traffic
TECHNOLOGY INTERNATIONAL

August/September 2013

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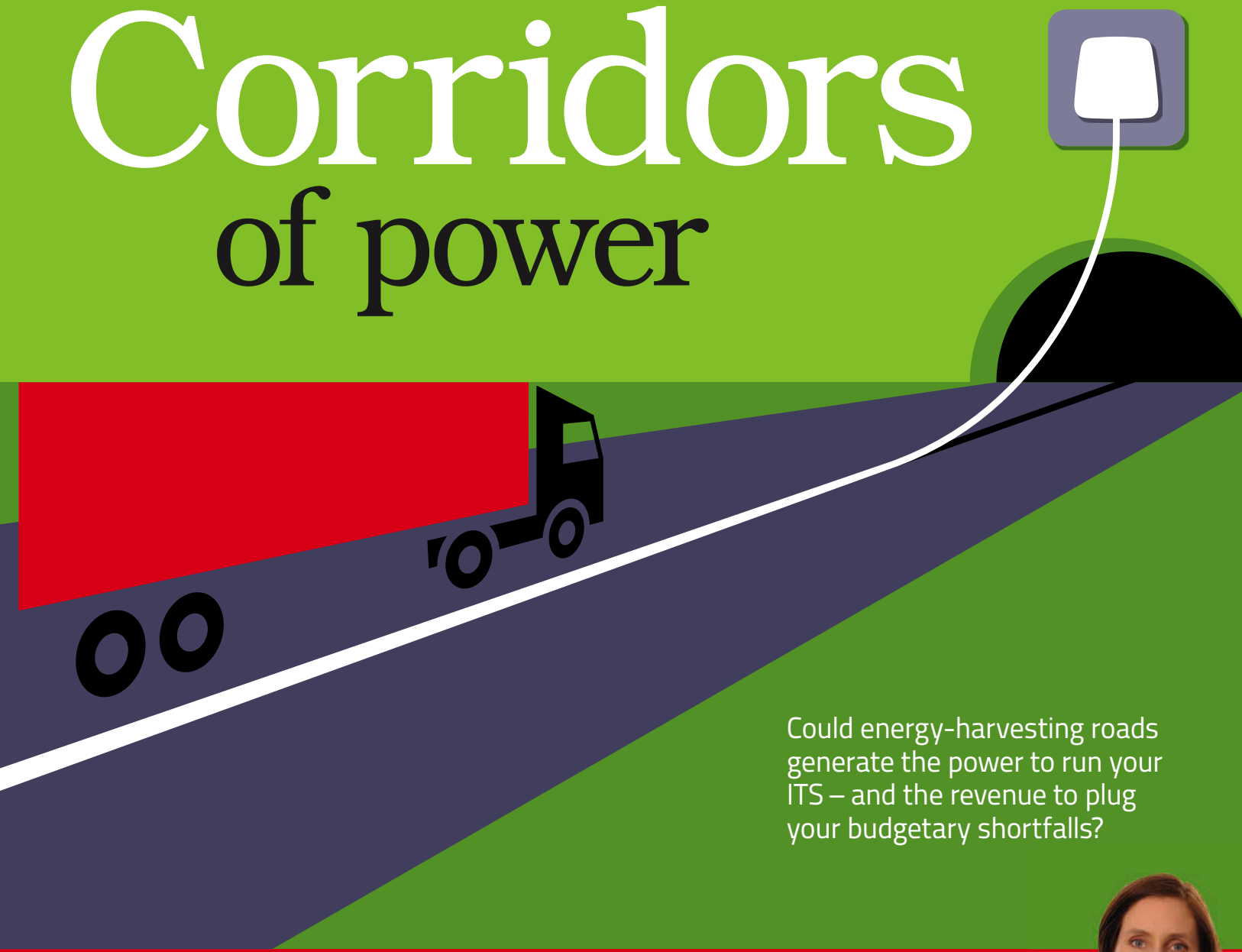
Features on DRIVE C2X, Rio's TOC, the Stadium project, Tokyo, ITS proving grounds and much, much more!

Ahead of the field
Japan's efforts to advance its cooperative infrastructure

Eyes on the prize
Our victory parade for the IBTTA's Toll Excellence Awards

Corridors of power



Could energy-harvesting roads generate the power to run your ITS – and the revenue to plug your budgetary shortfalls?

PLUS

Contingency plans
When mains power fails, have you got the backup in place to keep traffic on the move?

The modular bus
DARPA Challenge veteran Tyler Folsom presents his personal vision for autonomous transportation

Susan Harris, ITS Australia
"Our job is to make sure the benefits of ITS are promoted, so that funding isn't cut when times get tough"

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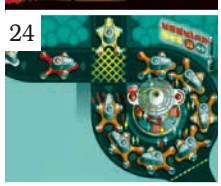
Answers for industry.

Cover story

42 Harvest festival

Turning traffic into energy generators to power your ITS infrastructure

Louise Smyth speaks with the experts who are pinning their hopes on piezoelectric energy-harvesting concepts



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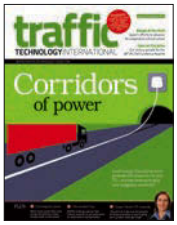
Foreword



To say I don't have much in common with my father-in-law is somewhat of an understatement. Whereas he was a farmer and more than happy to get his hands dirty, I drift in and out of nausea and delirium at the first whiff of muck-spreading. He likes vintage tractors, model railways and being constructive with his time; I prefer soccer, action movies and try to avoid anything remotely constructive whenever possible. He has an enviable IQ; I'm a dab hand in the kitchen.

Of course we have my wife in common, although I sometimes get the impression he'd rather we didn't. And my 3.5-year-old daughter shows the two of us disdain in equal amounts. But whenever we're in each other's company, there is one topic of conversation that we can debate for hours at a time: traffic management.

Seven years ago, when I was plucked from the world of industrial engines, fluid power and cab ergonomics to edit *Traffic Technology International*, his own take on its subject matter was that "traffic managers cause congestion". He remains a good source of anti-local authority witticisms to this day, which he conveys in writing to the *Morpeth Herald* on a regular basis (probably too regular in their view). More often than not, he rants about the incompetences shown in various traffic improvement schemes and accuses those praising their virtues of "sanctimonious verbal flatulence".

Our most recent rioja-fueled session on ITS focused on the advisability of raising speed limits, the subject of an article on page 50. On a similar thread he wanted to know if ALPR systems could read non-reflective plates. I assured him they can – thus dampening his joy at putting his 1967 Mini Cooper S back on the road (not because he wanted to evade detection by Northumberland's Safety Camera Partnership for speeding, but to prove the technology doesn't work).

He has less interest in developments in C2X and traffic flow optimization but regaled me with tales from the 1960s of riding his own green wave. Traveling late at night on the A4 out of London, he would cruise at precisely 29mph and breeze through every traffic light, shaving several minutes off his journey in the process. He was dead chuffed – until a friend of his told him you could ride that same wave at much higher speeds.

My guess is that he won't be embracing the cooperative future that now appears very real, evidenced by recent demos in Gothenburg and Frankfurt (p4), where the uber intelligence of our cars and infrastructure will make up for our failings as human beings. But I won't give up: he used to be dismissive of satnavs and now I'm shocked to learn he has a soft spot for the system in his X-Type, which he tells my mother-in-law is his "perfect woman" – always gives him the right directions and never, ever argues. What authorities in Japan are achieving through such systems takes things to a whole new level (p16).

The more I experience all of this ITS, the more convinced I become of the potential. Seven years on, I'm still trying to convince my father-in-law of the same. Enjoy the read!

Nick Bradley, Editor-in-chief

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SEEING IS BELIEVING

For the sim^{TD} research project, BMW engineers focused on developing a Cross Traffic Assistant and a Traffic Sign Assistant. "The investigations proved that, with the current close-to-production positioning technology, the Cross Traffic Assistant function already has the potential to prevent many accidents at intersections," said Dr Christoph Grote, head of BMW Group Research and Technology. In Germany alone, one-third of all accidents involving personal injury occur at intersections because other road users are noticed either too late or not at all.

Cooperative society

When C2X-equipped vehicles hit our roads, they'll revolutionize safety, traffic management, mobility and more. **Adam Saunders** reveals why that could be sooner than many of us initially anticipated

Photographs courtesy of BMW & Daimler

Fifteen demonstration cars from six European manufacturers were made available from the DRIVE C2X project's five test sites at the recently staged conference/exhibition that provided updates on cooperative vehicle projects worldwide. During the expert day of the two-day event, around 200 participants discussed in a series of workshops, presentations and exhibitions the test design and methodology of running FOTs. And in line with the project's efforts to harmonize technologies for cooperative services, the USDOT also gave a presentation on its own standards for wireless communication.

Anyone doubting that Car-2-X technologies would ever materialize should have been convinced otherwise in recent months. Not only did Dr Thomas Weber from Mercedes-Benz Cars make the bold statement that the game-changing systems will be going into series production in the German car maker's vehicles by the end of 2013, but BMW also presented its results from the multipartner sim^{TD} research project in Frankfurt.

Meanwhile, in Sweden there was a huge demonstration of C2X at the Lindholmen Science Park in Gothenburg, which was part of the four-year, €18.6m (US$24.8m) EU-funded DRIVE C2X initiative. And all this with the Safety Pilot Model Deployment still ongoing in Ann-Arbor, Michigan. The year's worth of data from the latter will support NHTSA's proposed decision this year to mandate the technology for light vehicles and its decision to do the same next year for heavy vehicles.

Production ready?

Daimler appears to be winning the race to take the technology from the research labs to the road. "With C2X communication, we have made a base technology ready for the market that will enable a new generation of driver assistance systems to be developed," says Weber of Daimler's progress in C2X. "Through the intelligent fusion of sensor data, we are able to obtain an extremely precise picture of the vehicles surrounding, including areas further away from the vehicle – which also helps us with the development of our autonomous driving functions."

In the sim^{TD} project, which involved not only BMW but Daimler, other car makers and suppliers, 120 vehicles were put to the test on Frankfurt's highways and urban routes in real traffic conditions. "In the course of the field test, a total of more than 41,000 test hours and more than 1,650,000km [1,025,260 miles) were clocked in the vehicles. Up to 120,000km [74,560 miles] were driven per week," revealed project coordinator Dr Christian Weiss from Daimler. "A full penetration with sim^{TD} functions could save €6.5bn [US$8.65bn] of annual economic costs from traffic accidents. Plus, the resulting efficiency and reduced environmental pollution could bring a macroeconomic benefit of €4.9bn [US$6.5bn]."

90%
of people surveyed for the USDOT's Driver Clinics said they would want C2X on board. And 58% said they would pay up to US$250 for the privilege

Coming soon

As part of an initial step to bring C2X to series production in the next few months, Daimler's Drive Kit Plus is being be used, which in combination with a smartphone and the Digital DriveStyle app developed by the car maker turns Mercedes-Benz vehicles into a simultaneous transmitter and receiver of information. Drive Kit Plus can be ordered for new vehicles and also installed in stock vehicles as a retrofit solution.

This mobile-communication -based approach is being pursued as it promises to offer the quickest way to deploy the future technology and also the quickest shortcut to unlocking the safety potential of C2X. Daimler is still involved in the further development of C2X however, and, based on a hybrid approach, is also able to extend its systems into the area of ad-hoc communication between vehicles.

> "A full penetration with sim^{TD} functions could save €6.5bn of annual economic costs from traffic accidents
>
> *Dr Christian Weiss, project coordinator, sim^{TD}*

In the field...

Looking at recent DOT activity, **Lloyd Fuller** and **Leanne Keeble** round up some of the successful deployments that you might want to consider for your own road networks

Situational awareness

The North Dakota Department of Transportation's (NDDOT) Fargo District has been trialing TrafficCast's BlueTOAD travel-time system throughout the I-94 concrete pavement repair project. The system uses MAC protocols in Bluetooth-enabled devices such as cell phones, headsets, music players and navigation units to measure and calculate road speeds between pairs of roadside detection units. "The information shared through the travel-time system gives motorists the opportunity to plan ahead and find an alternative route if needed," says Kevin Gorder, assistant district engineer for NDDOT Fargo district. "We hope in the future to be able to facilitate such a resource for the traveling public." **Tech stat: With standard equipment, BlueTOADs detect signals in a 150ft radius, or across six lanes of traffic**

(www.trafficcast.com)

Value of contract: US$1m

Adaptive control

Traffic engineers in the City of Spokane have deployed a new computerized signal system from Econolite's Aegis ITS division, which adapts to hourly changes in traffic volume – a first-of-its-kind system for Washington State. By adjusting signal timing to keep traffic moving more smoothly, as volumes and directions of travel change throughout the day it should prevent long waits at busy intersections. Studies have shown the technology could bring up to a 40% decrease in delays, a 25% improvement in travel time, a 22% reduction of vehicle emissions and fuel savings of 10%. **Value of contract: US$1m, of which FHWA is providing US$850,000 through a grant**

(www.aegisits.com)

With automated safety cameras not permitted in the Sunflower State, a University of Kansas School of Engineering project funded by Kansas DOT and the Mid-America Transportation Center is researching a blue confirmation light system to increase safety at four busy and carefully selected intersections in the cities of Lawrence and Overland Park. While the traffic signal is green, the blue light remains off but comes on the moment the signal turns red. If it's illuminated, no cars from that lane should enter the intersection. The blue light is visible from 360°, so law enforcement officers know that a motorist has run a red light, even if they cannot directly see the traffic signal change color. **Traffic stat: In 2011, the FHWA reported that 676 fatalities (10% of all signalized intersection crashes) were due to red light running**

(www.engr.ku.edu)

Value of contract: C$5.7m (US$5.5m)

International Road Dynamics has scooped a five-year contract from the State of Hawaii DOT (HDOT) for its Continuous Traffic Monitoring (CTM) Data Collection Goods and Services statewide project. It covers the supply, operation and maintenance of the CTM systems as well as data services, including the provision for real-time display via web access. There are currently 72 permanent traffic monitoring sites that will be incorporated into the project, located on six of the eight major islands. More sites will be added during the term of the project. **Value of contract: CAD$5.7m**

(www.irdinc.com)

Leicester City Council in the UK is in the process of replacing its entire network of 33,000 old-style sodium streetlamps with new LED technology. Simultaneously, it is also installing the PLANet (Public Lighting Active Network) central management system (CMS) from Telensa to control, monitor and meter each LED's performance. Once installed, the technology will help the council reduce the energy cost of the city's streetlighting by at least 57% and help cut carbon emissions by more than 5,300 tons each year. The three-year replacement project is due to be completed by February 2016. The city's residential streets will be the priority and will undergo the upgrade in the first year of the contract, with the bigger traffic route lanterns being installed in years two and three. **Value of contract: £13.8m (US$21m)**

(www.telensa.com)

Expansion plans

Belarusian authorities have pushed the start button on the new DSRC-based Kapsch ETC system on the M1/E30 highway, which replaces the existing manual tolling system on 815km (506 miles) of the country's road network. Electronic tolling will be mandatory for vehicles with a maximum laden weight of more than 3.5 tons, as well as all motor vehicles with a maximum laden weight of less than 3.5 tons registered outside the Customs Union of Belarus, Russia and Kazakhstan. In all, 56 tolling and enforcement gantries and 48 customer service points have been set into operation. Meanwhile, two modern data centers have been implemented, 500,000 OBUs for automatic payment supplied, and 16 specially equipped enforcement vehicles handed over to the Belarussian Transport Inspection department. **Value of contract: US$353m**

(www.kapsch.net/ktc)

Bialystok in Poland is to deploy Siemens' Sitraffic Concert traffic management system to improve traffic flow. With more than 300,000 citizens, the city is the largest in the northeast of the country and one of Poland's most densely populated. The project will see Siemens establish a TMC in the Skladowa district, which will bring together traffic information from more than 145 data points, including intersections, outstations, red light enforcement solutions and public transportation. On the basis of this data, the system generates forecasts and optimizes traffic light control programs to give priority to public transport. The control center also coordinates the remote maintenance of the individual system elements. Commissioning is planned for spring 2015.
Value of contract: €6m (US$7.8m)

(www.siemens.com/mobility)

Value of contract: €6m (US$7.8m)

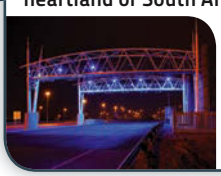
Ready to rock and toll

The Automotive Research Association of India (ARAI) has approved Star Systems International's Venus windshield tags for use across India's national highways. The tag from the Hong Kong-based company has met the requirements of India's Ministry of Road Transport and Highways (MoRTH) Resolution H-25011/4/2011-P&P (Toll) Vol II, hence is deemed fit to be used on the country's United Electronic Toll Collection System, across all toll plazas along the national highways. Indian automobile manufacturers must now comply with the new Central Motor Vehicles Rules that require vehicle makers fit an RFID tag on the windshield of all motor vehicles starting this October. **Did you know? Star Systems International was formed by a group of former employees of Sirit and Federal Signal Technologies**

(www.star-int.net)

Traffic analysis

South Africa's Gauteng Freeway Improvement Project (GFIP) is reducing commuter travel times, according to historical traffic data from TomTom. The cumulative travel time between 4pm and 7pm on the 18km (11.2 mile) stretch between the Buccleuch interchange and the Old Johannesburg off-ramp on the N1 North reduced from 23 minutes before the widening of the freeway in September 2009 to 12 minutes by August 2011. The main source of data was through TomTom's connected navigational devices, 50% of which feature SIM cards that pinpointed their exact location. **Did you know? Gauteng, the economic heartland of South Africa, generates nearly 38% of the total value of South Africa's economic activities**



(www.nra.co.za)

According to the Australian Transport Safety Bureau, there were more than 630 collisions at railway crossings in the country between 2001 and 2009. Although active systems such as boom gates, flashing lights and barriers can help cut such accidents, they're expensive to deploy and maintain; passive signs, while cheaper, are much less effective. As an alternative, a team from La Trobe University's Center for Technology Infusion in Melbourne has been working on a GPS/DSRC system to detect the possibility of a collision and alert drivers with in-car audio-visual alerts that escalate in volume and intensity as trains get closer to the crossing. Field trials at regional and urban railway crossings have involved around 100 road and rail vehicles. If deployed across the fleet, it could save an average of 37 lives a year and around A$100m.
Project cost: A$5.5m (US$5.3m)

(www.latrobe.edu.au)

Project cost: A$5.5m (US$5.3m)

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Events horizon

An EC project has developed a valuable resource for cities that are planning transport strategies for large events. **Lloyd Fuller** reveals the highlights of the online ITS Handbook

The EC's STADIUM (Smart Transport Applications Designed for large events with Impacts on Urban Mobility) project has published a new internet-based guide, the *ITS Handbook*, which features an interactive ITS Decision Support Tool. Enabling cities to choose the most appropriate ITS tools to respond to specific transport challenges, it has been developed especially to support cities that will be hosting large events in the planning of transport management, helping them to identify the most suitable and sustainable technologies. After defining an overall event by duration, magnitude, number of events and venue locations, users are then guided to an overview of topics that need to be addressed as well as to the respective tools.

