August/September 2017

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How soon should national governments legislate?

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MaaS revolution
The latest from 'the father of MaaS' Sampo Hietanen on the biggest change to mobility in our lifetimes

Securing communications
The new UK guidelines that have been issued to help protect connected vehicles from cyberattacks

Unlocking the power of location data in today's cities

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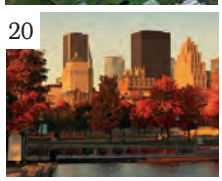
Join us at **ITS World Congress 2017** from **October 29 - Nov 2** in Montreal to learn more.

Cover story

48 Crash course

If you know where crashes are likely to happen, you can plan ahead

Michael Donlevy reports on a web-based database that is helping traffic managers make Connecticut's roads safer



Technology Profiles

Editor's letter

Global conference season is once again well and truly upon us, with the focus for September and October this year firmly on North America. The 'great American conference road trip' starts in the south, in Atlanta, Georgia, at the IBTTA's annual meeting, which runs from September 12-14 and is where its prestigious awards for excellence will be presented. (Meet the winners from page 36.)

Heading directly north, a drive of just over 700 miles on I-75 will bring you to the Detroit area of Michigan, where in Novi, over four days in October (23-26), the world's foremost experts in autonomous vehicle regulation, testing and design will be gathering for the Autonomous Vehicle Safety Regulation World Congress, the Autonomous Vehicle Test & Development Symposium, and the Autonomous Vehicle Interior Design & Technology Symposium. As one of the host publications for these events we have exclusive access to some of the key speakers and from page 12 you can discover more about the debate that is raging across the USA over how soon AV federal regulations should be brought into force, and what form those regulations should take when they do come.

Just three days after the AV events conclude in Michigan, the great and good of transportation will be gathering for the ITS World Congress. Plenty of time to drive the 590 miles on Ontario Highway 401 that will take you from Detroit to Montreal, the host city for this year's event.

The ITS World Congress is 'the big one' as far as transportation conferences go, and it is certainly one that I am particularly looking forward to. Not least because it is always an event packed with announcements, product launches and enlightening impromptu chats with contacts old and new, the best of which invariably end up forming the basis for future features in this magazine. Even more excitingly for me, it's a time of year when I get to put on my 'live news hat' and report events as they happen via stories and videos on our website. If you are a subscriber to our weekly email newsletter, when the Congress rolls around you'll also get a special daily update with all the latest event news direct to your inbox every 24 hours. If you're not, sign up now via the link at the top of our homepage, **traffictechnologytoday.com**, and you can be certain not to miss the most important events and announcements at the show.

Planning for such big events is, of course, key. So what better place to start than by turning to our interview with ITS America's interim president and CEO David St Amant on page 18, then dig into the Congress preview that follows. And if you're at the event, make sure you drop by and visit the Traffic Technology team at **Booth 2436**. See you in Montreal! If not before…

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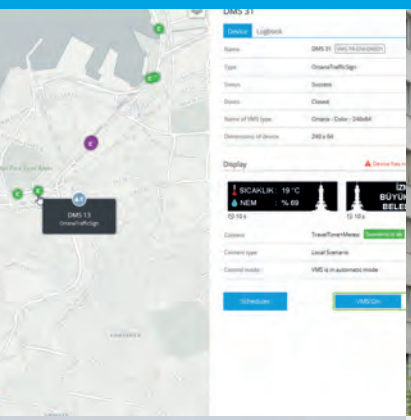

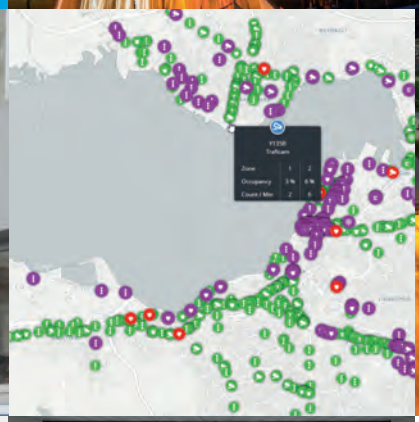

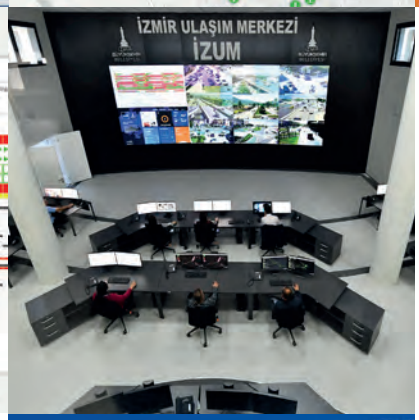

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Testing times

A new proving ground in Korea will provide a focus for the country's efforts to develop autonomous vehicles and test them in an integrated ITS environment. **Graham Heeps** reports

Construction of K-City, a dedicated proving ground for the research, development and testing of autonomous vehicle systems, is underway at the Korea Transportation Safety Authority's (KOTSA) huge Korea Automobile Testing and Research Institute (KATRI) proving ground in Hwaseong City, Gyeonggi Province.

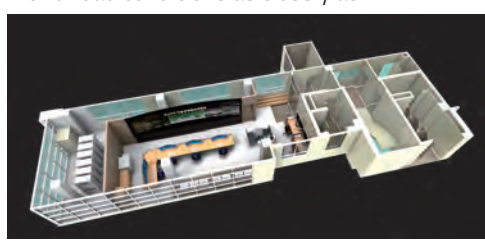
The Korean government intends to improve traffic safety through the early commercialization of Level 3 autonomous vehicles in 2020. The scope includes autonomous driving on designated roads and self-parking in designated spaces. The establishment of K-City will provide road, traffic and communication environments to test three key aspects of autonomous car safety: normal running and failure modes, communications and security, and control handover.

"Current test sites and public test roads have limitations when assessing general driving performance and when setting specific conditions for repeatable, reproducible tests," says Dr Han-Geom Ko, a manager at KATRI's Automated Vehicles Center.

KATRI is already home to Korea's Automated Vehicles Center, which was set up by KOTSA in May 2016 and is involved in establishing standards for autonomous vehicle technology and safety. In the future, it is hoped that a global database of possible driving scenarios will be established , with the resulting vehicle safety verification systems made available to all, to maximize AV safety.

City of dreams

K-City will incorporate around 5.5km (3.4 miles) of new roads. Each section has been designed to resemble real-world road conditions as closely as



Above: **The entire Korea Automobile Testing and Research Institute (KATRI). The new K-City facility is shown taking up the top right-hand quarter of the inner track area**

Left: **A close-up of the urban simulation area in K-City**

Below: **The new Data Support Center that will monitor V2X communications**

possible. The 1.5km (1 mile) freeway section will be dedicated to high-speed driving. A kilometer of urban roads will resemble several city blocks, complete with buildings, bus lanes, traffic signals and crosswalks. The combined community and autonomous parking area will offer 700m (2,296ft) of pedestrian-centric roads, bicycle lanes and self-parking facilities, while a 2.3km (1.4 mile) rural road will test systems in a low-infrastructure area.

KATRI's 14 existing test tracks, which were built in two phases between 1997 and 2013, cover a total of 28.5km (17.7 miles) and include a test area for ITS systems. The ability to use existing roads and facilities at KATRI will reduce the time it takes to establish K-City and reduce its cost, which is put at approximately KRW11bn (US$9.8m).

"K-City cannot be recognized as an effective test bed if the facilities are always fixed," says Ko. "It is impossible to reproduce all the road traffic environments that arise on actual roads, but evaluation scenarios will be diversified if the environments are created in as many different manners as possible. As such, K-City will offer test flexibility through lanes in different widths marked in detachable tape; weathered or damaged road signs made from various materials and in different shapes; false-wall, movable building facades, and so on."

Communications revolution

The use of V2X communications technology will establish a connected ITS environment that includes three roadside units (RSU), an accident detector, seven signal-controlled intersections and numerous CCTV cameras. CCTV monitoring will be centered on specific evaluation points, constantly managing the safety of vehicles on the tracks.

Other communications protocols are part of the picture, too. Existing 4G (LTE) will be used to collect position-based vehicle information and wi-fi will help synchronize assessment systems and the vehicles themselves. As 5G networks are developed, they will open up opportunities for ultra-high-speed and large-capacity data collection.

The glut of information that results from both test cars and the traffic cameras and infrastructure will be collected, monitored, integrated and assessed in the dedicated Data Support Center – an expansion of KATRI's existing driving test control center.

From test track to real world

Back on the test tracks, next-generation multi-target testing equipment will be used to simulate potential accident scenarios and automated assessment systems will be available and interfaced with the Data Support Center. When an autonomous test car is in motion, cars will be placed nearby to simulate traffic conditions and a crash target will be placed to simulate an accident.

Hyundai Mobis, in collaboration with Seoul National University, has been manufacturing the autonomous vehicles that will create the traffic environment. At the time of writing, contract negotiations were in progress, looking for a supplier of the car-to-car, multi-target test equipment.

The Korean government is keen to see the project completed soon. To this end, the first section of freeway essential to the commercialization of Level 3 autonomy will be completed in 2017, with further roads in the urban and other areas to be finished in the second half of 2018. The construction has been phased so that already completed sections can be available to use immediately, even while other areas are still under construction. This should, in turn, accelerate the development and commercialization of autonomous vehicles.

Montreal mobility

Key transportation statistics from Montreal, Canada's recognized 'connected city', which is set to host the 24th ITS World Congress, taking place from October 29 to November 2

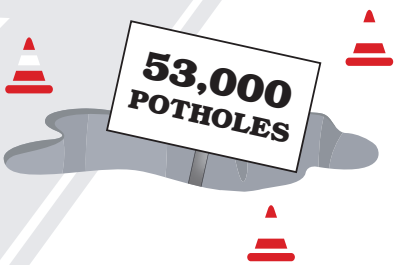
Infographics: Andrew Locke

Total road network length

13,906 miles (22,380km)

Highways 551 miles (887km)

Non-highway 13,355 miles (21,493km)



TRAVEL TIMES IN 2016 INCREASED BY

3%

COMPARED WITH 2015

400 miles of bike paths (644km)

6,200 bike-share bicycles

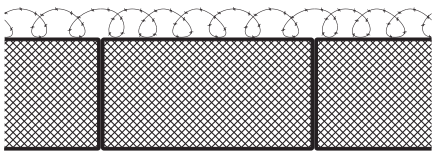
MONTREAL'S METROPOLITAN AREA IS

1,355 SQUARE MILES

(3,510 SQ. KM)

Over 90 million people live within a two-hour flight

29 MILES FROM US BORDER (47KM)



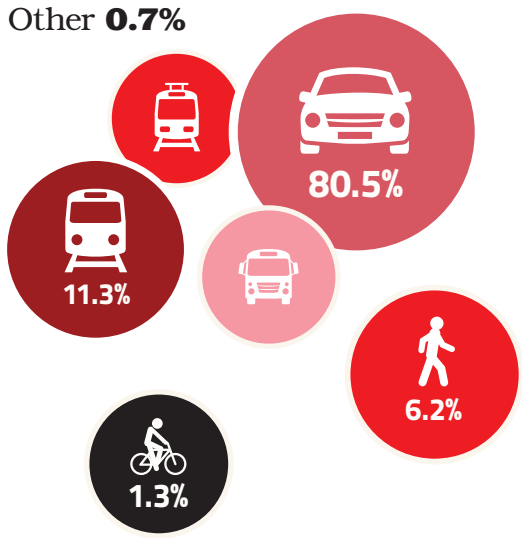
51% of public transit users in Montreal take the bus

20 miles (32km)

of connecting footpaths beneath street level, used daily by 500,000 people

Workers commute by:

Car, truck or van **80.5%**
Public transport **11.3%**
Walking **6.2%**
Bicycle **1.3%**
Other **0.7%**

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New power

James Allen looks at how an innovative battery backup technology is changing the way traffic engineers think about uninterruptible power supply

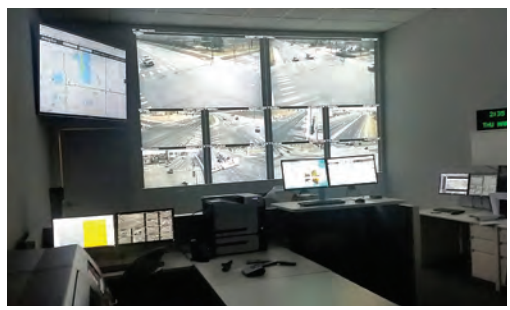
A new kind of nickel-zinc battery backup technology is minimizing power-out problems and has helped keep traffic moving in the City of Loveland, Colorado.

Traffic power systems in the area battle against everything from tornadoes and flooding to high annual snow levels, in order to ensure safety on the roads for locals – and the millions of visitors drawn each year to the state's Rocky Mountain National Park.

A review by the city determined that too much time and money was being spent on maintaining the lead-acid batteries, while the toxic make-up of the power source was also a growing environmental concern.

With money from a Federal Highway Grant, the Loveland road authorities replaced the old system with ZincFive's UPStealth battery backup solution, which requires minimal maintenance and has a lower environmental impact (see below).

96
The percentage efficiency achieved by nickel-zinc batteries thanks to intelligent management software
Source: ZincFive



The City of Loveland's traffic operations center

ZincFive's UPStealth battery system uses nickel-zinc chemistry

A major deployment on the city's busiest roads, and those made most dangerous by power interruptions, saw 42 of its 93 traffic signal locations and 29 signalized intersections benefit from the long-life nickel-zinc batteries.

The new backup system was put to the test when a large power outage, covering one block in the downtown area, occurred during the working day. All of the district's traffic signals protected by the new ZincFive solution remained fully operational.

"The UPStealth systems are performing very well and are an important part of our city's intelligent transportation system plan," says Bill Hange, City of Loveland traffic engineer. "The life of these units may prove to be even longer than anticipated – a great surprise to have."

UPStealth is currently used by more than 100 other Departments of Transportation across the United States and Canada.

> "The UPStealth battery backup systems are an important part of our city's intelligent transportation system plan"
>
> *Bill Hange, City of Loveland traffic engineer*

Award-winning power

ZincFive's battery solution is generating a lot of attention, including being named 2017's Most Disruptive Technology of the Year by the Oregon Technology Awards.

There are several reasons for the heightened interest. Firstly, it is more environmentally friendly than other battery backup solutions as it is made from 90% recyclable components, has no explosive or contamination concerns, and is lightweight.

UPStealth also has intelligent battery management software that leads to 96% efficiency – twice the life and twice as powerful as lead-acid.

Finally, once deployed, the nickel-zinc batteries can be monitored remotely, with minimal maintenance necessary, while its compact size means secondary traffic signal cabinets are not required.

This battery make-up becomes only the fifth rechargeable chemistry to commercially scale, but in fact was Thomas Edison's original desired chemistry, although at the time the inventor was unable to bring the concept to reality.

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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

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Join the AV regulation experts in Michigan

Autonomous Vehicle SAFETY REGULATION WORLD CONGRESS 2017

On October 23-24, the US city of Novi, Michigan, will be the meeting place for experts considering the challenges to, and implications of, the creation of autonomous vehicle regulations. **James Allen** gets the discussion started

The Autonomous Vehicle Safety Regulation World Congress 2017 will be a unique conference aimed at discussing and exploring how to create a regulatory framework for progressing the public testing of driverless vehicles. As it stands, there are no unilateral guidelines for this innovative technology, meaning that there are a number of potential legal issues blocking its further development.

At US state level, patchwork regulations have appeared that in the long run could cause confusion for OEMs and divert attention from the bettering of the technology itself. However, introducing federal legislation is not without its challenges, as developers need flexibility to test different solutions to various challenges.

The conference will seek to address the underlying legislative issues to ensure that the safety of the general public is maintained without impeding the research and development of the vehicles.

Speakers will include legal experts, senior DOT officials and representatives from some of the companies involved in developing the technologies. But to whet your appetite for the two days of discussion, we present answers to three key questions around the subject, from some of the principal speakers…

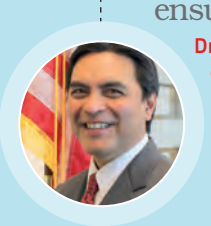
When should federal regulations for autonomous vehicles be introduced?

Autonomous Vehicle SAFETY REGULATION WORLD CONGRESS 2017

> Actual federal regulations, as opposed to the pending guidance, will be premature unless and until the industry, in combination with state DOTs and technology providers, agrees on a consistent approach to the technology and a workable means of logistics for use. Some time within the next 2-3 years I expect that an OEM will develop a protocol that satisfies the validation criteria for a leading state in this area (e.g., Michigan), which will accelerate considerations for national regulation.

Neal Walters, partner at Ballard Spahr, will be taking part in the panel discussion *And Now the Law: Product Liability, Cybersecurity, Privacy, Ethics, Insurance, and Regulatory Compliance,* at 3:45pm, Tuesday, October 24

> Federal regulations for autonomous vehicles should be implemented as soon as possible, as NHTSA is responsible for setting and enforcing compliance with federal motor vehicle safety and performance standards. As federal and state governments work together toward a common objective of the safe testing and deployment of autonomous vehicles on public roads, quick and comprehensive action at the federal level to develop safety standards is necessary to ensure safety.



Dr Bernard Soriano, deputy director, California Department of Motor Vehicles, will be giving a presentation entitled *A perspective from the California Department of Motor Vehicles,* at 10:45am, Monday, October 23

> We are at the very beginning of this journey and we still don't have a good understanding of what 'regulations' will be helpful and what would be a hindrance. We in Colorado have heard loud and clear from our industry partners that what they need at this time is flexibility – a wait and see approach. Industry is financially motivated to make autonomous vehicles successful, so imposing regulations now with our limited understanding could stifle the growth and deployment of these technologies.

Shailen Bhatt, executive director, Colorado Department of Transportation, will be taking part in the panel discussion *State Departments of Transportation Perspective on Challenges of Autonomous Vehicle Adoption,* at 9:00am, Tuesday, October 24

> As soon as possible, as long as they are well considered. In the absence of federal regulations or model state laws and policies, 28 states and the District of Columbia already have enacted AV laws and four additional states have executive orders, the provisions of which vary widely from highly to minimally restrictive. Wide AV implementation will require consistency in state laws and regulations.

Dr James Hedlund, principal, Highway Safety North, will be giving a presentation entitled *Autonomous vehicles: traffic safety issues for states,* at 9:00am, Monday, October 23

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Several companies are pursuing the design of an autonomous vehicle without a steering wheel. Should testing of such vehicles on public highways be allowed?

Autonomous Vehicle SAFETY REGULATION WORLD CONGRESS 2017

> Federal law allows manufacturers to test automated vehicles on public roads today. It is important that automated vehicles be tested in a variety of environments as well as weather and road conditions. Doing so will help enhance their safety and functionality. States should therefore be discouraged from imposing unnecessary restrictions on manufacturers' ability to test automated vehicles on their public roads.

Charles Haake, assistant general counsel, Association of Global Automakers, will be giving a presentation entitled *Creating the right legal framework for AV regulation,* at 2:00pm, Monday, October 23

> There should be on-street driverless testing of vehicles with human controls before vehicles without controls.

Don Hunt, senior fellow, Buechner Institute for Governance, University of Colorado Denver-School of Public Affairs, will be moderating the panel discussion *State Departments of Transportation Perspective on Challenges of Autonomous Vehicle Adoption,* at 9:00am, Tuesday, October 24

> Yes, these vehicles need to be tested to find problems, issues, etc, so that they can be resolved.

Prof. Dorothy Glancy of Santa Clara University School of Law, will be giving a presentation entitled *Automated and connected vehicles require both privacy and cybersecurity,* in the 2:00pm session, Tuesday, October 24

> In the testing realm, it's important to assure the diversity of test conditions including roads, traffic flow and climate. Supporting testing in more states can help achieve this while promoting the technology among consumers who may see the vehicles during on-road tests. Despite this, testing requires significant monitoring and investment by the manufacturers and suppliers and each state's testing regulations should reflect those needs. As long as a state has the proper enabling legislation and regulation to make testing successful, these vehicles should be allowed access today.

Jennifer Dukarski, shareholder at Butzel Long, will be taking part in the panel discussion *And Now the Law: Product Liability, Cybersecurity, Privacy, Ethics, Insurance, and Regulatory Compliance,* at 3:45pm, Tuesday, October 24

> Ford believes the FAST Act amendments passed in 2015 allow for the testing of otherwise non-FMVSS-compliant vehicles on public roads. This testing, responsibly performed, is necessary to help ensure the future smooth deployment of automated vehicles.

Emily Frascaroli, counsel for Ford Motor Company, will be giving a presentation entitled *Legal Challenges: Product Liability, Cybersecurity, Privacy, Ethics, Insurance, and Regulatory Compliance,* at 2:00pm, Tuesday, October 24

What is the main obstacle impeding the creation of autonomous vehicle legislation?

Autonomous Vehicle SAFETY REGULATION WORLD CONGRESS 2017

> Resources and the direction at NHTSA is a short term obstacle. The new executive administration in Washington has yet to address those issues but I believe this administration will or has already recognized the importance of autonomous driving tech to job growth and capital development in the USA, so I see this as a short-term obstacle that will be resolved.

Thomas P Branigan, managing partner at Bowman and Brooke, will be giving a presentation entitled *Road ready? Adapting safety standards for real-life public testing regulation,* at 3:15pm, Tuesday, October 24

> People want to make sure that highly automated vehicles are safe before they are deployed on the road, but there is little consensus on how auto makers can prove they are safe. And there may be a chicken-and-egg problem where people are hesitant to put 'untested' vehicles on the road, but the best test environment for these vehicles is the unpredictable reality of public roads, rather than an artificial simulation or test course.

Jason Orr, attorney at O'Melveny & Myers, will be taking part in the panel discussion *And Now the Law: Product Liability, Cybersecurity, Privacy, Ethics, Insurance, and Regulatory Compliance,* at 3:45pm, Tuesday, October 24

> The simple answer is "a lack of understanding". You're talking about trying to put legislation around something that doesn't exist just yet. I think Colorado took the right approach this year when we passed autonomous vehicle legislation that didn't try to answer every question that may come up in the next decade, but instead tried to address just a few things. We did it in a way that protects the safety of the traveling public while encouraging innovation.

Shailen Bhatt, executive director, Colorado Department of Transportation

Reasons to stay longer in Novi

This year, for the first time, once the Safety Regulation World Congress is finished there will be two more events relevant to those in the autonomous vehicle field, running alongside each other at the Suburban Collection Showspace in Novi, Michigan, from October 25-26. The Autonomous Vehicle Test & Development Symposium and the Autonomous Vehicle Interior Design & Technology Symposium will be well worth extending a stay for.

The Autonomous Vehicle Test & Development Symposium is focused entirely on the test and validation processes for AVs, and it will bring together collective thought and experience to review the mechanisms needed for testing, which will have to provide the highest level of assurance to legislators, highway authorities and car buyers.

Meanwhile, the Interior Design & Technology Symposium will host automotive design teams from car manufacturers and design companies, Tier 1 and Tier 2 suppliers, electronics specialists, in-car entertainment companies, interior safety experts, materials companies, and anyone involved in the future of automotive and passenger vehicle interiors. The experts will address the design challenges presented by the new way in which vehicle interiors will operate and be used in the AVs of the future.

Additional autonomous vehicle conferences announced!

Book your delegate passes at…

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autonomousvehicle interiors.com/detroit

Book your pass at: autonomousregulationscongress.com

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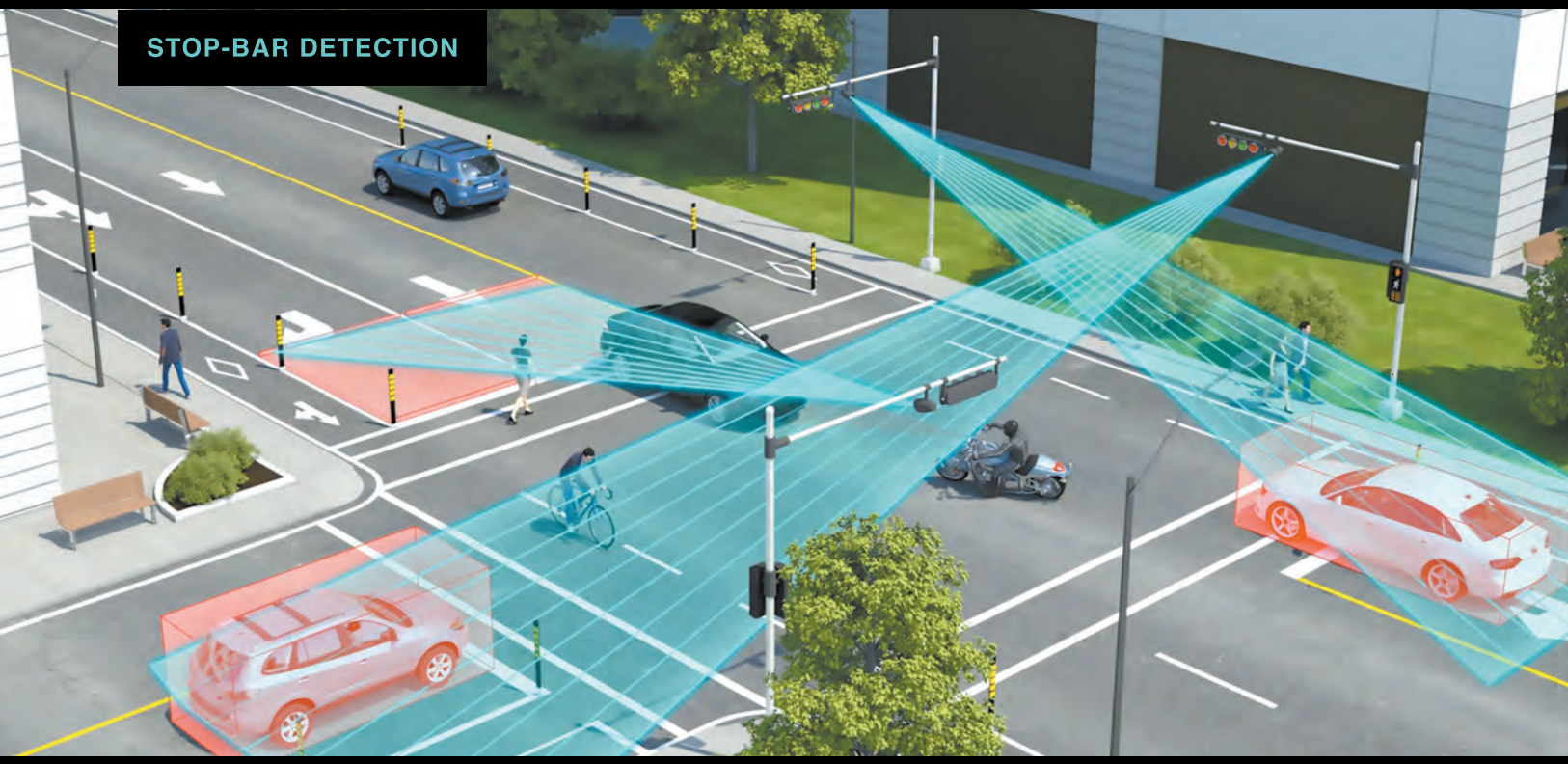

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ITS WORLD CONGRESS 2017
Montréal | OCTOBER 29 - NOVEMBER 2

David St Amant, interim president and CEO of ITS America, talks about why Montreal is the ideal location for this year's ITS World Congress

By Rachelle Harry and James Allen

At the end of October, transportation management leaders from around the globe will converge for the annual ITS World Congress. Produced by ITS Canada, in conjunction with ITS America, the location of the 2017 event will be the city of Montreal in Canada.

