than they actually do pay.

Direct user payments already exist on toll roads, bridges and transit systems. Users simply pay for the use of the service, either at point of sale or with an account. The industry is now considering how to extend this to road user charging, or having drivers pay per mile driven.

The final idea would be to use federal dollars from the general fund to pay for infrastructure. The last several surface transportation bills depended in part on general fund transfers due to declining revenues from the motor fuel tax.

Proposals from the Trump administration for an expansion of public-private partnerships (PPP) fueled by tax reductions bridge the first and third idea. They would be dependent on a user pay revenue stream, but would also benefit from federal tax support.

Why have I started this column with a tutorial on transportation funding? I believe that there is a relationship between how we pay for things and how we value them and that this relationship is critical to keeping our transportation infrastructure vital and up to date. But

"There is a relationship between how we pay for things and how we value them"

before I draw that connection closer, let me mention one important trend. That is that increasingly, transportation technology is being provided by private sector firms and not the government. Traffic conditions, navigation guidance, route planning, all the way to automated cars, are purchased directly by consumers. While so much of government-provided infrastructure and data are critical to these services, the role of government is increasingly obscured.

If we are to maintain the critical public sector infrastructure that underlies the entire system, then we will need public dollars to support it and we need the public to understand and see the connection between their dollars and the transportation system.

The critical solution is that the user pays and the user knows that he/she is paying. Tolling, transit, road user charging and PPPs are all a necessary part of the solution.

Larry Yermack is strategic advisor to Cubic Transportation Systems, USA. lyermack@gmail.com

Efficient solutions for weight enforcement

Huge amounts of money must be regularly invested to repair road networks damaged by overloaded vehicles. So what is the best way to protect the roads from such damage?

Weight enforcement is part of a sustainable development of road infrastructure and, with the right approach, a lot of money can be saved.

Nowadays, weight enforcement can be carried out with mobile patrols or with stationary systems such as weigh bridges. However, weigh-in-motion (WIM) systems are more suitable for preselection purposes as, because of the uncertainty of the measurements, they are too dependent on road and vehicle conditions.

Mobile patrols are, on average, 30 times more effective in detecting violations than the permanent operated weight systems (according to a study from the University of Manitoba, 1993). Experience demonstrates that one hour after the weighing checks start, the number of caught overloaded vehicles decreases as operators avoid the area. So the police need more efficient and creative solutions to trap the remaining offenders.

Best of the bunch

Based on an objective assessment of the options, currently the best method for effective weight enforcement is mobile scales.

Daniel Kneubühl, managing director of Haenni Instruments, says, "It is a very simple and cost-effective solution. But it's important to look not only at the initial cost, but also at the total cost of ownership.

"With less manpower and a simple, easy-to install solution, mobile weight enforcement reduces the ongoing costs."

Left: **Type WL 108, for certified static weighing**

Inset: **The WIM type WL 400 is designed for low-speeds**

Need to know

Key facts of the WL 400 strip sensor

- The system can handle weights of up to 20 metric tons per axle or 10 metric tons per wheel
- It can be used in both mobile and fixed istallation for example, freight management applications
- Vehicles can be weighed traveling with a speed of between 0.5km/h and 10km/h
- The strip weighs 2.3kg and is 1,246mm long, 80mm wide and 11mm high

Having a weight of only 50kg for the equipment and an installation time of just three minutes, the low-speed WIM system with the WL 400 mobile strip sensor is a very useful solution for detecting overloaded vehicles.

Low vehicle speed (up to 10km/h) is important to improve accuracy of measurements, as all axle loadings can then be detected correctly.

"According to our experiences, external factors such as vehicle oscillation and aerodynamic effects may also lead to disproportionately high errors," adds Kneubühl.

Importance of safety

Safety aspects are also increasingly becoming an important issue when policing the roads. Overloaded trucks are a risk for the safety of anyone on the road.

The simple drive-over system of the WL 400 mobile strip sensor allows a police officer/inspector to detect overloading quickly. They can then focus on other safety aspects such as unsecured loads or overheated brakes.