Lessons learned

The guide is based on the experiences gathered at the South Africa World Cup (2010), India's Commonwealth Games (2010) and the London Olympics (2012). At these three events, the STADIUM project team demonstrated how ITS applications could help to manage the transport challenges arising from such events.

In fact, the Brazilian city of Curitiba is currently making practical use of the guide while preparing for the 2014 World Cup. City officials have identified ITS applications to improve public transport management and are, among other systems, installing passenger counting for bus rapid transit (BRT) lines.

"Through a multiple-step planning process, it helps transport authorities to identify the ITS tools most appropriate to implement," reveals STADIUM project coordinator Maurizio Tomassini (pictured bottom left). "These would be the tools to help them manage the transport policies that have been selected in order to cope with the demand in the context of the existing or predicted infrastructures and services."

The guide will also assist host cities in implementing the strategies that will help them comply with the, generally quite strict, requirements posed by large event organizers such as FIFA, the International Olympic Committee (IOC), UEFA, etc. "Starting from these requirements, the tool guides the users in identifying the most suitable strategies ranked by effectiveness – choices that are then made according to the specific city context," Tomassini continues. "For each of the strategies being considered, the ITS tools that demonstrate the ability to support the implementation, management and enforcement of the strategies are again ranked by proven effectiveness.

"Implementing the solutions proposed by the decision support tool should improve the management of road transport demand, ensure a better delivery of services, and more effectively integrate the dedicated fleets deployed by any organizing committee – participants (players and athletes), press, VIPs, workers, freight deliveries, and so on."

The global nature of the STADIUM project has been crucial to its success. "International cooperation is very important, given global transport trends," concludes Patrick Mercier-Handisyde from DG Research's Urban Mobility Sector. "We can learn from other countries. New competitors are emerging but at the same time, new opportunities for collaboration are emerging as well. The STADIUM project is a very good example of this." ○

£7.2bn
(US$11bn) was invested in transport for the 2012 London Olympics, including ITS tools, new infrastructure and public transport improvements

Tools in the box

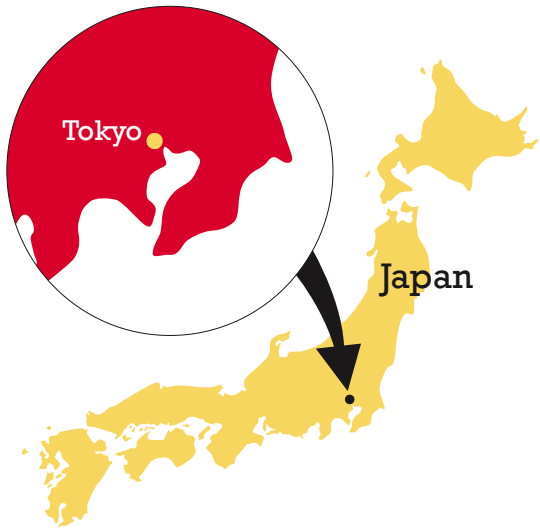
The STADIUM ITS Toolbox is a catalog of more than 30 commonly used ITS tools. IT provides information about the main purpose of each tool, its functions and benefits, and also offers indications about its potential use for supporting mobility management strategies during large-scale events. In addition, it presents a set of case studies that offer examples of best practice and use of the tools in past large-scale events. The main feature relies on a 'matrix' linking the tools with a set of transport-related objectives.

The ITS tools included in the online handbook have been classified into six areas: collective and alternative transport; demand management; integrated payment systems; integrated platforms; traffic management systems; and traveler information services.

Each of the tools is linked to the transport strategies, wherever the tool might be useful to enforce the transport strategy. The relationship between strategies and ITS tools has to be considered in general, as the use of an ITS tool to suit a transport strategy depends on the local transport infrastructure and ITS technologies already in place.

Capital gains?

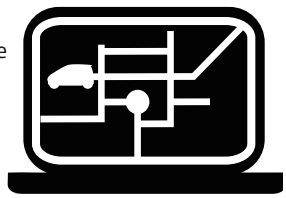
A devastating legacy of the 20th century, traffic congestion drains economies, pollutes the environment and reduces quality of life. But authorities in **Tokyo** are placing huge faith in public transport and ITS to bring some much-needed relief



Infographics courtesy of Andrew Locke

Tokyo's Traffic Control System (TCS) is managed by the **Tokyo Metropolitan Police Department** – a division within the **Tokyo Metropolitan Government** that is run by Governor **Naoki Inose**

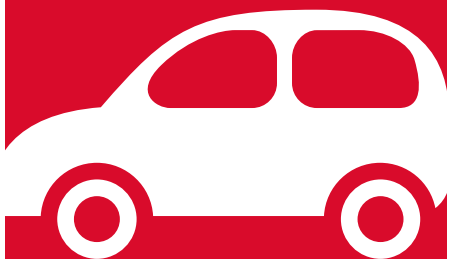
From 1997 to 2006, the Vehicle Information and Communication System (VICS) reduced lost hours resulting from traffic congestion by



3.7 trillion

As of 2011, the population of the city was estimated to be 13.19 million – or roughly 10% of Japan's total population

In 1955 there were just 240,000 vehicles in Tokyo – 50 years later there were around 4.6 million



28.85m

people use public transportation daily within the 23 special-ward area

On the approximate 2,825km of roads in Tokyo, there are

8,000

signalized intersections, 13,000 vehicle detectors as well as infrared beacons installed at around 1,900 locations

During the morning rush-hour in downtown Tokyo,

91%

of people travel by rail while only 6% use cars – yet there are still jams!

Of the total CO_2 emissions in the city, automobiles account for 25% of the pollution (12.28m tons of CO_2 a year)

12.28m tons

The death toll from road traffic accidents in Tokyo in 2012 was 183 – the lowest figure since the end of World War II, according to the National Police Agency. The figure was also 32 fewer than 2011. The highest toll was in 1960, with 1,179 deaths

800,000

liters of gasoline are saved a year from the VICS, which also reduces CO_2 emissions by 214 million tons

The Tokyo Metropolitan Region has an estimated 8.4 million bicycle owners. So 1 out of 1.5 people has a bicycle

Tokyo has a population density of

6,029

people per square kilometer, making it the most densely populated prefecture in Japan

Tokyo's total road network stretches for

24,000km

Its 13 subways stretch more than 400km

Tokyo's Metropolitan Expressways total around

300km

around 30% of which (90km) were built 40 or more years ago. Another 16% of the network is between 30 and 40 years old

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One of many recent successes of **sanef its technologies** is the PMH1 Toll system in Vancouver, Canada. We implemented our **FastFlow AET** (All Electronic Tolling) solution, powered by leading-edge back office product **FastToll ERP.** This unique solution helps people save time while commuting in this highly populated region. More than just providing technology components, we deliver complete solutions to help people spend more time doing what they choose.

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Coordinated action

Rio's new Operations Center had a pivotal role in managing the response when a 20-story office building in downtown Rio de Janeiro collapsed in January 2012. "The Operations Center took immediate action, alerting the fire and civil defense departments and working with the local gas and electric companies to shut down service surrounding the building," reveals Dr Guruduth S Banavar, vice president and CTO, global public sector, IBM. "The Operations Center employees handled related tasks such as halting the underground subway, diverting traffic, securing the site and nearby buildings, and alerting local hospitals."

Banavar suggests that social media generated from the Operations Center was also invaluable. "A Twitter feed alerted citizens about the incident, which helped divert people away from the site and preempt traffic congestion."

Command central

Timothy Compston takes a look at a pioneering operations center in Rio de Janeiro – a glowing example of IBM's Smarter Cities initiative

At the heart of a city and traffic management revolution that is underway in Rio de Janeiro, Brazil, sits the multimillion dollar Rio Operations Center. The result of a December 2010 agreement between the city government and IBM, the new facility at Cidade Nova brings together an unprecedented number of government departments and agencies from across the municipality.

Rio is a large, bustling and fast-growing city and is now home to some 6.5 million people in the city proper and 11.5 million across the wider metropolitan area. Celebrated the world over for its carnival, in recent times it has also been the venue of choice for international summits on critical issues such as climate change. It will be a host city for Brazil's FIFA World Cup in 2014 and, crucially, will also be the host of the 2016 Olympic Games, with billions watching.

In 2011, the average travel speed on Rio's roads slowed to 12.4mph (20km/h) in the case of private cars, and 10mph (17km/h) for its buses

As a result of advanced urban systems for visualization, monitoring and analysis, the Rio Operations Center is redefining the way that information can be gathered and interconnected. This includes how traffic is flowing city-wide and helps to build a smarter, bigger-picture view of what is happening on the ground. The state-of-the-art facility enables the city authorities to enhance safety by offering timely warnings of potential dangers, as well as coordinate their responses to major incidents as and when they occur.

Changing capabilities

Carlos Roberto Osorio (pictured right), municipal secretary for conservation and public services in the City of Rio de Janeiro, believes the center has been a game-changer or day-to-day operations. "The quality of traffic management has improved immensely through our 800 video cameras and information-gathering systems," he says. "We have 30 agencies here at the center, with some 70 operators working at any one time. Enhanced communications and a single protocol facilitate the management of incidents that could impact on traffic. Now our traffic controllers know in real time what is happening in each of our major corridors. In addition, we have the largest videowall in Latin America and can quickly change the information displayed to show areas of interest such as traffic cameras, the weather and conditions on particular roads." All the city's traffic signals are controlled by the center.

Osorio cites the ability to deal with events more quickly as a key deliverable of the project. "With lines of communication concentrated in the center, we have been able to shorten the response time to incidents by 25-30%. This has very positive results on traffic flow," he states.

Similar to many other cities with strong economic growth, Rio faces major hurdles on the traffic front. "The number of private cars has increased by more than 10% year-on-year to around 1.8 million vehicles at the last count," says Osorio. "There is also a rapid

transit corridor that impacts on traffic. The increasing pressure on existing roads means that this Operations Center is vital to our daily operations."

Weather forecasting was a priority in the center's first 18 months. "Due to climate change, rainfall on our hills can result in landslides and flooding, so we were keen to have a warning system in place," he continues. "The high-resolution weather forecast model developed by IBM can tell us what to expect 48 hours in advance, enabling us to act before a weather-related incident occurs. We have also installed sirens to warn people living on hillsides that they should go to shelters." Fortunately, he adds, this flooding doesn't tend to create problems on the city's main network of roads.

Moving forward, more attention will be focused on traffic-related initiatives. "One of our top priorities has been Rio's 9,000 or so buses," Osorio says. "All will have GPS systems and video cameras to show the driver's view and inside the bus, enabling the fleet to be managed from the Operations Center. More efficient buses will have a great impact on both the bus users and the traffic in general."

Event management

According to Osorio, the partnership with IBM has assisted the Operations Center in meeting the city's expectations – and even surpass them. But it's an ongoing process. "This project will never be truly completed," he stresses. "In phase three, we will implement more technology for traffic and the management of public transport. Also, over the next few years, we will be focused on dealing with large-scale events."

In June 2012 the center successfully managed the UN Conference on Sustainable Development, which saw more than 100 heads of state and government – plus tens of thousands of delegates – gather in Rio. In contrast, in July 2013 the visit of Pope Francis and the city's transport challenges made front-page news when his silver Fiat 'Pope-mobile' became stranded in traffic as boisterous well-wishers tried to get a closer look at the pontiff. An electrical fault also brought Rio's Metro system to a grinding halt, leaving pilgrims scrambling for cabs and buses to get across the city to Copacabana Beach, where three million people watched the Pope celebrate Mass. Rio mayor Eduardo Paes accepted the city had "scored closer to zero than 10" over the organization of the Pope's visit.

Challenges clearly remain, but Osorio believes the center to be a worthwhile investment – not just for the 2016 Olympic Games and the 2014 World Cup but the city's future. "It's an important communications tool," he says. "Television, radio studios and the whole media report from here, and we make information and camera feeds available to the public. We also actively communicate through social media platforms such as Twitter."

A joined-up approach

The center undoubtedly transforms the way the city handles major incidents. "Rio didn't previously have a way to monitor emergency situations or oversee a coordinated response," adds Dr Guruduth S Banavar, vice president and CTO of IBM, global public sector. "It now has a hub for information that impacts the city's day-to-day life."

Furthermore, the center is the first in the world to integrate all stages of crisis management. "You have everything from prediction, mitigation and preparation to immediate response and finally, the feedback from the system for use in future incidents," explains Banavar, who adds that he is enthusiastic for others to follow Rio's example. "We are working with thousands of cities to help deliver better services and enable sustainable growth. Our goal is to make these solutions accessible to cities of all sizes. And as a result of the project in Rio, IBM has further developed its Intelligent Operations Center software."

A WHO study from 2011 revealed Rio to have the highest level of air pollution in Brazil, and more than other world cities including New York, London and Paris

Essential elements

One of the main initial drivers for the development of the Operations Center was the desire of Rio's forward-thinking mayor, Eduardo Paes, to improve how the authorities in Rio could deal with natural events such as flash floods and landslides. Consequently, part of the agreement the City of Rio reached with IBM was the creation of an advanced high-resolution weather forecasting and a hydrological modeling system. This element of the initiative – which went 'live' nearly a year to the day after the Operations Center opened its doors in December 2010 – was, appropriately enough, a major project for IBM's ninth research lab, the first in Latin America, which opened in Brazil shortly before the Operations Center itself.

> "We have been able to shorten the response time to traffic-related incidents in the city by 25-30%

Tools in the box

Since 2009, the FHWA has committed more than US$3.8bn to more than 11,000 projects to make travel safer for pedestrians and bicyclists. The agency provides resources and expertise to improve walking routes and infrastructure, such as offering technical assistance to cities and states with the highest pedestrian fatalities, and tools such as Pedsafe, an online toolbox that communities can use to improve pedestrian safety in their area.

Additional information on the new pedestrian data can be found in NHTSA's latest issue of *SAFETY 1N NUM3ERS*, an online monthly newsletter on key topics in auto safety – including problem identification, people at risk, and recommended practices and solutions to mitigate injury and death on the USA's roadways.