"Montreal is a charming city, one of the most picturesque in the world – not just North America," says interim president and CEO of ITS America, David St Amant, who stepped up following Regina Hopper's unexpected departure in July.

"If you have never been, you are in for a real treat. And in the fall, with the cooler weather beginning, Montreal is more beautiful than ever."

The city government has been "exceptional" to work with, says St Amant, and incredibly hospitable to the ITS team. As a result, compared with previous World Congresses, registration numbers are up and the number of exhibiting companies will also be larger than at previous events.

"We are very optimistic that it will be very special," says St Amant.

By 2025 nearly 60% of the world's population – more than 4.6 billion people – will live in cities. It is because of such forecasts that traffic management in an urban setting will be a major theme running through this year's gathering.

The centerpiece of the October 29 to November 2 event will be the Smart Cities Pavilion, featuring innovative solutions to the challenges growing cities face as demand on infrastructure increases.

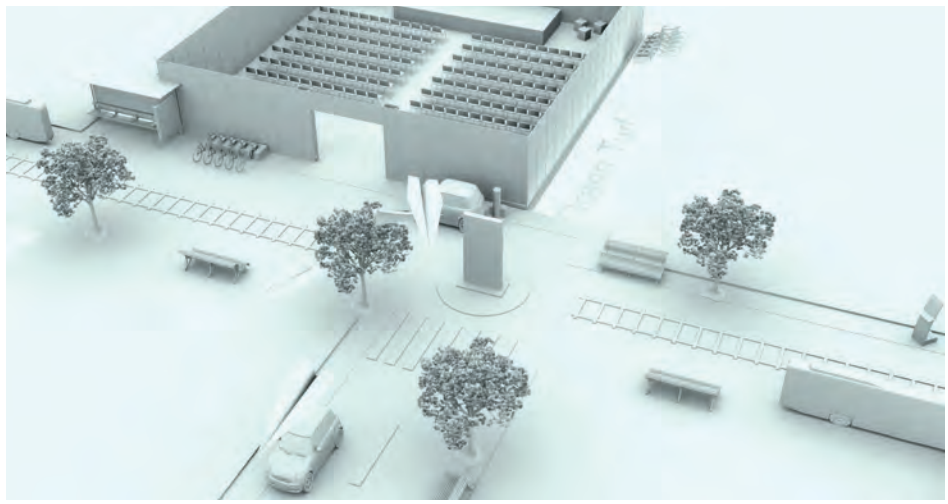
In addition to the host city's offering, contributions from Singapore, Copenhagen in Denmark, Christchurch in New Zealand, and Columbus, Ohio will also be on display in the pavilion.

St Amant says, "The Smart Cities Pavilion will be an opportunity to show the world the future, now. With the themes of

Far left: **Montreal is at its most beautiful in autumn**

Left: **The Palais des congrès de Montréal is the main venue for the ITS World Congress 2017**

Below: **A plan for the Smart Cities Pavilion, which will be built on the show floor**



urban mobility, engaged citizenry, smart security, economic cluster and smart democracy, the demonstrations will illustrate how transportation and integrated mobility are central to the critical infrastructure of smart cities. They provide seamless connectivity, improved systems delivery and a better, more equitable, quality of life for citizens.

"The technology is there to make the world's cities even better places to live and more mobile, making transportation systems safer, more efficient and providing people with more options to get around – on public transport, in private vehicles or using other forms of transportation."

Complementing the demonstrations inside the pavilion will be a comprehensive and wide-ranging program of papers presented by speakers who are expert in their chosen field. According to St Amant, these special-interest sessions will be the meat of the technical program, specifically developed to address the big issues facing the ITS community.

"Two major challenges are the implementation of connected and autonomous vehicles," continues St Amant These two technologies individually, and potentially in concert, have the potential to dramatically improve highway operations and safety. Though the technologies are maturing quickly, there are a number of institutional issues that must be addressed."

> Two major challenges are the implementation of connected and autonomous vehicles

Practical demonstrations

Another important feature of the show will be the varied selection of technical tours available to delegates. This year's choice will include traffic management and transit management centers, Canada's national crash test facility, and two major reconstruction projects using innovative technologies and strategies to maintain traffic operations during construction.

Coinciding with the event will be the festivities and activities taking place to commemorate Canada's 150th anniversary and the 375th anniversary of Montreal itself. It means that there will be even more opportunities to network than are usually afforded to attendees of the event, an activity St Amant is particularly looking forward to.

"It is always wonderful to reconnect face-to-face with the other people who work in this field and talk with them about the exciting changes and opportunities that are taking place," he says. "Maybe the most important part of any conference is the networking opportunities, both for potential business but also collaboration purposes. It is especially true at a World Congress because we give delegates a chance to learn about how other parts of the world are taking on some of the same challenges they are facing. First time attendees are always surprised at the breadth of opportunities for interacting with peers from around the world that are available."

Final preparations are being made but, for the most part, St Amant and his team have already put in the hard work and now are looking forward to what is gearing up to be an informative and entertaining show.

Turn the page for our full ITS World Congress preview.

And don't miss our daily, exclusive news updates, live and direct from the show floor! Just sign up for our FREE email newsletter at ***traffictechnologytoday.com*** *to make sure you don't miss out!*

ITS World Congress Guide

The 24th ITS World Congress takes place in Montreal – Canada's 'most connected city' – from October 29 to November 2, 2017. In this special preview, **Rachelle Harry** rounds up event highlights and outlines the top five ITS projects in Canada

ITS WORLD CONGRESS 2017
Montréal | OCTOBER 29 - NOVEMBER 2

ITS WORLD CONGRESS GUIDE

Industry experts and professionals from across the globe will soon gather at the largest intelligent transportation systems event of the year: the ITS World Congress.

More than 10,000 delegates from fields including transportation, technology, research, policy and education are expected to attend the event, which will be held in the Palais des congrès de Montreal. This year's theme is: Integrated mobility driving smart cities.

"Not only is Montreal innovative, as witnessed by having been awarded Intelligent Community of the Year for 2016 by the Intelligent Community Forum [ICF]," says Denis Coderre, mayor of Montreal, "but it also aims to become the North American leader in transport electrification and mobility by 2020."

"The 2017 ITS World Congress will showcase state-of-the-art concepts in integrated mobility and smart city innovations," says David St. Amant, interim president and CEO, ITS America. "We are looking forward to reuniting the thousands of people from the transportation, automotive, telecommunications, infrastructure and technology sectors for a productive week of discovery, networking and collaboration in the city of Montreal, which features an extensive tech-driven transportation system that makes getting around the picturesque island easy, safe, and efficient."

The ITS World Congress will provide visitors with the chance to network and share ideas with their peers at galas and roundtables, explore and purchase innovative products showcased in the exhibition hall with more than 200 exhibitors, and experience the very latest technologies at demonstrations and on technical tours that will take place across the historic city.

Listed among the technical tours are visits to the Transports Québec Greater Montreal Traffic Management Center, which monitors traffic on provincial roads across the province of Quebec, as well as the Ville-Marie Tunnel; and the PMG Motor Vehicle Test and Research Center, which, among its projects, is testing and evaluating the performance and efficiency of electric and autonomous vehicles.

> Montreal was awarded Intelligent Community of the Year for 2016… Now it aims to become the North American leader in transport electrification and mobility by 2020
>
> **Denis Coderre, mayor, Montreal**

For delegates wishing to broaden their industry knowledge, there will be plenaries, presentations and workshops on topical areas, including: connected technologies; infrastructure challenges and opportunities; smart(er) cities; big data, security and privacy; and disruption and new business models.

To book your delegate pass, visit www.itsworldcongress2017.org

TOP 5
ITS projects in Canada

On the next four pages, we showcase the Top 5 ITS Projects deployed recently in Canada, as well as bringing you Congress highlights to look out for, from TTI *partners...*

VERSATILE TRAFFIC CAMERAS *from Lumenera*

Lumenera offers a wide range of cameras specifically designed for use in advanced traffic systems. Compact, lightweight, versatile, with onboard memory buffering, a choice of data interface and ruggedised for harsh environments, Lumenera's cameras are ideally suited for traffic applications such as tolling, red light and speed enforcement, and automated parking.

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TOP 5
ITS projects in Canada

#1 Color coding

Montreal's smart bridge is managed and illuminated thanks to data-collecting sensors installed throughout its structure

Montreal's Jacques Cartier Bridge, which was completed in 1930, now operates as a five-lane 'smart bridge', with intelligent sensors installed throughout its structure. Thirty-five million vehicles cross the bridge each year.

Operators use traffic data from the bridge – collected by intrusive loops, sensors and high-definition radar array – to safely manage the opening and closing of lanes, warn drivers of congestion up ahead, and control warning lights.

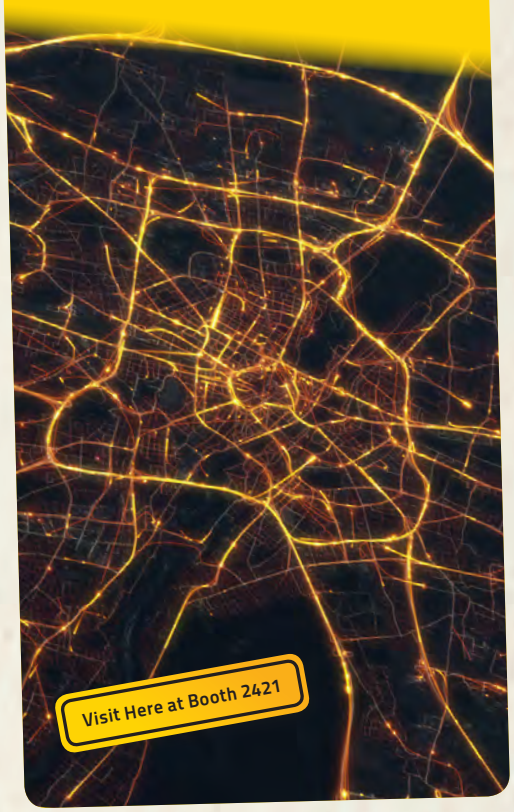
Montreal is marking its 375th anniversary this year, and as part of its 'Alive 375' celebration, the bridge has been illuminated by 2,400 intelligent LEDs. These reflect 'the mood of Montreal'– changing to indicate how often residents discuss the city live on social media. The illumination was made possible thanks to bridge operator Jacques Cartier and Champlain Bridges Incorporated (JCCBI); Wavetronix and its Quebec dealer, Orange Traffic; and multimedia studio Moment Factory.

Map factor

Here will demonstrate its next-generation services at the ITS World Congress

Here has a proud legacy of creating some of the world's most precise map data. Its location platform processes and analyzes massive quantities of real-time data from connected vehicles, devices and infrastructures, resulting in powerful products and services for its partners.

At the ITS World Congress, Here will showcase its portfolio of state-of-the-art mobility, transportation and infrastructure services that will form the heart of tomorrow's smart cities and will deliver smart solutions for a safe, satisfying and sustainable future.

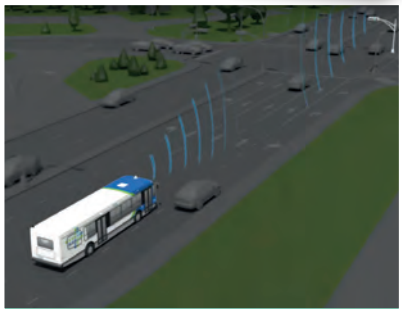


TOP 5
ITS projects in Canada

#2 Smarter intersections

Laval's connected technologies system enables public transit to take priority at intersections

A new system in the city of Laval, Quebec, 18 miles (30km) north of central Montreal, features a vehicle-to-infrastructure (V2I) GPS communications system to prioritize STL (Société de transport de Laval) buses approaching smart traffic signals at busy intersections. The system allows buses to notify the traffic signal when it is ahead of, or behind, schedule. The traffic signal then extends or shortens its green light time by a few seconds, to safely facilitate buses' re-entry into the traffic flow and to help them to keep to their schedule.



Traffic signal prioritization for STL buses in Laval is managed by Montreal's Urban Mobility Management Center (UMMC). Having UMMC as a control hub enables emergency service vehicles to benefit from the prioritization system, too, as well as other transit companies, provided that their vehicles are technologically advanced enough.

To watch a video of Laval's bus traffic signal prioritization, visit: trafficTechnologyToday.com/STLtech

#3 Fast lanes

Canada's first-ever HOT lanes will cut traffic congestion

In September 2016, Canada opened high-occupancy toll (HOT) lanes to reduce traffic congestion in the province of Ontario. The HOT lanes, the first of their kind to be installed in the county, are operating as a pilot project that will run for up to four years.

The lanes are located in both directions on the Queen Elizabeth Way (QEW), from Trafalgar Road in Oakville to Guelph Line in Burlington. They are 10 miles (16km) in length.

The scheme allows vehicles with two or more occupants to travel in the lanes for free. Drivers of single-occupant vehicles, however, can only travel in the HOT lanes with a purchased permit (a three-month permit is CA$180/US$143).

Strong connections

Actelis Networks is a global supplier of Ethernet solutions

World Congress exhibitor Actelis Networks manufactures advanced managed Ethernet switches and extenders for use in flexible topologies such as drop and continue, and resilient Ethernet rings over fiber and copper. Power Over Ethernet (PoE) and extended reach PoE were tested and certified with multiple cameras.

A highly compact fanless design, extremely low mean time between failure (MTBF) along with enhanced security capabilities and advanced management solutions, makes Actelis's products a perfect ITS solution for challenging environments and applications.

Visit Actelis Networks at Booth 1727

TOP 5
ITS projects in Canada

#4 Advanced weigh-ins

A WIM sorter system is helping to capture overweight vehicle violations

New Brunswick in Eastern Canada has collaborated with International Road Dynamics (IRD) to build and maintain a number of mainline WIM sorters throughout the province. The WIM sorters are comprised of IRD-manufactured high-speed WIM systems, tracking sensors and automatic license plate recognition (ALPR) cameras.

The mainline WIM sorters identify vehicles that are violating weight restrictions. Suspected violating vehicles (and their license plates) are photographed and images are shown on the operators' display. The operator can then decide to direct the suspected vehicle to the weigh station for inspection. An alarm is incorporated into the system to notify operators of vehicles trying to bypass the weigh station.

WIM sorters and weigh stations help to prolong the life of road pavements that may otherwise be damaged by overweight vehicles.

ITS WORLD CONGRESS GUIDE

Scale it up

Haenni Instruments will showcase its wheel load scales at the ITS World Congress

Haenni Instruments is a leading supplier of mobile wheel load scales. Its mission is to provide the best solution for mobile weight enforcement.

The company's unique and patented measurement systems give its wheel load scales a high level of accuracy. Known as the thinnest on the market, Haenni scales are light, robust and have a long lifespan. The types, sizes and range available means that they can be used in a variety of applications. The wheel load scales are mainly used for weight enforcement, but they are also used in private industries, universities and test laboratories.

Visit Haenni Instruments at Booth 1829

Embedded WIM

Intercomp will exhibit its in-ground strain-gauge-based strip sensors at the ITS World Congress in Montreal

Suitable for operation in a wide range of temperatures, these weigh-in-motion (WIM) sensors are used for data collection, screening for enforcement and tolling applications, to detect axle and vehicle weights, and they can also use axle spacing to determine vehicle classifications. These sensors enable accurate weighing technology, usually reserved for static scales, to be used at speeds up to 80mph (130km/h).

When incorporating and updating WIM sites, the sensors can be installed in a vehicle lane within a single day. This means that minimal road works are required, so lane closures can be kept to a minimum.

Visit Intercomp at Booth 2226

TOP 5
ITS projects in Canada

#5 Weather checks

A Canadian city has installed a smart RWIS to monitor roads and keep drivers safe during winter weather

The city of Magog in Quebec has partnered with Campbell Scientific Canada (CSC) to implement a smart road weather information system (RWIS) as part of a winter pilot project that aims to keep its 550km (341 miles) of roads safe during adverse weather conditions. The RWIS stations will monitor the roads, as well as collecting and analyzing road and weather data in real time. Data types include snow thickness on and off the pavements, temperature and dew point. The RWIS will use the data to automate decision making and to suggest courses of action to the city's authorities.

The CSC smart RWIS has been designed for easy integrating with existing ITS and intelligent weather systems.

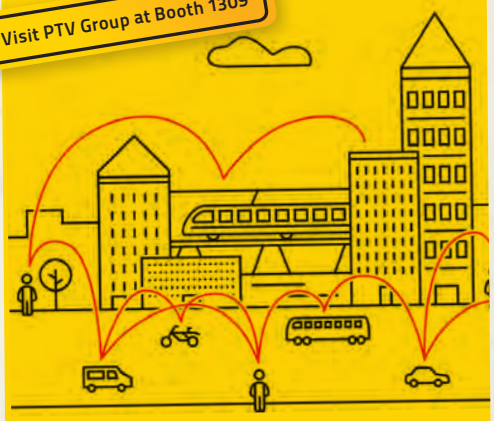
Software solutions

PTV Group optimizes the movement of people and goods

World Congress exhibitor PTV Group draws on scientific knowledge of software and data, gained from four decades of experience, to improve mobility systems around the world. As a global market player with German technology, PTV Group helps cities, businesses and people to save time and money, enhance road safety and minimize the impact on the environment.

The company supports smooth traffic flow, using its unique expertise in the entire mobility ecosystem. PTV Group offers technologies for traffic planning, transportation network modelling and simulation across all modes of transportation, including real-time traffic management and Mobility-as-a-Service (MaaS) solutions.

Visit PTV Group at Booth 1309



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*Center for Transportation Research, The University of Texas at Austin.

Speed matters

What is the best way to cut the number of speeding motorists on our roads? **Saul Wordsworth** looks at the latest high- (and low-) tech methods that road authorities and enforcement agencies are using to keep traffic moving and improve safety

Speeding is illegal, and dangerous. Risk of causing death or serious injury in a crash increases exponentially with vehicle speed. As your speed doubles, your stopping distance quadruples. According to a study[1] carried out by the USA's AAA Foundation in 2011, the average adjusted, standardized risk of death if a vehicle strikes you as a pedestrian at 23mph is 10%, at 32mph the risk is 25%, at 42mph the risk is 50%, at 50mph it's 75%, and if the vehicle is traveling at 58mph and you are unlucky enough to be hit by it, you have a 90% chance of dying.

Most of us have heard these statistics or similar ones before, but they are worth repeating, for it is human nature to forget, which is why speed education and enforcement are so essential. Traffic managers and police operatives who are concerned with keeping road networks free of accidents and the resulting congestion, as well as enforcing speed limits, will do well to consider some of the obvious – and less

Reminding drivers of the possible serious consequences of speeding is an effective prevention measure

2.7

The number of road deaths in the UK in 2015, per 100,000 of population (total: 1,732 fatalities)

11.3

The number of road deaths in the USA in 2015, per 100,000 of population (total: 35,092 fatalities)

obvious – ways in which speeding is addressed around the world.

Speeding in the City of Angels

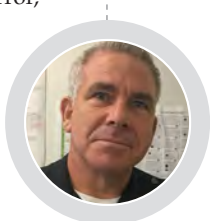
"We do a lot of tried-and-tested stuff like electric traffic signs with messages to remind people, plus radar displays," says Capt. Andrew Neiman, commanding officer of the Los Angeles Police Department's (LAPD) Valley Traffic Division. "We also use social media as much as possible regarding issues related to speeding. We try to include a recent tragic incident where somebody was injured or lost their life, and where the primary cause was speed. We remind people that slowing down by 5mph only adds two minutes to a typical 30-minute journey. When my officers stop someone, our focus is education as much as penalizing, in an attempt to effect behavior change. It's a constant process."

Like many jurisdictions, the LAPD uses traffic data to justify speed enforcement schemes, tracking collisions daily and building up a risk profile.

"We are very much entrenched in predictive policing here," says Neiman. "We started using that for crime, but are now applying it for traffic collisions. We look at statistical data daily and create missions for our traffic enforcement officers utilizing a combination of statistics and the predictive policing model. This is an algorithm running on years of statistical data to predict where enforcement should be done in order to prevent injury or fatal collisions."

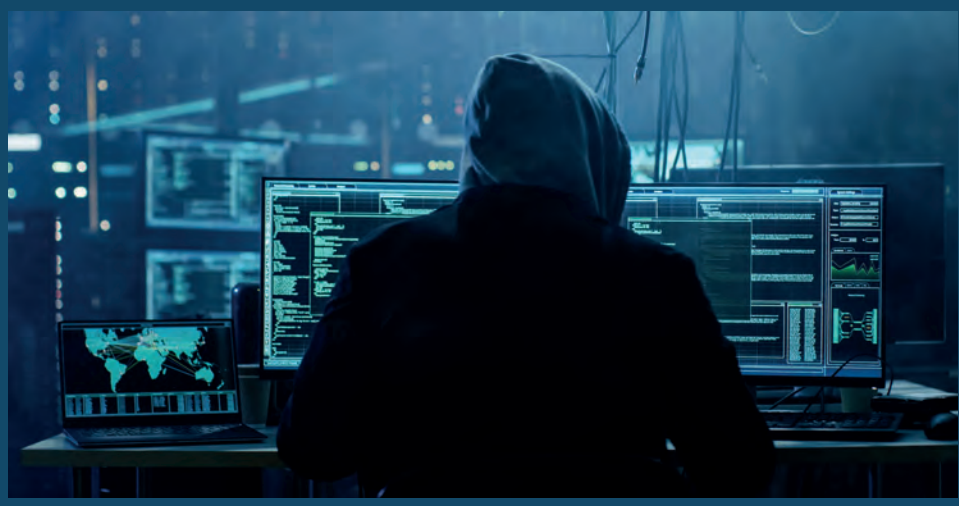
In the past five years, the LAPD has been acquiring video cameras for use in both in its vehicles and more recently via body-worn devices. Full implementation is close to completion. All video footage is maintained in a secure database and is admissible in court as evidence.

"The in-vehicle camera is a fixed, mounted camera that faces forward right behind the rear-view mirror," says Neiman. "The officer can either activate it manually, or the system is automatically triggered anytime the officer operates the emergency lights. There is a two-minute buffer. The camera is constantly recording, but it is not activated until the button is hit. When you hit the button it will capture and maintain two minutes prior to the point of triggering so that hopefully all the violation will be captured on the video."



Mock-up shock

The Canadian city of Laval has paired up with the local fire department and the Quebec automobile insurance board to devise an ingenious method of teaching motorists about the impact of



WannaCry for ITS?

Could ITS be hijacked in the future by malicious hackers wishing to extort money from road authorities? One recent high-profile incident suggests so

In May 2017, the WannaCry ransomware attack affected over two million computers across 150 countries, bringing to its knees Deutsche Bank, FedEx, a Honda production plant in Japan, and parts of Britain's NHS. Also affected was Victoria Police in Melbourne, Australia, in particular 280 speed and red light cameras, encompassing the state's entire fleet. As a result more than 8,000 fines were suspended.

WannaCry exploited a flaw in Microsoft's file-sharing protocol to carry out its attack. It is thought the spread of malware occurred as a result of a maintenance worker connecting an infected USB stick to the camera system, leaving the cameras in continual reboot mode. It was initially thought that only the 55 cameras found within Melbourne's inner-city had been affected by the ransomware. However, it came to light that at least 42 further devices had been compromised, but initially failed to inform the Justice department.

"It's important that we give the public some confidence around our camera system in Victoria," said Victoria Police's acting deputy commissioner of specialist operations, Ross Guenther. "These cameras are about saving lives, so until I'm satisfied, I think the public will expect those fines are withdrawn."