In summary, Haenni's solution includes a mobile low-speed WIM system for preselection and a mobile static weighing system for enforcement (based on certified scales and local regulations). The static system was also improved.

The new wheel load scale WL 108, being 16.5kg, is lightweight for its class and can be used in a certified temperature range of between -20°C and 60°C.

The reliable wireless solution has also reduced installation time to a minimum.

Kneubühl says, "I am convinced the whole concept makes sense, because it is very important to stop the overloaded truck and not to let it go on until it is unloaded. Just detecting it with an automatic system will not solve the problem, as the truck will continue its trip and the company will just pay the fine at a toll road.

"Not even 100% control of vehicles, with reasonable fines, would cover the expense of the road maintenance and that is the reason why the goal must be to prevent overloads rather than just detect and penalize them."

Accurate WIM for a host of common applications

Experience has shown that well-planned road maintenance ahead of time prevents the further deterioration of roads and more costly repairs later on.

In recent years, weigh-in-motion (WIM) technology has proved to be an integral part of complex intelligent transportation systems (ITS).

WIM-based information maintenance operations considerably reduce overall costs and consequently optimize public spending.

Vehicles that exceed traffic regulations on weight and overall dimensions are classified as abnormal loads, and therefore require a special permit for public roads.

Despite weight limits being in place for vehicle access, traffic data shows a large number of trucks using roads and bridges are in fact overloaded, causing severe structural damage.

Need to know

Key takeaways from Kistler's weigh-in-motion technology

- Lineas quartz WIM sensors and datalogger supply reliable data on traffic volume, axle loads and gross vehicle weight
- In 2015, Kistler was the first to receive the OIML R-134 for vehicle weighing using strip sensors at 3-65km/h.
- Applications of WIM technology range from weight enforcement to traffic data and toll collection and industrial truck weighing.

Above: **The datalogger is able to process various traffic data**

Right: **WIM systems are increasingly useful for ITS**

Far right: **Kistler's systems include sensors made of quartz crystal**

WIM equipment monitors traffic and can detect overloaded trucks before they drive onto a bridge. As a result, the trucks can be stopped in time and they can be diverted to another, stronger bridge.

Continuous collection

WIM systems collect traffic data continuously, providing data that can identify traffic violators who operate special transport services without the correct permit.

WIM technology screens traffic flow efficiently and accurately. This is essential when designing new roads and bridges, optimizing road maintenance, increasing safety and improving traffic flow.

The accuracy and handling capabilities of WIM systems for non-standard driving situations – such as stop-and-go traffic or lane changes on multilane roads – are increasing.

Kistler produces WIM systems that consist of extremely durable quartz crystal sensors that can be integrated into any manual or automated weighing system.

High-speed WIM systems have traditionally served as a preselection tool for the identification of vehicles that violate weight limits.

In recent years, however, a tendency toward the use of WIM systems for the direct penalization of overloaded vehicles has been observed.

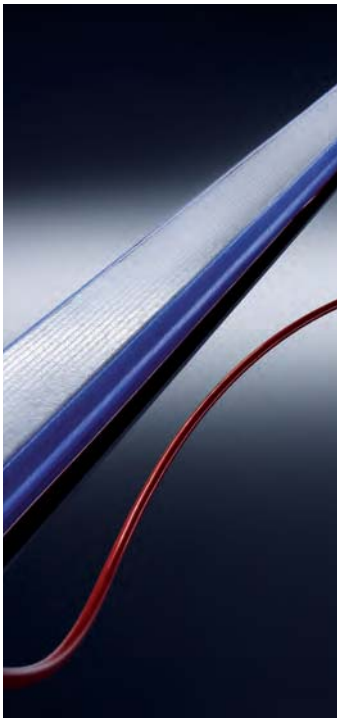
Global appeal

Several countries are in the process of constructing direct enforcement sites or are revising regulations in order to provide a legal framework for such operations.

The vast majority of these systems – provided by different system integrators – use Kistler quartz sensors for data acquisition.

In 2015, Kistler was the first WIM manufacturer to receive the OIML R-134 certificate for vehicle weighing using strip sensors at 3-65km/h.