Walk this way

Adam Saunders reports on a new US initiative to supplement education and enforcement in cities where pedestrian death rates are higher than the national average

Photographs courtesy of USDOT

According to data from the National Highway Traffic Safety Administration (NHTSA), 4,432 pedestrians were killed in traffic crashes in the USA in 2011 – an 8% increase over 2009 statistics (although a 7% decrease on 2002 figures). That equates to one pedestrian death on US roads every two hours, or an injury every eight minutes, as a result of largely avoidable traffic crashes.

Three out of four of those pedestrian deaths occurred in urban areas and 70% of those killed were at non-intersections. Additionally, 70% of deaths occurred at night and many involved alcohol. "Whether you live in a city or a small town, and whether you drive a car, take the bus or ride a train, at some point in the day, everyone is a pedestrian," said the recently appointed US Transportation Secretary Anthony Foxx at the launch of the 'Everyone Is A Pedestrian' safety initiative in August. "Unfortunately, in 2011, pedestrians in the USA were one of the very few groups of road users to experience an increase in fatalities."

27%
of the 92,492 people who die annually from traffic injuries in the WHO European Region were pedestrians. Around the world, more than 5,000 pedestrians are killed on the road every week

> "In 2011, pedestrians in the USA were one of the very few groups of road users to experience an increase in fatalities

Concerted effort

As part of a new campaign to combat that increase, NHTSA announced US$2 million in pedestrian safety grants, with states having until August 30 to apply for a share of the fund, which is intended for education and enforcement initiatives in the 22 focus cities where pedestrian deaths are higher than the national average.

The cities with the highest percentages of pedestrian fatalities were New York (51%), Los Angeles (42%) and Chicago (30%). However, Birmingham, Alabama (19.7), Waco, Texas (19.9), Charleston, South Carolina (17.9), Hesperia, California (17.5) and Knoxville, Tennessee (17.2) were the five cities with the highest pedestrian fatality rates per 100,000 population.

Breaking down the data

A closer inspection of NHTSA's most recent pedestrian safety figures reveals that in almost half of the crashes, either the driver or the pedestrian had a blood alcohol concentration of 0.08 or higher. In these cases, it was much more often that the pedestrian was drunk (35% of the time) than the driver (13%). Pedestrians aged 65 and older accounted for 19% of all pedestrian fatalities and an estimated 10% of all pedestrians injured in 2011. More than 20% of all children between the ages of 10-15 who were killed in traffic crashes were pedestrians.

With distracted driving a hot topic for USDOT and former Transportation Secretary Ray La Hood in particular, it was interesting that he [Foxx] acknowledged a rise in 'distracted walking, which he suggested has played a role in the escalation of pedestrian crashes.

Working with the FHWA, NHTSA also announced a new portal dedicated to the topic. "Everyone Is A Pedestrian offers safety information that communities can use to keep pedestrians safe," Foxx revealed. "With ideas for parents on teaching children about safe walking, reports on effective pedestrian projects for state highway safety offices, guides for community pedestrian safety advocates, and more, the new website hosts a tremendous collection of useful content. We all have a reason to support pedestrian safety and now everyone has new tools to help make a difference."

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Big in Japan

As the World Congress on ITS prepares for its 20th installment in Tokyo this October, **Saul Wordsworth** examines one of the world's most mature and innovative markets for intelligent transportation solutions

Illustration courtesy of Ben White


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If ever there was a country made for intelligent transportation systems, it's Japan. With 136 million people inhabiting its islands, the Land of the Rising Sun remains one of the most densely populated nations in the world. Its cities bear the biggest brunt. The Greater Tokyo Metropolitan Area, for example, has an estimated population of 36 million people. And despite the fact that most of its citizens choose to travel on the subway – where white-gloved 'people-pushers' ensure the doors of packed carriages are properly closed before departure – 25-mile tailbacks on the roads are not unheard of.

The economic impact of these delays is astounding. Nearly five billion hours are lost annually to traffic congestion, equating to a financial dent of ¥12tn (US$120bn). The transport sector is responsible for 20% of the country's CO_2 emissions. And as for how all these vehicles clamoring for limited road space affects road safety, in 2012 there were 4,411 road traffic fatalities. If there's a positive in that, it's that it is the twelfth consecutive annual decline. The Japan Automobile Manufacturers Association also reports that road accidents and road injuries, both of which climbed to all-time highs in 2004, fell for the eighth straight year in 2012, to 665,138 and 825,396 respectively.

With backing from the Japanese government, the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) is investing big in ITS. Advanced vehicle navigation, safe driving assistance, the optimization of road and traffic management systems, as well as continued advances with electronic toll collection, are seen as key focus areas. Through such means, the MLIT hopes to reduce congestion by up to 25% by 2015, and road deaths by 50% by the end of this decade.

Spot the benefit

Cooperative systems will be critical to achieving these goals, so it's just as well this is a field in which Japan excels. Around 35 million cars in the country boast Vehicle Information and Communication Systems (VICS), while up to 39 million are ready for the Electronic Toll Collection (ETC) network.

Established in 1996, the dynamic VICS guidance technology helps drivers get from A to B intelligently, and by 2009 achieved that so well that it helped in reducing annual CO_2 emissions by 2.4 million tons. The use of ETC, meanwhile – introduced in 2000 – had by 2009 eliminated all but 0.1% of toll-gate expressway jams, which at one time accounted for 30% of all expressway congestion. But a traffic engineer's work is never done, especially in Japan.

"We're now in the so-called 'second phase'," reveals Professor Katsuhiro

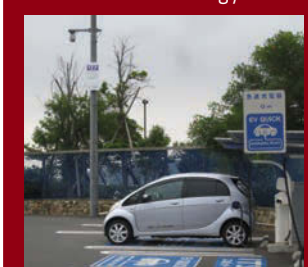
(Above) **ITS Spots have been installed at more than 1,600 locations in Japan. The three basic services include dynamic route guidance, safety driving support and ETC** (Right) **Pioneer's Carrozzeria ITS Spot-compatible navigation device** (Main) **An increasing number of car makers are incorporating ITS Spot navigation systems as standard**

Nishinari of the Research Center for Advanced Science and Technology at the University of Toyko. "In the first phase we were focusing on tools such as ETC. Now, having embarked upon this second stage, vehicle-to-vehicle interaction and more efficient signal communication will be the main areas of attention to help us address some of our societal problems."

The MLIT believed a common 5.8GHz platform for VICS and ETC was essential to advance through stage two and eventually reach stage three, where advanced C2X and autonomous elements could come to the fore. To pave the way to that future, in 2009 the

An island revolution

Goto, an island near Nagasaki off the coast of south-west Japan, may be a surprising location for ITS innovation but with local industry struggling and a falling population, it was singled out as an opportunity for the region's new social and economic strategy.



"Our idea is to apply ITS technology to tourism," explains Hironao Kawashima, professor emeritus of the Co-Mobility Society Research Center at Keio University. "Our challenge is to build an eco and smart island."

Goto is connected to Nagasaki mainland by a 53km underwater electric cable – Japan's longest – while its Electric Vehicle (EV) infrastructure is powered by a local floating wind turbine.

With onboard ITS systems delivering local sightseeing information to tourists, as all rental cars on the island are electric, this will not only bolster the local economy but remain in keeping with the region's green principles.

Ten recommended routes are being developed and built into the OBUs, complete with 100 sightseeing spots, with information such as EV charge points, routes to tourist sites, recommended restaurants and cautions about dangerous roads.

The project is promoted by the Nagasaki EV & ITS consortium, established in October 2009. It consists of 140 members from ministries, local governments, academia, related associations and manufacturers of cars, infrastructure and PNDs.

> No other country has experienced the commercialization of ITS as fast as Japan … Nowhere else can you find expressways with such a level of IT installation
>
> **Hiroyuki Watanabe, senior technical executive, Toyota Motor Corp**

MLIT began deploying 'ITS Spots' at the roadside and as of January 2013, 1,670 such technology-rich sites were in action, the majority of which are on expressways positioned every 10-15km or so. More than 50,000 ITS Spot OBUs have also now been sold. Each ITS Spot relays safety and route guidance information to drivers and also enables use of ETC services. To date, 10 auto makers (Audi, Mazda, Citroën, Mercedes-Benz, Suzuki, Peugeot, Mitsubishi Motors, Volkswagen, Nissan and Toyota) and six navigation systems manufacturers (Alpine, Clarion, Panasonic, Pioneer, Mitsubishi Electric and Mitsubishi Heavy Industries) have been working on ITS Spot solutions. By 2015 the projected number of ITS Spot-compatible OBUs could reach the 10 million mark.

"These ITS Spot services are enabled by a 5.8GHz DSRC-based high-speed two-way communication system that boasts a very large data capacity," explains Kazufumi Suzuki, research engineer for the ITS Division of the National Institute for Land and Infrastructure Management (NILIM), part of the MLIT. "This real-time information enables car navigation to intelligently search for the quickest route to a destination. It also enhances safety by alerting you about sharp curves, congestion ahead and even objects in the road."

Fallen objects are actually a major problem in Japan, with approximately 50,000 instances occurring on the Metropolitan Expressway annually, equating to one every 10 minutes. By using ITS Spots to broadcast information about that obstacle to drivers, it is hoped the number of accidents and close calls can be reduced.

Early evidence of the effectiveness of ITS Spots overall can be found in the case of Sangubashi Curve, a notoriously dangerous section of the Metropolitan Expressway. Through a combination of advance warnings and ITS Spot technology, rear-end collisions have so far been reduced by 60% since deployment.

"No other country has experienced the commercialization of ITS as fast as Japan," believes Hiroyuki Watanabe, senior technical executive of Toyota Motor Corporation and chairman of ITS Japan. "And nowhere else can you find expressways with such a level of IT installation. At one time it was just fixed equipment collecting

various data from cars; now we have probe cars. The idea of collecting data in this way came from NEC Corp and the University of Tokyo. Auto makers are collecting data about where cars are going and at what speed. When Honda started collecting information about sudden braking, for instance, that information evolved into a service to inform drivers about traffic jams and safer routes. When you combine all the data from the car makers, the government, the taxi companies, etc, you can achieve some really big things. It's been the prelude to what we now call 'big data'."

Hironao Kawashima is professor emeritus at the Co-Mobility Society Research Center, Keio University, and worked on the ITS Spot project, which was recently cited by a panel of experts in *The Japan Times*, which included Toyota's Watanabe, the most important ITS project in the country. "The basic architecture was the most essential part of the process and it took time to reach a consensus among the various stakeholders," Kawashima admits.

But get there they did. So as Europe and the USA press ahead with their Cooperative ITS and Connected Vehicle testbeds respectively, Japan's equivalent is already very much up and running.

Probing further

The benefits of this network intelligence were especially highlighted in March 2011 when the magnitude 9.0 Great East Japan

Earthquake triggered a 23ft-high tsunami in the north-east Tohoku region. Watanabe will never forget the widespread devastation, but he says vehicles integrated with probe technology proved vital in helping to identify parts of the road infrastructure that hadn't been damaged in the disaster and were thus clear of debris, making it easier to transport people and supplies to stricken locations. "We thought it would be helpful for rescue and recovery efforts if drivers going to Tohoku in the aftermath knew information about the roads," remembers Watanabe's colleague, Yasumasa Murai, senior vice president and the secretary general of ITS Japan, which helped to compile the probe data from the various car manufacturers.

Disasters such as the one that struck Tohoku are, of course, rare, but it demonstrated the full potential of a technology that on a day-to-day basis could go some way in helping Japan meet its increasingly challenging mobility aims. By creating this massive database of vehicular information – revealing in real-time where vehicles are going and at what speed, pinpointing abnormal behavior such as rapid deceleration, etc – authorities believe it could play a huge role in developing Japan's future social infrastructure.

Crosstown traffic

Fortunately for Japan's crowded expressways and roads, ITS Spots are not the only weapon in the armory – there's as many ways of tackling congestion as there are tailbacks. Hence a company claiming to be able to reduce congestion at intersections by 35% would certainly pique the interest of any traffic engineer.

While traffic in Tokyo – this year's host of the World Congress on ITS – mostly trickles along during peak hours, a situation made worse when traffic lights struggle to manage the flow, in Japan's Iwata City things are different, because of a profile signal control system known as ARTEMIS. Developed by Kyosan Electric, ultrasonic vehicle detectors are installed every 200m on roads as well as at intersections, each one sensing the number of vehicles and the distance between vehicles. That signal is then relayed back into the traffic management system, which calculates the timing of the signal. Each signal is also connected through a traffic signal control board and connected through an IP network, and adjusts in real-time to the demands of the traffic. This Intelligent Traffic Light System is able to reduce vehicle waiting time by estimating traffic conditions. The resulting 35% reduction in traffic has also greatly reduced overall travel times.

"As well as Iwata, we have supplied it to the Japanese cities of Miyazaki, Hikone and Ebina," reveals Akira Shimizu, general manager of projects at Kyosan Electric. "India and Indonesia are also interested. We think the technology is unique worldwide."

(Left) **The Shin-Tomei Expressway will eventually link Tokyo and Nagoya when it is completed in 2020**
(Below) **NEC's traffic control systems contribute to the safety, security and comfort of drivers on the Shin-Tomei Expressway**

Controlling the busy stuff

Away from arterials, in 2012 the Shin-Tomei Expressway was opened as an alternative, parallel route to the busy Tomei Expressway. Operated by NEXCO Central, this new super highway features a suite of technologies from NEC, which are coordinated from the NEXCO Central Tokyo Traffic Control Center. The new traffic control system provides real-time traffic data by processing large volumes of information gathered at high speed from sensors embedded in the roadway. Collected at 60-second intervals at five times the frequency of existing systems, IP networks are used to transfer data from the sensors to the control center, where traffic conditions are observed on massive, easily viewable screens.

"We can monitor a wide range of information, including traffic volumes, densities, weather conditions, etc," confirms Joseph Jasper from the transportation and public network division of NEC. The high-speed processing of this big data enables up-to-the-minute information, a reliable high-speed communications

Color me good

Does grass look blue to you? Perhaps it does. And if that's the case, how easy is it for you to read traffic lights? Probably not that easy since 2003, when light-emitting diodes were first introduced as an alternative to ordinary bulbs. Although more efficient and longer-lasting, people suffering from color blindness immediately found LED signals more difficult to see. Fortunately, Taro Ochiai, a professor at Kyushu Sangyo University, and lighting manufacturer Koito Electric Industries, have found a way around this.

Although color-blind drivers get used to the traffic light sequence, they might not be able to tell whether a light is red, amber or green. By using blue LEDs in the shape of a cross with a brightness four times that of the other diodes, red-green color-blind drivers are able to distinguish the blue X against a background they see as yellow, while ordinary motorists discern no difference at all.

network (all 744 roadside access points, complete with phone and sensors, feature network equipment) and remote back-up systems in the event of a large-scale disaster. "As Japan is prone to earthquakes and tsunami, numerous back-up systems have been prepared in order to meet the needs of large-scale emergencies," Jasper continues. "Even if a main-site server happens to fail, back-up-site servers are able to take over, so highway sensors can continue providing the very latest information through NEC-constructed networks connected to back-up sites."

Information is distributed to drivers via digital signs at the entrances to highways, on signs at toll booths, on the highway's main corridors, tunnel information signs and on digital maps along highway passages. Cars equipped with OBUs are also able to receive live traffic information through the ITS Spots installed along the highway. "The scale of NEC's traffic control systems and level of detail they provide is unique when compared to systems provided outside of Japan," claims Jasper.

Help me Honda

A further example of Japanese innovation can be seen between Honda Motor Company and the University of Tokyo, which are collaborating on a smartphone app that Honda states has the ability to detect the potential for traffic congestion to form, based on users' driving patterns.

With congestion caused by the irregular flow of traffic, the purpose of this smart solution, announced last year, is to get each driver's speed aligned with the vehicles in the immediate vicinity. A color code on the app that changes from green to blue suggests a driving pattern likely to cause congestion. The system also syncs with a vehicle's adaptive cruise control (ACC) to maintain constant distances between vehicles, which improves safety and can lead to a fuel consumption reduction of up to 20%.

Since the initial announcement, the technology has been road-tested in the Indonesian capital of Jakarta. Early results so far on a toll road between Ulujami and Pondok Ranji demonstrated that traffic jams could be delayed by up to six minutes, although the aim in future is to avoid them entirely. For this to happen, rather than being standalone, the system must consist of multiple smartphones in multiple vehicles connected to a cloud server, to provide group-synchronized assistance and data. This latest trial, involving the Jakarta Police, should further verify further the system's potential.

Driving the issue

Honda isn't the only car maker engaged in exciting ITS development. Toyota will soon road test a new support system that warns drivers of impending traffic light changes. A stretch of road in Toyota City is equipped with a system to transmit traffic signal information via a 700MHz waveband – selected due to its highly propagative qualities – to

vehicles equipped with onboard testing systems. The system receives information then provides alerts to occupants via the audio system and the navigation device screen.