> Our algorithm runs on years of statistical data to predict where enforcement should be done in order to prevent injury or fatal collisions
>
> **Andrew Neiman, commanding officer, Los Angeles Police Department, Valley Traffic Division**

186,209

The total number of casualties of all severities caused by vehicle crashes in the UK in 2015

> We would pull over drivers and give them an alternative: either get a ticket, or go live with a radio interview on local station 680 News
>
> **Roger Browne, Traffic Safety Unit manager, Toronto, Canada**

speeding. Once a year, Laval mocks up the immediate aftermath of a car accident, pulling in speeding drivers and bringing them to the scene in an effort to relay the impact their behavior might have on them and others. What they are presented with is shocking: a vehicle on fire, a large police presence, firefighters with hydraulic rescue tools – the so-called 'jaws of life' – attempting to 'rescue' an imaginary victim from this simulated scene. On hand last year was Nicholas Terresco – a paralyzed victim of a speeding motorcycle crash – there to tell his story to those pulled over.

"When they hear me tell them, they think, 'Oh, it can happen to me too'," he says.

Trial by radio

Still in Canada, Toronto's traffic safety department has been experimenting with a most unusual and innovative means by which to embarrass speeders. Roger Browne, manager of the Traffic Safety Unit, tells the story: "In 2016 we experimented with a campaign targeting those who, in their attempts to bypass traffic, often end up down roads with schools on them. We would pull over drivers and give them an alternative: either get a ticket, or go live with a radio interview on local station 680 News. The DJs really took these individuals to task, hammering home the message, 'What were you thinking?'"

242

The estimated annual cost (in US$bn) of vehicle crashes in the USA each year

Since the media couldn't be there all day, this approach was combined with an orchestrated dressing down from schoolchildren, who were on hand to dispense a brow-beating.

"No one," notes Browne, "wants to be told off by a child."

Targeting the youth

Greater Manchester is one of the more innovative and savvy police forces in the UK, and is constantly searching for new ways to change and improve road-user attitude and behavior. One of its schemes – which it is proud of and committed to – is the Safe Drive Stay Alive initiative targeting 16- to 18-year-olds. This project involved a recent gathering of young Mancunians at Middleton Arena to highlight the problems of speeding. In a packed auditorium, those with yellow seat covers were asked to stand. The 93 who did were told they represented the number of young people killed on the city's roads in the past 10 years.

Project TED (Technology Enhanced Driving) was introduced in Manchester 2015 in an attempt

Black box success?

Can in-car technology positively affect driving styles, and even help to educate users to drive more safely in the future?

Whatever one may think about issues surrounding personal freedom, there is little doubt that Intelligent Speed Assistance (ISA) reduces our road speed and therefore the number of speed-related accidents, although this is more an unavoidable influence on driver behavior than a means to educate. What, then, of black box technology?

"Telematics, also known as 'black box insurance policies', have seen a big increase in the UK in the last few years," says Rob Cummings, head of Motor and Liability at the Association of British Insurers. "The youngest drivers tend to face the highest insurance premiums, reflecting their likelihood to make claims, in particular large ones involving multiple casualties.

"Black box technology lets young people demonstrate they are safer than the average pool of drivers their age by monitoring their driving over a number of miles, or a period of time," he continues. "It doesn't only look at speed, but also cornering, and takes into account variations of road, and time of day. Many systems offer feedback to the driver on where they have made mistakes. It helps to encourage better and safer driving, and there is some evidence it's taken the edge off price increases for some young drivers."

While this technology may indeed "encourage better and safer driving", it does not do this on its own, according to a report carried out in 2015 by the UK's Transport Research Laboratory. It must be combined with other methods in order to be effective. "It has been demonstrated that telematics can influence driver behavior in a desirable manner when combined with feedback and incentives," it says.

It also states that telematics tend to "manipulate behavior" while being used and do not lead to "sustained behavior change".

to introduce young people to telematics devices (see *Black Box Success?*, above) while dispelling the negative connotations.

"It's about getting data to the driver, providing extensive feedback and encouraging them to drive better," says Sam Li of Transport for Greater Manchester (TfGM). "TED is now part of CityVerve, a Manchester project pioneering the use of the Internet of Things (IoT) in an effort to redefine 'smart' in the context of a living, working city.

"CityVerve aims to provide insight into how all manner of people drive, and how technology can help all of us really," says Li. "Greater Manchester Police record all killed and serious injured collisions (KSI) on a national database. TfGM analyzes the data on a regular basis and identifies locations and routes containing a high incidence of speed-related KSIs. With enough data from CityVerve we could get very precise information about aggressive braking at certain junctions, drill right down into what drivers do and where, building an even fuller picture."

> Black box technology lets young people demonstrate they are safer than the average pool of drivers their age by monitoring their driving over a number of miles
>
> **Rob Cummings, head of motor and liability, Association of British Insurers**

2

Percent decrease in UK road deaths in 2015, compared with 2014

Data-driven future

Scope for education, with or without the deployment of technology, is almost limitless. Witness Transport for London's recent Exchanging Places scheme, an initiative giving cyclists, HGV and bus drivers the chance to switch places to understand what it's like to drive other modes of transport, as well as the dangers their actions pose to other road users.

However, increasingly, technology will play the defining role in our education. As vehicles become more connected, there will be the opportunity to make greater use of data to inform and instruct drivers about their speed and driving style, not to mention curbing their excesses and correcting errors. Driving safely is a choice and the opportunity exists, through a greater volume of more accurate information, to help drivers make the right choice.

1. https://www.aaafoundation.org/sites/default/files/2011PedestrianRiskVsSpeed.pdf

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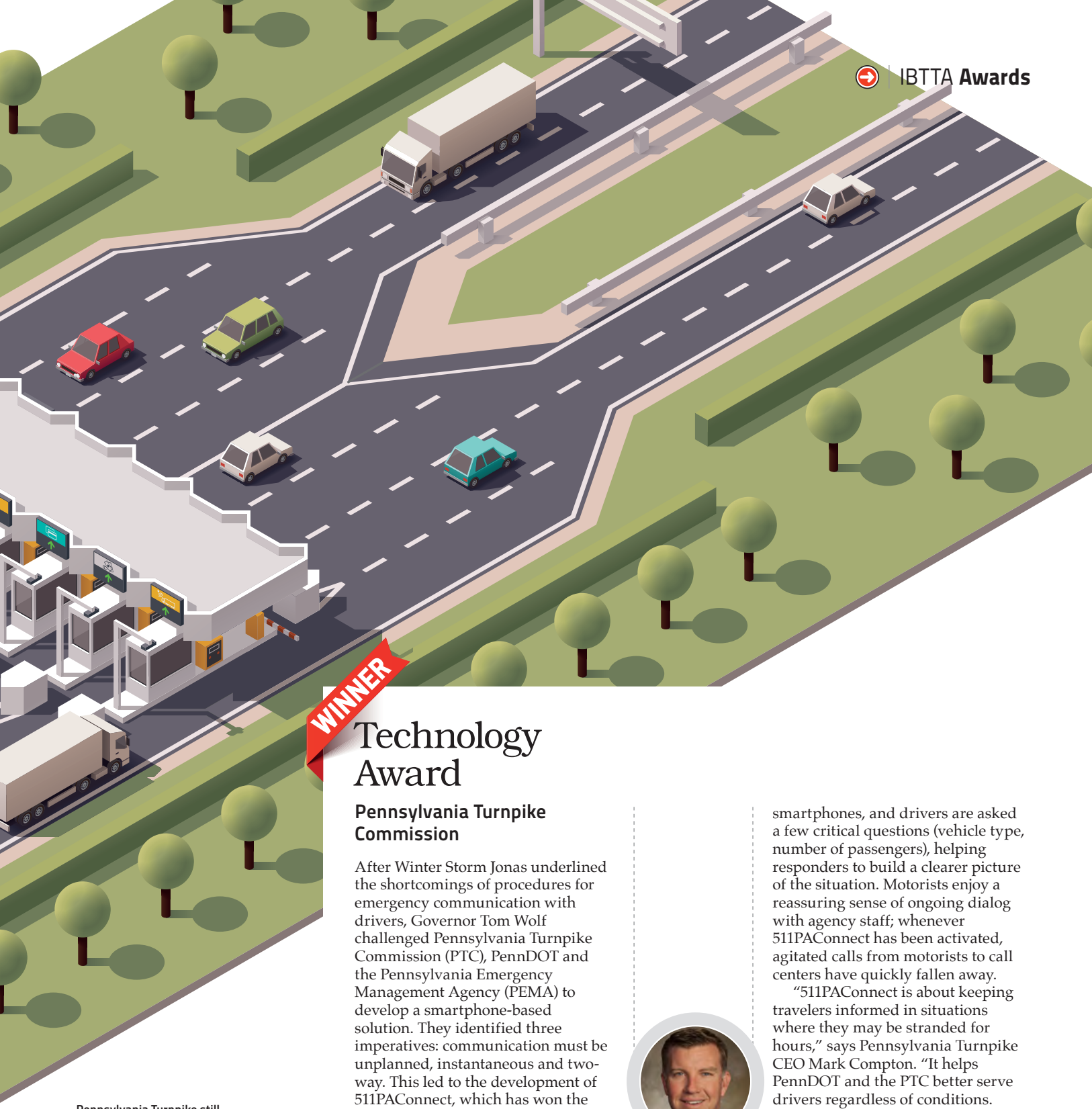
The World's best toll operators

As the international tolling community prepares for the IBTTA annual meeting this September, **Jack Roper** catches up with the winners of the association's annual awards, and uncovers some of the latest innovations that are leading progress in the industry

The International Bridge, Tunnel and Turnpike Association (IBTTA), established in 1932, works to connect toll facility owners and operators across six continents with the common goal of developing cutting-edge solutions to modern transportation challenges. To this end, the IBTTA's annual Toll Excellence Awards recognize innovation and excellence in the field.

The 2017 Awards are being presented during a special session on September 11 at IBTTA's 85th Annual Meeting in Atlanta, Georgia. Over the next six pages you'll meet the winners in the six categories. During the Closing Banquet, on September 12, IBTTA president Emanuela Stocchi will bestow the coveted President's Award on one of them.

"The 2017 awards submissions consisted of 28 public and eight private sector entries," says Oklahoma Turnpike Authority's David Machamer, chairman of the 2017 Awards. "The committee, consisting of 12 members, selected five winners from the public sector and one from the private, scoring submissions against a set of criteria. The committee determines that the project's objective was reached, that it is applicable to the toll industry and provides excellent customer service."



Pennsylvania Turnpike still has toll booths, but as the march of technology makes all-electronic tolling more and more prevalent, for how much longer?

WINNER

Technology Award

Pennsylvania Turnpike Commission

After Winter Storm Jonas underlined the shortcomings of procedures for emergency communication with drivers, Governor Tom Wolf challenged Pennsylvania Turnpike Commission (PTC), PennDOT and the Pennsylvania Emergency Management Agency (PEMA) to develop a smartphone-based solution. They identified three imperatives: communication must be unplanned, instantaneous and two-way. This led to the development of 511PAConnect, which has won the IBTTA Technology Award this year.

As soon as a trapped-driver scenario is identified, 511PAConnect pushes a wireless emergency alert (WEA) to all mobiles in a geo-targeted incident area. This WEA explains how to receive incident updates, offering a choice of phone, text or website communication, thus initiating a two-way channel. Location data is requested from smartphones, and drivers are asked a few critical questions (vehicle type, number of passengers), helping responders to build a clearer picture of the situation. Motorists enjoy a reassuring sense of ongoing dialog with agency staff; whenever 511PAConnect has been activated, agitated calls from motorists to call centers have quickly fallen away.

"511PAConnect is about keeping travelers informed in situations where they may be stranded for hours," says Pennsylvania Turnpike CEO Mark Compton. "It helps PennDOT and the PTC better serve drivers regardless of conditions. Drivers have rapid communications when major incidents impact their travel – along with peace of mind that responders are aware of their situation and precise location."

> "511PAConnect is about keeping travelers informed in situations where they may be stranded for hours"
>
> **Mark Compton, CEO, Pennsylvania Turnpike**

WINNER

Private Sector Innovation Award

Raytheon

Give Raytheon staff a challenge and nothing, it seems, will stop them meeting it, even if it means pioneering an entirely new construction process – thereby minimizing disruption to road users, while providing a seminal template for future all-electronic tolling system (AETS) installations.

The Massachusetts Department of Transport (MassDOT) hired Raytheon to design and build a statewide AETS infrastructure capable of collecting tolls at highway speeds, replacing a legacy toll booth system that cost 79% of tolling revenue to operate. Raytheon's contract entailed constructing 32 AETS toll zones and providing the system host with a MassDOT go-live date of October 2016. But after three months, a directed change order stipulated that, instead of Janus (E-Z Pass) readers, multiprotocol readers had to be installed instead due to emerging nationwide interoperability standards. Additional antennae and a sixfold increase in cabling would necessitate new gantries – and a three-month projected delay.

Raytheon's inexorable commitment to the original timeframe drove an accelerated construction procedure entailing off-site gantry assembly running parallel to vertical support construction. Rather than the three-night road closures envisaged for each of the 32 AETS zones there were typically six hours of lane closures, with traffic completely stopped for just 15 minutes during cross-member placement. Miraculously, 90 days were saved and the system went live as planned in October 2016.

MassDOT says its new free-flow AETS now routinely saves 132,000 commuters two hours on the road each week while reducing congestion and emissions, improving safety and increasing revenue. "Going through an automated toll today should be like logging on to your computer and going to your favorite app or search engine – just an ordinary, seamless experience," says Raytheon Transportation vice president Bob Delorge. You don't need to worry about what is happening behind the scenes. And that's what we and our partners accomplished with MassDOT."

> Going through an automated toll today should be like logging on to your computer and going to your favorite search engine – just an ordinary, seamless experience
>
> **Bob Delorge, vice president, Raytheon Transportation**

MassDOT says its new free-flow AETS now routinely saves **132,000** commuters two hours on the road each week

Above: **One of the new multiprotocol-enabled gantries installed by Raytheon for MassDOT**

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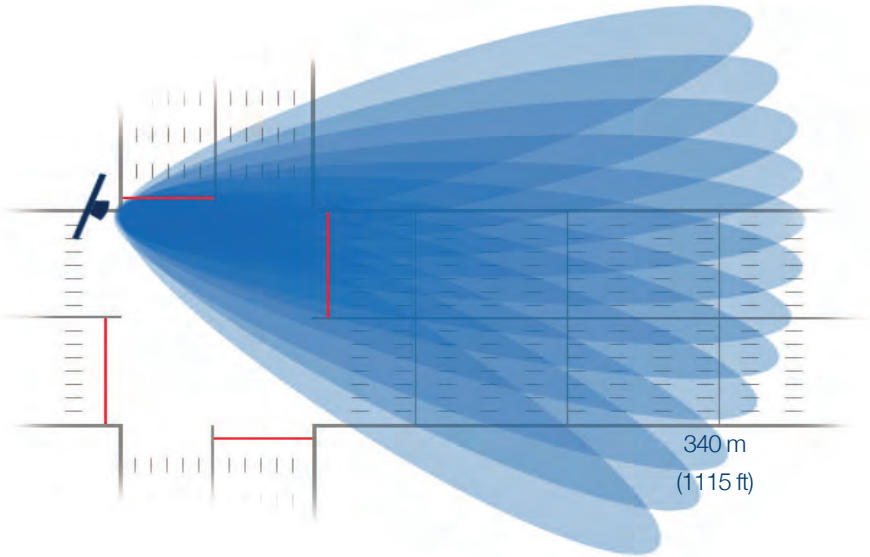

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WINNER

Customer Service and Marketing Outreach

State Road and Tollway Authority, Georgia

Created through a strategic consolidation in 2014 to provide a more integrated response to Georgia's transportation needs, the State Road and Tollway Authority (SRTA) is being recognized for its innovative Commuter Credits program, a pilot scheme promoting alternatives to solo travel during peak periods on Atlanta's congested I-85.

This three-pronged Commuter Credits scheme leveraged the partnership between SRTA's existing Peach Pass system and the robust commuter bus network on the corridor's Express Lanes to incentivize traffic-reducing journey choices. The first element of the pilot was Shift Commute, which offered selected Peach Pass customers US$3 per week in toll credits for reducing their weekly number of peak period Express Lane commutes. The second element – Start a Carpool – offered US$3 per day to Peach Pass customers who organized a carpool. The third element – Ride Transit – offered toll credits to customers opting to ride on buses rather than driving at peak times. Shift Commute was offered to 243 Peach Pass customers and saw around 500 commutes translated to an alternative time or mode, while the Ride Transit pilot involved 210 participants and converted some 4,500 solo car trips into bus rides.

> SRTA wanted to encourage commuters to explore alternatives to driving alone during the most congested periods
>
> **Chris Tomlinson, executive director, SRTA, Georgia**

"A growing state means more cars than ever on Georgia's busy highways," says SRTA executive director Chris Tomlinson. "SRTA wanted to encourage commuters to explore alternatives to driving alone during the most congested periods. The Commuter Credits program gave people the positive incentive they needed to experience the benefits of alternative commuting and still reap the benefits of Georgia's Express Lanes. As a result of the pilot's success, SRTA plans to continue with a broader program in conjunction with the opening of the Northwest Corridor tolled Express Lanes in 2018. Our team is proud of the program and grateful to IBTTA for recognizing our efforts with their award."

4,500

solo car trips were converted into bus rides (among 210 participants) in the six-month SRTA pilot to ease congestion on I-85 at peak times

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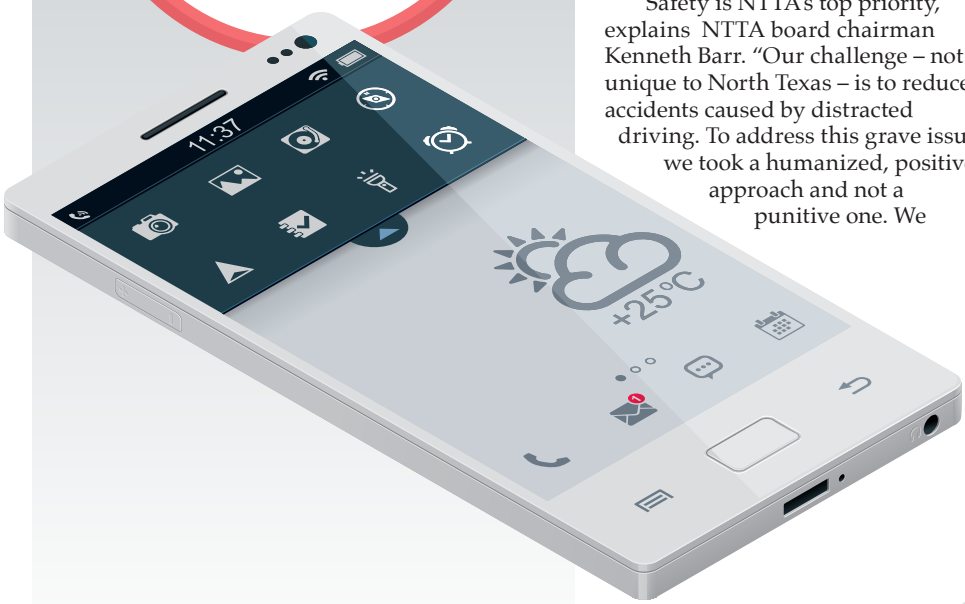
WINNER

Social Responsibility Award

North Texas Tollway Authority

100,000
NTTA-branded red thumb bands bearing the legend 'W82TXT' have been distributed since 2015



Every day people suffer death or injury when drivers become distracted, perhaps only for the few seconds needed to read a text or switch playlists. Driving distractions fall into three fundamental categories: visual (taking one's eyes off the road), manual (taking one's hands off the wheel) and cognitive (taking one's mind off the road). Texting while driving is singularly pernicious in combining all three – and statistically, at any given moment, 660,000 drivers across America are doing it. This parlous situation has spurred the North Texas Tollway Authority (NTTA) into action with a safety campaign entitled Spreading the Dangers of Driving 'Intexticated', which urges 'red thumbs for all'.

"Safety is NTTA's top priority," explains NTTA board chairman Kenneth Barr. "Our challenge – not unique to North Texas – is to reduce accidents caused by distracted driving. To address this grave issue, we took a humanized, positive approach and not a punitive one. We didn't harp on about what not to do, but concentrated on what every passenger could do. A picture means a thousand words, so we took a visual approach in order to tell our safety story."

In 2015 the NTTA joined a nationwide campaign encouraging drivers to redden their thumbs as a sign of their resolve not to text and drive. A community engagement program was mounted, spreading the simple, consistent message across North Texas, through storefronts, online and in coordination with businesses and municipal partners, distributing nearly 100,000 NTTA-branded red thumb bands bearing the legend 'W82TXT' since 2015.

The campaign's preventive impact is not readily quantifiable, but its message has been cemented in the public consciousness in an enjoyable, uncensorious fashion, benefiting NTTA's profile and community partnerships. "It's an old-school solution to a 21st century issue, fueled by the evolution and accessibility of technology at drivers' fingertips," says Barr.

> Our challenge – not unique to North Texas – is to reduce accidents caused by distracted driving
>
> **Kenneth Barr, board chairman, NTTA**

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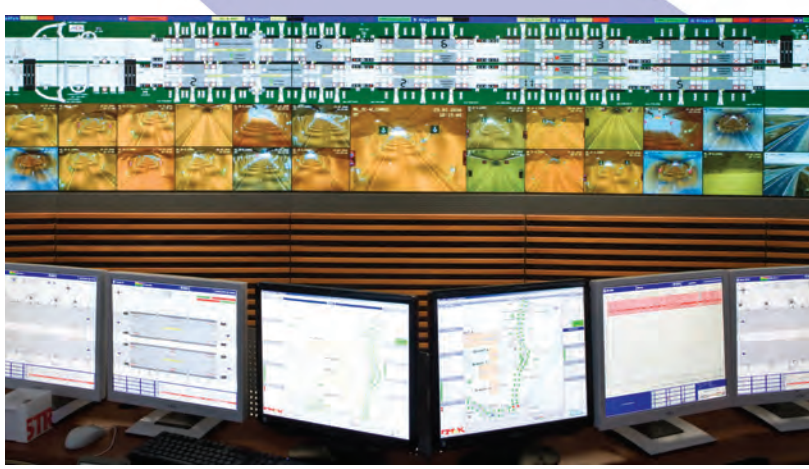

WINNER

Administration and Finance Award

Indiana Toll Road Concession Company

The Administration and Finance Award recognizes the innovative procurement approach the Indiana Toll Road Concession Company (ITRCC) adopted for the US$220m 80/90 PUSH construction project. This imposed an exacting deadline, delivering excellent value and a favorable allocation of risk while minimizing the impact of the works. The ITRCC sees the 80/90 PUSH procurement process as a template of excellence that can benefit other toll agencies and DOTs in the future.

"The 80/90 PUSH project is the largest undertaken on the Indiana Toll Road since its original construction in 1956," explains chief financial officer Ashley Holmes. "The procurement approach successfully delivered mutually favorable outcomes for ITRCC, the contractor (Rieth-Riley), customers and the State of Indiana." The project involves 292 lane miles of interstate highway pavement upgrade, rehabilitation of nine interchanges and 53 bridges, and installation of a fiber-optic backbone to facilitate state-of-the-art ITS deployment. The project is several months ahead of schedule and tracking to be completed under budget.

A payment of US$250,000 to the unsuccessful design-build team kept multiple teams involved and provided the tension of competitive pricing. The ITRCC maintained a strong contractual position to mitigate budget risks, with terms including liquidated damages for non-completion by the agreed date and non-compliance with maximum queuing levels in workzones, while a reduced 20-month completion schedule also sought to minimize road user disruption. An extended warranty ensured that the contractor would be accountable for any remediation or repairs within a seven-year term.

"ITRCC is delighted to be recognized by the IBTTA for the innovative process pursued in procuring such a large-scale construction program within a highly abbreviated period," says Holmes. "The procurement approach leveraged an aggressive schedule via early contractor engagement, running concurrent processes and maintaining a high degree of interaction and transparency with our contractors."

Right: **Installation of the fiber-optic backbone in progress on Indiana Toll Road**

> The 80/90 PUSH project is the largest undertaken on the Indiana Toll Road since its original construction in 1956
>
> **Ashley Holmes, CFO, Indiana Toll Road**

The project involves **292 miles** of interstate highway pavement upgrade

WINNER

Toll Operations, Engineering and Maintenance Award

Road and Transport Authority, Dubai

Can paying tolls ever make you happy? The answer, it seems, is 'Yes', if you're using the award-winning Smart Salik online system, developed as part of a government Happiness Strategy aiming to make Dubai the happiest city on Earth.

It is an all-electronic tolling system with three million existing customers, and won the 2014 IBTTA Technology Award for a sophisticated system expansion, featuring state-of-the-art gantry design. Subsequently the Road and Transport Authority (RTA) set its sights on a cash-free, paperless future with a target of shifting 80% of all its tolling transactions online by 2018.

RTA and its contractor, TransCore, pursued this goal through a host of projects amounting to a coordinated self-service development strategy. This included an upgraded user interface, a revamped website and mobile app and use of personalization features and user experience analysis tools. Interactive voice response, mobile fingerprint log-in and smartphone integration have been introduced, along with a PIN-free 'Recharge by Mobile and Plate' facility and an enhanced dashboard with near-real-time account and violation data. The list goes on – and the net outcome is friendly and usable online tolling with minimal clicks.

"As the world of ITS evolves, the RTA continues to lead in encouraging partners to provide innovative improvements to already successful solutions," enthuses TransCore's MENA-region managing director Karim Rizkallah. "TransCore is proud to be involved in Dubai's dynamic approach and forward thinking."

The project targets have already been exceeded, with over 90% of Salik tolling now transacted online and call center demand down 30%. Most importantly, the system's Happiness Rating has shot up since the Smart Salik launch – from 72.2% to 93.2%, to be exact.