This certificate highlights that Kistler's WIM systems, comprising the maintenance-free Lineas quartz WIM sensors and the Kistler WIM datalogger, can be used for legal weighing applications.



Future benefits

In the near future, the trend toward the application of WIM-based direct enforcement and toll-by-weight systems across a full speed range, up to and including highway speeds, is set to continue.

Kistler's WIM equipment provides a number of highly flexible, reliable and maintenance-free traffic monitoring options.

Improving WIM screening efficiency with portable dynamic scales

Developed countries generally have effective inspection stations and weighing systems in place on primary truck routes, but many agencies have difficulty ensuring compliance on secondary routes and in urban areas. Portable weighing systems, such as IRD's SAW III portable wheel load weighers, can help agencies to target enforcement at vehicles that are bypassing main roads.

The SAW III is an updated and improved version of PAT Traffic's SAW I and II series scales with modernized electronics and an available weigh-in-motion (WIM) configuration that uses wireless communication to send vehicle weights to the weighing software. The SAW I was certified for enforcement weighing in the USA, while the II series was certified for enforcement weighing in Europe. With its newest wheel load weigher, IRD sought to develop an international product and has obtained static weighing certifications in both the USA (NIST Handbook 44) and Europe (OIML R 76). SAW III scales are rated for a maximum weight of 15,000kg (30,000 lb) or 10,000 kg (20,000 lb), depending on the model. Multiple SAW III scales can also be connected for axle weighing.

Need to know

The SAW III is a portable dynamic scale system

- It has a robust and lightweight design with a flex frame to achieve better weighing accuracy
- The scale can be used for the pre-selection of overloaded trucks
- It also has a dual-scale system configuration with computer-based processing for reporting, protocol printing and data archiving

One-person system

While slower than weighing at permanent sites, the advantage of using portable, static wheel load weighers for enforcement is that a single enforcement officer can set up, weigh and issue citations in any location. This makes portable wheel load weighers, like the SAW III, ideal for enforcement weighing on secondary roads. However, using portable static scales does require a highly skilled enforcement officer, as the decision to select a vehicle for weighing depends on the officer's judgment in perceiving visual cues, such as tire contact length or the type of load. It is also a time-consuming task. If enforcement is being carried out in an area with a high volume of trucks, using WIM to screen vehicles will improve efficiency and there will be less of a need to depend on an officer's judgment in selecting vehicles for static weighing. This is why many agencies are looking for screening systems such as virtual weigh stations or portable WIM scales to improve the efficiency of their enforcement programs.

WIM screening

Agencies looking for a portable, low-cost alternative to a permanent weigh station can use the SAW III portable dynamic weighing system for WIM screening. Setting up a WIM screening site can also be a safer option than situations where the vehicle has to be pulled over and weighed in a potentially unsafe location. Officers can set up a temporary weighing area and screen vehicles in the same spot that they will use for enforcement weighing.

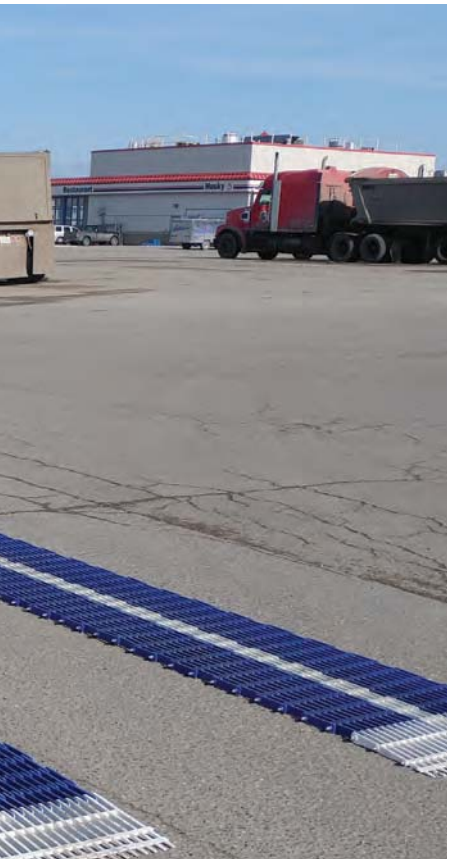
The SAW III dynamic scales can also be used in static weighing mode to carry out enforced weighing, and the accompanying software can be used to print tickets. This system enables agencies to quickly set up a temporary portable enforcement station on any level stretch of road.