This is one of a series of Driving Safety Support Systems (DSSS) driven by the Universal Traffic Management Society of Japan. Other components of the sensor-based DSSS program include a rear-end collision prevention system, a stop-sign recognition system and a high-accident information provision system designed specifically for accident blackspots.

> "Vehicle probes will be the key component of our ITS future and will play an increasingly important role"
>
> **Hironao Kawashima, professor emeritus, Co-Mobility Society Research Center, Keio University, Japan**

(Below left) **Around 60% of congestion in intercity expressways occurs in sag sections** (Bottom) **Honda's app for monitoring driving patterns to help smooth traffic flow**

The future?

Japan is clearly determined to set a strong ITS pace, especially given that this year's World Congress on ITS is to be held in Tokyo – the third time the event has rolled onto its shores. The MLIT, backed by the Universal Traffic Management Society of Japan and the Japanese National Police Agency, has bold plans regarding the direction of next-generation ITS. This involves new experiments with ACC at congestion points, further I2V technology and, by the early 2020s, the realization of cooperative vehicle control on highways or 'autopilot'.

"Vehicle probes will be the key component of our ITS future and will play an increasingly important role," believes Professor Kawashima of Keio University. "The problem at the moment is the penetration rate and data accuracy. These various databases of private and public probe systems are not interoperable, so for the short term, the application of probe data to actual real-time control or management of our road traffic system cannot realistically be considered. But there are various technologies to handle databases of so-called big data and with the social needs for an open data environment emerging, I am certain that an integrated probe data system will be realized sometime soon." ○

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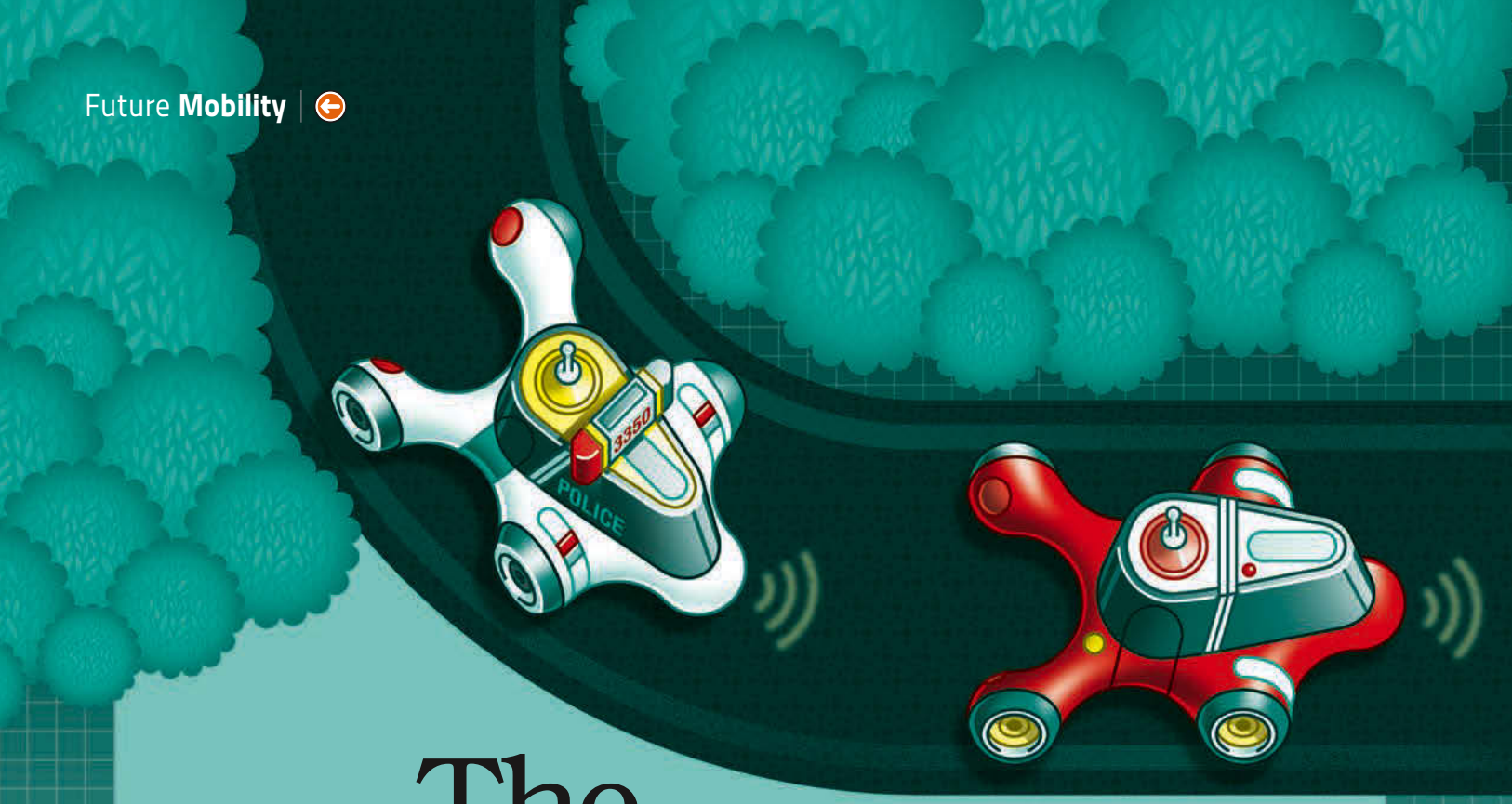


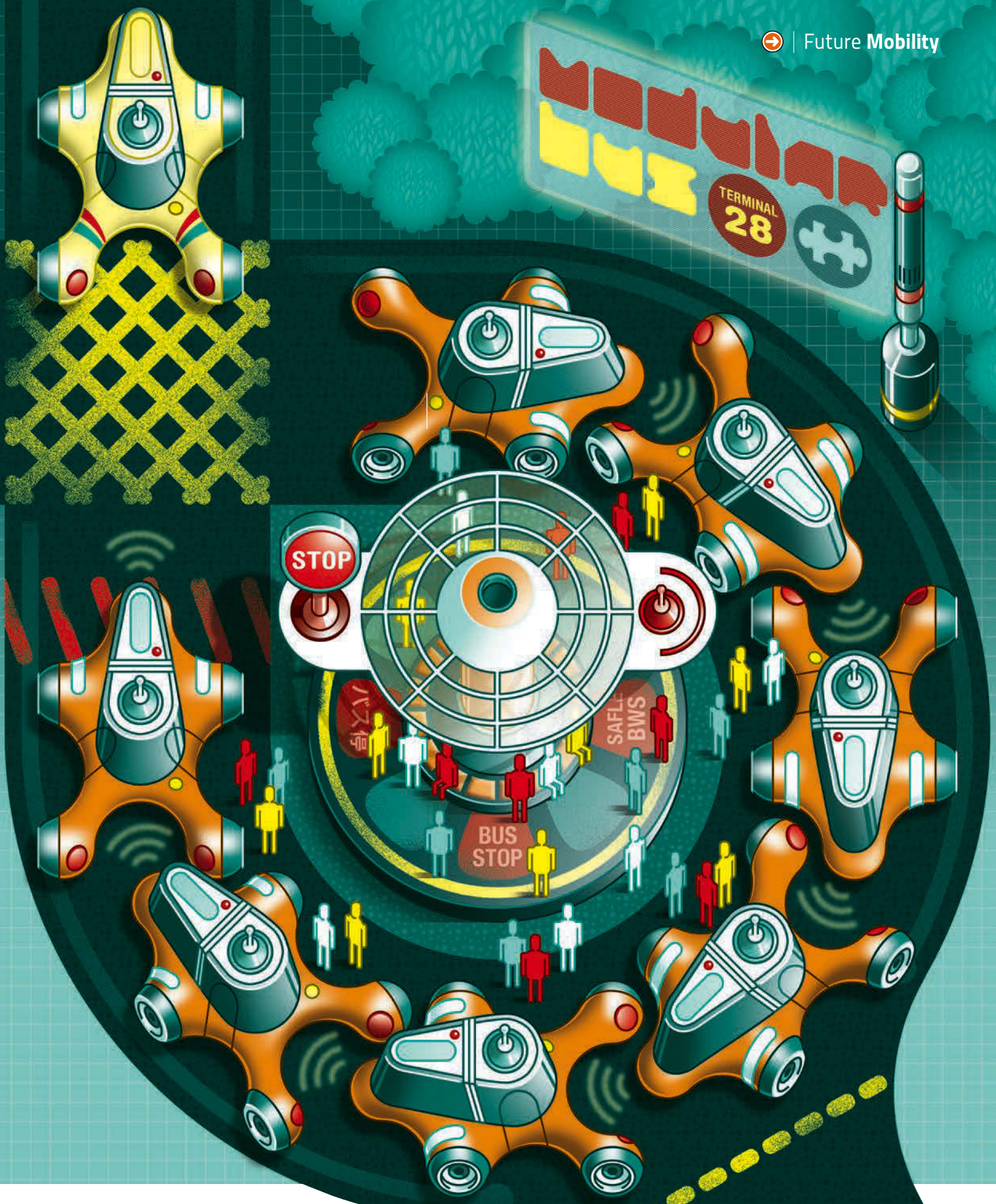
The modular bus

Transit buses may shortly be displaced by self-driving taxis, according to some industry experts. Here, **Tyler Folsom** takes a look at exactly what effect that might have on road management, safety and efficiency

Illustration courtesy of Lee Hasler

Autonomous vehicles such as the Google self-driving car sense their surroundings, in doing so making the decisions needed to get to their destinations without drivers. In a *Traffic Technology International* article published last year, contributor Bern Grush argued transit buses could soon be replaced by autonomous vehicles in the form of self-driving taxis (see *Kiss your bus goodbye*, August/September, p46). So right now, let's debunk the myth that there are currently no autonomous vehicles. Most of the world's elevators are autonomous as operators are no longer needed. Elevators are simple systems in which vehicles run on a reserved guideway that isn't used by anything else, much like the concept of personal rapid transit (PRT). And that's where the secret of making autonomy work lies: start with a simple environment and expand to more complex situations as the technology permits.

The concept of PRT dates from the 1960s. The first system with most of PRT's characteristics has operated in Morgantown, West Virginia, since 1972. The second was put into service at London Heathrow Airport in 2011, and a third is operating in Masdar in the United Arab Emirates.


TERMINAL
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Slow takeup of personal rapid transit

Aside from these, there have been very few PRT systems. Maybe it's uncertain costs, as soaring overheads have killed several attempted projects thus far. There has also previously been a lack of technology needed to support PRT. And in addition to a substantial amount of upfront investment being needed for the reserved guideway, transportation planners also prefer systems that are already working successfully on the same scale elsewhere.

These problems aside, in 2011 Ultra Fairwood signed a contract to construct the world's first urban PRT system in Amritsar, India, on a build-own-operate-transfer basis. So if it is, indeed, possible to build PRT with private financing and make a profit from fares, everything changes.

There are already around 130 driverless train systems operating worldwide. There's been an autonomous metro in Lille, France, since 1983, connecting 60 stations over 27 miles of track. And in Vancouver, Canada, the autonomous SkyTrain has been operating since 1986. In fact, driverless trains have much better safety records than conventional light-rail systems.

1 Personal rapid transit

The notion of PRT dates back nearly 50 years and has been defined as[2]:

- Fully automated vehicles capable of operation without human drivers;
- Vehicles captive to a reserved guideway;
- Small vehicles available 24 hours a day for exclusive use by an individual or a small group, typically one to six passengers, traveling together by choice;
- Uses guideways that can be located above ground, at ground level or underground;
- Vehicles able to use all guideways and stations on a fully coupled PRT network;
- A direct origin-to-destination service, without the need to transfer or stop at intervening stations;
- Service available on demand rather than on fixed schedules.

2 Highway roadtrains

Japan is currently looking to implement self-drive by the early 2020s. This would take the form of a roadtrain where the lead vehicle is driven by a human professional, with the following vehicles under automatic control. Volvo has already operated a roadtrain on 118 miles of Spanish highway under the European SARTRE program. Semi-autonomy leaves the lead driver to respond to situations, while the drivers in the following vehicles can be doing other activities.

However, developers need to take into account that only 1% of Japan's highways have three or more lanes, as a result of many tunnels. There is also the risk that trains of more than 10 vehicles could block exits. Plus, is there a revenue model that makes it attractive for commercial drivers to lead a train?

On the other hand, roadtrains do adhere to the Vienna Convention rule that "every combination of vehicles shall have a driver".

3 City roadtrains

When a roadtrain takes to city streets, it becomes a modular bus. Drivers may be traditional transit operators, but their vehicles do not necessarily have passenger seats or the power to pull other vehicles. Passengers ride in the cars of the train. There might be two types of self-driving module: standard two-seat modules and cargo modules for wheelchairs, luggage or bicycles.

The bus would drive straight past bus stops without halting. Modules would link together and close their doors before the bus arrives, then accelerate and latch onto the rear of the road train as it passes. Each module preselects its destination, so there wouldn't be the need to make any other stops. As the module nears its destination, the train would separate in front and behind it, before the module moves over to the next lane. The train then closes back up as the exiting module slows and halts for the passengers to get out.

These modular buses could be afforded the privileges of emergency vehicles. They could travel faster than cars and could be coordinated with traffic signals.

Of course, exiting a roadtrain from the middle requires two lanes, but the modular bus could be only 1m wide, so a single standard lane could function as two lanes.

The cost of a modular bus would be similar to that of a standard bus, with each module coming in at US$20,000-US$40,000. When linked to form a 60-passenger bus, the total cost is comparable. The main expense of

operating transit is the driver salary, which would not change. No drastic infrastructure changes would be needed either, although work to provide module parking at bus stops would be required. Once a city had a modular bus running, it might want to reserve certain lanes in which the modules could operate without a driver. These could be redesignated HOV lanes or busways.

4 | Technology gap: physical coupling

Roadtrains make use of virtual coupling: vehicles drive close together but leave enough of a gap to allow time for the electronics to react to an emergency. However, several concerns have been raised about this. Worries include how the roadtrain could prevent a manual driver from merging into the train. If this were to happen, it would split the train and force at least one of the drivers to start operating their vehicle at short notice. The whole premise of autonomy means the driver could be asleep or might not even have a driver's license. Other concerns relate to unplanned maneuvers. Under the system design, all planned maneuvers are known to all roadtrain vehicles in advance, but what about unexpected events such as a tire blowout, or a skid on an ice patch?

If the roadtrain inter-vehicle gap were to shrink to zero, fuel efficiency would increase

by about 30%. For heavy trucks, that could mean an annual fuel saving in the USA of US$24,000 per truck, and more in Europe where fuel is about twice as expensive. As a further bonus, bumper-to-bumper roadtrains shrink the length of a modular bus and increase the capacity of a PRT system.

Bumper-to-bumper roadtrains could happen if the vehicles were physically coupled to each other. In the coupled configuration, the train would essentially become an all-wheel-drive vehicle with good traction, and pods support other pods in trouble instead of crashing into them. However, if the lead vehicle attempted to pull the train, the couples would need to withstand tremendous force, and cornering would be problematic. French firm Modulowatt built a prototype of a linked vehicle system that failed because the forces between the linked vehicles were excessive.[3]

A physical coupling device must be combined with a sophisticated control system that predicts forces between vehicles and keeps the force on the couple close to zero. It should be designed to allow vehicles to join or leave a roadtrain at any exit. [And it just so happens that the author, Tyler Folsom, has a detailed plan for this technology, which needs about US$1m in funding!]

Google's self-driving car clocking up more driverless miles

> Every vehicle in the automated lane would know both its own position and those of all nearby vehicles, with every maneuver transmitted before it begins

5 | Dual mode

Suppose a city has converted its bus lines to be modular. The modular bus still faces some of the problems that make transit less convenient than the automobile; for example, it is bound to fixed schedules, with fixed routes and fixed stops that may not suit passengers who live too far from them. The city could institute vehicle sharing to eliminate the first/last mile gap. Envision a car-pool program in which the vehicles are bus modules or 'pods', each of which would have manual controls and could be driven around the city. But as the pods are dual control, upon arrival at a bus

stop, they can be switched to fully automatic mode and join the modular bus. If the bus isn't due, the driver can make his own way to his destination.