> The RTA continues to lead in encouraging their partners to provide innovative improvements to already successful solutions
>
> **Karim Rizkallah, managing director, MENA region, TransCore**

Georgia on my mind

This year's IBTTA Annual Meeting venue is Atlanta, Georgia

Founded in 1837 at the intersection of two railroad lines, Atlanta, Georgia, has grown into a populous multimodal transportation hub for the southeastern USA, with Hartsfield-Jackson International becoming the world's busiest airport. Originally named Terminus, Atlanta rose phoenix-like from its ashes after being razed to the ground during the Civil War. It was the birthplace of Martin Luther King Jr and hosted the 1996 Summer Olympics.

In recent years the city's vibrant economy has drawn a rapid influx of people and the population of the Atlanta Metropolitan Area is fast approaching 5.8 million.

Such growth creates transportation challenges – especially given the millions of visitors choosing the city as a destination each year – and tolling has been fully embraced as a means to provide reliable road network mobility.

The State of Georgia opened its first reversible managed lanes in 2017 and more than 60 center-line miles of tolled Express Lanes will follow over the next 18 months. They will run alongside existing interstates in Atlanta's most congested corridors, offering drivers the option of paying a toll to bypass congestion during peak times, with dynamically priced, all-electronic tolling maintaining free-flowing travel.

Atlanta's civic resilience was put dramatically to the test in March 2017 when a fire caused a 100ft (30m) section of bridge to collapse on I-85 – a major arterial route carrying 243,000 vehicles per day. Around 6,500 tons of debris were removed and 13 columns and 61 beams were replaced, while 253 tons of steel, 56,786ft^3 (1,608m^3) of concrete and 54,000 hours of manpower were required to repair the damage in just six weeks. Grown great out of the ruins of the Civil War, this is a modern city that shows its true mettle in a crisis, taking reconstruction in its stride.

6

The number of weeks it took to repair a 100ft (30m) section of bridge that collapsed on I-85 in Atlanta, Georgia, after a fire

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Predicting crashes

What if a map could give a detailed history of crashes and help to predict the future? **Michael Donlevy** finds out more about Connecticut's new database that does just that – and how it can be used to plan better roads

Road safety is a massive issue on congested 21st century roads, especially for traffic managers and road planners who are charged with reducing the number of accidents, injuries and fatalities. That's where the US state of Connecticut can help.

One university, the University of Connecticut (UConn), has spent six years developing the Connecticut Crash Data Repository, an interactive public database that has logged millions of motor vehicle collisions in an attempt to improve safety on the state's highways.

"These data visualization tools are becoming a national trend," says Eric Jackson, director of the Connecticut Transportation Safety Research Center (CTSRC), which built the database with funding from the Connecticut Department of Transport (ConnDOT) and now updates it daily.

The resulting website is interactive, accessible to the public and allows real-time analysis of data to identify trouble spots and trends. The homepage even includes a ticker comparing Connecticut traffic fatalities this year to other years.

"Members of the public can find very detailed information about crashes with very little effort," says

Above left: **A satellite view on UConn's accident database**

Above right: **A more traditional police sketch of an incident**

Jackson. "That's what we were going for: a user-friendly Google-esque application, where you don't need to be a data expert to use it."

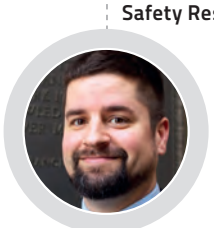
Once logged in, users can search for crash trends across the state or specific black spots in particular towns or streets. In the latter instance, the database reveals how many crashes have occurred, what kind of collisions they were, and what, if any, injuries were reported. Users can also find out if the driver was wearing a seatbelt, their sex and age, and whether the motorist was charged with being under the influence of alcohol or drugs. The site even includes an investigator's drawings of the crash scene – a legal requirement even before the database was commissioned – and a Google Street View of the location.

22 years of data

"There are more than two million crashes logged on the database, going back to 1995," says Jackson. "We log any crash that causes US$1,000-worth of damage or an injury or fatality. The database has several uses, particularly for traffic planners to identify crash hot spots and areas of concern. It can also be used to analyze behavior, in terms of the number of drivers under the influence (DUI), drivers not wearing seatbelts, and so on. And the public can access it and use it however they want, whether that's to avoid accident hot spots or to be more vigilant. A ticker on the site helps to keep the topic trending, and fresh in people's minds."

The site is proving popular, too – and not just with local users. Officials in New York, Massachusetts, Vermont and South Carolina have all contacted UConn's transportation safety engineers in recent months to find out more about the database in the hope of replicating the system.

> The database has several uses, particularly for traffic planners to identify crash hot spots and areas of concern
>
> **Eric Jackson, director, Connecticut Transportation Safety Research Center**



Getting it off the ground

Engineers and IT staff from the CTSRC at UConn's main campus in Storrs began building the repository in 2011 in collaboration with the Connecticut Department of Transportation's Highway Safety Office and the Connecticut Traffic Records Coordinating Committee. There were several challenges…

"We started by hosting a meeting in 2010 because the authorities needed a database for the public and we said, 'We can build that for you'," recalls Jackson. "There was a beta version of the database up and running within eight months."

It then took UConn staff over a year to input details from thousands of crash reports to create the database. "We were dealing with an antiquated system – mailing CDs to each other. The file format was built using ASCII, so we were parsing information into the database. It was like going from a mainframe to a modern IT system. The biggest problem was time. It took a *lot* of man-hours to input the reports because they were all written out on paper."

Data collection improved dramatically in 2015 with the implementation of a new state system that allows police departments to file digital versions of their crash reports. "The law enforcement agencies finally went fully electronic, but they were the hardest to persuade," says Jackson. "They were used to filling out a two-page paper form, and had to be convinced to fill out an eight- or nine-page report online. They thought we were trying to quadruple their workload, but eventually they realized it was faster."

Now the database is up and running, it is easy to maintain – UConn employs one full-time staff member to manage the site and input data, along with a team of up to 10 students to check for accuracy and data quality.

Crunching the numbers

The last couple of years have seen a rise in road fatalities across the USA. Connecticut was no different. There was little doubt that, looking at the headline figures, something had to

US$1,000

A road accident must cause property damage above this amount, or involve an injury or fatality, in order for it to be recorded in the UConn database

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be done to improve road safety, and the database happened to come along at just the right time.

"Up until 2015 there had been a steady decline in fatal crashes, but in the past couple of years there has been a dramatic increase. We can use the database to try to figure out why," says Jackson. "It may, at least in part, be down to the fact that vehicle miles traveled have increased sharply as the country comes out of recession. It could also be that, thanks to the growing use of smartphones, drivers are more distracted. That could well be the case with pedestrians as well – stepping off the pavement without looking, while on their phones. This is something that was added to the crash report forms in 2015."

Meeting federal guidelines

Ultimately, the UConn team hopes to improve the database and data integration to the point where Connecticut becomes the first state to meet all of the guidelines currently recommended by the federal government. To that end, Jackson and his team are working with Connecticut's judicial branch and departments of public health, motor vehicles and transportation to obtain more transportation safety information for the database. That data includes toxicology reports, injury and treatment information from hospitals, and citation and adjudication information, as well as records involving driver and vehicle history.

"Hopefully, we'll be able to merge that data with our own, so that when a crash occurs, we can find out how many prior DUIs a person had, how many speeding tickets they've had, what injuries they suffered, how long they were in the hospital, how much it cost to treat those injuries, and so on," says Jackson. "We can then analyze that data to see whether current drunk driving or speeding laws are adequate."

Again, though, there are challenges. "Working with the government has been difficult," says Jackson. "The Department of Motor Vehicles wasn't exactly gung ho about the database and has prioritized other initiatives, so

137

Road deaths in Connecticut this year to July 4, 2017

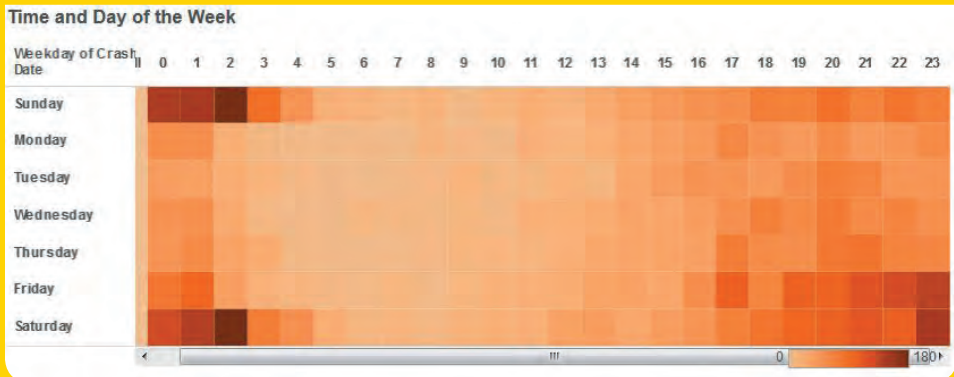
Peaks and troughs

The UConn crash database can be used to analyze the peak times for various collisions to help both the police and road safety campaigners

The UConn database has a wide range of data filters available. The chart below shows crashes involving drivers under the influence of alcohol or drugs by day and time. The darker the color, the more crashes took place.

One recent search revealed that in 2016, fatal pedestrian crashes in Connecticut occurred most often on Thursdays between 5:00pm and 7:00pm. Car/pedestrian crashes occurred most often during daylight hours on Wednesdays. Another query found there were five fatal motorcycle crashes in one week in June 2017.

"Some of the findings are exactly what you'd expect: accidents involving DUIs are most common over the weekend, from Friday night onward, while most crashes involving pedestrians happen at peak travel times," says project leader Eric Jackson. "But the evidence can be used by law enforcement agencies to help prevent these crashes – by patrolling the streets looking for drunk drivers and being visible during peak times. And it's an important marketing tool, if you can call it marketing. We display the number of fatalities in Connecticut on variable message signs. This year, crashes killed 137 people up to July 4. People are dying out there."



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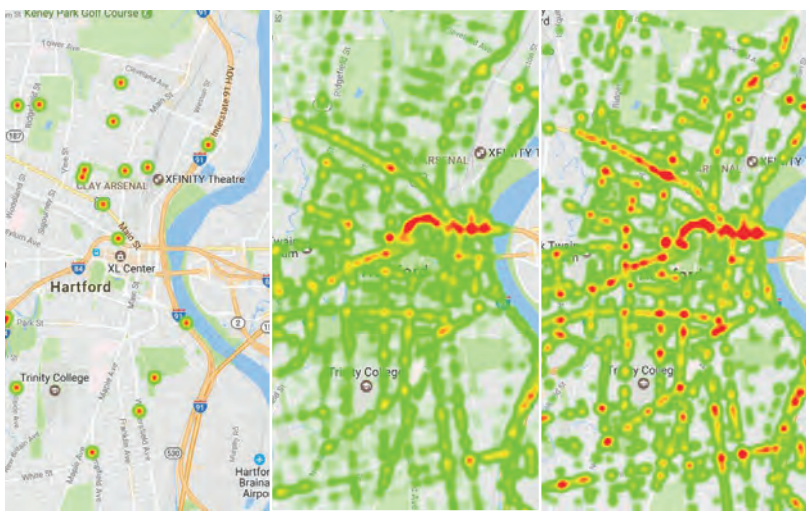
> **Eric Jackson, director, Connecticut Transportation Safety Research Center**



Below: **Locations of accidents in Hartford, Connecticut – fatal accidents are on the left; the middle has fatal and injury-causing accidents; the right-hand map shows all accidents**

24
The hours between updates of Washington DC's new crash database

Capital idea

Following the lead of the UConn project, Washington DC's mayor has announced that the US capital will start publishing crash data

Washington DC (District of Columbia) traffic crash data is to be available in an open format, updated every 24 hours. The initiative has been announced as part of DC mayor Muriel Bowser's Vision Zero initiative to eliminate all road fatalities and serious injuries by 2024.

The new project is the result of collaboration between the District Department of Transportation (DDOT), the Metropolitan Police Department (MPD), and the Office of the Chief Technology Officer (OCTO). It is part of the District Government's new open-data policy.

The open-data set will include every reported crash in the District, for all modes of transportation. In addition to the location of the crash, summary statistics of the crash are provided such as, the ward in which the crash occurred, the number of injuries, the types of vehicles involved, whether or not drink or drug impairment was involved, whether or not speeding was involved, the nearest intersecting street names, and the distance from that intersection.

The data also includes a summary of details for each crash, which provide information about each of the persons involved in the crash, such as the type of participant (driver, occupant, cyclist, or pedestrian); the age of the participant; whether or not the participant was injured (minor, major, fatal); whether or not the participant was issued a ticket; and the jurisdiction in which the vehicle was registered.

"Evaluation of safety data is critical in improving the District's street design, education and enforcement efforts," says Bowser. "With this near-real-time publication of open data, scientists, coders, and civic hackers in the District and worldwide can aid the District in safety analysis and get us closer to Vision Zero."

DDOT director Leif Dormsjo notes, "By using traffic data transparency we are advancing the District's Vision Zero goals, and most importantly, protecting the traffic safety of residents and visitors. This new data will help the work toward Vision Zero, by providing access to the most informed traffic safety analyses available."

> "Evaluation of safety data is critical in improving the District's street design, education and enforcement efforts"
>
> **Muriel Bowser, mayor, District of Columbia, USA**

we're trying to change the culture. For example, a driver's first DUI is wiped off their record, which doesn't help. Will they repeat offend? It's a major worry."

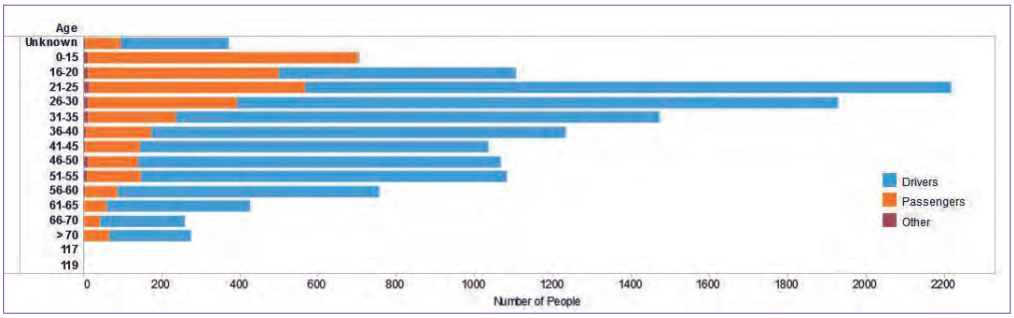
Talking of laws, privacy is another potential issue with any repository that uses real data, but Jackson says the information is coded in such a way that no personal identifying information about drivers and injuries is available through the database. "We don't hold personal data here at UConn," says Jackson. "That's how both we and the public are protected from any potential breaches of privacy."

Habits of a lifetime

Data is only valuable if it's used as a tool for change, and this is another of UConn's aims. The CTSRC is currently working with the Connecticut Department of Motor Vehicles on a pilot project involving the transfer of data from the state's graduated driver license program for teens and first-time drivers. The aim is to change bad driving styles before they become habits, so that future generations will be safer drivers from the moment they get behind the wheel of their first car.

"We run several programs over the summer in which high school students come in and look at the data," says Jackson. "It really hits home because this isn't just the government talking at them – these are real numbers. And the number of teenage drivers involved in crashes, fatal or otherwise, has fallen dramatically."

And that, of course, is the point.



UConn's database shows that the 21-25 age group contains the drivers most at-risk from injury on Connecticut's roads

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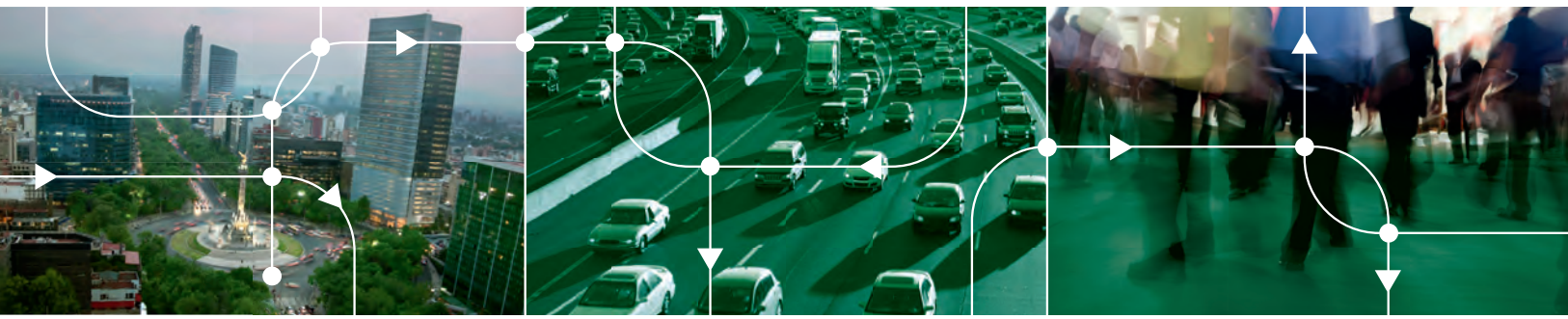

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Smarter ways to make drivers pay

Low- and zero-emissions vehicles mean some drivers pay less fuel tax or avoid it altogether, while others subsidize infrastructure investment. **David W Smith** discovers why Washington is the latest in a growing number of US states to look to road user charging as a solution

It looks increasingly inevitable that a great swathe of western US states, including Oregon, Washington and California, will replace the gas tax with a road user charge (RUC) based on the number of miles driven. Oregon has already adopted an RUC as an option for drivers and several more states are trialling, or have trialled, systems. Oregon began the introduction of gas tax when it was the first state to introduce such a charge, in 1919. Other states soon followed and the federal government belatedly got the message. In all likelihood, history will repeat itself with RUC.

Washington is the latest state to do its sums and realize that the current system of financing road infrastructure is unsustainable. The state has the second-highest fuel tax in the USA, at 49.4 cents per gallon, but it won't be enough to pay for the upkeep of highways, bridges and ferries as the increasing fuel efficiency of vehicles causes revenues to fall. In partnership with D'Artagnan Consulting, a steering committee has designed the Washington Road Usage Charge Pilot Project. A minimum of 2,000 volunteers will 'test drive' a proposed RUC system for 12 months. The new

pilot project is expected to begin in January 2018.

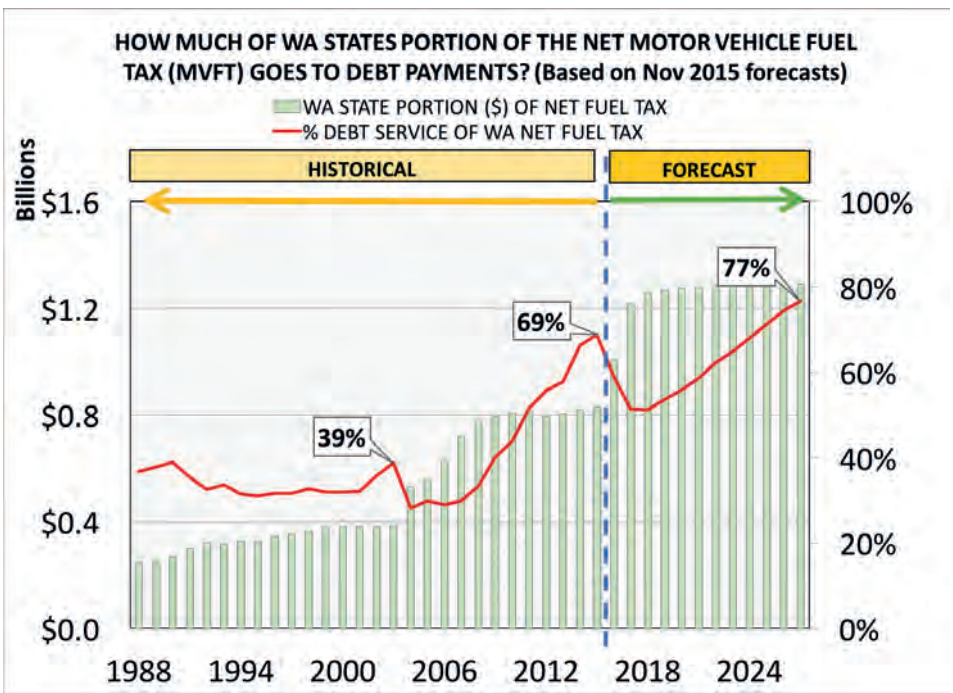
"We see a perfect storm brewing," says Reema Griffith, executive director of Washington State Transportation Commission. "Washington vehicles run at an average of 20.5mpg, but that will rise to 35mpg by 2035, reducing revenues by 45%. That's a conservative estimate and the situation could be far worse. Volvo, Ford, Toyota and others are investing billions of dollars in making the transition away from fossil fuels to using electricity, or hydrogen fuel cells. It's a huge problem for policy makers as the entire US road infrastructure is funded through a consumption-based tax."

Clearing the debt

Washington state doesn't see continually putting up the gas tax as a viable option. As well as the punishing costs for drivers of gas-guzzling older cars, it would mean the state taking on more and more debt.

"Every time our legislature raises gas tax it leverages it to get more money on the bond market. In 2015 it raised the tax by 11.9 cents, which will generate about US$16bn over 16 years after the revenues are leveraged by selling bonds, but that also means paying the bond holders back.

> The owner of an old car pays double the average fuel tax, while the owner of a Tesla pays nothing, despite using the same road infrastructure
>
> **Jack Opiola, transportation consultant**



On the current path, we calculate that by 2027, 77% of gas tax revenues will go to debt service repayments."

Opinion tolls

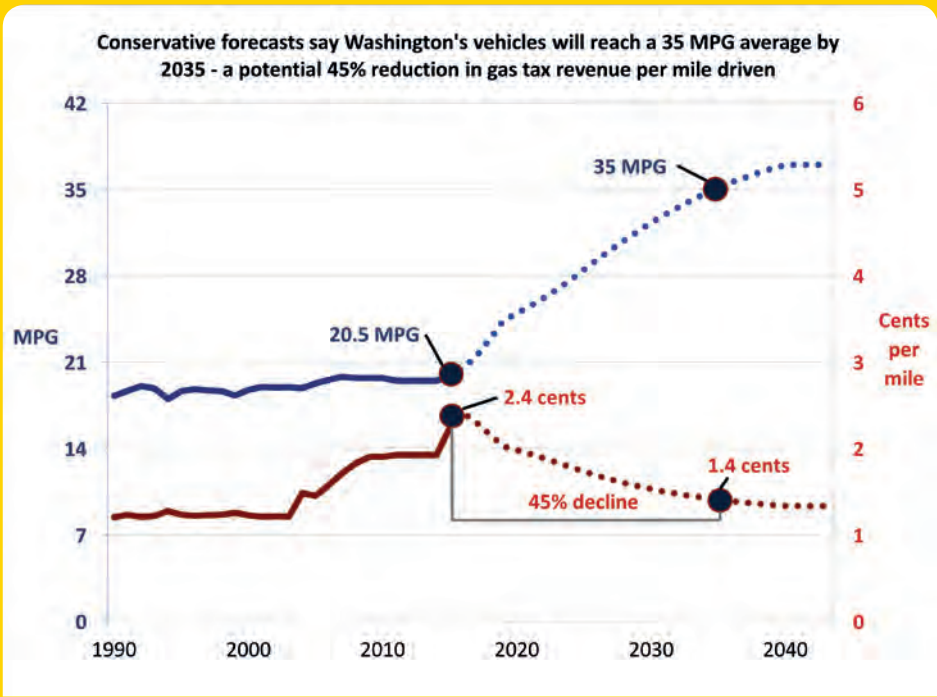
It is one thing convincing state legislators of the necessity of the RUC revolution, but it's quite another persuading the public of the legitimacy of a new form of taxation. Transportation consultant Jack Opiola says the best argument is that RUC is a more equitable method of taxation. "The gas tax creates huge inequities," he says. "Middle-to-upper-income drivers can afford the latest hybrids that offer 50mpg, whereas poorer drivers might own older cars that do 15mpg. The owner of an old car pays double the average fuel tax, while the owner of a Tesla pays nothing, despite using the same road infrastructure."

Debates are complicated by the backlash from environmental groups about 'punishing' drivers of low-

Left: **Seattle, Washington state's largest city**

Below left: **How debt servicing makes gas tax increasingly unsustainable**

77% of gas tax revenue is predicted go on debt servicing by 2027, in Washington state



emission vehicles. But Opiola says there are plenty of reasons to continue buying fuel-efficient cars. Owners of electric cars, for example, still benefit from paying vastly lower sums to power them.

To communicate the fairness message to the public, US states must correct misconceptions about the RUC. One mental hurdle to overcome is the association with more expensive tolls. "The average toll cost per mile is 18-20 cents," says Opiola. "It's no wonder the public has a limited appetite for tolling. But the RUC will be around 1.5-2 cents a mile. We have to get that message across." For Washington state to generate as much money as the gas tax does today, Griffith says it would need to set the RUC at 2.4 cents.

Winning hearts and minds

An awareness of public sensitivities encouraged Washington state to make the pilot project as democratic

Plunging revenues

When it comes to using fuel tax as a way to raise funds in the future, the figures just don't add up

The fuel efficiency bar continues to rise. The current federal CAFE standards will be 54.5mpg by 2025. Washington state has an average of 20.5mpg today and believes its vehicles will reach a 35mpg average by 2035, a potential 45% reduction in gas tax revenue per mile driven.

Auto manufacturers are setting the pace. Toyota has set itself a challenge of reducing its CO_2 emissions by 90% by 2050. Ford is investing US$4.5bn to transition to hydrogen fuel cells and other alternative fuels over the next 15+ years. Meanwhile, Tesla has released the electric Model 3 and over 400,000 people have already placed a US$1,000 deposit to own one. And most recently, Volvo announced it will offer only electric and hybrid cars, starting in 2019.