Main image: **The SAW III can measure the weight of vehicles driving over it at low speeds**

Inset: **The SAW III dynamic WIM scale**

Finding a good, level section of pavement, leveling the weighing surface using mats, and minimizing scale movement, are all key to ensuring accurate WIM screening using portable scales. The WIM version of the SAW III is available with a flex frame accessory to improve weighing accuracy with moving vehicles. The flex frame locks the scales into a dual configuration that will not shift or detach from the leveling mats.

Rish Malhotra, IRD's vice president of international business, says SAW III represents a major step forward for IRD's



portable scale technology. "With Bluetooth communication, a rapid charge cycle, faster analog-to-digital conversion, and both North American and EU certifications for enforcement weighing, we believe that the SAW III is the next step, providing flexibility to enforcement officers, for both portable WIM screening and portable enforcement weighing," he says.

by **Don Hunt**

Connected vehicles, yes; DSRC, not so much

In January, NHTSA issued a Notice of Proposed Rulemaking that would require new lightweight vehicles in the USA to be equipped with dedicated short-range communications (DSRC), with an implementation period between 2021 and 2023. The system would allow vehicles similarly equipped to communicate via V2V (vehicle-to-vehicle) technology, and to send drivers warnings of potentially dangerous situations within a 300m radius. Transmitted basic safety messages could warn of a vehicle braking ahead, or detect a car quickly approaching a cross-intersection.

NHTSA has been developing a case for V2V and V2I (vehicle-to-infrastructure) for at least 12 years. As it became clear that the outgoing Obama administration needed to set the mandatory implementation of V2V in motion, NHTSA noticed its proposed rule-making on January 12, 2017. Public comments were due by April 12, and in all, NHTSA received 477 comments from the public on the proposed rules. Comments were received from auto makers, the communications industry, state DOTs and industry associations.

Connected Vehicles is a complicated topic. While many issues emerged from the public comments, a few conclusions are fairly clear.

First, there is broad support for V2V from the commenters. The advantages of connecting vehicles for better safety and mobility, with or without future vehicle automation, is difficult to dismiss. Auto makers and state DOTs are especially supportive of a mandate.

Second, most industry comments are critical of the rule's dependence on DSRC technology. The comments suggest offering interoperable standards rather than designating DSRC as the design around which all other technologies must conform. NHTSA has been criticized for years about its stubborn cling to DSRC. With other communication alternatives such as cellular advanced LTE and 5G getting closer every day, this rigid government approach could doom DSRC. That's especially true with other users that are competing for the same spectrum as DSRC.

Third, there is a small part of industry that plainly doesn't support DSRC, or even a V2V mandate. Mercedes-Benz and Tesla argue for a voluntary approach with an "if-equipped" standard, rather than a requirement for V2V. Both auto makers believe that onboard automation systems will not necessarily require V2V, and data security and privacy concerns are paramount and far from being resolved.

"The DSRC approach to connected vehicles is dying or dead"

When you add up these comments, the conclusion must be that the DSRC approach to connected vehicles is dying or dead. The technological window for DSRC is closing, and the windows for other communication technologies are quickly opening. Furthermore, NHTSA has never been able to conjure up a believable case for DSRC's ability to support mobility applications through V2I connectivity. DSRC still relies on the construction of a new broadband network with roadside radio units to capture and make use of the data thrown off by connected vehicles. That compares to a robust system of existing cellular towers ready to use new LTE or 5G technology.

The time is nearing when NHTSA will have to make a DSRC decision. Every day that goes by makes a commitment to DSRC more difficult. And the opportunity to adopt rules for any type of mandatory connected vehicle technology may have sailed with the Obama administration.