Also suppose someone wants to own his or her very own pod, and keep it at home when not in use. This person is willing to find a parking place at work. The city can authorize properly inspected and certified private vehicles to participate in the modular bus. There needs to be a strict inspection system, to ensure the vehicle is physically capable of required performance in road trains and automated lanes, as well as strict hardware encrypted security measures to make tampering difficult. Any vehicle that fails to perform as expected will be banned, and an electronic inspection of vehicle credentials will be conducted each time a vehicle requests to join a modular bus or enter an automated lane. This system could then gradually expand until it engulfs the bus lines, and most vehicles are automatically driven.

Meanwhile, Google's autonomous cars have clocked up more than 500,000 miles of driving in California traffic, in tests during which an operator is present only to take control if needed. Google predicts the technology will be ready for release in four to five years. Simultaneously, the world's auto companies have been developing ever more sophisticated driver assistance systems. In fact, the new Mercedes S-Class already appears capable of driving itself.

Self-drive on the majority of the world's highways is currently prohibited by a 1968 UN treaty, the Vienna Convention On Road Traffic, which states that "every moving vehicle or combination of vehicles shall have a driver". This treaty forms the basis for motor vehicle laws in most countries.

So what will it take to change the law and launch the first unattended vehicle on our highways? How much testing will it take until regulators are convinced all cases have been foreseen? Don't hold your breath…

The main advantage of a single autonomous road vehicle is that it would be

safer than a manually driven vehicle. Traffic accidents cost America US$230bn each year, and research shows human factors contribute wholly or partially to 93% of traffic accidents, not just in the USA but also in the UK.

Capacity gains

Secondly, when automated vehicles communicate and drive in tight platoons, highway capacity increases by a factor of three to eight.[1] Reaping the full advantage of automation would require separating the automated lane from manual lanes; otherwise drivers in the clogged manual lanes would switch to the freely flowing automated lane and snarl it up. Restricting lanes would also mean automatic vehicles don't have to deal with a more complex environment, where other vehicles behave unexpectedly. Each vehicle in the automated lane would know both its own position and the position of all nearby vehicles, with every maneuver transmitted before it begins. As a result, the technology for instrumentation and software would be simpler and less expensive for lane-restricted automated vehicles.

It would therefore be desirable to have safer, higher-capacity lanes that are used

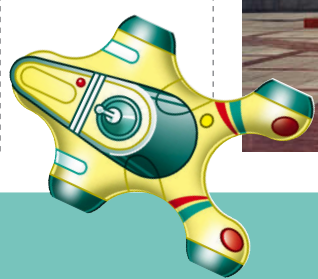
6 | Uncanny valley

There is an effect in 3D animation called the 'uncanny valley' which works on the principle that if you have a cute, cuddly animated character, people tend to cut it some slack. When the character is photo-realistic, viewers are less forgiving, so the character needs to be better looking and behave well to avoid being perceived as creepy.

There is a similar effect in transportation. If an Adaptive Cruise Control (ACC) unit is right 95% of the time, the driver is likely to be prepared to take over when it is wrong. But if it is right 99.9% of the time, the driver may not notice when it is wrong, with catastrophic results. Does that mean it needs to be 99.9999% accurate to be safe?

When automated systems pass a certain state, it is unrealistic to expect a non-professional driver to take over if needed. They may be nervous about tight following distances or close maneuvers that are safe for automated systems; and if the driver tries to slam on the brakes, they may mess up a safe situation. An automated system should not expect the driver to serve as a fallback or scapegoat. The driver should be either totally in control or locked out from sudden action.

GM hopes to begin field trials of its pod cars in the next two to three years, but the vehicle probably won't go into production for around 10-15 years



7 | Urban speeds

Some futurists talk of 100mph cars. Let's get real – the only way you are going to do 100mph in the city is on an aircraft or bullet train. Seattle's Link Light Rail covers 15 miles from downtown to the airport in 38 minutes, an average of 24mph (or 21mph with wait time); Canada's Vancouver SkyTrain (pictured) runs at a maximum of 55mph and an average of 27mph; and in Tokyo, Japan, the Marunouchi subway line from Kasumigaseki to Ikebukuro covers six miles in 25 minutes, an average of 16mph.

Japanese city driving fuel ratings assume a peak speed of 43mph and an average speed of 14mph, with 52% of driving time

spent stationary or decelerating. In the USA, the Environmental Protection Agency's city mileage figures assume a 55mph peak speed, an average of 19mph, and 43% time spent stopped or decelerating. The average US drive to work is 11 miles at 27mph.

Work out the average speed of your favorite trip by measuring the distance and the time it takes to complete. If you break 30mph, congratulations; you have a good urban transportation mode. If not, that trip would be better served by an automated vehicle that never changes speed between origin and destination but can travel at a constant 30mph.

8 | Energy impacts

The average US car weighs 4,000 lb; the average American male weighs 190 lb and the average car occupancy is 1.57. That's a 13:1 ratio of vehicle-to-passenger mass. When traffic accidents become rare, bicycles and motorcycles will be almost as safe as SUVs. Using composite materials, pod weights could safely fall to 300 lb. The total average loaded vehicle weight would then be 600 lb instead of 4,300 lb – a reduction by a factor of seven.

The energy needed to move a vehicle consists of two parts: energy to overcome rolling resistance and energy to overcome aerodynamic drag. Rolling resistance is proportional to mass and speed, and increases when the vehicle accelerates. Aerodynamic drag is proportional to the cube of speed: a vehicle that speeds along at 60mph is using eight times as much energy to fight drag than one that moves at a constant 30mph. The low peak-speed, light, non-stop vehicle may be able to complete the trip faster than a standard car, but use a tenth as much energy.

As a vehicle gets lighter, aerodynamic drag becomes more important in determining required energy. Extreme streamlining of light self-driving pods could make possible efficiencies of 500-1,000 mpg equivalent.

Once a vehicle becomes this efficient, a 25 lb battery would be sufficient for urban trips. And with a lighter battery, refueling could easily be done by battery swap. If the vehicle were autonomous, it could monitor its charge and go for refueling when not being used. A bank of recharging batteries would make it possible to take power from wind or solar when available.

only by automated vehicles. But this raises a chicken-and-egg dilemma: there are no vehicles because there are no lanes, and no lanes because there are no vehicles. The solution is to introduce autonomous road vehicles as public transportation. ○

• *Dr Tyler C Folsom is a licensed professional engineer in the state of Washington, USA. With 28 years' engineering experience, his work includes autonomous vehicles in the DARPA Grand and Urban Challenges. Feel free to contact him by emailing tyler@tfolsom.com*

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Something in reserve?

If there was one lesson learned following the USA's northeastern blackout of 2003, it was that battery back-up systems and uninterruptible power supplies for essential ITS deployments are well worth the money. **Timothy Compston** speaks to some enlightened DOTs now in a much better state of readiness

Main photograph courtesy of Frank Franklin II/Press Association Images

It's challenging enough for traffic managers to keep vehicles on the move safely and efficiently. But throw a power outage into the mix, such as the blackout that hit northeastern USA in August 2003, and the task becomes almost impossible.

The blackout affected 45 million people in eight US states and 10 million in Ontario. Many traffic lights went down, leading to pandemonium at intersections. Severe weather events such as Superstorm Sandy, which ravaged the US east coast in October 2012, can have a similarly chaotic impact on mobility. Even the high temperatures seen in western USA and Canada this summer have led to rolling outages and congestion at unprotected intersections as demand outstripped generating capacity.

Although the number of intersections covered by uninterruptible power supplies (UPS) and battery back-up solutions (BBS) is relatively small in the USA, perhaps no more than 1 in 10, people looking to drive ahead with failsafe technology for strategic locations are well placed to take advantage of advances that have resulted in less power-hungry traffic signals, more efficient UPS solutions, and batteries that incorporate a greater power density. Increasingly, alternative energy options are being sought to keep traffic signals illuminated when mains power fails.

Cars try to navigate their way through New York City during the August 2003 blackout that hit US and Canadian cities

Georgia's generation

"We usually have them on the signals at our freeway ramps," reports Mark Demidovich, assistant state traffic engineer at the Georgia Department of Transportation (GDOT), adding that several hundred UPS/BBS systems are in operation in the state. "Some intersections where there's a low volume of traffic can still function when they go dark as motorists tend to treat them like a stop sign. But when there's a large intersection with lots of left turns and eight phases it becomes chaotic, so they're the ones we concentrate on."

When asked how he approaches system selection, the GDOT engineer underlines the importance of back-up time. "How long a signal can remain operational is key for us, so as a prerequisite we look for 60-90 minutes, which in most cases should keep us going."

Demidovich is quick to single out the weather as a primary cause of the power losses he and his colleagues have to contend with. "Lightning knocks it out a lot in the summer," he says. "The outages are thankfully short-lived as the power company looks to re-route the supply." Of course, when there's a hurricane tearing down trees and poles – something Demidovich is grateful he hasn't had to face yet in the Peach State – then it's an entirely different proposition.

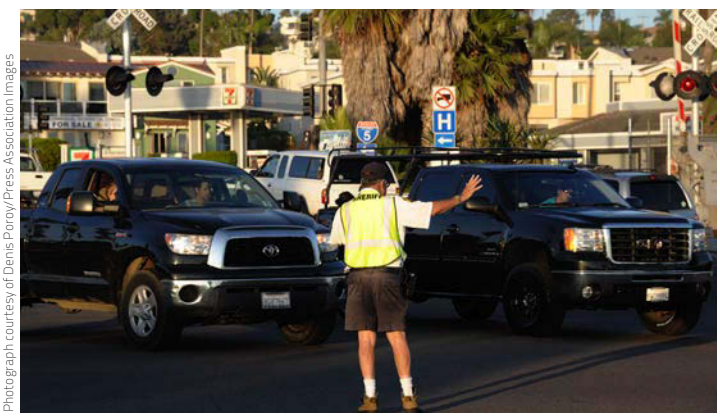
"You're talking many hours of outage and you wouldn't expect the back-up to handle intersections for days at a time." For DOTs facing such occurrences, generators are usually used to run the signals.

UPS and BBS are also in operation on Georgia's freeway management system hubs: "These in-the-field facilities are focal points for all the electronics in a five-mile radius," reveals Demidovich. "In the past if the power went out at a hub, we would lose a huge section of our freeway management, cameras and all of the detection. The UPS means we keep these vital hubs online."

A rail interface

In Edmonton, Canada, UPS and BBS are proving invaluable at traffic signals where routes interface with the city's train and Light Rail Transit (LRT) network. "These signals definitely require battery back-up as they're deemed as high priority," asserts Daniel Kabaroff, systems maintenance engineer for transportation operations at the Traffic Management Center in Edmonton.

Edmonton has adopted an external cabinet to house both the UPS batteries and the UPS itself. "Previously when the UPS was inside the traffic cabinet, we found it very tight in terms of space – it was really cumbersome for the techs in the field especially. You'd have all manner of conduit coming up into the cabinet from the bottom where ordinarily the batteries would sit."



Photograph courtesy of Denis Poroy/Press Association Images

(Below left) **A county sheriff's deputy directs traffic at a dark intersection following a power outage** (Right) **A jam follows an outage and rains on the Delhi-Gurgaon road on the outskirts of New Delhi, India**

Photograph courtesy of Press Association Images

> Our grid is usually fairly solid but because of the high demand and some capacity being lost for maintenance, rolling power blackouts were instituted
>
> **Daniel Kabaroff, systems maintenance engineer for transportation operations at Edmonton TMC, Canada**

Kabaroff knows only too well the impact power outages can have on traffic at intersections where there's no back-up in place. In early July, the central Canadian city saw temperatures soar to 33°C: "Our grid is usually fairly solid but because of the high demand and some capacity being lost for maintenance, rolling power blackouts were instituted," Kabaroff recalls. "We experienced long queues, reduced traffic signal performance, and safety problems associated with signals going down. Having a wider UPS infrastructure would have definitely been beneficial in this case, allowing us to ride out that critical 30- to 60-minute period."

Tunnel vision

The Dublin Port Tunnel in Ireland employs an extensive UPS network, as Jeff Burt, project manager for network operations at the National Roads Authority (NRA) details. "Much of the essential ITS in the tunnel – loops, cameras, VMS, etc – is tied to UPS so should the power go down we can continue operating for a brief period to basically close the tunnel safely," Burt explains. "We figure we would need 30 minutes, but the system is designed for approximately an hour."

The scale of the UPS deployment in the tunnel is highlighted by the fact that Burt puts the cost of just replacing the back-up batteries at €179k (US$232.7k). UPS has proved particularly beneficial in the cases where vital tunnel equipment breaks down and is fooled into thinking it's out of power. "A breaker would pop, for example, and would revert to the UPS supply."

Express solution for Ontario

Toronto's policy is to focus UPS at signalized intersections with railway preemption (RPE): "There are five RPE signals; by 2012 four were equipped with UPS," says Rajnath Bissessar, manager of urban traffic control systems at City of Toronto Transportation Services.

For a province-wide perspective, we spoke with Martin Aitkenhead (left), head of the Electrical Engineering Section at the Traffic Office for the Ministry of Transportation Ontario (MTO): "In 2003 we started converting signals from incandescent to LED, which consumed quite a bit less power and made putting in back-up supplies much more practical as it was easier to power them for a reasonable period of time."

For safety reasons, Aitkenhead reports a strong focus of UPS in rural areas. "A factor to consider is maintenance, though. There are rural signals that could take several hours to reach if a failure is reported."

Aitkenhead also underlines an issue caused by brownouts and short power outages that UPS systems are ideal to address. "Sometimes the traffic signal conflict monitor can mistake power fluctuations for a conflicting signal, which is less likely to happen where you have the continuity provided by the UPS."

Remote control

Power availability and quality at remote ITS sites are known to compromise equipment reliability and performance. Inadequate, unreliable or unavailable power may also result in service personnel being sent out to diagnose problems. This is an especially crucial consideration when demands peak during summer and winter months and cause fluctuations in nominal AC.

Designed in response, Ablerex's MS RT2000 ITS UPS fits in the smaller cabinets and enclosures used in many ITS applications. It features internal batteries, LED control/display, front-mounted duplex receptacles, a twist-lock anti-vibration input plug and a standard SNMP/Ethernet interface.

"Jurisdictions would often say they lacked the room inside cabinets for a traditional traffic UPS and wanted an integrated solution with all the benefits but no space restrictions," reveals Mike Mayhue from TechPower Developments Inc, a strategic partner with Ablerex USA in this project. "There is a valid concern that in non-urban locations, many of their cabinets were at the end of long runs of AC conductors; the voltage might be much less than the desired 120V AC, which can occur with voltage drop and decreased efficiency."

The MS RT2000 ITS is a double-conversion true-online UPS. It continuously provides conditioned uninterrupted power to the cabinet loads, even if the voltage is as low as 80V AC during power demands as well as aberrations in the electrical system.

"Ethernet/SNMP connectivity is increasingly important in ITS," Mayhue adds. "Even using line-of-sight, radio communications can be Ethernet/SNMP based to retrieve information from ITS and forward it to the next unit in the chain and then back to the TOC."

For Burt, though, a key challenge is not so much the UPS and battery back-ups themselves but the environment in which they're operating: "We have equipment rooms off to the sides of the tunnel and it's imperative we keep these rooms clean and cool. It's really dusty down there; carbon dust off the tires isn't much good for the electrical equipment and we also have a lot of heavy goods traffic, grain transporters, etc, leaving dust. Barley dust is especially fine."

Rural response

Regarding the wider roads network under the remit of the NRA, Burt's colleague, David Laoide-Kemp, says that the UPS and BBS were initially brought in about five years ago to address temporary outages to ITS equipment, especially in rural areas: "The outages weren't necessarily bringing operations to a halt but maintenance contractors had to attend the site each time they happened as they didn't know what the problem was. This resulted in many 'no-fault-found' visits – something that has reduced considerably following the adoption of UPS. We can now confirm that the power is actually off because there's an intrinsic monitoring device that remains online and can send an alert." Another factor identified by Laoide-Kemp as beneficial is the way UPS systems level out peaks and troughs in the power supply.

Fueling the future

Away from actual deployments, there's a great deal of work being done in the field of alternative forms of energy. "We got into the traffic market with our EFOY Pro fuel cells because of the demand for off-grid and temporary energy," reveals Dr Peter Podesser, CEO at SFC Energy AG.

"What we bring is added functionality – we're providing weather- and climate-independent battery charge functionality from fuel cells," says Podesser. "All in all, this makes it a better hybrid solution. In the case of road weather stations such as those in Austria, even when their solar panels are covered with snow, a combined system incorporating fuel cells ensures the timely delivery of mission-critical, life-saving information to authorities."