The US Federal Energy Information Administration conservatively predicts that all new cars will average 48mpg by 2040 and all cars – both new and old – will average 37mpg. Many think this forecast is very conservative and in fact such figures will be achieved much sooner than that.

California dreams

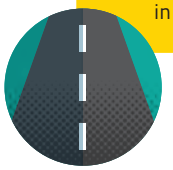
A road charging pilot in California met with widespread acceptance

In 2014 the California legislature called for a pilot to study road charging as an alternative to gas tax. The nine-month pilot began in July 2016, with more than 5,000 participating vehicles statewide (4,471 were private vehicles).

The volunteer participants in the pilot were given a choice of methods of payment and 60% of them selected a plug-in device to monitor their mileage. A smartphone (18%), odometer readings (14%) and a mileage permit (4%) were the next most popular methods. Of the 5,000 volunteers, 86% were satisfied with their mileage reporting method and 73% thought an RUC was actually fairer than a gas tax.

The California State Transportation Agency (CalSTA) will report its findings imminently and the California Transportation Commission (CTC) will make recommendations to the legislature in December 2017.

as possible by offering several ways to pay. "We observed the Oregon RUC pilot closely and one conclusion was that consumers won't accept the government telling them they have to pay in a certain way. If you tell people they have to use GPS, there'll be a revolt," says Griffith. "Not everyone is ready for high-tech solutions, so we are trialling two non-technical approaches and two other high-tech ones."



73% of drivers in the Californian RUC trial thought it was fairer than the gas tax

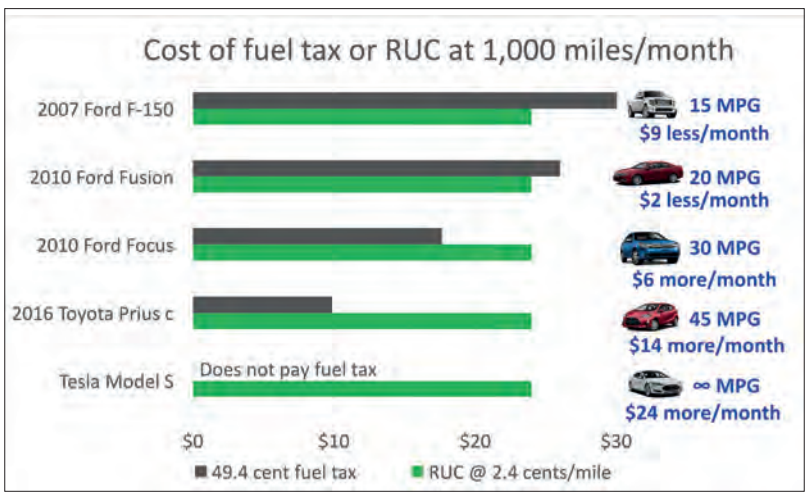
The first approach involves drivers purchasing permits for fixed numbers of miles. This method will require periodic verification of the vehicle's odometer, which could be done at a licensing office, or by using a smartphone to take a picture of the odometer on a vehicle's dashboard and the car's VIN. Griffith says a car's unique dashboard 'fingerprints' mean the system would have 95% accuracy. "If I tried to cheat by sending in a picture of my mother's Volvo odometer because she doesn't drive much, the software would show a red flag given that I actually drive a Mercedes," she says.

A second non-technical method involves paying for miles already driven. Bills could be settled monthly, quarterly or annually when car registration takes place. Again, smartphones could be used to send readings. In states where the gas tax continues to exist for a period in conjunction with the RUC, drivers would receive credits for tax paid on purchased fuel, which is estimated based on the make, miles per gallon and age of their car. A driver who has paid the gas tax could end up paying a little extra for the RUC, or receiving a refund, depending on their MPG.

Getting technical

The two more technical options use GPS technology. One method plugs a device into the onboard diagnostics port to capture miles driven. The second GPS option uses smartphones to capture the data and, although there is no viable software yet on the market, students at the University of Washington have developed some test apps. "The advantage of GPS is that if you're driving in another state, the system captures that and you won't be charged for those miles, whereas if you use the non-technical means it will add up all your miles even if some were driven out of state," says Griffith. "Ultimately we need a national mandate from Congress to avoid a patchwork situation across the USA. This would help states more seamlessly deal with interstate travel."

In the meantime, Washington state has made an agreement with Oregon



Right: **Estimated RUC payments compared with fuel tax for different models of car, in the Washington pilot**

to test the interoperability of their RUC systems. A further cross-border test will be carried out with British Columbia, which is also considering the RUC route. "There's a lot of border crossing from Canada. The big question here is how to reconcile two RUC systems in different countries," says Griffith.

In anticipation of RUC, the state of Washington has begun outreach programs to inform the public about how it works. But it's tricky to convince people that the state government will introduce one tax in order to take another away. For this reason, Griffith expects there to be a transitional period when customers can choose between paying the gas tax and the RUC.

"It's also impractical to take seven million cars over to the RUC in one day," she says. "Unplugging the whole system could be disastrous if something went wrong. Initially we might say that all cars that run at over 40mpg, including electrics and hybrids, could pay the RUC. Then later other cars would move over. I don't expect full implementation for at least another decade as it will take that long to evolve policy and bring the public along."

History repeating itself

There are strong parallels between the emergence of the RUC and the birth of the gas tax. Oregon introduced the first US fuel tax in 1919, followed by other states such as Illinois and Pennsylvania. Only after 38 states had adopted a fuel tax did the federal government introduce its own fuel tax on top of the state ones. Once again, Oregon has led the way by launching OReGO, the first US pay-by-the-mile RUC program, in 2015. It is now in a voluntary transitional phase ahead of full implementation. With RUC systems already being trialled in Washington, California and Hawaii, other states are likely to follow in short order. Opiola believes there is interest in New Mexico, Oklahoma, Indiana, Illinois, New Hampshire, Massachusetts and North Carolina.

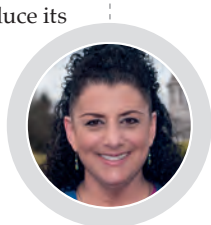
This time around he expects the federal government to step in much sooner than it did with the fuel tax. It is already providing grants for states to trial RUC systems. The Federal Highway Administration (FHWA) awarded Washington a US$3,847m federal grant to prepare for its tests. "It won't take 38 states to change federal minds," says Opiola.

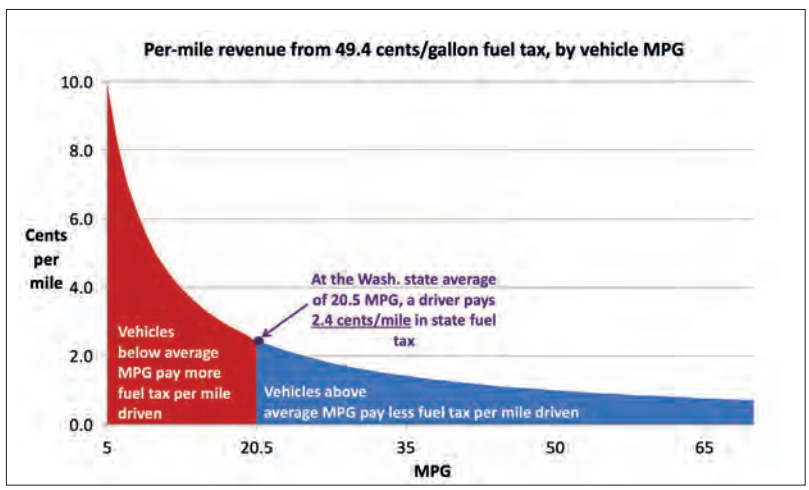
"National budgets are hurting as well because the federal tax of 18.4 cents a gallon is not enough, and so we will need the mechanism of a national, distance-based charge.

"I see Congress stepping in once 10 or 12 states have introduced an RUC and bringing in a federal tax to complement the state systems." ○

US$3,847m – the federal grant awarded to Washington state to prepare for RUC tests

> Initially we might say that all cars that run at over 40mpg, including electrics and hybrids, could pay the RUC, then later other cars would move over
>
> **Reema Griffith, executive director, Washington State Transportation Commission**





Above: **Washington state's extensive rural road network requires significant maintenance funding**

Right: **The current uneven distribution of tax burden to the detriment of those with high MPG cars**

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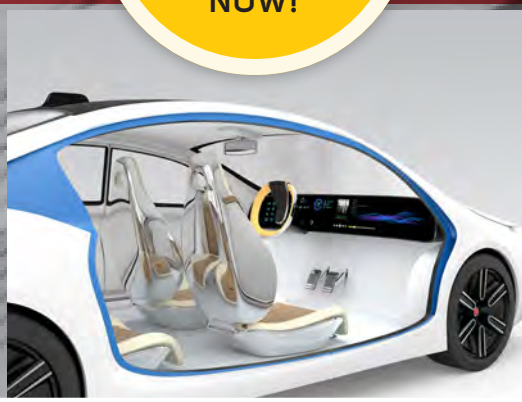

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Increased security

New UK guidelines for connected vehicle developers have been introduced to provide better protection from hackers

Next-generation connected vehicles will have more protection from the threats posed by hackers, following new, tougher guidelines for manufacturers and suppliers, issued by the UK government.

Increasingly common on our roads, smart vehicles allow drivers to access maps, traffic information, and digital radio services from the driving seat, but could be targeted to access personal data, steal keyless-entry cars, or even take control of the vehicle for malicious reasons.

The new guidelines include eight principles that set out how the automotive industry can ensure cybersecurity is adequately considered at every level of the vehicle's development.

UK transport minister Lord Callanan says, "It is essential all parties involved in the manufacturing and supply chain are provided with a consistent set of guidelines that support this global industry. Our key principles give advice on what organizations should do, from the board level down, as well as technical design and development considerations."

For more on this story visit trafficTechnologyToday.com/cyber

68: Rewiring transportation
The father of Mobility as a Service, Sampo Hietanen, explains why he has put so much effort into changing how the masses travel

74: Antenna characteristics
The most important criteria to consider when choosing an appropriate vehicle-to-vehicle antenna

Rewiring transportation

Eighteen months after becoming CEO of MaaS Finland Sampo Hietanen, the 'father of Mobility as a Service' (MaaS), tells **Rachelle Harry** about his latest plans to change in the way that the world thinks about transportation

A lot can happen in 18 months. MaaS Finland has become MaaS Global and the concept of Mobility as a Service has become a reality. With a new app, Whim, up and running, MaaS operating in parts of Europe, and plans to launch services on other continents, MaaS is on track to becoming a truly global service.

One would expect it to have been a challenge to persuade various transportation operators to provide their services as part of a MaaS package, but Sampo Hietanen, Maas Global's CEO – speaking of his company's experiences – says this wasn't the case.

Illustration: Sean Rodwell

€14.2m
The amount MaaS Global raised in its first round of funding, which was completed in August 2017 (US$16.7m)

> People's expectations for MaaS are quite high – as they should be – and we have to meet those expectations
>
> **Sampo Hietanen, CEO, Maas Global**

"Of course there were doubts and misconceptions, but overall, transportation providers have been much more positive towards us than we expected," he says. "In the Helsinki region, taxis were the first to join us. HSL, the region's transportation operator, which is similar to the UK's Transport for London (TfL), was also happy to join us. Even though it was in the middle of a huge system change, HSL still opened its ticketing information to us, as well as giving us access to its city bikes service. It was a nice surprise, and we had similar experiences when we started trials in the UK.

"MaaS is live in Finland [in Helsinki] and the UK [in the West Midlands] at the moment," says Hietanen. "Next is Amsterdam in the Netherlands. Toronto, Canada, is also on the list."

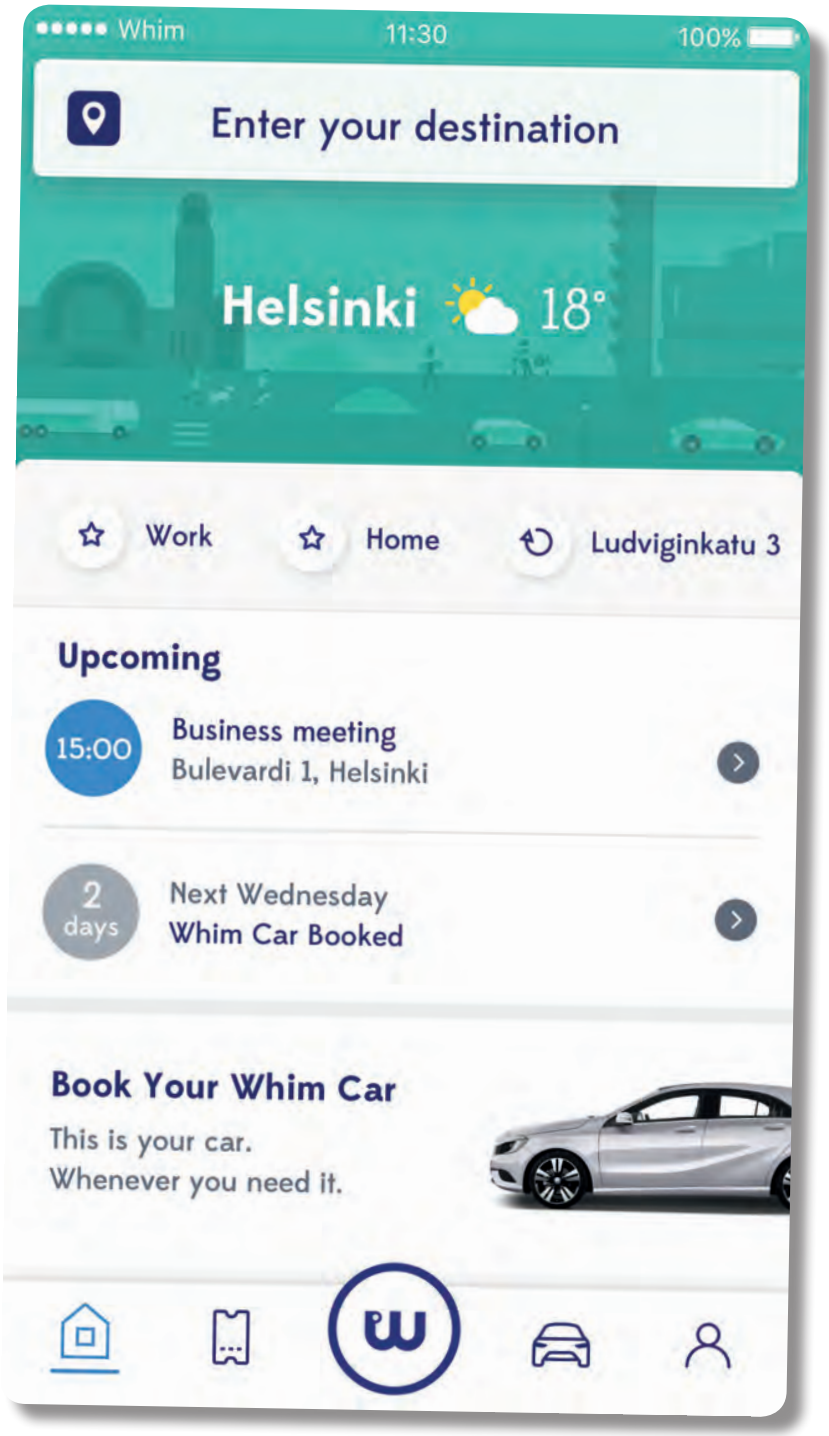
Teething problems

A key challenge for Hietanen was implementing MaaS as a benefit that is equal to, or better than, that of a private car. As a starting point, MaaS Global launched its Whim app in Finland last year (with a pilot in June 2016 followed by official operation in October 2016) to provide users with a convenient means of accessing public transportation services, taxis and rented cars, in and between major Finnish cities.

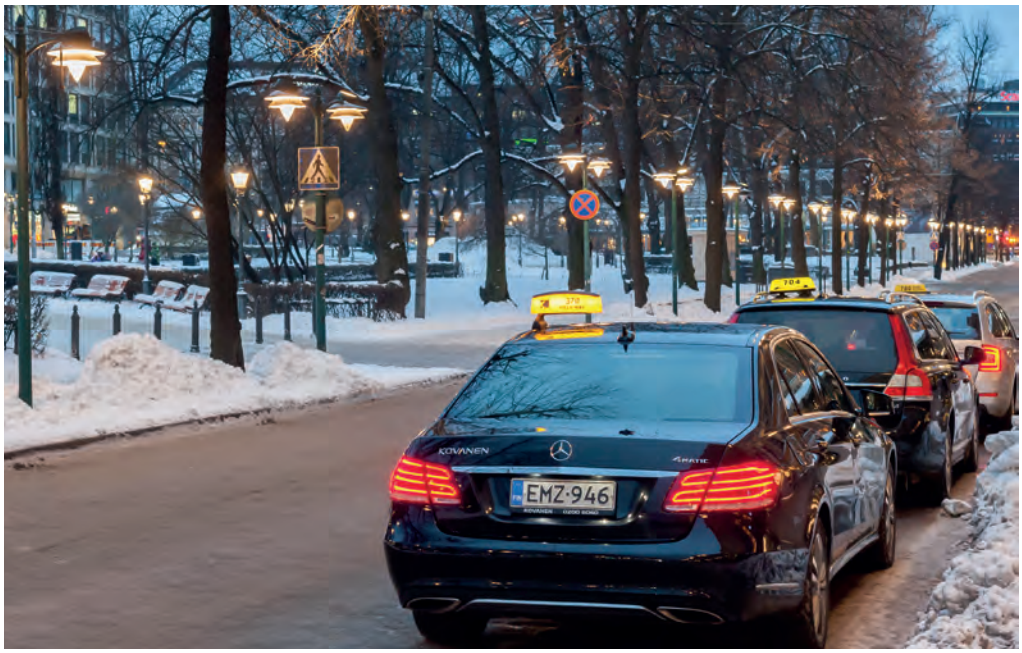
"We always like to test things thoroughly before we start moving ahead," says Hietanen. "When you go from a pilot phase to implementation, you need to have secure funding in place for things like customer care, to ensure that customers do not end up disappointed.

"That's why, as of August this year, we're live [with the Whim app] in the UK, but for now, only in the testing stages," he says.

Hietanen maintains, however, that despite the app being essential for



Right: **MaaS Global's Whim app offers MaaS in Finland and the UK, with more countries to follow**



MaaS to operate efficiently, the focus should be on the quality of the service, rather than that of the app.

"In the early stages, getting some things right took longer than expected," says Hietanen. He points out that in many aspects, first impressions are vital – and this includes people's first experience using MaaS. "Here's an example," he says, speaking of the Finnish pilot phase last year. "A father gave up his car in central Helsinki. On the first Sunday, he tried to get a taxi using MaaS and the waiting time was unacceptable – around 15-20 minutes. This resulted in him missing an appointment. On the second Sunday, the taxi didn't arrive at all. At that time, it turns out that we didn't have a large enough taxi supply – and we realized that that kind of service is just unacceptable. It was a learning curve for us. Understandably, people's expectations for MaaS are quite high – as they should be – and we have to meet those expectations."

Other logistics include coming to an agreement with transportation operators to agree on suitable pricing for MaaS. Customers can pay for MaaS by purchasing Whim points – a first-of-its-kind travel currency that enables them to pay for different transport services through the app. Customers buy Whim points with pay-as-you-go pricing, or via a monthly subscription, which is cheaper than running a private car – taking gas, insurance, tax and maintenance into consideration. One Whim point equates to €1 (US$1.20).

> We need all of the available transportation services involved to really astound people
>
> **Sampo Hietanen, CEO, MaaS Global**

A 'Whim basic' subscription costs €89 (US$105) per month for taxis and car rentals up to €39 (US$46) and unlimited public transportation in Helsinki; and a 'Whim Go' subscription costs €149 (US$176) for taxis and car rentals up to €124 (US$146) and unlimited public transportation. Customers can also inquire about the cost of a 'Whim business' subscription, depending on their needs, and all users can also pay for extra services such as fees for using MaaS in wider regions, and flexible leasing.

Above: **Taxis in Helsinki were the first transportation service to join the Whim app**

Successful future

A recently completed funding round brought in €14.2m (US$17m) from investors including Toyota Financial Services, Swiftcom, Denso, Aioi Nissay Dowa, Transdev, Veho and Karsan. Hietanen says that MaaS Global will strive to implement MaaS as a top-quality service to the public and insists that its main focus is not to rake in profits, but to successfully disrupt the way that we travel – hopefully forcing people to question if they really need their private cars, and even, give up their cars altogether, as he himself has done.

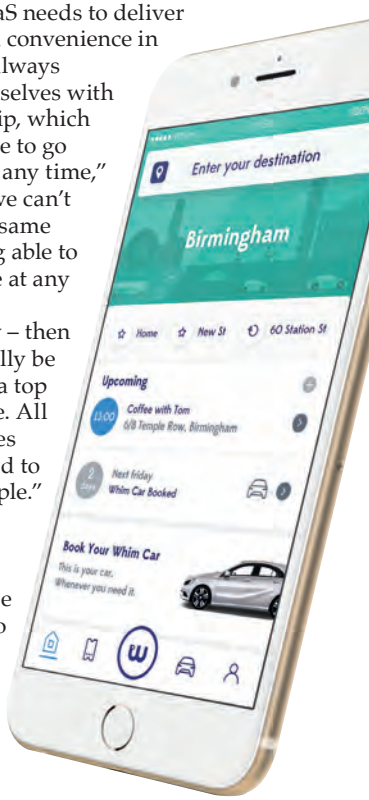
As well as improving MaaS technologies already in operation, Hietanen plans to use MaaS Global's funds to expand into other countries.

"There are a number of cities and big players that are extremely keen on MaaS," he says. "We're currently in talks with about 60 different areas. There is a lot of innovation happening in this field in the USA at the moment, so that's where we really want to be, as well as in Europe.

"In addition, we've received interest from areas as far as Australia – and in well-developed parts of Asia, such as Singapore, Japan and China."

With Hietanen's plans to make MaaS truly global, one thing remains constant: to be a success in any country, MaaS needs to deliver freedom and convenience in travel. "We always compare ourselves with car ownership, which allows people to go anywhere at any time," he says. "If we can't promise the same thing – being able to go anywhere at any time, and conveniently – then we won't really be able to offer a top MaaS service. All of the services involved need to astound people."

A lot can happen in a year-and-a-half. It will be interesting to see what the next phase in the 'MaaS takeover' will be…



Antenna characteristics for vehicle-to-vehicle communications

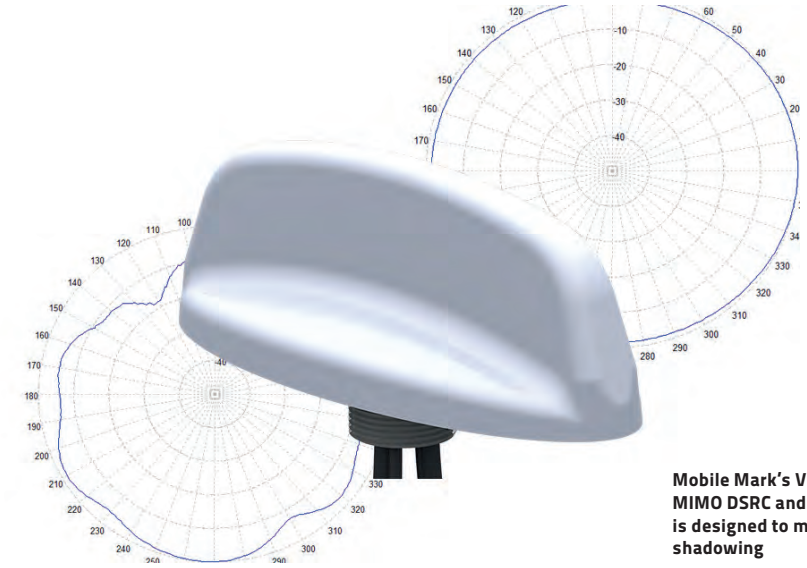
Reliable vehicle-to-vehicle (V2V) communications is critical to an effective intelligent transportation system, and selecting reliable antennas is key. When choosing an antenna, gain, beamwidth and efficiency are important, as is the potential for 'shadowing', which arises when multiple antenna elements are combined in the same antenna housing.

Wireless systems involved in vehicle telematics have become increasingly complex. A simple DSRC network at 5.9 GHz may be used in conjunction with cellular, wi-fi, GPS or GLONASS. Some trials may require multiple streams for MIMO (multiple-input, multiple-output) coverage.

As the number of systems increases, there is a growing desire to combine some of these antennas into a consolidated package. Effective design work can ensure optimum performance for each antenna element and minimize interaction among the elements. The only way to truly gauge the shadowing effects is to carefully study the antenna's azimuth pattern, which should show a near-round pattern without any nulls greater than 3dB.

Nothing gained

Higher gain antennas can transmit signals over longer distances, but V2V communications will take place close together, with the most critical communications within 100m. Lower-gain antennas have a broader hemispherical coverage than higher-gain antennas, which exhibit wider but flatter coverage. For communications in hilly terrain or among vehicles of very different heights, such as between a bus and a sports car, the hemispherical coverage will be more effective.



Mobile Mark's V2V antenna for MIMO DSRC and GPS/Glonass is designed to minimize DSRC shadowing

Need to know

Criteria to consider when evaluating V2V antennas

- Antennas producing nulls greater than 3dB indicate possible shadowing
- Higher gain antennas have wider, but flatter coverage. Lower gain creates broader hemispherical coverage – better for communicating between objects at different heights
- Obstacles on the vehicle such as roof racks, car trims, or other antennas, may cause shadowing or pattern interference

Shadowing can be created by the environment in which the antenna is mounted or by the antenna itself. For example, antennas mounted on the trunk of a vehicle will find their forward-facing signals blocked by the car itself, but the metal around the installation setting will also skew their radiation pattern. Many DSRC antennas are therefore best positioned on the roof of the vehicle, where there is better line-of-sight for the radio frequency (RF) signal.