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

Increasing accuracy in traffic counts

Founded in 1977, Applied Concepts Inc. introduced the first Stalker traffic radar to the law enforcement industry in 1989, and has leveraged its expertise to create a line of high-performance radar sensors for numerous traffic monitoring and control applications.

The company's Traffic Statistics Sensor (TSS) tracks up to 10 vehicles simultaneously using a proprietary signal processing algorithm based on nearly three decades of radar tracking experience.

Above: **The data collector has various modes available**

Right: **The TSS has a range of 400m**

Accurate measurements

Each vehicle's direction and speed is individually measured, and then assigned to one of five vehicle sizes, yielding considerably more accurate and reliable vehicle counts.

"In order to gain the most accurate data set, our Traffic Statistics Sensor has a 'classification training' mode where it learns by measuring the intensity range of targets that are actually in its survey area and automatically sets the five thresholds within that range," according to Russell Kautz, Stalker's chief technology officer.

Because the TSS stores traffic survey data internally, it is well suited for longer autonomous operation in non-connected speed awareness and variable message signs, as well as other traffic surveying devices.

The TSS provides: range up to 400m; accurate measurement from 1.6 km/h to 321 km/h; communication through RS-485, RS-232 and USB 2.0, using any of 16 streaming and three polled protocols; IP67 enclosure or bare sensor; and 30 x 32° beam width or 6 x 26° narrow beam configuration.

Recently, the Stalker sensor was upgraded with a substantial increase in internal memory. It now easily stores over one-half year's traffic data at one-minute sample intervals and moderate traffic levels. The sensor is also able to stream data for any real-time speed/statistical measurement application.

Above: **Traffic data can be displayed in a number of ways**

Mode setting options

The TSS offers the traffic engineer a variety of data collection modes; always on, on in a single set time range, on at the same time period every day, or on selected days.

It is protected by an IP67 enclosure and is also available as a bare-board, unenclosed version. It is well suited for a variety of applications, including pole-mounted signs, speed awareness trailers, and dedicated traffic data collectors.

Traffic Analyst, the company's traffic statistical analysis tool, is also available and designed specially to work hand-in-hand with the TSS. It displays traffic data in a number of useful ways, including count versus time, count versus speed, and 85th percentile.

Full color reports

Traffic Analyst renders full-color reports designed to present traffic data in fully compiled, easily understood documents. It aids in TSS configuration through a clear, understandable user interface. Its intuitive survey management tools walk the user through calendar setup, location details, speed and time resolutions, vehicle classifications, speeds, distances, and more.

For the technically inclined, Stalker offers a sensor Developer's Resource Kit that contains everything an application engineer needs to develop, test and integrate the TSS into any project. The kit includes an interface box, power supply, cabling, application CD and Traffic Analyst CD.

Need to know

Key facts of the Stalker Traffic Statistics Sensor

- It can track up to 10 moving vehicles simultaneously
- It has a range of 400m
- Measurements are recorded between 1.6km/h and 321km/h
- Information is communicated through RS-485, RS-232 or a USB interface
- It can operate between -30°C and +70°C

Free reader inquiry service

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

traffic TECHNOLOGY INTERNATIONAL

LinkedIn
Join our LinkedIn group page at
www.TrafficTechnologyToday.com

17,413*

Print circulation to **100+** countries

*ABC audited circulation, average net figure, Jan-Dec 2016

ITS WORLD CONGRESS 2017

TRAFFIC INDUSTRY HIGHLIGHT

Your next opportunity to meet the *Traffic Technology International* team will be at the ITS World Congress 2017, which takes place in Montreal from October 29 to November 2, 2017. For the latest news, see page 6.

LATEST SUBSCRIBERS INCLUDE...