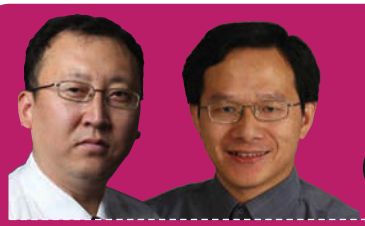
> "Ten liters of methanol is the equivalent to 11kWh of energy. You would need more than 250kg of standard lead acid batteries to produce this amount of energy"
>
> **Dr Peter Podesser, CEO at SFC Energy AG, Germany**

(Left) **In the Dublin Port Tunnel, UPS provides back-up for critical systems and equipment** (Inset) **The UPS systems support designated control, communications and lighting systems in the event of failure** (Top right) **ITS application of the EFOY Pro fuel cell power supply**

An area that makes fuel cells stand out is their ability to prolong the runtime of a system based on the energy density: "Ten liters of methanol is equivalent to 11kWh of energy. You would need more than 250kg of standard lead acid batteries to produce this amount of energy," Podesser estimates.

Technology matters

The trend toward more sustainable options could widen the scope for UPS deployment in the UK, in Keith Manston's opinion. "With the advent of LED signals, power consumption has fallen enormously – perhaps only 25% of the amount that incandescent signals use – while battery technology has got better," says the head of product management for Siemens Traffic Solutions. More capable options such as lead crystal batteries are having a positive impact: "These have a higher power density so there is greater support time out of the



Power in motion

In New York, some clever people are looking at an emerging and potentially radical new approach to power generation for traffic monitoring: on-road energy harvesting (see page 42).

Energy is a huge part of transportation, states Jeff Ban (above left) from the Rensselaer Polytechnic Institute, a member of the research team. "Our idea is trying to help transportation to support itself. In many areas, power isn't readily available or they suffer from power outages. Motion and vibration generates lots of energy that is currently just wasted and we want to try to harvest and use this wasted energy in a meaningful way."

Being around the size of a traditional wireless sensor, the harvester the team is developing should be relatively easy to install in the roadway. Such dimensions would make it a viable proposition to power sensors and potentially traffic signals, either as a back-up or a primary power source where the grid isn't available.

Lei Zuo (above, right) is the principal investigator for the project from the State University of New York at Stony Brook: "Essentially you can put our solution any place where there is a vehicle passing over and have 'free' energy," he says. A full-scale prototype is being built and tested. The amount of energy produced depends on the weight of the vehicle and the speed it passes over the top: "I estimate that we can generate in the order of 10-100W. Piezoelectric pads harvesting energy on the road might only obtain a micro watt, which is really too small and too expensive. For this reason, we opted for a new electromagnetic energy harvesting design instead."

battery. They also provide a longer life than traditional lead acid batteries."

Manston says there is a growing recognition that specifying long periods of support time – say 24 or 48 hours – is excessive given the cost of batteries: "A better approach is to specify the UPS to give just enough breathing space," he says. "This might be a case of putting out signs and guarding around the intersection or to bring along a generator to plug in to the UPS."

Selection process

As to specific breeds of UPS, Manston says there are essentially two approaches: "One is double-conversion UPS, which gives a very precise output voltage that is very well controlled, although the converters are going all the time so you're always losing power in the process." This type of system isn't really necessary for a traffic controller that's designed to connect to the mains and experiences the normal ups and downs of the main voltage. A line interactive unit is his preferred choice. "Once the batteries are charged, it transfers the incoming supply directly to the load, hence higher efficiency. Even if the UPS has to assume the load 5% of the time, which would be unusual, you're still looking at 97-98% efficiency."

"It should be remembered that UPS stands for uninterruptible power supply," says Craig Bolden from California-based Clary Corporation, offering some further considerations for DOTs when selecting a solution: "This means providing clean, consistent power, without interruption. BBS units don't meet this standard. Another factor is whether power is converted and then regenerated." He also says units should satisfy NEMA standards for temperature (-40 to +74°C) and vibration. And a final piece of advice is to check the UPS runs on fluctuating voltage and frequency without switching to battery or outputting fluctuating voltage and frequency.

Questioned about the advances he is witnessing in UPS, Bolden says increased processing power has brought better voltage and frequency regulation as well as features such as datalogging and user-friendly displays. "Power densities have also improved, enabling a smaller footprint, and lower power units are available to meet the requirements of most ITS assets."

As with much of our modern world, the more we rely on technology the more vulnerable we become to any disruption to the power driving the systems – and ITS infrastructure is no exception. The good news is that where DOTs are seeking to minimize the impact of any disruptions at key transportation corridors and intersections, there's a growing range of practical UPS and BBS options so that when the power cuts, the systems keep running.

> With the advent of LED signals, power consumption is perhaps only 25% of the amount incandescent uses, and battery technology has got better
>
> **Keith Manston, head of product management, Siemens Traffic Solutions, UK**

(Left) **Clary UPS are listed by many states as the preferred UPS system for traffic intersection back-up** (Below) **Siemens UPS ensure full traffic control is maintained during mains failures**

What happens next?

Once a product has been tested and evaluated, it's time for the proof-of-concept phase. "In our case, a limited deployment will take place to show the benefit of the product to Caltrans practitioners," reveals Fred Yazdan from the Advanced Testbed Program Branch of Caltrans. "At this stage, the research team will work with potential end-users to select the site and to conduct pilot testing under real-world operating conditions. Test specifications and standards are developed, research assistance is provided to ensure proper installation and operation, and problems are corrected and adjustments made as necessary to complete pilot testing."

Upon successful completion of the POC phase and depending on the type of product being developed, two distinct paths can be followed. If the product is a device tested in the Detector Testbed, the final phase of deployment will be to go through the Caltrans' New Product Evaluation Process whereby a set of specifications are written so Caltrans can procure the device in the open market. If, on the other hand, it's a software tool that may need to be integrated into an existing Caltrans process – or is a new tool that's not been used before – a more elaborate Feasibility Study Process will be followed to satisfy the IT requirements. "This may take several years to complete depending on the complexity of the software tool," confirms Yazdan.

Process of approval

The proving grounds of today are the perfect real-world laboratories to put the intelligent mobility solutions of tomorrow to the test. **Saul Wordsworth** speaks with a handful of the facilities helping to usher in this new era in roadway management

Photographs courtesy of CTMLabs, MIRA & VTTI

MIRA's R&D programs in ITS are focused on developing solutions in the areas of transport information, intelligent vehicles, and intelligent infrastructure

Proving grounds are as old as the automotive industry itself, built to put cars through their paces and test their limits. Proving grounds dedicated to ITS on the other hand are a more modern and rarefied concept.

UK-based MIRA is one of the largest independent automotive proving grounds in the world, with a 96km performance circuit, highly advanced testing equipment and an array of surfaces and conditions. What makes it different – some would say unique – is its 2km Cityscape Urban Test Facility, a stretch of circuit dedicated to the testing, validation and demonstration of cooperative vehicle-highway systems.

"In the past, all of the sophisticated components in the car were tested in

isolation," explains Tim Edwards, principal engineer at the Warwickshire-based facility. "We can still do component tests around other parts of the circuit or in test chambers but when it comes to the more integrated systems, the car needs to be placed in an environment akin to a real urban layout, with road signs, gantries, traffic, etc.

"The trend in the future will be one of convergence," Edwards adds. "Intelligent cars are starting to interact with the traffic systems around them, which means the test facilities we use from an automotive perspective will become very closely aligned to the test facilities for ITS and traffic management systems.

"Different places around the world deal with this in their own way. It is not unusual to gather data from live field trials or by building specialist facilities to evaluate specific characteristics in detail. I don't fundamentally disagree with this but for me it's best to take the components and validate them, then integrate systems and validate them in a safe and controlled environment before you look toward field trials.

"A safe controlled environment is quite a challenge to create now there are so many different data sources," Edwards adds. "What we've tried to do with our city environment facility is futureproof ourselves while securing as many different functionalities in one place that can be reconfigured. I don't know of any other place like this in the world.

MIRA's urban canyon, for instance, was recently used to test the interoperability of different eCall systems. "The trial was a success and we expect more in the future," says Edwards. "Public trials are often the final testing phase undertaken here. It's vital when looking to change the characteristic of a traffic signal or of a vehicle to solicit unbiased evaluation from the public."

California scheming

Established in 1991 with support from Caltrans and the FHWA, the California Traffic Management Laboratories (CTMLabs) is a research facility developed for the purpose of testing, demonstrating and evaluating new traffic technologies to help improve the safety and efficiency of California's transportation network.

"It's a real-world, real-time laboratory within the University of California, Irvine campus, and provides intelligent computer-assisted traffic management and traffic data communication capabilities across arterial and state highway networks," explains Fred Yazdan from the Advanced Testbed Program Branch, Caltrans. "Our Detector Testbed is a permanent facility, the aim of which is to develop and evaluate emerging traffic detection and active traffic management technologies. It also helps with advanced capabilities to assess the performance of many different types of non-intrusive roadway detectors, innovative ways to conduct travel-time and origin-destination studies using available real-time traffic data, and an environment to carry out innovative corridor management studies such as adaptive arterial signal control."

The Detector Testbed is spread across two sites. The Irvine Detector Testbed is on the northbound I-405 and comprises an instrumented eight-mile freeway section along with a parallel

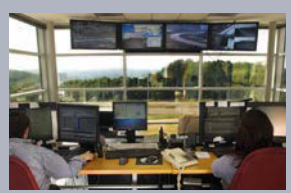
MIRA's living laboratory, which until March of this year belonged to innovITS, offers real-time vehicle monitoring, modern communication technologies, cellular networks, fully configurable wireless networks and dedicated V2V and V2I communications

> The trend for the future is one of convergence… Intelligent cars are starting to interact with the traffic systems around them
>
> **Tim Edwards, principal engineer, MIRA, UK**

Smarter than the average road

At the Center for Sustainable Mobility within the Virginia Tech Transportation Institute (VTTI), laboratory trials and live tests are combined with their own private two-mile-long smart road.

"By using a lab, testbeds and proving ground we get the best of all worlds," feels Hesham Rakha, senior professor at VTTI. "We do our initial testing in a simulated environment then move on to our smart road where we can manage the environment or alternatively the testbed,



before switching back to the lab for further simulations to examine the network-wide benefits."

The Virginia Smart Road is a private controlled environment built to Federal Highway standards. It is designed for both ITS and safety research, and is highly adaptable. Not only is it capable of making fog, mist and rain, it can produce up to 4in of snow per hour. Furthermore, a lighting test bed comprising 38 overhead light poles is able to simulate nearly all lighting conditions in the USA.

The road is equipped with a fiber-optic data system, RWIS sensors and a wireless network that links itself to the research building. This network can transfer data between the vehicle, the building as well as the road infrastructure.

Field analysis

The California Traffic Management Laboratories recently tested newly developed Portable Traffic Monitoring Devices (PTMD) known as iCones. These can be placed in workzones at short notice and are able to transmit average speed information to a web server, which can be viewed in real time by any standard web browser.

In this quantitative test, the portable iCones' speed measurement accuracy was compared directly against that of conventional inductive loop speed traps located in the Berkeley Highway Laboratories Detector Testbed. After the successful completion of the tests, the iCones were used to measure average speeds of vehicles traveling through various workzones in a series of studies to determine the effectiveness of automated radar-activated signs as compared with California Highway Patrol enforcement in slowing traffic and increasing worker safety.

arterial street. The Berkeley Highway Laboratories Testbed, meanwhile, is located on I-80 in the San Francisco Bay Area – an instrumented 2.7-mile freeway section that contains double-loop detectors, instrumented roadside stations and a robust wireless network for data transmission to CTMLabs.

Testing and analyzing

"In these Detector Testbeds there are several different types of detection equipment," continues Yazdan. These include inductive loops, wireless magnetometers, video image processing, ultrasonic detectors, and side-fire radar detectors looking at passing vehicles. "Each detector sends a contact closure or DC voltage change output to a custom-designed data-acquisition system for each vehicle that is detected. This then triggers the system to record a time-stamp, lane number and a JPEG image of the vehicle taken from cameras that are mounted above on an overpass spanning the detection area.

"Once the data for each vehicle has been collected and evaluated, a software program running on the system automatically correlates the detections from the different detectors, tallies the results and displays a comparative analysis of the detection accuracy."

So far, devices that have been tested and evaluated include those from familiar vendors such as Sensys Networks, Wavetronix, Image Sensing Systems (RTMS), IST Detector Cards (from Inductive Signal Technologies, Inc), and iCones (see *Field analysis*, above).

Texan technology

To the east of CTMLabs, the Texas Transportation Institute (TTI) has a great tradition in product testing and development and is where the life-saving Extruder Terminal guardrail was first created. When it comes to traffic management and ITS, the institute has several development testing facilities, including its TransLink laboratory, a freeway sensor testbed and an arterial railroad corridor. "The TransLink Gilchrist Laboratory is still the only facility of its type in the country, despite opening in 1999," says Dr Chris Poe, assistant agency director at TTI. "Here, ITS professionals can conduct research within an environment designed to mimic a TMC."

Based in TTI's Gibb Gilchrist Building at the Texas A&M University Research Park, TransLink was developed specifically to accommodate the multimodal integration of ITS infrastructure and solutions. "With an installed base of roadside equipment, computers and communications infrastructure, the lab is able to support the design, development, testing, implementation, and long-term operations needs of virtually any project," Poe adds.

A further example of TTI and TransLink's innovation is what it calls its hardware-in-the-loop (HITL) simulation testbed, in which a microscopic simulation model is linked with field equipment. This converts digital events in a software simulation into physical events that can be hardware-recognized.

HITL has been used to optimize existing signal systems, improve algorithms used in response to arterial or corridor traffic situations, research methods for hastening emergency service response times and develop mechanisms for examining freeway performance measures in real time.

Last words

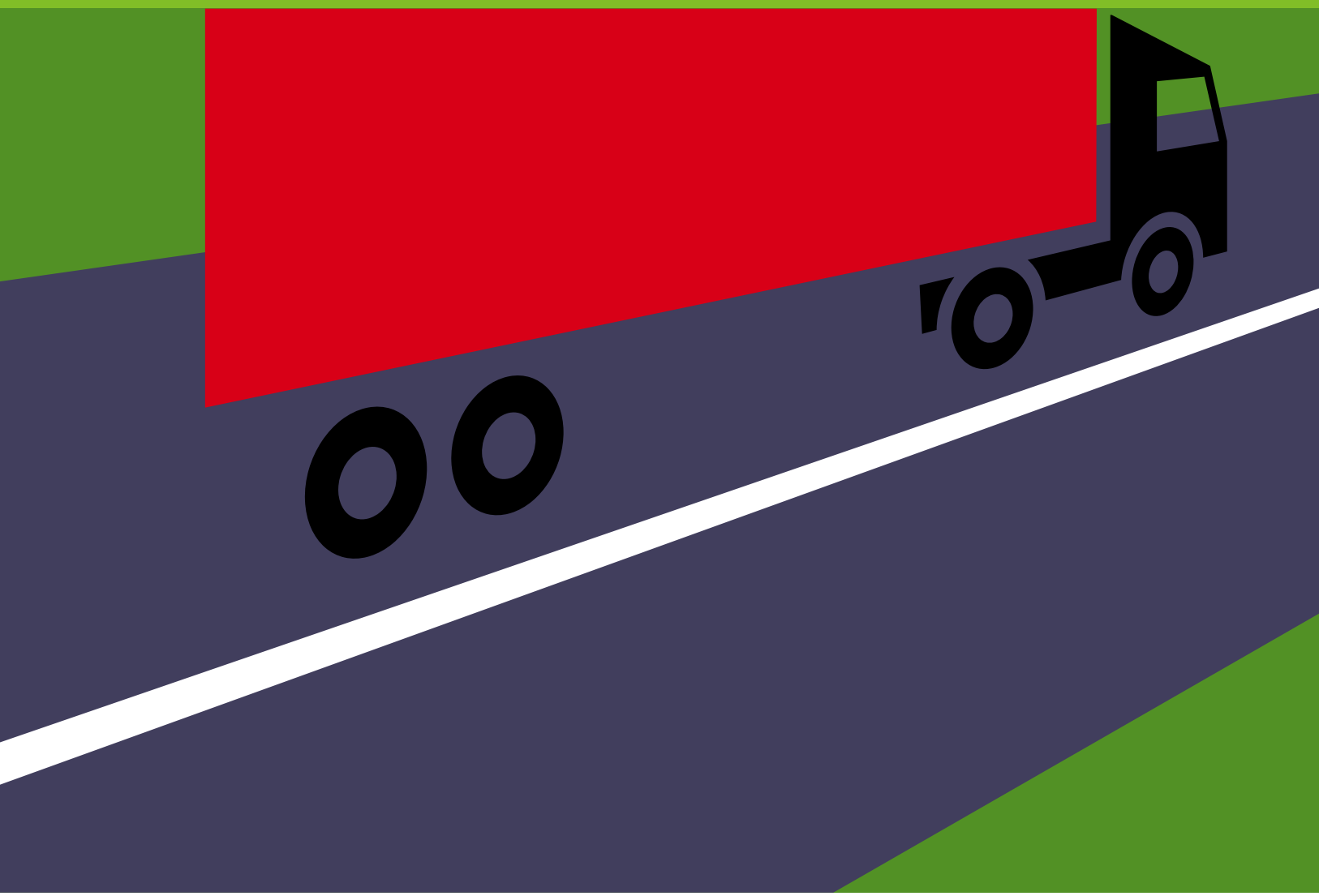
Not all countries or organizations can afford a dedicated ITS proving ground, with some preferring to analyze on the fly. What's key is making the most of what you have. "We don't want to mandate putting sensors on every street corner," concludes MIRA's Tim Edwards. "The answer for us is not to rely on new infrastructure or vehicle programs but to do as much as possible with the systems already in existence."