Importance of design

Shadowing can also be caused by antenna design. Positioning of elements within the antenna can create undesirable trade-offs. Some may block or redirect the signal of a neighboring element, creating an uneven radiation pattern.

Shadowing can be detected by looking at the radiation pattern. Testing the antenna on a standard ground plane, measured in free space, will enable evaluation, independent of any impact from the vehicle setting. Nulls in the omnidirectional radiation pattern indicate that shadowing is occurring within the antenna itself. Non-circular patterns with nulls greater than 3dB will reduce V2V dependability.

Shadowing can occur when antenna elements are positioned on different physical planes within the antenna and can be eliminated by redesigning the board positions. Critical elements essential for collision avoidance and other safety-oriented communications, in this case the DSRC elements, should be located where they are not shadowed by other antenna elements. When ideally designed and positioned, the radiation pattern of these elements should be balanced and even in the horizontal plane. Any nulls in the radiation pattern should not exceed 3dB variation.

Antenna gain and VSWR (Voltage Standing Wave Ratio) performance are important measures for evaluating antennas. Checking for the impact of shadowing on the radiation pattern is crucial when selecting an antenna.

Big data for multimodal traffic analysis in the cloud

Faster, greener, safer and cheaper transportation options are objectives of smart communities as they brace for major population growth. Over 500 smart communities embrace the growing importance of information technology in economic competitiveness, and leading cities are implementing an Internet of Things (IoT) framework for adaptive systems consisting of networks of sensors consisting of networks of smart sensors that enable not just smart objects, but smarter decisions, too.

Sensor ubiquity

Sensors are everywhere in the IoT world, and sensor networks make it possible for data to be collected, analyzed, and used across infrastructure sectors for the creation of new information that will drive change in policies and solutions. In transportation this data can take many forms – from probe-based or Bluetooth travel-time data, to highway vehicle classification, to traffic movement counts of all modes traveling through signalized intersections.

Below: **Permanent video detection cameras can help collect multimodal road use information**

Right: **VantageLive! data can be accessed at any time of the day or night**

But agencies don't just want data, they want insights to help them make improvements to their networks straightaway. Smart communities become more proactive and productive in delivering the benefits of faster, greener, safer and cheaper transportation.

Performance measurements in this field is an increasingly hot topic. Questions are evolving from 'Am I improving the traffic network?' to 'Am I enabling technologies to create environments where more of our residents succeed?' These questions cannot be answered without data feeds that analyze key performance indicators (KPI). Travel time reliability data is one such KPI that the public can understand well. For traffic engineers, however, it is about more than just travel times…

Urgent need for data

There is a real need to have more data for vehicles, bicycles and pedestrians on the roadways that can help evaluate real-time improvements, as well as set priorities for proactive safety projects. Turning movement counts of trips across all modes that are moving through an intersection is one such data feed that is collected daily by temporary methods. Peak-hour calculations and simulated movements are performed with the data. Engineers can then adjust signal timings to improve traffic flow.

A more permanent counting method has been developed by Iteris with a new software-as-a-service product called VantageLive! Instead of relying on a temporary counting method such as a camera or person, Iteris has made it possible to extract the vehicle count data stored at the intersection and push it up to the cloud for 24/7/365 access. In addition to vehicle counts, bicycle and pedestrian count data can be collected from the permanent video detection cameras, providing valuable multimodal information on road use. VantageLive! provides easy access to this count data so that multiple departments at an agency can use the service, and reduce the quantity of temporary data analysis that is being completed, saving time and money for the agency.

With vulnerable road users and active transportation in mind, smart communities are adopting goals to walk and cycle more. To monitor progress of these goals, it will be critical to collect bicycle and pedestrian data. Iteris is leading the industry by providing its sensors with the ability to collect both bicycle and pedestrian count data from existing sensors deployed at signalized intersections, and sending this data to the cloud for further analysis.

Need to know

Key takeaways from the Iteris VantageLive! technology

- Stored in the cloud, the collected vehicle, bicycle and pedestrian count data can be accessed online at any time
- Multiple departments within an organization can use the service
- Smart communities adopt goals to walk and cycle more; Iteris sensor technology collects data to evaluate their progress

Standardizing terminology to move the tolling market forward

Implementation of any complex large-scale project inevitably carries with it some unexpected costs. A tolling system is no exception. Still, when you choose an automatic license plate recognition (ALPR) solution, you expect 'automatic' to mean automatic. Unfortunately, toll authorities often incur much higher operating expenses than anticipated due to the large and unpredictable number of images requiring manual review.

This is what happens when people use the same words to mean many different things.

Manual review costs can be high, in part because various ALPR camera providers use different terminology and methods for measuring the most basic functions of their systems. What is the formula for measuring accuracy? What is an 'exclusion'? What is the difference between 'read rate' and 'attach rate'? Or should it be called 'yield'? Through careful use of ambiguous and undefined industry terms, some suppliers are able to create the illusion of procurement specification conformance without committing to an objectively measurable standard.

To avoid confusion and unintended expenses, it is vitally important to understand the terminology and methodology ALPR providers use before assessing the value of each solution.

Without a shared definition of industry terms, how can toll authorities ensure compliance or compare providers? Without knowing what formulas are being used to calculate these measurements, how does a toll authority know how much to budget for the manual review process? It doesn't have to be complicated.

Perceptics uses the following definitions, whose standardization across the industry could ensure real communication and neutralize much of the subterfuge and confusion we see today:

Exclusions: All plates are considered readable unless extenuating circumstances prohibit an ALPR camera from finding a plate. A vehicle that is missing a plate, or whose plate is obstructed (covered with snow or blocked by the ball of a trailer hitch, for instance) would be excluded.

Readable license plates: This is the number of plates (not vehicles) that have not been excluded. Fewer excluded plates means more plates are considered readable. Unfortunately, a provider could exclude a large majority of plates encountered yet still claim a very high accuracy rate, thus misrepresenting their system's true performance.
Number of Readable Plates = Total Number of Vehicles – Number of Exclusions

Low-confidence reads: If a plate can't be read at or above the threshold set by the toll operator, it is considered to be a low-confidence read. It is readable, but the system isn't confident enough to register a result.

Results: The number of readable plates minus the low-confidence results.
Number of Results = Number of Total Readable Plates – Number of Low-Confidence Reads

Attach rate: The percentage of readable plates that produced a result.
Attach rate = (Number of Results/ Number of Readable Plates) × 100

Accuracy: The percentage of results that were read correctly.
Accuracy = (Number of Correct Reads/Number of Results) × 100

Read rate: The percentage of readable plates that were read correctly.
Read Rate = (Number of Correct Reads/Number of Readable Plates) × 100

i.e. read rate is the attach rate times the accuracy, or a measure of the overall efficiency of the ALPR solution.

With national interoperability a near-term goal and only 30% of vehicles in North America RFID-enabled, ALPR technology

Need to know

Points to remember when selecting a free-flow toll collection and enforcement solution

- Some ALPR manufacturers allow for a greater number of exclusions than others, meaning they are still able to claim a high accuracy percentage
- Read rate is a good overall measure of ALPR efficiency, when compared with number of exclusions
- Only 30% of vehicles in North America are RFID-enabled, making ALPR a superior toll-collection and enforcement solution

is ideally positioned to unify toll collection systems across the country. Every vehicle that travels on public roads has a unique identifier in the form of a license plate. Since these plates are distributed and managed at no cost to the toll collection market, and since the technology needed to read them is already incorporated in most systems, it makes sense for the industry to use them to improve toll collections.

But, before we can agree upon and effectively implement a common technology, we must speak a common language.

Richard Butter

As disruptive change accelerates, the challenge is to keep up

"We are getting more consumer orientated and new business models will appear"

Being on a boat on the Bosporus in Istanbul gives you a different perspective on life. I remember thinking it was one of the most beautiful settings I could imagine, as I watched the sun going down behind the beautiful mosques on the riverside and enjoyed a party with our customers. It was the social highlight of our most recent Intertraffic event in Istanbul last May. It felt like going back to basics – working hard, but also playing hard. The boat party and the wider event enabled us to connect with our customers, our customers with each other, and visitors with our customers. So many new developments are taking place – in disruptive technologies like connectivity, electrification and Mobility as a Service – that it almost felt like we were inventing our business all over again, meeting each other and finding out more about what is being achieved in the transportation sector. And this in a difficult period for Turkey and the international community. We're blessed to be working in such a progressive industry.

Being on the boat also gave me the opportunity to have a chat with this magazine's deputy editor, Rachelle Harry, who asked me to fill the gap that previous columnist Neil Hoose left behind. And I'm honored. I'm not a traffic engineer like many of the readers of this magazine, but I'm very proud to give you my view on the industry as the 'captain' of Intertraffic.

I have already explored some of the key challenges facing us in my regular blogs, published over the past year on TrafficTechnologyToday.com. These contain themes that I am certain to return to in the coming months in this column.

In my first blog I wrote about the experience of cycling through my home city of Amsterdam. Beautiful, I must say, but it makes you wonder if autonomous vehicles will ever be able to handle chaotic cycling behavior.

I've also mused recently about how the pace of development in autonomous vehicles is accelerating. What does this mean for our traffic technology industry? We are now entering an era when vehicle OEMs, IT, telecoms, big data and Tier 1 suppliers such as Delphi or Continental, all meet each other in the car. We're getting more and more consumer orientated and as a result, new business models will appear. I hope to be able to alert you to these in their formative stages in the coming months.

Another topic that is often discussed at Intertraffic events and across the industry is that of smart cities. I remember that following my visit to the ITS America conference in San Jose, California last year, I wondered if having free wi-fi on public transport was enough to qualify a city as 'smart'? And if not, what the definition of a smart city really is? It's a definition that's still up for grabs. Perhaps we'll get closer soon.

At Intertraffic, connecting today's mobility to the future of mobility is our mission. On a smaller scale that will also be the mission of this column. For most of the year I may be based in Amsterdam, but I hope to be able to give a global perspective on the changes to the way we do business and the challenges that lie ahead.

• *Richard Butter is director of traffic technology at RAI Amsterdam and is responsible for Intertraffic worldwide events,* ***www.intertraffic.com***
• *To read Richard's recent Traffic blogs, log on to* ***trafficTechnologytoday/opinion.php***

The C-ITS revolution and how the new technology is being tested

Many people assume Cooperative ITS (C-ITS) is simply the addition of communication with cars to 'traditional' ITS. However, although it brings together intelligent vehicles and infrastructure, that perception fails to grasp the shift in ways of working. C-ITS involves moving all ITS applications onto a common platform, each communicating using a standardized set of protocols.

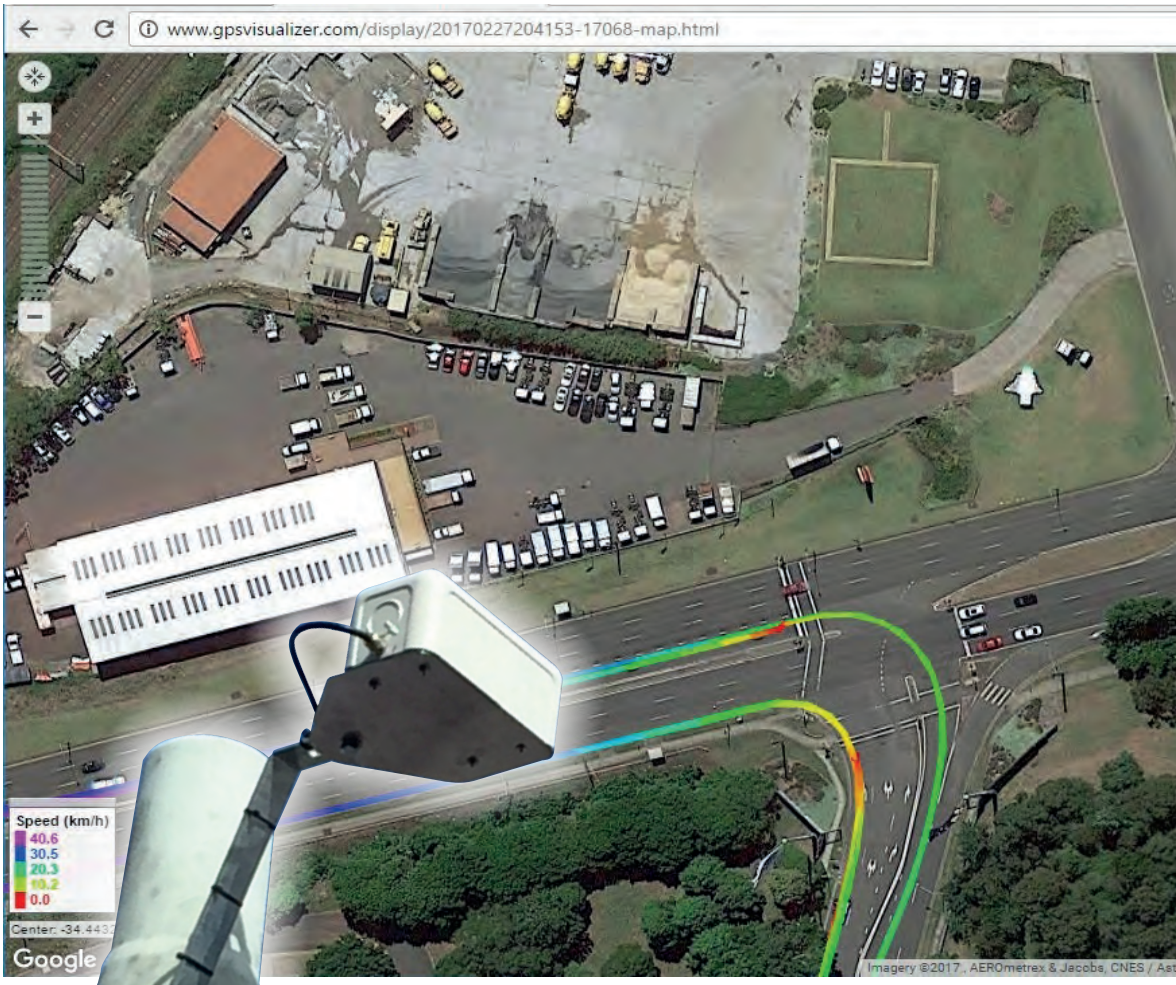
To date we have used separate systems for intersection control, parking management, traffic counting and profiling, weather and pollution monitoring, tolling/road user charging and enforcement. Each requires its own power, communication, sensors, boxes, operations, management and maintenance contracts.

Maximizing the space

Incorporating as many applications as possible onto a single platform therefore makes budgetary and operational sense, but this mitigation will take time, due to many factors. These include the relative lifespans of deployed systems; the time taken for procurers and users to realize the extent of change; and the vested interests of some product manufacturers keen to preserve market share. Nevertheless, in the coming years we will see the plethora of solutions currently marketed and deployed shrink into single, universal alternatives.

In Australia, Q-Free is engaged in a series of projects that support national and state-driven initiatives designed to prove and facilitate the deployment of next-generation traffic management to improve safety and reduce emissions.

Australia has a very active program of research and development. It has also committed considerable finances, with the iMOVE Cooperative Research Centre being the principal funding vehicle. It has been awarded A$55m (US$43.4m) in federal government funding for the next 10 years. In total over A$107m (US$84.6m) has been committed to the country's C-ITS effort by industry and government partners.



Above: **Q-Free's U-ITS solution can accurately map vehicle location, speed and heading down to the individual lane level**

Inset: **One roadside unit is able to perform multiple functions**

Q-Free's Universal ITS (U-ITS) Station is a compact, comprehensive C-ITS solution providing full hybrid, ETSI/ISO-standard communications. It is available in roadside and in-vehicle versions that use many of the same components and its conformity with internationally agreed C-ITS standards enables ready interfacing with other manufacturers' technologies.

During the 2016 ITS World Congress in Melbourne, C-ITS Station-equipped coaches traveling to and from the outdoor demonstration area passed through a series of intersections. The roadside U-ITS Stations broadcast standard messages including intersection map and traffic signal status (SPaT/MAP),

roadside awareness messages (CAM) and service announcements. A central ITS station provided open web access, enabling smartphone, tablet and PC users to follow the demonstration live.

Government backed

Following expressions of interest from several World Congress exhibitors, including major automotive companies, the systems will remain in place in Melbourne and will potentially form a part of the National Connected Multimodal Testbed. Meanwhile, the government of New South Wales has acquired its own set of Q-Free Universal ITS Stations with which to further C-ITS development work taking place in the state.

In November 2016 the country's largest C-ITS trial to date was announced, part of the Connected and Automated Vehicle Initiative (CAVI). It will take place in Ipswich, a town near the Queensland state capital, Brisbane. The trial will involve some 500 vehicles in the testing of seven Day One applications. These include: emergency brake light, stopped/slow-vehicle warning, red-light warning, road-works warning, back-of-freeway-queue warning, and in-vehicle speed warning (an application dealing with the delivery of variable message sign-type information directly into the vehicle). Another application will look at using connectivity to provide warnings of pedestrians' and cyclists' presence and intentions. Although the future ideal is that all individuals will carry some form of connected device, this is still some way off, so information from pressed crossing call buttons will be used initially.

Need to know

Key facts about Q-Free's U-ITS Station technology

- A compact C-ITS solution, it has full hybrid, ETSI/ISO-standard communication
- The technology can host Bluetooth, wi-fi and 5.6GHz-based tolling
- It is compatible with G-5/WAVE and also 3G/4G
- It is available in roadside and in-vehicle versions
- In March this year, tests proved that it could be used for applications where precise positioning is critical

Size does matter

Australia is also home to the largest C-ITS test facility currently in operation in the southern hemisphere. The Cooperative Intelligent Transport Initiative (CITI) is based in the Illawarra region, to the south of Sydney in New South Wales.

The testbed includes three C-ITS-equipped intersections that provide signal-status information, as well as a roadside station that broadcasts speed-limit information to heavy vehicles. Almost 60 trucks and 11 buses have been fitted with C-ITS systems, and drivers in participating vehicles can see information on speed limits and signal phases, and receive warnings of intersection collisions and heavy braking ahead. CITI is to be expanded to include 55 cars from the Wollongong area.

In March 2017 Q-Free Australia demonstrated the GNSS positioning capabilities of its vehicle ITS Station at the CITI test facility.

The tests involved 34 maneuvers at three intersections, with each maneuver repeated twice. The unit's latitude, longitude, speed and heading were recorded every second, then plotted on satellite images.

Conclusive results

The results proved that the Q-Free station accurately recorded the position of the test vehicle, with consistent results across repeated tests. The plotted tracks appeared at the center of the lane in which the vehicle actually traveled, proving a ±2.0m positioning accuracy and showing the Q-Free hardware's ability to be used for applications where positioning down to lane level is critical.

The company has also demonstrated its hybrid communications capabilities. The U-ITS Station is capable of hosting a wide range of protocols, including the ETSI ITS G-5 and IEEE WAVE protocol stacks. It can also host Bluetooth, wi-fi and 5.8GHz-based tolling if desired. 5G cellular is presumed by many to be the complementing technology to G-5/WAVE, but Q-Free has also already shown the ability to use 3G/4G on ISO CALM (communications access for land mobiles) standards. This has great potential given Australia's sheer size, but is also highly relevant where other deployments may be required to cover a very large area.

Although G-5/WAVE are the presumption for safety applications, and 5G the preference for non-safety applications, the delivery of ITS/C-ITS services via multiple generations of cellular has merit because it would enable quick, interoperable C-ITS deployment with greatly reduced numbers of roadside units. Given that 5G is still at the definition phase, this is a major plus, and confers a distinct advantage both to Q-Free as a technology supplier and to its potential customers and partners.

Driving into a more realistic simulation future

Japanese three-dimensional (3D) virtual reality (VR) simulation expert Forum8 is pushing the boundaries of what it is possible to achieve using its cutting-edge, interactive 3D VR driving simulation software VR-Design Studio (formerly called UC-win/Road). It can now be used for driver training, vehicle and human factors research, public consultation and more recently vehicle safety, advanced driver assistance systems (ADAS), V2V (vehicle-to-vehicle) and V2I (vehicle-to-infrastructure) communications and autonomous vehicle testing.

The use of drive simulators, especially for driver training and research, has never been so popular and, as a result, the demand for replicating the real world, replicating the feel of a real car, and the ability to interact with your VR environment in a realistic manner, is not just desirable, but in this modern technological world, fully expected.

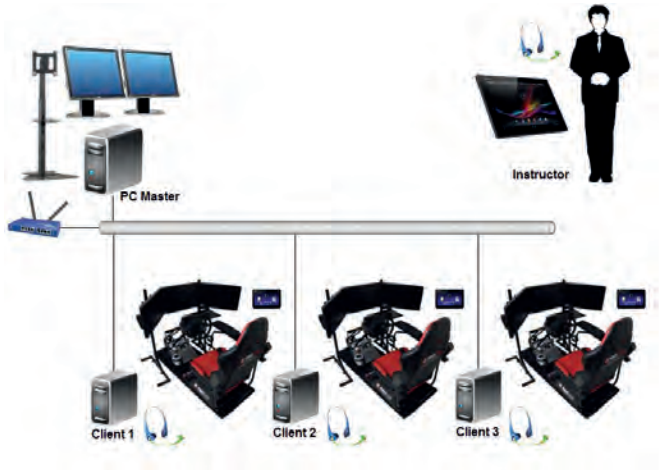
Unfortunately, lots of systems out there simply don't 'cut it' when it comes to matching these needs. All too often you will have a drive simulator with excellent 'feel', but combined with inferior software that prevents the driver from interacting with the environment or having a fully immersive experience.

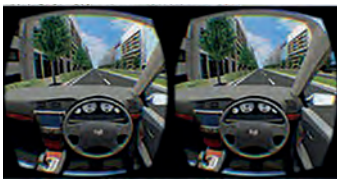
Need to know

Key takeaways of Forum8's VR-Design Studio software

- Typically, driving simulation software fails to offer the driver a fully immersive experience
- Forum8's package allows for everything from basic driver training tests to more complex multiple-user applications
- Recording the data produced from the simulations enables comparisons of driving behavior and performance

A completely immersive 3D experience helps to create useful testing conditions





Above and left: **Forum8's software allows for multiple drivers to experience the same 3D space simultaneously**

Meeting the challenges

Forum8 drive simulator packages strive to meet all three of these crucial factors and more, and combined with the company's own software, VR-Design Studio, offer the user a unique driving experience.

The software's ability to allow the driver to interact with their 3D VR environment is critical, whether it be a simple driver training test setup or a more complex driver research program where multiple drivers are linked together and all driving within the same 3D space.

Of course, having the ability to link multiple drivers using Forum8's software and cluster plug-in within the same 3D space is hugely beneficial and opens up many possibilities and applications, especially in complex research and driver training projects.

Being able to record all the data from multiple drive simulator systems and compare and contrast driving behavior, performance and style from an unlimited number of driving scenarios, monitoring how the drivers interact with one another, is a huge leap forward in driver training and road safety research.

Technological progression

Another technological advance is the ability to use the Oculus Rift head-mounted display. When it is used in a driving simulator, this helps fully immerse the driver within the 3D VR road network and surrounding environment,

giving them a full and unique 360° experience.

As part of the company's continuous software development philosophy, Forum8 has produced a plug-in that seamlessly links this relatively new VR hardware technology and its driving simulation software. This is just another example of what is possible with the very latest 3D VR simulation software.

It also emphasizes the determination of Forum8 to keep advancing the technology to make the driver's experience as realistic as possible, enabling researchers and driving instructors to gain the most accurate results possible from within the safety of the lab.

by **J J Eden**

Multimodal payment solutions must be developed soon

"The younger generation want to pay for their whole commute using just one device"

Over the past couple of months, I've written and spoken about the rapid changes occurring in transportation. I have also participated on a few panels with some very knowledgeable experts. As I listened to the presentations, I realized that we tend to focus on the impact to our segment or our micro-segment of this large and diverse industry. We tend to separate tolling, ITS, autonomous and connected vehicles, Hyperloop, in-pavement charging systems, Elon Musk's subterranean highway system, highways in the sky, and any other innovations, into their own little silo. I started to think about when the tolling industry was creating the electronic toll collection (ETC) systems in use today. At that time, except for E-ZPass, which was a large regional system, nobody was looking at the impact on interstate travel. National interoperability was not even envisioned in the early days of ETC. As I looked back, I thought, if we had involved other parts of the country, and other evolving systems in these decisions, it would have saved us from having some of the interoperability issues we are seeing today. Would compatible national electronic toll collection systems have prompted other new innovations in technology or payment systems and ultimately expanded tolling? Would there be a national mobility system of not just tolling but parking, transit – even aviation?

But what's past is done. My question today is, who is looking at the impacts of innovation and interoperability that each of the transportation segments will have on each other? How will these systems and modes be interoperable with each other – or should they be? Can the basis of systems such as RFID be coordinated? Can we design each payment system so all modes work together? I realize there is more than just technology required to do this. The business and operating rules that are much more difficult to negotiate. Every mode and every agency wants to maintain their own autonomy. There are financial considerations that need to be resolved, not just in deployment, but more importantly in long-term operations.

We all need to remember our ultimate clients are the families that use our mobility systems to get them from point A to point B. And our clients' needs and wants are changing. Particularly our younger generation want an easy-to-use mobility system. For the most part, they are willing to pay for the convenience of the systems. They want to be able to change the commute when they wake up in the morning, log into their device and find the fastest, most convenient, or least expensive route to work. But that's not all. They want to be able to pay for this commute – regardless of which agency or which mode of transportation they are using – with one device.

There are a lot of other systems that play into this, such as connected cities and vehicles, autonomous vehicles, maybe even the highways in the sky. Paying for all these systems must be easy and convenient for this demographic to use it. We've seen the development of popular payment systems such as Apple Pay and Google Wallet and are starting to see smaller systems and hubs develop. The payment side of these transportation systems further complicates their integration. But I think it's a necessary step that has to be considered in order to make the systems a reality.