Professionals from: ▪ Ada County Highway District ▪ Câmara Municipal do Porto ▪ Canadian Highways Institute Ltd ▪ Caribbean Civil Group Ltd ▪ Carnegie Mellon College of Engineering ▪ City and County of Denver ▪ City of Detroit ▪ Empresa Pública de Transporte e Circulação ▪ Feng Chia University ▪ Ford Motor Company ▪ IL&FS Transportation Networks Ltd ▪ ITS Mexico ▪ Singapore Land Transport Authority ▪ Lithuanian Traffic Police Service ▪ Metropolitan Transportation Commission, San Francisco ▪ MIT Academy of Engineering ▪ Rijkswaterstaat ▪ RTA ▪ Southwestern Pennsylvania Commission ▪ Toyota ▪ TRL ▪ TRNC Police Headquarters ▪ University of Oldenburg ▪ US Traffic Network ▪ Warsaw University of Technology ▪ And many more...

Next issue...

- ITS World Congress special edition
- IBTTA Annual Meeting report
- Road pricing, road user charging and ETC
- Big data collection, counting, transmission and management
- Speed enforcement and management
- Uninterrupted power supply and battery backup

CONTACT OUR SALES TEAM TO GET INVOLVED:
Godfrey Hooper, sales manager: godfrey.hooper@ukimediaevents.com
Website: www.TrafficTechnologyToday.com

SUBSCRIBE AT: www.ukimediaevents.com/recard/traffic.php

FREE! READER INQUIRY SERVICE

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

Index to Advertisers

Express lanes

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

"We're stewards of a system facing pressure from growth and from limited resources, so we're moving from a standard, one-size-fits-all approach, to performance-based planning"

***Roger Millar**, secretary of WSDOT*

Watch the video to see how new technology is lifting weight restrictions from bridges
traffictechnologytoday.com/restrictions

"Air pollution is very local, it changes block by block, city by city and, by providing hyper-local information, it's going to be transformative in how we understand how pollutants change and modify"

***Melissa Lunden**, chief scientist, Aclima*

Watch to see how Google Street View cars are helping researchers better understand air pollution
traffictechnologytoday.com/hyperlocal

"We have about 12km [7.5 miles] of single-tube tunnels with cameras every 50m. In total, we have at least 400 cameras. If there's an alarm, it's stamped with the best camera position and we'll automatically get a view of that stretch of tunnel"

***Tor Thomassen,** installations project manager, Norra länken, Stockholm, Sweden*

Page 20

"We installed a high-resolution camera on Poito Peak that enables us to monitor a 20-mile stretch of Highway 447 – which is a 75-mile, two-lane road – in real time"

***Jim Graham**, senior advisor, special projects, Burning Man Festival*

Page 28

"My job is to look at technologies five to 10 years from now and consult with the CEO and senior leadership about the areas to invest in. We picked traffic safety because it is one of the leading causes of death"

***Dr Victor Bahl**, Microsoft Research director, mobility and networking*

Watch to find out how an Institute of Transportation Engineers project will reduce traffic-related deaths
traffictechnologytoday.com/ITE

"Recycled asphalt pavement is one of the more beneficial and economical tools to improve secondary roads, and allows us to complete even more work due to the cost savings"

***George McAuley**, PennDOT's deputy secretary for highway administration*

Read more about an innovative recycled paving project
traffictechnologytoday.com/paving

Next Generation Integrated Mobility:

Driving Smart Cities

Opportunity exists on transportation's cutting edge. Tap into the potential by attending ITS World Congress 2017, where the newest information—on connectivity, infrastructure, Smart Cities, security, systems integration, business models and more—will provide the advantage needed to anticipate change, respond to demand and navigate effectively in the rapidly moving marketplace.

Gain insights, exchange ideas, work through solutions and acquire strategies for deploying technology at dynamic education sessions, presented by the industry's best thought leaders, transportation experts and technology pioneers.

REGISTER TODAY AND SAVE UP TO 20%:
www.itsworldcongress2017.org | #THISisITS

ITS WORLD CONGRESS 2017
Montréal | OCTOBER 29 - NOVEMBER 2

cross®

Road Traffic Technology

CROSS WIM
FOR TOLLING AND ENFORCEMENT

CrossWIM is a cutting edge high-speed weigh-in-motion system.

It meets the most demanding criteria for traffic detection and dynamic weighing. It is designed for traffic statistics, pre-selection, tolling systems, and direct enforcement.

CrossWIM control unit

www.cross.cz