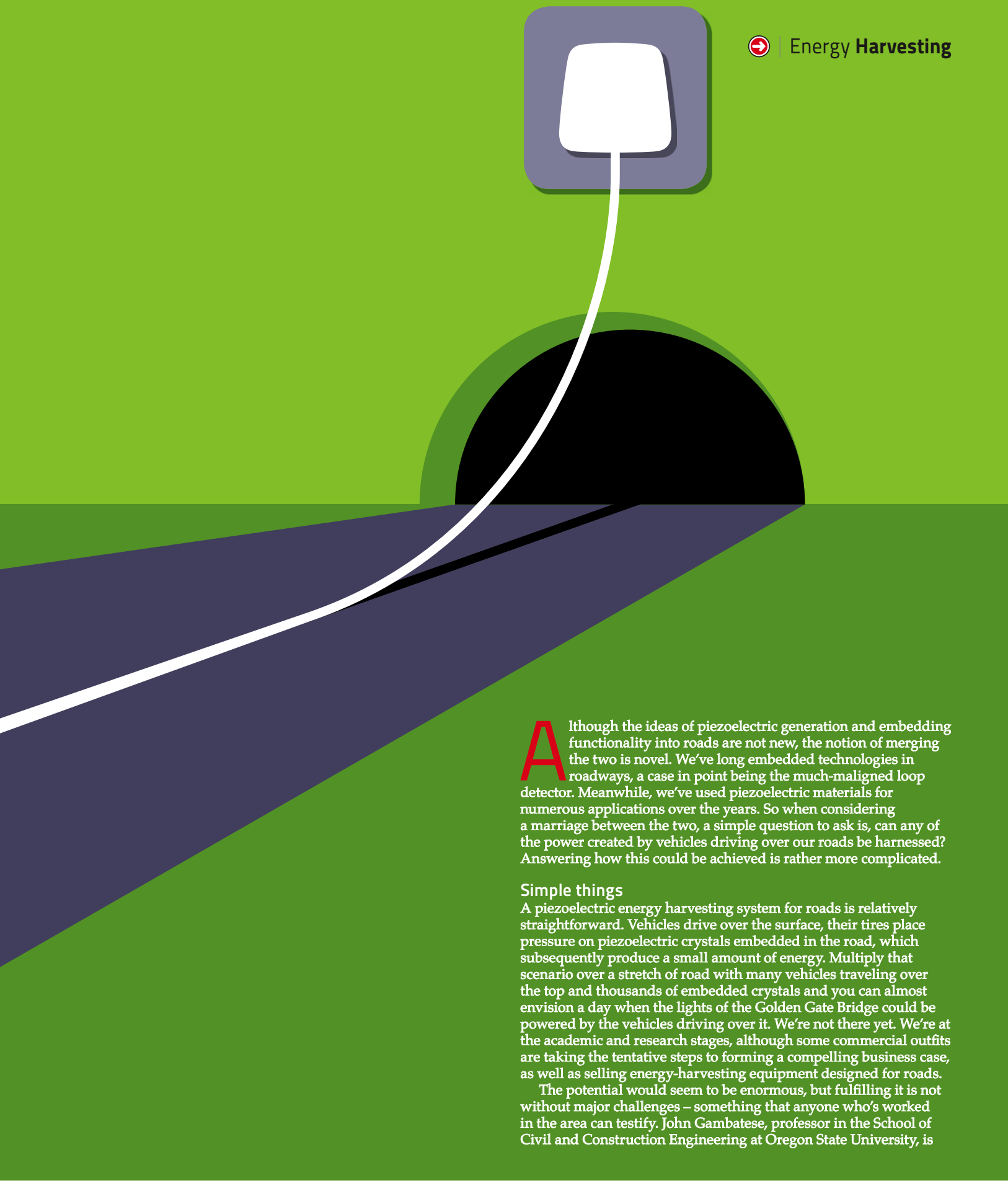
MIRA's Cityscape test track environment is designed to develop, validate and demonstrate new intelligent mobility innovations

Harvest festival

The energy produced by vehicles driving on our roadways is a potentially huge source of untapped electricity. **Louise Smyth** meets the people who will have cause to celebrate if the concept sparks into life

Illustration courtesy of Patrick George





Although the ideas of piezoelectric generation and embedding functionality into roads are not new, the notion of merging the two is novel. We've long embedded technologies in roadways, a case in point being the much-maligned loop detector. Meanwhile, we've used piezoelectric materials for numerous applications over the years. So when considering a marriage between the two, a simple question to ask is, can any of the power created by vehicles driving over our roads be harnessed? Answering how this could be achieved is rather more complicated.

Simple things

A piezoelectric energy harvesting system for roads is relatively straightforward. Vehicles drive over the surface, their tires place pressure on piezoelectric crystals embedded in the road, which subsequently produce a small amount of energy. Multiply that scenario over a stretch of road with many vehicles traveling over the top and thousands of embedded crystals and you can almost envision a day when the lights of the Golden Gate Bridge could be powered by the vehicles driving over it. We're not there yet. We're at the academic and research stages, although some commercial outfits are taking the tentative steps to forming a compelling business case, as well as selling energy-harvesting equipment designed for roads.

The potential would seem to be enormous, but fulfilling it is not without major challenges – something that anyone who's worked in the area can testify. John Gambatese, professor in the School of Civil and Construction Engineering at Oregon State University, is

one of those researchers. Hot on the heels of Oregon's successful solar highway deployment, he submitted his *Research Problem Statement* on energy harvesting for roadways to Oregon DOT at the end of 2012. "We leave a lot of energy on the road in different ways," he says. "Whether it's the vibration on a bridge or roadway, or the wind produced by the traffic, there's energy there that can be harvested. It might only be a small amount at each location but when you add it up, it could help to power our traffic infrastructure, our streetlighting, or other electrical requirements we may have."

So if that goes according to plan, what about selling the surplus back into the grid? "For now we're just trying to develop the technology so we can start collecting energy," Gambatese says. "Once we do that, we can monitor how much we obtain and then there's a chance we can optimize the technologies with the goal being to feed electricity back into the grid. Whether or not we'll have that capability in the next five to 10 years, though, I'm not so sure."

From research to reality?

The **FHWA** is funding work on energy harvesting for roads, indicating that it sees some future potential in the concept. The Administration's **Eric Weaver** reveals how the testing is being conducted and what the initial results have shown

The Virginia Tech Transportation Institute (VTTI) is a notable presence in the testing of piezoelectric energy harvesting for roads and is currently involved in a US$1m FHWA-funded project. The stated aim isn't to assess commercially available systems but to put a VTTI-developed system through its paces.

The research is being overseen by Eric Weaver, a research civil engineer in the FHWA's Office of Infrastructure, R&D, and an expert in this sector. "We are currently exploring the potential," says a cautiously optimistic Weaver about the technology. "Our initial research indicates that the amount of energy harvested might be modest but could theoretically offset some utility costs or provide power in areas that are currently inaccessible to the grid."

Like many people in the field, Weaver foresees any power generated being used only where it is harvested, for the short term at least. "It's meant to provide energy within the right-of-way to be used for transportation infrastructure demands," he continues. "However, depending on the application and the infrastructure demand, excess energy could potentially be transferred back to the grid, provided that the electric grid infrastructure is updated to enable this.

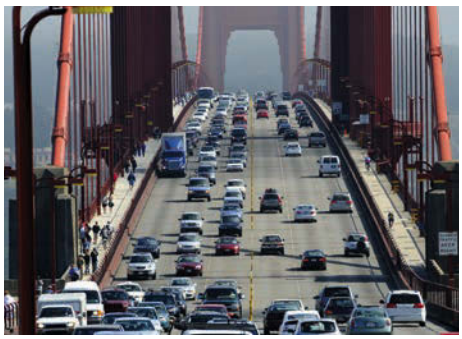
> "Depending on the application and the infrastructure demand, excess energy could potentially be transferred back to the grid

"Our work has involved a significant amount of analytical modeling, as well as laboratory trial and error with different geometric configurations of piezoelectric generators and the materials that encase them. Virginia Tech researchers have installed some sensors at two locations in the state, one of which is at a truck weigh station and the other at a full-scale test road called the VA Smart Road."

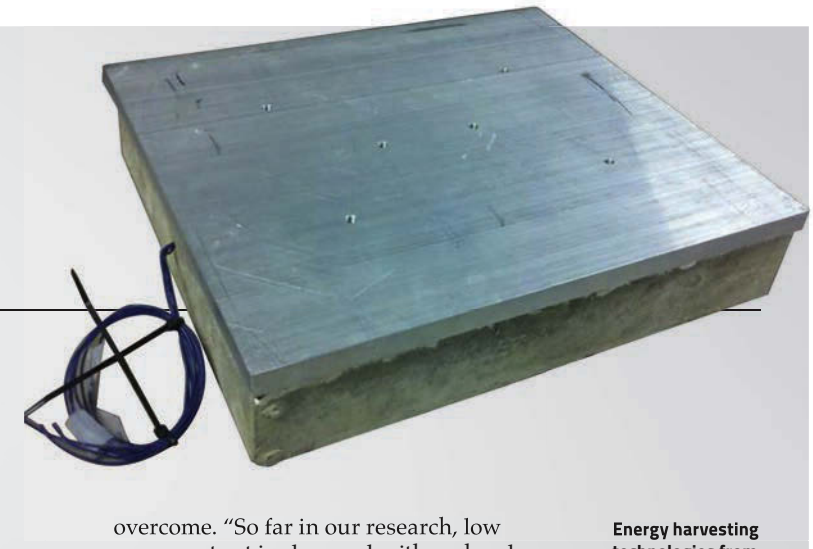
Interestingly, for comparison purposes, researchers also installed some sensors

from the Israeli company Innowattech in at least one of those locations.

Although Weaver reveals that the results so far are perhaps not as encouraging as vendors or proponents of the technology might hope, the work is helping to identify teething problems that can likely be



(Main) **With more than eight million lane-miles of public roadway under US state DOT supervision, such locations have the potential to generate substantial amounts of renewable energy** (Left, top) **Harvesting low-frequency and low-amplitude vibration energy from bridges is entirely feasible and has been demonstrated** (Left, bottom) **Harvested energy could be transferred back to the grid or used for specific public infrastructure purposes such as lighting and traffic management tools**



overcome. "So far in our research, low power output is observed with each axle load application. Part of the reason for this is that the wheel load doesn't always pass directly over the generator, because they're centered in the wheel path, where the wheels don't consistently track. To mitigate this problem, researchers are exploring other generator geometries that provide more spatial coverage."

"The sensors have been rugged enough so far to hold up to the traffic loading they have received," Weaver continues. "A further benefit is that the data from this project has been used to support another study performed for the California Energy Commission to evaluate the feasibility of all piezoelectric generation technologies currently on the market."

Energy harvesting technologies from road infrastructure is a new territory of research encompassing technologies that capture the wasted energy on highways, then accumulate and store it for later use

Regardless, the proposition of gathering essentially 'free' electricity to power ITS is attractive to DOTs. And there's a great business case for lower operations and maintenance costs, for instance, by producing energy to power streetlighting. "Other issues have emerged and we need to look into these," Gambatese adds. "Installation for one: where should the harvesters go and how much will they cost? Maintaining them could also be problematic. We repair our roads regularly, so what impact will that have on what lies beneath the surface? These are aspects we are yet to figure out."

Until Gambatese receives more funding for his research, he and, indeed, Oregon DOT won't be able to address these areas. He also acknowledges a limitation of energy harvesting that's both obvious and possibly insurmountable enough to keep the purse strings closed for now: energy density. "If you deploy energy harvesters in rural areas, they're not going to be anywhere near as effective as on busy highways or in urban areas as vehicle density is so much lower."

And even in urban areas, such a system wouldn't be without its flaws: "If the traffic is moving freely, that's a good thing. But congestion isn't as you need the vibration that vehicles produce to create the energy."

Despite these obstacles, Gambatese feels the rewards could still be well worthwhile. There's a clear business case for combining energy harvesting with solar power, for instance, to commercialize an energy harvesting system, with a simple back-up or complementary technology possibly all it takes to bring such a technology to the mass market. "Or you could combine piezoelectric energy harvesting with wind power," Gambatese notes. "As you drive, you car creates wind, so there could be some wind generation too. Another application might be on a bridge. If you stand on a long-span bridge, you can feel there's quite a bit of vibration. We obviously have fewer bridges than lane miles of roadway, but there could be more potential for harvesting energy from our bridges."

> If the traffic is moving freely, that's a good thing. Congestion isn't such a good thing because you need the vibration that the vehicles produce to create the energy
>
> **Professor John Gambatese, School of Civil & Construction Engineering, Oregon State University, USA**

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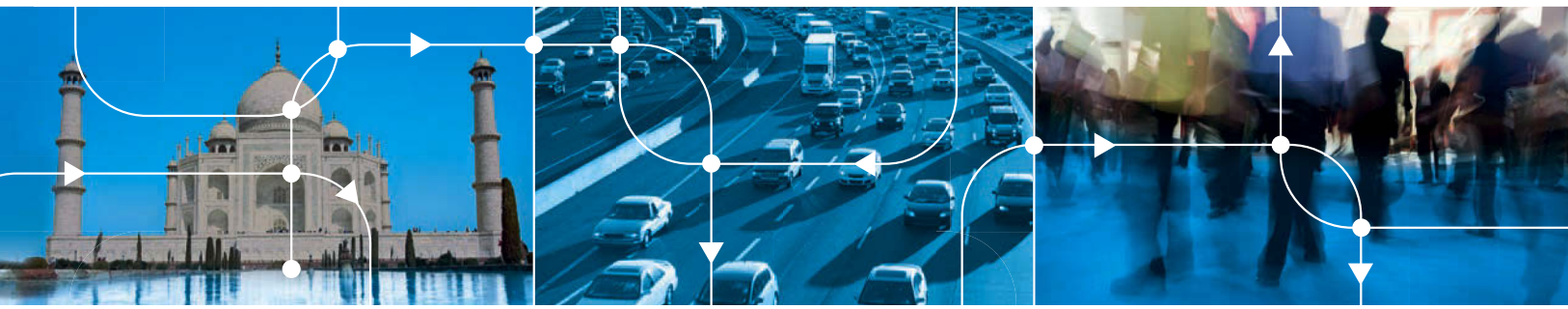

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Decelerate to generate

USA-based company New Energy Technologies is working on a number of solutions to harvest the available kinetic energy present in moving vehicles and convert it to sustainable electricity. Its MotionPower system is available in three variants – Express, Auto and Heavy – all of which are designed to capture the energy from decelerating vehicles. This means the systems need to be installed at sites where vehicles are slowing down to a stop, so locations such as toll booths, intersections and even drive-thru restaurants are a natural fit for the equipment.

The MotionPower technology is what's known as a peristaltic energy harvesting system, which relies on passing vehicles driving along a contiguous deformable roadway surface. That surface then compresses a 'fluidizing' system that interacts with mechanical fixtures to produce electrical energy.

New Energy Technologies states that power production is enhanced when vehicles traveling at speeds of more than 15mph pass over the system. To highlight how much energy its system could generate, the company says an 1,800kg car traveling at 7m/sec (15.7mph) must dissipate approximately 44,000J to slow to a stop. Assuming six seconds to stop, that would result in 7,300W of power (from operating to a complete stop). The potential? When 300 automobiles traveling at approximately 15mph come to a stop, enough kinetic energy could be dissipated to generate electricity to light up 0.12 homes. For comparison purposes, a 4kW solar PV system lights approximately 0.13 homes.