J J Eden is director of tolling at Aecom
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Combining traffic management sensors with car radar technology

Road travel is now part of every day life almost everywhere around the globe. Every day, billions of miles of travel are recorded on arterials and streets. In order to manage this traffic it is not enough just to have adequate infrastructure, it is also necessary to implement innovative traffic management systems. In the future, one important aspect will be the communications of vehicular onboard sensors with the surrounding infrastructure. In such vehicle-to-infrastructure (V2I) communications scenarios, radar sensors will play an important role.

smartmicro designs, develops and manufactures sensing solutions for the traffic and automotive industries. Safer roads, an optimized flow of traffic, autonomous driving and the transformation of today's urban areas into smart cities are the key motivations for its technological developments.

Forward-looking radar

smartmicro's forward-looking, object-tracking radar delivers consistent all-weather, maintenance-free, 24/7 performance for many years. The sensor can be mounted on existing road infrastructure with very few positioning constraints. One single radar can cover both stop-bar detection and advanced lane-specific detection [up to 450m (0.3 miles)]. It saves costs in terms of hardware and installation by integrating many functions. Thanks to a wide field-of-view, it is possible to cover up to eight lanes.

For each vehicle there is a true measurement of range, Doppler and azimuth angle (some models also measure elevation angle). smartmicro's 3DHD technology is able to detect, separate and track 256 objects simultaneously in the field-of-view. 3D stands for three-dimensional, i.e. the products feature range gate specific (one dimensional), Doppler specific (two dimensional) and angular beam-by-beam (3D) detection. HD stands for high definition and means that vehicles can be separated, even if they drive at the same speed, same range and same angle.

Need to know

Key facts about smartmicro's radar systems and the benefits for traffic managers

- Its 3DHD system is able to detect and track 256 objects simultaneously
- Independent tests have shown the system to deliver detection values of 99%
- smartmicro also makes automotive radar systems and is already working to connect its technologies using V2X innovations

Unique technology

smartmicro is the only traffic radar manufacturer to offer products with 3DHD. With dense traffic, 3DHD makes the difference and keeps detection performance high. Scenarios like traffic jams, stop-and-go traffic and busy intersections show almost no decrease in performance. Recent long-term independent tests prove presence detection accuracy of 99%.

smartmicro's reliable traffic management radar technology is an enabler for smart cities, providing precise real-time data for the traffic flow on arterials and intersections. As an example, smartmicro radars were recently introduced in a project in the Netherlands for queue length estimation in an urban environment. In this special application, the sensor covers approaches with up to six lanes at a range of 450m (0.3 miles). Any vehicles in this field-of-view, whether traveling fast, slowing down or stopping, can be reliably detected. The real-time object data is fed into central software to precisely determine the length of the waiting queue. The equipped intersections become fully adaptive and the traffic flow can therefore be controlled, taking into consideration the queues at several intersections.

Another application where smartmicro technology is used is the integration of a radar sensor into a 'smart traffic light' in Denmark. Cars approaching the intersection faster than the indicated speed limit will be stopped by a red traffic light, while cars that go at the correct

Far left: **Multifunction radar units from smartmicro are quick to install**

Left: **smartmicro has 20 years experience developing radar systems for cars**

Below: **3DHD radar enables recording of multiple data sets for each vehicle**

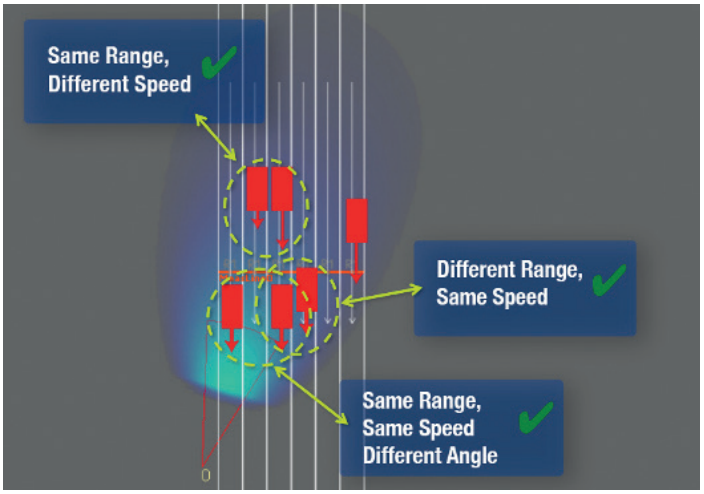
Below left: **Radar units can be used to adapt signals to vehicle speeds instantly**

speed will see the light turn green when they are approximately 55m from the stop bar. smartmicro's traffic management radar sensor, installed directly on the mast above the traffic light, detects the vehicles, measures their speed and provides the appropriate signal. Again, smartmicro's radar technology promotes traffic flow and ensures safe conditions.

Automotive inspiration

Millions of automobiles worldwide carry radar sensors designed by smartmicro. With 20 years of experience in the design and development of advanced driver assistance systems (ADAS), smartmicro offers design, development and related engineering services and complete solutions for first-tier automotive suppliers.

smartmicro invented the lane-change assist (LCA) radar; series development started in 2003 and high-volume production began in 2006 with a partner. It is now one of the leading LCA technologies worldwide. Other applications are blind spot detection (BSD), front and rear cross traffic assist (RCTA) and exit assist applications. The rear-collision warning (RCW) function was brought to production in 2010. Longer range forward-collision warning (FCW) sensors went into production in 2008.



Today 76-77GHz sensors are manufactured for FCW, adaptive cruise control and active emergency braking, among other functions. The latest automotive sensors under development are 77-81GHz high-bandwidth sensors for autonomous driving, parking assistance and other 360˚applications.

For its traffic management products, smartmicro uses technology and experience from its automotive sensors. Not only hardware, but also software and functional safety-related development processes are applied. Rigorous testing and fully automated end-of-line testing and calibration are other takeovers from automotive production. Taken together, this enables an enormous level of reliability and quality for the company's traffic products, as well as attractive prices.

Traffic sensors, however, often need a higher level of performance, larger field-of-view, longer range, other data interfaces, and accessories such as detector cards, special setup software, data collection options and more. So direct automotive-to-traffic migration isn't possible.

By using traffic management sensors, placed at an intersection to make it smart and adaptive, many new applications beyond traffic control become possible. The stationary radars relay the data of all detected objects on all roads at an intersection to the intersection controller, which in turn detects dangerous situations such as potential collisions. A V2X module attached to the controller can then transmit warning messages to approaching vehicles.

In this example, the data of the stationary infrastructure radars is fused with the data of the onboard radars.

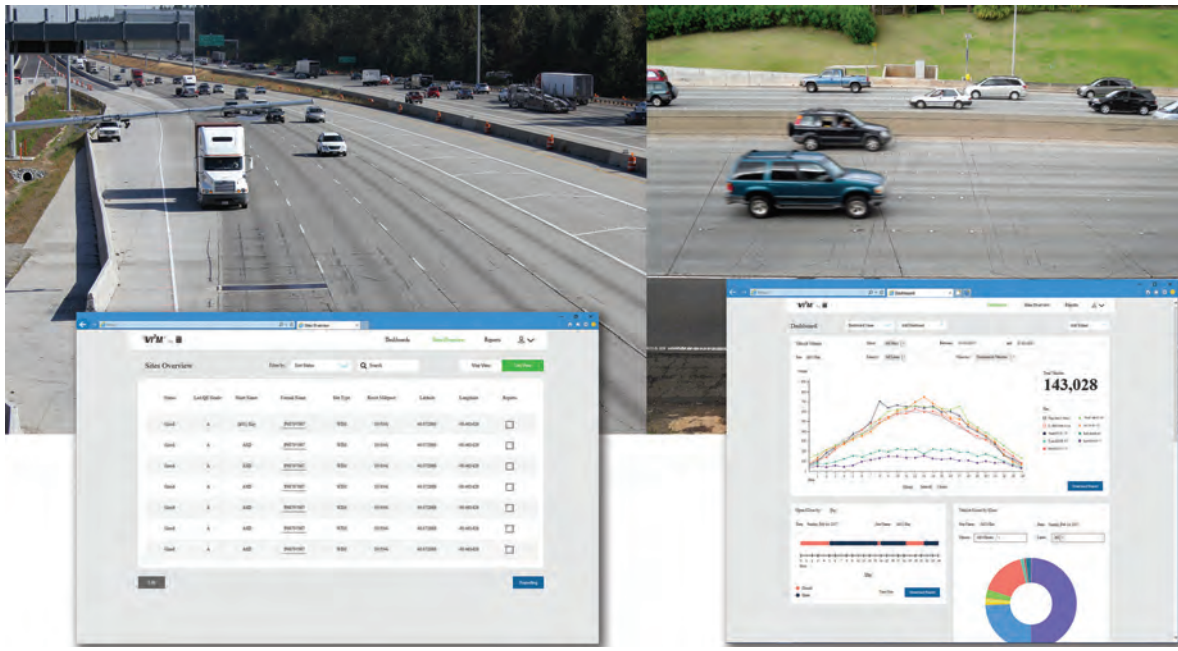
smartmicro develops leading technology in both of these worlds and is working today on increasingly challenging applications to make road travel safer in the future.

Advanced weigh-in-motion and traffic data collection software

As the world leader in weigh-in-motion (WIM) technologies, International Road Dynamics (IRD) has developed a stellar reputation in providing solutions for highway preservation, commercial vehicle enforcement and data collection applications.

To date, most data processing at commercial vehicle ports of entry and weigh station facilities occurs locally on the road, providing a closed monitoring and control loop at the roadside.

The value of the information collected at these local sites is often under-appreciated. Agencies could benefit by using the information collected not only to improve the underlying operations (e.g. truck compliance checks), but also to help solve today's challenges in freight logistics, mobility and transportation management. In order to support this need for transportation intelligence, IRD has invested in the Vehicle Information in Motion (VI²M) software suite to assist transportation professionals in unlocking the value of the information collected at commercial vehicle operations and traffic data-collection sites on their road networks.



Above **The secure portal allows the user to view only the most relevant information**

Below: **The VI²M software can assist local operations as well as reporting remotely**

Need to know

Key facts of VI²M software

- The software provides cloud-based traffic data and statistics
- A wide range of monitoring functions is accessible through the widget-based user interface
- Users are able to tailor the dashboard to their own preferences, selecting the most relevant information

Cloud-based functionality

The VI²M software suite provides traffic data and statistics in a cloud-based environment, facilitates off-line reporting, and supports the monitoring of traffic operations on a network-wide basis.

VI²M collects traffic count, volume and vehicle classification data in conjunction with commercial vehicle information from individual sites and provides access to a multitude of reporting, analysis and monitoring capabilities that are all accessible through a widget-based user interface. Widgets include a zoomable map view with dynamic site and station information, standard reporting widgets, and a site summary widget.

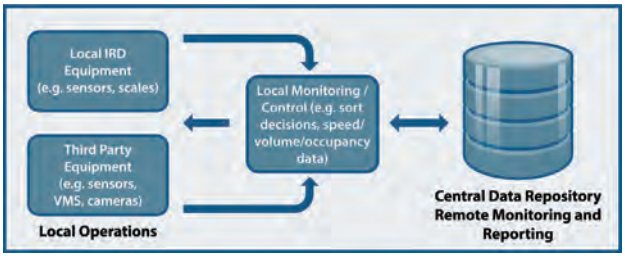
Secure AaaS application

IRD is offering the system as a cloud-hosted application-as-a-service (AaaS) through a secure portal. Every user can define their own dashboard, selecting the information most relevant to their needs.

IRD's VI²M solution provides a core platform of data services, offering actionable information, notifying of anomalies and providing trending analysis and reports tailored to an agency's needs, for planning activities, operational improvements and funding proposals.

The following widgets are part of the core VI²M software suite that is available today.

- Map view. This widget provides a zoomable map view of the agency's area of concern (e.g. statewide view) and provides information particular to that location.
- Standard reporting. This widget provides an interface to the current traffic data reports from IRD's iAnalyze software.
- Site summary. This widget provides graphs showing information for a specific site, such as the number of counted vehicles, vehicles with potential



weight issues, vehicles with valid weight, and vehicles with violations (all by class), as well as the distribution of vehicle counts by class.

• Site status. This widget monitors the status of equipment, providing operational status and up/down time at a specific site.

Answering questions

VI²M can answer questions such as: What is the percentage of screened commercial vehicles (trucks) that bypass an inspection station? How long on average does it take to process a truck? What is the distribution of vehicle classes over a specific time interval? How many potentially overweight trucks passed the site while an inspection station or virtual weigh station site was closed or not being operated?

Questions such as these address performance measurement in commercial vehicle operations.

Performance measurement is also increasingly being applied in other areas, measuring the transportation infrastructure against key performance indicators such as average travel times and number of incidents. Providing performance measurement solutions to support commercial vehicle compliance processes and transportation effectiveness can increase transparency and accountability, thereby setting the foundation for network and operations process improvements. ○

by **Larry Yermack**

Governments need a new strategy for procurement of ITS in order to keep pace with technological advances

"Consumers buy more technology than government"

It wasn't that long ago public agencies were the primary buyers of the transportation technology we've got used to calling ITS. It was never easy but it was straightforward. The public official secured the budget, had staff prepare an RFP and then selected a provider. Whatever they bought, well that was it – traffic signals, freeway management systems, toll collection… After quite a few years they thought about a refresh and repeated the public procurement process from scratch: design, bid, build.

Recently we have seen two dramatic changes. The first is that technology does not sit for years until it needs refreshing. It's moving so fast that the procurement cycles cannot keep up. Imagine writing tech specs today, bidding next year and installing a year after that. We are talking instant obsolescence. But that's not the only problem. The other is that consumers buy more technology than government. With our cellphones and multiple transportation apps we have become walking ITS systems. Who needs an official 511 system (do you remember?) when we have Google Maps, Waze and Weather.com?

These two combine to make the provision of technology by government a huge challenge – but one that must be met. The safety and security of the transport system is not an outsourceable option. Government has the responsibility to manage the transportation network as well as the expectations and needs of the traveling public. The private provision of traveler information operates by different metrics – how popular the app is. And that flows from how well an individual can manage a trip by using it. Automated and connected vehicles on the horizon won't make it any easier on government.

Let me suggest two areas they ought to explore to get out of this technology trap. The first involves partnership. Most public agencies make traffic incident, accident and travel speeds data available for free to all companies asking for it. That makes sense because having an informed public is their job. On the other hand, how many government apps do you have on your phone? If government would enter into partnerships with app providers to fuse all the private data with public data then maybe they could offer information services that can generate some traction with the public. At a minimum they could manage the network better with a fuller picture on operators' screens.

The second area is more pressing. Government will continue to buy and deploy technology as long as it owns the roadway network. It needs to figure out how to get ahead, or at least not fall years behind, the technology curve. To do this it is going to have to change how it buys technology. It needs to let providers offer the best technical solution and a plan for keeping it current for the life of the contract. The suppliers know how to do that; they need the right contract vehicle to provide it. There is not enough room here to flesh out what this performance-based solution would look like, so I'll just say: stay tuned.

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

Multispeed, OIML R134-certified, WIM system for enforcement and tolling

Weigh-in-motion (WIM) has already proved to be a fundamental utility in collecting data and selecting vehicles for further investigation. Many countries require certification for tolling (WIM-T) and enforcement (WIM-E) systems. In the WIM-DSP 32/TMCS-U, Traffic Data Systems (TDS) has come up with an affordable solution, with OIML R134 certification.

The WIM-DSP 32 powers and controls up to four 8-channel charge amplifiers (Kistler 5163A108), and analog and digital processing is done inside the unit itself using 32 parallel 24-bit ADCs.

All components and wiring are protected according to IP67/EN 60529 and the user interface functions via sealed touch sensors. All electronics are certified for temperatures from -30°C (-22°F) to +75°C (+167°F) and relative humidity up to 85% at less than 1% deviation.

Above: **Installation showing the three lane-width strips and message system**

Right: **WIM-DSP 32 and TMCS-U units**

Software control

Applications running on the TMCS-U join, store and transmit data coming from the autonomous subsystems via network or serial interfaces.

Like most WIM systems, the TDS solution consists of sensors built into the road surface and appropriate electronic equipment to analyze sensor data. The TMCS-U acts as a controlling device for the WIM-DSP 32, providing and monitoring power for all the WIM equipment, including extra devices required to operate the road sensors.

An independent, inductive-loop-based vehicle classification system inside the TMCS-U generates redundant information about the vehicle under inspection for up to eight lanes. Autonomous operation of WIM and the inductive loop system verifies the accuracy of data that has been acquired, which is an important feature for documentation. External ALPR and environmental data can be added to the data set by the TMCS-U.

Need to know

Traffic Data Systems' WIM solution is accurate and versatile, thanks to the latest technology

- OIML R134 certification means the WIM-DSP 32/TMCS-U can be used for both enforcement and tolling applications
- Redundant information is generated for up to eight lanes for superior verification of data
- The system can be connected to ALPR and RWIS to create richer, more useful data sets

Hardware setup

The TDS WIM System uses OIML R134-certified Lineas quartz sensors from Kistler. To function correctly it is mandatory to have a level road surface with solid subsoil covering at least the sensor area and no less than 100m (328ft) in front of and 50m (164ft) behind the sensor field. The layout uses two or three equidistant (1.75m or 2m (5.7ft or 6.5ft)) strips covering the full lane width.

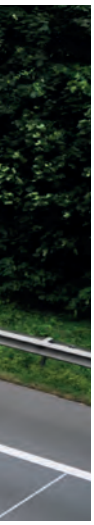
For statistical applications, two rows of Lineas sensors and one optional sensor installed at an angle for checking the wheel position within the lane and the type of tires fitted (single or twin tires) are sufficient.

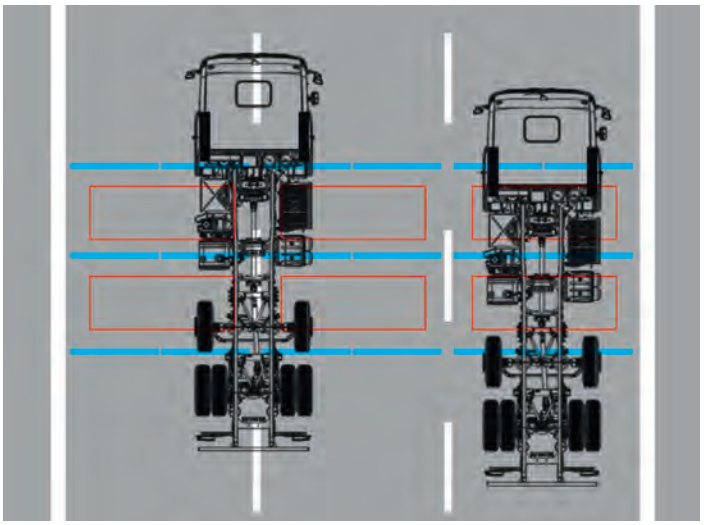
Three rows of Lineas sensors are required for WIM-E or WIM-T systems in order to satisfy the requirements of OIML R134 certification.

The sensors, which 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.

The second angled sensor can be used to determine the tread surface of the tire, and therefore indirectly measure the inflation pressure.

WIM-E and WIM-T also require an RWIS (road weather information system) which can switch off the system if adverse weather conditions – such as





Above: **An ALPR and overview camera with integral infrared LED**

Far right: **Sensor arrangement for WIM enforcement and tolling, showing lane changing (left) and correct traversals (right)**

strong winds,snow, slush or ice – affect weight measurements.

In addition, ALPR and overview cameras are required to document correct traversals and the number of rolling and raised axles, and to identify overloaded vehicles automatically for checks.

Combined wheel tracks

The WIM-DSP 32/TMCS-U supports an array of up to 32 Lineas sensors. Known sensor geometries enable various wheel tracks to be combined – in the simplest case, the left and right neighboring tracks.

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/TMCS-U also helps to greatly 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.

Work from distance

The distance between the WIM-DSP 32 and the WIM interface of the TMCS-U can be up to 300m. An RJ45 cable in protection class IP67 is used across the extended temperature range for data communication and supplying power.

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

The WIM-DSP 32 is built around a powerful micro-controller unit for outstanding real-time capabilities and low power requirements. As well as the basic WIM functionality, a set of useful support features is implemented within the WIM-DSP 32. This means that the proper operation of quartz sensors and other monitoring features can be verified during installation and operation, without the need to invest in additional hardware.

New techniques

The above described technology was made possible by using new software techniques that combine fast, real-time response with advanced programming methods. MicroPython was used for the system architecture, allowing seamless integration of high-speed signal processing with clean and efficient application programming, avoiding the overhead of traditional operating systems.

The software has been proven suitable for critical embedded systems and high code quality, due to work undertaken by the European Space Agency to integrate it into space flight software.

To develop and certify the WIM system, TDS built a fully equipped WIM measuring site on a private high-speed test track, enabling tests with axle weights of more than 16,000kg (35,274lb) and speeds from 5km/h up to 120km/h (3mph-75mph) for heavy goods vehicles and 140km/h (87mph) in the case of light goods vehicles.

OIML-certified WIM solutions create new opportunities for advanced enforcement and tolling applications. Redundant measurement systems are paramount to maintain enforcement/tolling and validity, and Traffic Data Systems has created a well equipped ecosystem to move WIM to a new level of usability.

The WIM-DSP 32/TMCS-U is the world's first system with PSHC (Piezo Sensor Health Care) long-term sensor monitoring on a 32-channel sensor array, which will soon be obligatory in WIM enforcement and tolling systems.

The importance of ergonomics in the control room

Efficient control rooms are essential within the transportation sector. Be it a major European airport or an international freight shipping company, it is vital that the employees working within their control rooms can carry out their roles efficiently and make important decisions on the fly.

The only way to guarantee that users are achieving this is through ergonomics – something that should be seen as a top priority when considering the design of any control room. By focusing on a human-centered design, businesses can create a more comfortable control room that dramatically increases productivity and accuracy among users by letting them move seamlessly between different workstations, displays and applications.

The benefits of optimizing the ergonomics of a control room with a human-centered design approach are plentiful. It can minimize human error, improve overall control safety, security and efficiency among all users, and even result in cost savings for businesses if implemented correctly. But for the best results, businesses should not improve their control room ergonomics incrementally. Instead, they need to do it once and do it right.

Need to know

Ergonomic factors in a control room

- Minimizing information overload for users allows brain power to be used most effectively
- Allowing multiple systems to be accessed via a single portal reduces errors
- Control rooms are often cramped and produce excessive levels of heat and noise, but addressing these aids productivity

Ergonomics is key

Information technology hardware manufacturer Adder Technology likes to split ergonomics into three different areas that must be covered to ensure control room success. While some of these areas have been well-documented in the past, others are often glanced over or missed entirely.

Cognitive ergonomics is all about creating a control room that enables users to focus their brainpower on the tasks that require the most attention, while preventing any operational complications or confusions that might stand in the way of this. For example, if a certain user is tasked with ensuring an aircraft lands safely at an airport, they want to be able to access the systems and applications required without any mental distractions.

Although the least considered area in wider ergonomics, cognitive ergonomics is arguably the most important when it comes to ensuring that all users remain motivated, stimulated and satisfied. Goals within this area range from improving situational awareness and avoiding information overload among users to preventing 'tunnel vision'.

Workplace ergonomics is perhaps the most self-explanatory area, and involves making sure the workplace of each user is optimized for their specific roles and responsibilities. Quite often, this means consolidating the number of user workplace areas and using IP-based KVM technology to offer users access to multiple systems and applications from a single workstation and single mouse or keyboard. This eliminates the need to work across multiple machines, input devices and displays – something that always results in a lack of efficiency and increased risk as they move from one to another.

The final area – environment ergonomics – is all about making sure the wider environment is comfortable for all users, and this involves tackling the three biggest issues of any control room: noise, heat and maintenance. Almost every control room is dependent upon a large number of workstations and hardware, and this often results in a cramped, extremely loud and excessively hot space. Consequently, workstations are far more prone to overheating or crashing completely.

Problem solver

Once again, IP-based KVM technology can solve these problems, enabling the physical machines to be located externally in an area that is safe, secure and temperature-controlled. Suddenly, the control room itself is quieter, cooler and far more reliable from a technical perspective.

For a truly ergonomic control room, technology must be

implemented around the users and not vice versa. By focusing on human-centred design, and considering all three areas of ergonomics while doing so, the control room becomes as effective and efficient as possible. An environment that works with and better serves the users it hosts is an enabler, and can reduce stress and improve workflow.

by **Don Hunt**

Hey! Get your hands off my data!

"If OEMs control all connected car data, how do DOTs and other transportation agencies get to use it to improve safety and mobility?"

We know that we are sharing increasing amounts of personal data with companies via the internet. Every time we surf the web or use a smartphone app, providers are profiling our behavior to target advertising or up-sell our purchases. We don't often think of our car as another tool that tracks our behavior and our environment, but increasingly, connected cars are just that.

In 2016 about 22 million cars sold worldwide were equipped with cellular internet. By 2021 that figure will have risen to about 94 million, or 82% of new car sales. The services for connected vehicles will range from entertainment, to vehicle performance, to driver trip information. And one thing is certain – if you allow the manufacturer to turn on connectivity, your vehicle will become a probe for massive data capture. Estimates are that connected cars will generate 25GB of data per hour, equivalent to 12 full-length HD movies. Transmitted data will include all aspects of vehicle operation – engine performance, location, acceleration, speed, braking, and even windshield wiper use. Eventually vehicle cameras and sensors will transmit physical roadway and traffic information. And that doesn't even include other information that will be captured, such as what music you are listening to or which store your car is parked near.

Wait a second, you say. It's my car. That's my data. So who owns it? It's somewhat comforting to know that, as owner or lessee of the vehicle, you probably do own the data. But OEMs and other businesses want that connected car information and they will figure out how to encourage you to hand it over.

Ford recently announced the construction of a US$200m data center in Michigan to ready the company for the massive amounts of data that will flow from connected cars. Without legislation, OEMs and their partners will be in a position to embed data communications technology in new vehicles and ensure that only they will be the initial recipients of the connected car data. The future value of this data is huge – McKinsey places 2030 connected car data monetization at US$750bn.

This column focuses on how changing technology affects the operators of public transportation systems. The question at hand is: if OEMs control all connected car data, how do DOTs and other transportation agencies get to use it to improve safety and mobility? The simple answer is that we really don't know. It will depend on the resolution of policy questions such as: Will data transmission from vehicles be mandatory or at the owner's option? Will new vehicles be required to transmit some amount of standardized data to a public entity, whether by cellular communication or DSRC? Or will auto makers control the capture and redistribution of connected vehicle data? How will transportation system operators obtain connected car data, and at what cost?

These are important questions, and the outcomes will affect the ability of public transportation operators to improve system safety and efficiency. Further discussion of these questions will be the subject of my future columns.

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

The benefits of lidar for speed measurement and traffic monitoring

Lidar sensors are definitely a hot topic these days. Major industries with stringent detection and ranging requirements, such as automotive and more recently ITS, have come to realize the unique benefits of using lidar to detect, measure and collect real-time traffic information.

The lidar market today is thriving: many lidar startups have emerged, research and development investments are higher than ever, new partnerships are growing, and demand is rapidly ramping up.

All this is a good thing for the evolution of ITS, which is starting to add lidar to its arsenal of traffic sensors in various applications. The industry will benefit from the new generation of solid-state lidar sensors, which provide major performance and reliability improvements as well as dramatic reductions in costs.

Unique capabilities

One of lidar's unique traits is its ability to detect a vehicle's position accurately and collect ranging data, all of which allows precise speed measurement.

TrafficLogix is a company that specializes in the design and development of various traffic calming and speed enforcement solutions. The company wanted to provide roadside sensors that automatically detect vehicles, calculate their speed and enforce infractions.

To be legally enforceable, the technology had to provide very precise and consistent measurements. The sensors needed to be rugged, to operate 24/7, rain or shine, all year round. After analyzing various technologies, TrafficLogix selected LeddarTech's M16 multisegment lidar sensor module as the best solution to meet the application's requirements.

"Finding an accurate, undetectable technology that could be used to measure speed and pinpoint which vehicle is the violator, so ensuring enforceability, was a game-changer," says project manager Ahuva Basch about LeddarTech's solid-state lidar technology.

TrafficLogix's packaged solution, called Enforcer Cam, identifies vehicles that exceed a given speed, and provides enforcement officers with the location as well as real-time photos and videos of the scene.

The compact system can detect incoming traffic (vehicles and motorcycles) driving at a range of 0-180km/h (110mph) at a distance of up to 35m (115ft). It also determines vehicles' real speeds with less than 3% error. The system is also able to distinguish vehicles from one another when clustered in dense traffic, for optimal enforceability. The Enforcer Cam is positioned diagonally facing the rear of traffic, 3-5m (10-16ft) from the roadside, at a height of 2m (6.5ft).

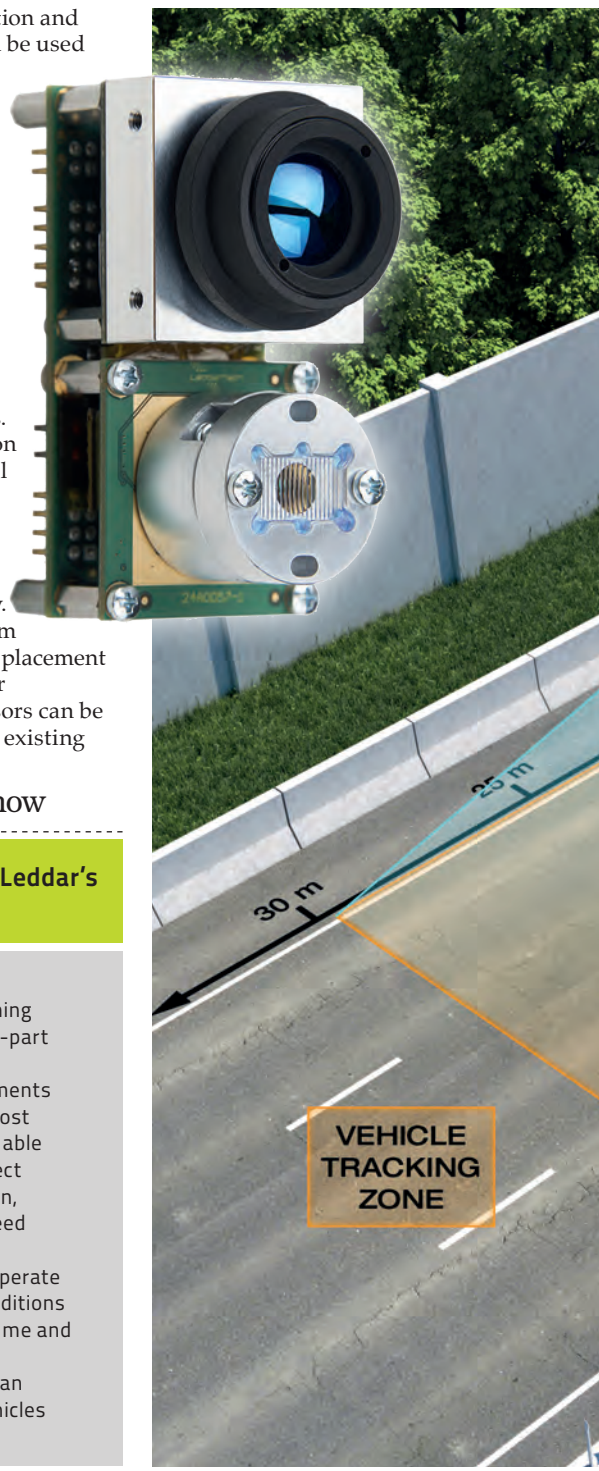
The solution sets itself apart as an accurate and affordable speed measurement solution. And unlike radar-based traffic enforcement systems, the infrared light beam emitted by lidars is virtually undetectable by common means.

Big data move

Cities and transportation authorities are moving toward big data and real-time monitoring of roads, with the aim of optimizing traffic flows. A comprehensive deployment of affordable lidar sensors on sensitive roadways provides traffic management systems with valuable, real-time information on vehicle count, type, position, direction and speed. Such data can be used to identify pressure points and traffic jams as well as to enable advanced statistical analysis and modeling.

Solid-state lidars, such as the Leddar M16, compile data thousands of times per second, tracking several vehicles simultaneously on multiple traffic lanes. Rapid data acquisition and optimized signal processing provide precise speed calculations of all vehicles in the sensors' field-of-view.

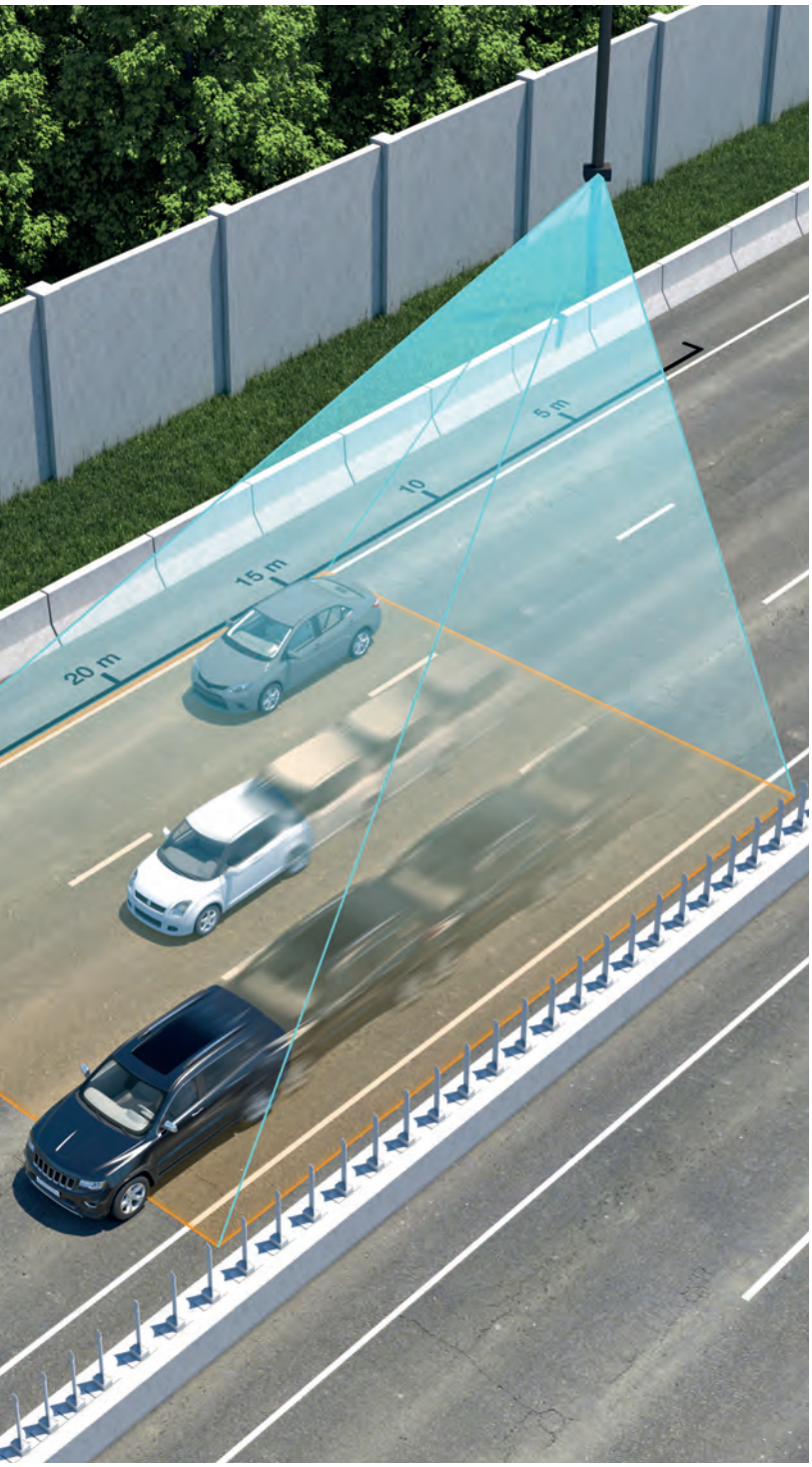
Lidar benefits from a greater freedom of placement than radar in angular positioning. The sensors can be mounted directly on existing



Need to know

The truth about Leddar's solid-state lidar

- Compared with mechanical scanning lidars, no-moving-part designs provide precise measurements at a much lower cost
- Lidar sensors are able to accurately detect a vehicle's position, aiding precise speed measurement
- The system can operate in all weather conditions as well as in daytime and at night
- The Leddar M16 can track multiple vehicles simultaneously



Leddar solid-state lidars can reliably provide precise speed calculations for all vehicles within its field-of-view

road infrastructure with very few positioning constraints, either above the road or on the roadside. Public authorities also appreciate the fact that lidar sensors capture only data, not images, which eliminates privacy concerns and improves social acceptance.

Real-world deployment

A global ITS solution integrator had to develop a system capable of efficiently determining the average speed of vehicles passing on roads and highways, which was part of the local law enforcement strategy. The data collected on vehicle count, type and speed would also be used to improve traffic flow and lower greenhouse gas emissions.

The system had to accurately detect and identify each passing vehicle with a 50cm maximum error margin at both ends of the detection zone. It also had to pinpoint vehicles of any color or shape traveling at 20-250km/h (12-155mph). The system had to monitor two traffic lanes simultaneously and work in adverse weather (rain, snow, fog, wind) and difficult lighting conditions (direct sunlight, at night, in obscured areas such as tunnels, etc).

After unsuccessfully testing various laser-based solutions, which failed to meet its detection rate requirements, the client selected the Leddar d-tec, a traffic sensor integrating a solid-state lidar with a wide-beam flash illumination from infrared LEDs. The lidar-based sensors achieved a near 20% better detection rate than laser-based solutions. Moreover, the Leddar sensors were found to be more affordable and easier to integrate than others.

The solution that was developed consisted of two lidar-based detection units that tracked each vehicle at entry and exit points over a given distance to calculate average speed. The sensors were coupled with automatic license plate recognition camera modules to capture each passing vehicle's license plate. The collected data could then be transmitted to the local authorities for law enforcement purposes.

The system developed fully met the clients' requirements and set itself apart from a performance standpoint, reliably detecting each passing vehicles with a near 100% success rate. Today, the speed control system is in operation in more than 150 sites across Europe.

As demonstrated through these use cases, solid-state lidar technologies can be used in a variety of ways in new traffic management solutions – all while being more cost-efficient than previous lidar generations. They are also put to good use in systems that require pedestrian and cyclist detection. Using no-moving-part designs and affordable components, combined with highly efficient, patented signal processing algorithms, Leddar-based lidars deliver superior performance to provide a wealth of value-added insights into traffic, such as vehicle count, size, position, direction and speed for a wide variety of ITS applications.

Specialists in traffic management and toll systems

The traffic technology industry is evolving rapidly. Vehicles and infrastructure are becoming more connected, all electonic tolling is becoming commonplace. Traffic managers must keep pace. To do this they need cutting edge hardware and software they can rely on. Tecsidel, headquartered in Barcelona, Spain, is a multinational provider of traffic management solutions. Globally, more than 2,000 lanes are equipped with the company's technology. Sales manager Michele Ganz explains what the business has to offer.

What type of products does Tecsidel develop and manufacture?
Tecsidel is focused on the development and integration of two traffic solutions – advanced toll systems and ITS.

Our Toll Plus systems can integrate on four distinct operative levels: lane, plaza, concessionaire and multi-concession, for cases where we connect back office applications of different concessions. We are specialized in stop-and-go tolling and multilane free flow.

Also, our turnkey traffic management application, ITS Plus, is tailored to customer requirements.

How are these solutions important to the traffic technology industry?
The highways concessions and management business mainly exists to guarantee road users' safety, avoiding congestion and manage road charging.

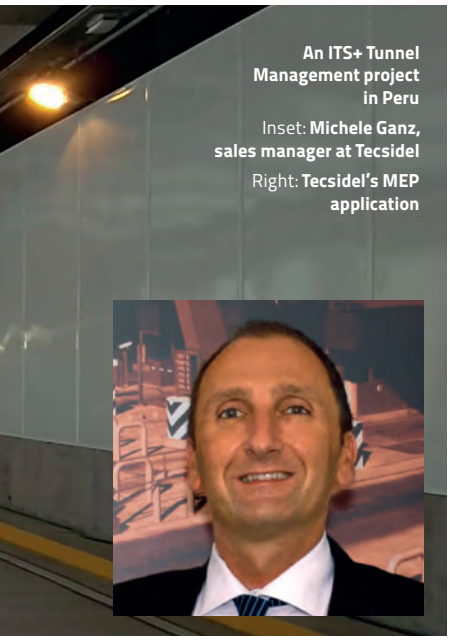
As an integrator Tecsidel is able to fulfill all highways/concessions needs thanks to ITS Plus and Toll Plus. These state-of-the-art turnkey solutions are continuously enhanced, updated and customized to ensure the highest performance in every project.

What changes have you seen in the traffic technology industry? How is Tecsidel developing its products to keep pace?
I believe the industry is concerned about three aspects: **Safety**. Tecsidel ITS Plus allows the integration of all subsystems and has highly qualified algorithms that provide an excellent action protocol in a very short time, in case there is any incident. The solution enables complete management of the highway, including maintenance and assets. **Traffic flow.** ETC (electronic toll collection) installations have hugely increased in recent years to reduce congestion and pollution, among other benefits.

Tecsidel offers MEP (management of electronic payments), which promotes interoperability for faster, safer and more comfortable tolling, since cash payments can be avoided. **Access to information**. ITS Plus and Toll Plus report data in real time and access is possible from Android and iOS applications. The operator is always connected and obtains reports on all activity along the highway and toll collection points.

Tell us more about ITS Plus...
The appeal of ITS Plus is the flexibility for integration of all market subsystems and technological solutions applied to traffic business in one application. This application can be multiconcession and allows for simultaneous and

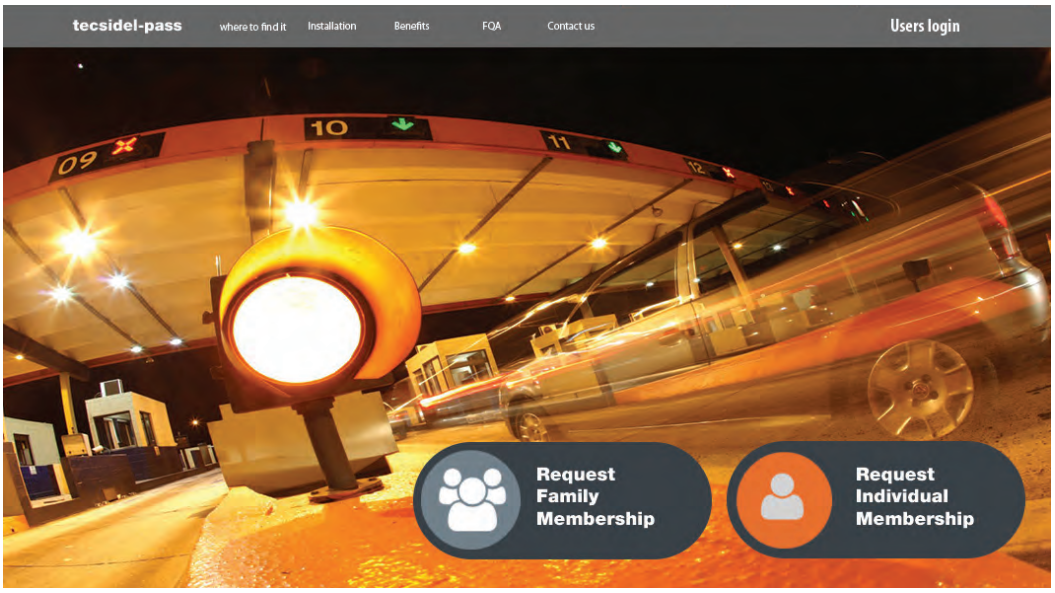
Tecsidel's ITS+ solution



An ITS+ Tunnel Management project in Peru

Inset: **Michele Ganz, sales manager at Tecsidel**

Right: **Tecsidel's MEP application**



real-time operation of highways, bridges and tunnels.

The main purpose of this innovative system is to obtain better operations efficiency. Tecsidel has updated ITS Plus for complete control and management of tunnels (including electromechanical systems) through a user interface installed in an operations control center and integrated with SCADA (supervisory control and data acquisition).

The solution is composed of customized management modules, the main ones being for control equipment, alarms, action plans, incident reports, ticketing systems and rules associated with alarms.

What are the benefits of the solution?

ITS Plus is highly sought after by traffic management officials, due to the following benefits:

- User-friendly interface;
- Remote access through smartphones and tablets;
- Robust and reliable system;
- Multiprotocol and multilanguage;
- Real-time solution;
- Customization performed by the end user.

Can you tell us about the features of MEP?

MEP is a back office solution that becomes an intermediary between final customers (road users, individuals or companies) and vehicular infrastructure operators such as highways concessionaires, car parks, gas stations and municipalities for access control. Payment is electronic, and made by onboard units or other standard electronic payment methods.

The most important technical features of MEP are related to its modularity. The first module (public webpage) is dedicated to end users, for subscribing and checking fares, bills and transactions. The second (web service) is dedicated to the operator, for billing, checking accounts and providing financial strategies. The third is the interface with the various payment options, such as credit card, RFID tags or vouchers issued by the operator.

What are the benefits of the product?

Key benefits for the road user are:

- Speed of transaction;
- Comfortable and secure transactions;
- Complete control of the account with online recharge;
- The same electronic device and account can be used by all integrated concessionaires;
- Multivehicle – users can register more than one vehicle;
- Possibility of an interoperable solution throughout an entire country, thanks to the integration with electronic road pricing, credit operators and back office applications;
- Alerts and notifications to the customer can be made by conventional mail, email or SMS.

Need to know

ITS Plus is a traffic management system developed by Tecsidel

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Balancing the benefits of automated driving

Autonomous and automated driving is expected to bring some major breakthroughs and advantages for both individual and public transport. The proposed advantages are extensive, but it will take more than the introduction of automation alone to bring them about.

The potential advantages of automated driving and traffic primarily fall into one of the following categories: comfort, safety, traffic efficiency and/or traffic effectiveness.

Attention is required

Each of the proposed benefits are somewhat adversely affected by another of the benefits. For example, safety (reduction and elimination of collisions and injuries) correlates with low traffic densities and low velocities. Traffic efficiency correlates with high densities and high velocities (for example, in the case of vehicle platooning), so does not correlate with safety.

Similarly, comfort (e.g. giving back time to the user) conflicts with traffic effectiveness, which can be seen as the choice of the right transportation mode with respect to the actual traffic situation. For instance, the comfort of new fully automated cars may become so pronounced that even more people will drive instead of using public transport. In this way, the traffic problems may be intensified rather than improved. In a similar way, comfort may also conflict with safety, when driving with SAE automation levels 3, or 4.

A lot of the current discussions and predictions, with respect to the advantages of automated driving, only exaggerate a single dimension of these described benefit categories, but do not take their conflicting effects into account. In fact, the description and prediction of such quantities is difficult, if not impossible, not least because the outcomes of the current transport automation hype will depend on human factors and the customer acceptance of the automated traffic solutions.

Left: **Traffic efficiency correlates with high densities and velocities, but clashes with the preferred conditions for increasing vehicle and road safety**

Need to know

Andata's key points to consider concerning increased vehicle automation

- Proposed benefits of automated driving fall under four categories: comfort, safety, traffic efficiency/ effectiveness
- Each of the proposed benefits, to a greater or less extent, conflicts with another of the benefits
- Andata is providing test fields capable of quantifying the opposing effects of automated driving functions

Test field definition

In the opinion of the developers from Andata, a technology firm that is intensively engaged in the development of automated driving functions and traffic automation, the implementation of test fields with measures for quantification of oppositional effects will become a major instrument for the proper implementation, management and control of automated driving and traffic.

Andata developed a concept for the quantification of the described effects together with their consortium partners in the Vienna-based project WienZWA (HiTec marketing, Swarco, Austrian Road Safety Board). WienZWA has been set up for the definition of a test field, not purely limited to the vehicle perspectives, but also infrastructure, organizational and legal issues.

Besides purely providing the street and traffic infrastructure, a number of neatly integrated, complementary methods for the assessment of traffic automation are combined in the WienZWA test field concept. Namely topics like distributed system-of-systems design and evaluations, multi-level effectiveness rating, automated anomaly detection for test monitoring, automated identification and prediction of traffic situations, and other boundary conditions, co-simulation, complexity and robustness ratings, are incorporated and integrated in the concept.

Findings of WienZWA and the resulting methodological concept will be transferred into the 'Connecting Austria' initiative. Resulting concepts are also available for other test fields via WienZWA consortium partners.

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ITS WORLD CONGRESS 2017

TRAFFIC INDUSTRY HIGHLIGHT

Meet the *TTI* team at **Booth 2436** the ITS World Congress. The event takes place in Montreal, Canada, from October 29 to November 2, 2017. See page 20 for our ITS World Congress preview.

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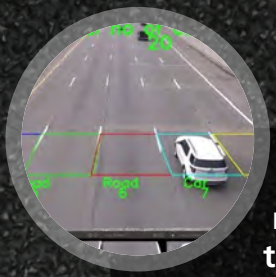
Express lanes

Shortcuts to some of the highlights you will find in this issue – and beyond!

"The EPA Congress and Exhibition, biennially hosted by the European Parking Association, brings together international parking professionals, representing every level of experience and segment of the industry. The event delivers three days of exceptional education, a large display of parking products and services, and a unique opportunity to connect with the global parking community"

***Simone Pfisterer**, vice president, Mesago Messe Frankfurt*

The 18th EPA Congress, organized by Mesago Messe, will be hosted by the Dutch Parking Association VEXPAN, September 20-22, 2017, at De Doelen ICC Rotterdam, the Netherlands. A detailed program, congress registration and a free exhibition ticket is available at epacongress.eu



"The best part of this new counting system is that you don't need any extra infrastructure, because the cameras are already placed at strategic locations on our roads and highways"

***Aleksandar Stevanovic**, Florida Atlantic University Laboratory for Adaptive Traffic Operations & Mgnt.*

Read more about the innovative vehicle counting methodology trafficTechnologyToday.com/count

"Up until 2015 there was a steady decline in fatal crashes, but in the past couple of years there has been a dramatic increase. We can use the database to try to figure out why this is happening"

***Eric Jackson**, director, Connecticut Transportation Safety Research Center*

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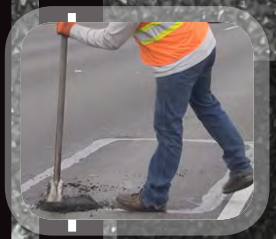
"The Smart Cities Pavilion will be an opportunity to show the world the future, now. With the themes of urban mobility, engaged citizenry, smart security, economic cluster and smart democracy"

***David St. Amant**, interim president and CEO of ITS America, looks forward to the ITS World Congress in Montreal*



"When the mix comes into contact with water, the organic additives react and cause it to set immediately, so we can open the road to traffic right then"

***Karen Bonnetti-Ramirez**, Caltrans engineer*

Watch to see how the new material is helping fix damaged Californian roads quickly trafficTechnologyToday.com/potholes

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