Selling points

If there is such a thing as an established vendor in such a fledgling field, Innowattech is undoubtedly one of them. Based in Israel and conducting a great deal of testing at the Haifa-located Technion-Israel Institute of Technology, the company is actively marketing energy harvesting products for roads. Under the guidance of president and founder Haim Abramovich, a professor at the Technion Institute, his team has created the IPEG (Innowattech Piezo Electric Generator).

In Innowattech's own testing, Abramovich says that 1km of road equipped with its harvesters can produce 200kWh of electricity, or 1MWh from a four-lane highway. A neat illustration of what this amount of power could achieve, sadly, never happened, but could have seen a roadway test with drivers reading VMS powered by their own vehicles. Similar to the research arena, the practical side of testing such technology has also been fraught with delays and hurdles. Although frustrated by this situation, Abramovich is nonetheless pragmatic about the time it will take to see real progress. "It's a young technology and there's a reluctance on the part of road owners. At the moment the initial investment is too high to provide an attractive ROI. And it's a renewable energy that doesn't perhaps have the same sex appeal as solar or wind. It's getting there but it's going to take time to convince people to use it."

That's not to say Abramovich doesn't have some convincing arguments to persuade people of the merits of his solution. "For certain applications it makes very good sense, such as when you don't have access to the local grid or where you're not allowed to rely on the local grid for security reasons. Harvesters can also work at night, which is an advantage over solar-powered technologies.

> This form of a renewable energy doesn't yet have the same sex appeal as solar or wind power. It's getting there but it's going to take time to convince people to use it

Haim Abramovich, professor at the Technion Institute (Innowattech), Israel

Innowattech is looking at commercializing its energy harvesting technology with a solution for truck weighing stations, staging this trial in Virginia

"In the beginning we thought about harvesting the energy and selling it back to the grid, but the output isn't so big, so harvesting enough energy to make that viable would require a hell of a lot of investment. You'd have to cover every inch of the road, for instance. So we took a step back and said, 'Okay, if it's going to be about selling energy back, it could be an instant solution for specific sites'."

The cost of installation is the biggest hurdle holding back energy harvesting roads, in Abramovich's view. And having, in his own words, been "burned" before by offering estimates about the costs of installing and maintaining the Innowattech system, he now prefers not to throw figures around liberally. He does admit it isn't going to be cheap however. But can it ever be cost-effective? "When the price of 1kWh is three or four times what it is today, then I would say 'yes'," he replies. "But we're looking at what we can do to make the technology more competitive in terms of price. Today roads need to be closed while generators are installed but in the future, roads could be built with generators embedded from the outset, which would massively reduce the initial investment."

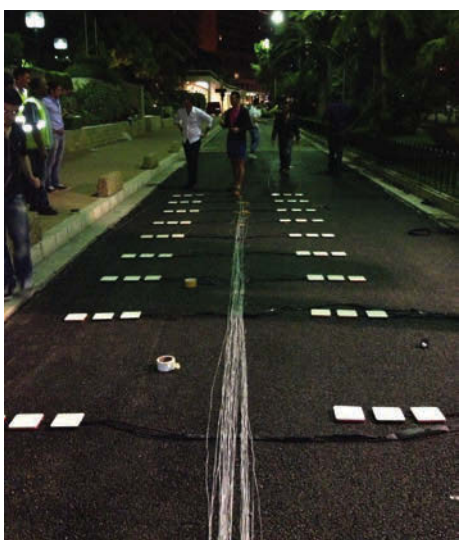
In the shorter term, Abramovich is taking a slightly alternative route to ensure commercial success. Following a successful deployment at a truck weighing station in Virginia, USA, Innowattech is now selling a weigh-in-motion (WIM) system, an entirely self-contained system that powers itself.

The trucks driving over the sensors provide the energy needed to monitor their output and send the vehicle data to a central control unit. Piezeoelectric sensors are a mainstay of WIM, so it's a natural fit for Innowattech's technology. "Our IWIM system doesn't need any extra batteries like other systems. We can measure the weight while a truck is in motion, take an image of the license plate via our connected camera and then combine the weighing process with our generators – it's self-sufficient."

Not only but also...

One of Innowattech's main competitors is also seeing some success in bringing energy harvesting to roads: Colombia-based Treevolt, headed up by Esteban Ramirez. "I think widespread energy harvesting on roads is a reality, but the big issue is establishing just how much energy we can harvest and how profitable this business could be," Ramirez observes. "But in the next five years I think we'll see more developments and pilot projects from companies, research centers and universities that will create the environment for future progress." Ramirez is determined to be in this for the long haul. "Any alternative energy takes time to reach an economically sustainable level," he says.

In a similar vein to Innowattech, Treevolt is looking at commercializing energy harvesting for roads by merging energy production with an existing ITS application. "Our sensors, for instance, can gather road information such as vehicle speed, traffic conditions and state of the pavement in real time. Each source of energy can be a potential source of data," Ramirez explains. "The harvesters use the vehicle's weight and motion (compression) to generate energy pulses, each of which is optimized with custom electronics and transmitted to the batteries."



Despite the political and even cultural challenges ahead of him – Ramirez believes governments should lead the way in promoting and enabling renewable energies – the Treevolt CEO doesn't foresee a huge problem with cost efficiencies, so long as more action occurs. "Energy harvesting developments are part of the wider electronics and electric market, where we're seeing prices of products coming down all the time and companies getting more profitable each year. As soon as we can link these projects to road construction scheduling, that will greatly lower the costs of projects. And as soon as we start to see more projects using the mechanical energy of cars, we'll get closer to the real data on cost efficiency."

> "As soon as we can link these projects to road construction scheduling, that will greatly lower the costs of projects"
>
> **Esteban Ramirez, CEO, Treevolt, Colombia**

Treevolt's technology not only enables energy to be harvested from roads, but also has a real-time grid that senses speed, temperature, weight, humidity and other parameters

By the end of 2013, Ramirez says there will be 1km of Treevolt-powered piezoelectric roads in operation, due in part to test sites in the USA and a partnership with a company called PowerLeap that is helping bring Treevolt harvesters to North American roads.

Ramirez also reveals that a first-of-its-kind European project has just gone live. "Working with Green Heart Monaco, we have just released the first public showcase pilot," he enthuses. "This is a real road generating energy to power electronic devices, such as street warning lights and a screen showing the energy generation. The pilot is located at the Avenue Princess Grace in Monte Carlo."

Further deployments such as these are crucial if we're to validate the true potential of energy harvesting for roadways – as John Gambatese puts it, to "put some research behind the manufacturers' claims". Pioneers such as Abramovich and Ramirez have supreme faith and would welcome further trials and tests with open arms.

The real deal for California?

Traffic moving over the surface of a road – and lots of it – is an absolute must if energy harvesting is to realize its full potential. "Just think how much energy we could create if we were able to harness some of the wasted energy produced by cars and trucks as they rumble down our roads," says Los Angeles democrat Assemblyman Mike Gatto, who has been advocating the technology for California for more than two years.

Gatto, *pictured above*, is a big fan of the concept and authored bill AB 306, which passed the legislature in 2011 with bipartisan support but was eventually vetoed by Governor Jerry Brown for funding reasons. He advised Gatto to work through the California Energy Commission's grant process to obtain the necessary cash to pursue his electric dream.

In December 2012, Gatto secured that funding and is now hoping that California can join the ranks of nations actively seeking piezoelectric roads. "Thirty years ago, very few people would have believed that black silicon panels left in the desert could generate solar power," Gatto says. "And 10 years ago, people were skeptical about Bluetooth. This technology is very real."

The plan moved a step closer in January 2013 with the publication of a 93-page consultant report, *Assessment of Piezoelectric Materials for Roadway Energy Harvesting: Cost of Energy and Demonstration Roadmap*, for the CEC.

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Speed demons?

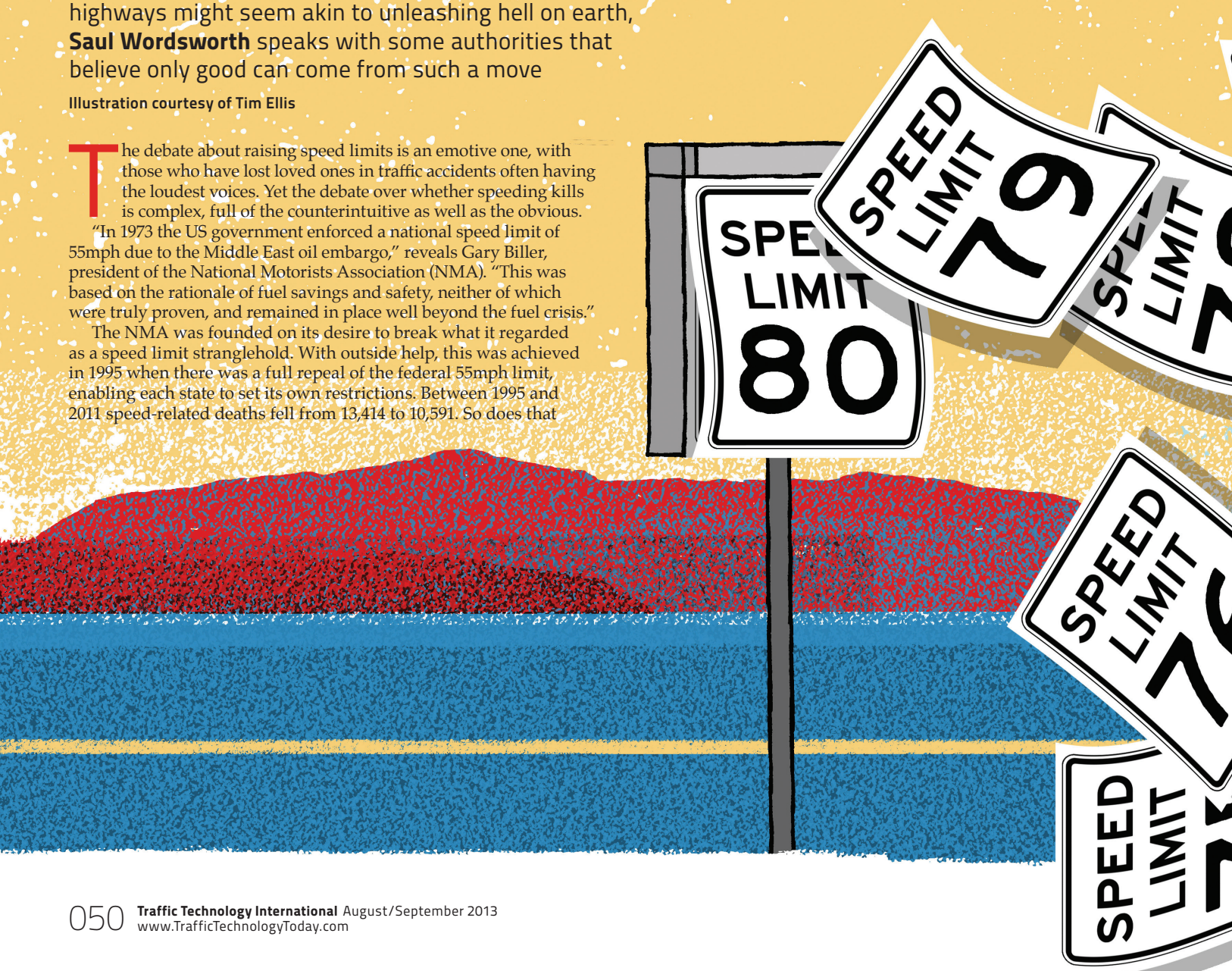
Although to some people raising speed limits on our highways might seem akin to unleashing hell on earth, **Saul Wordsworth** speaks with some authorities that believe only good can come from such a move

Illustration courtesy of Tim Ellis

The debate about raising speed limits is an emotive one, with those who have lost loved ones in traffic accidents often having the loudest voices. Yet the debate over whether speeding kills is complex, full of the counterintuitive as well as the obvious.

"In 1973 the US government enforced a national speed limit of 55mph due to the Middle East oil embargo," reveals Gary Biller, president of the National Motorists Association (NMA). "This was based on the rationale of fuel savings and safety, neither of which were truly proven, and remained in place well beyond the fuel crisis."

The NMA was founded on its desire to break what it regarded as a speed limit stranglehold. With outside help, this was achieved in 1995 when there was a full repeal of the federal 55mph limit, enabling each state to set its own restrictions. Between 1995 and 2011 speed-related deaths fell from 13,414 to 10,591. So does that

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mean faster is safer? Not necessarily – in this multifaceted field, it's tricky to isolate cause and effect – but such statistics are handy weapons to counter the naysayers.

"Obviously, safety technology in cars has improved enormously over the past three decades," concedes Biller. "Roadside emergency care has advanced. Roads and infrastructure are better designed. But you can draw a straight downward trending line on fatalities since 1995. Despite this we still have quite a large group who say 'Speed kills – let's go back to 55!'"

There have been some interesting occurrences during this period. In 2001 it was found that Montana's Interstate highways were twice as safe when there were no daytime limits. And when limits were reintroduced, deaths on interstates went up by 107%, from a record-low of 27 a year to a new high of 56. This became known as the 'no limit safety paradox'. The reason for the lower fatality rates, Biller claims, is that traffic will find its natural free-flowing speed and this velocity is the one at which there is the lowest probability of a collision. All this is based on a 50-year-old theory known as Solomon's Curve, which Biller says still holds up.

(Right) **Lawmakers in Utah overwhelmingly passed a bill that allowed UDOT to raise the speed limit to 80mph on the interstates leading to Idaho, Wendover and St George** (Below left) **President Jimmy Carter discusses the 55mph speed limit, which was an attempt by the federal government to reduce gasoline consumption. Initially passed under President Nixon as the 1974 Emergency Highway Energy Conservation Act, the law was relaxed in 1987 and eventually repealed in 1995**

"Most drivers don't pay attention to posted limits but instead to the traffic around them," he says. "It's clear that most of our limits are posted well below the actual flow of speed."

To that end, a 2012 study by the Transportation Research Board found the majority of US speed limits were as much as 15mph below what the 'safest' speed should be. The recommendation for cities that couldn't afford a proper study was to increase limits by 7mph.

The wild west?

One state that funded such a study is Utah, with a bill passed in 2008 that allowed limits higher than 75mph to be posted. The Beehive State's Department of Transport (UDOT) immediately identified specific rural interstate sections that could be subjected to further analysis with a view to raising limits if the study results proved it was sound and safe to do so.

Pay as you speed

In Sweden more than half of the population admits to regularly breaking the speed limit. So in 2010, insurance group Folksam embarked on a year-long study to try to alter driver behavior through financial incentivization. Using Intelligent Speed Assistance (ISA) , a test group of 141 people was selected, along with a control group of 86 – the carrot being a 30% discount on their premiums. Drivers within the test group received visual warnings when they exceeded the limit and could chart their progress online; the control group received no feedback. Over the course of a year, the control group collectively broke the speed limit 50% more than the test group.

"The main finding was that it was possible to change driver behavior by economic incentive and thereby reduce crash risk," reveals Helen Stigson, research leader and traffic safety researcher at Folksam. "Previous ISA studies have shown drivers tend to revert to old driving behavior after a couple of months. In our study the result was constant, indicating the reward of a premium discount encourages the participants to maintain a low proportion of speeding."

A similar 2012 study by the NHTSA in the USA also found that

financially incentivizing drivers not to break limits was effective. Each time a driver exceeded the limit by up to 8mph they lost US$0.03 from a total pot of US$25 a week. The final results were comparable to Sweden.

"An important factor was that the concept was built around rewards and not penalties," Stigson adds. "This could affect the participants' attitudes toward the concept. The acceptance was high. Nine out of 10 of the participants in the test group found it easier to comply with the speed limit, and 75% were positive toward an insurance product of this kind."

Ultimately, Stigson believes the ideal solution is for the system to be integrated into the vehicle. Euro NCAP will this year implement a test protocol for ISA, which means the basic platform for pay-as-you-speed techniques could shortly be available in most new vehicles.

"We looked for areas with a low history of speed-related crashes and identified two particular segments on I-15," reveals Carlos Braceras, executive director for UDOT. "The data was collected unobtrusively and our preliminary studies showed that the 85th percentile – in other words, the speed at which 85% or less of the traffic is traveling – was approximately 82mph. This is a long-established method first used in the 1960s and denotes the speed at which the fewest crashes occur and is very similar to Solomon's Curve. We also factored in other criteria including roadway geometry, local population and number of interchanges."

A follow-up speed test after the new 80mph limit was in place showed that the 85th percentile speed had increased slightly, by 2mph, but that there had been a 20% reduction in the number of drivers exceeding the speed limit. Of the two I-15 segments, one saw an 11% drop in overall crashes, the other 20%. Neither registered a fatality and the state has since been given broad approval to open up new segments of I-15 and I-80 to this type of investigation.

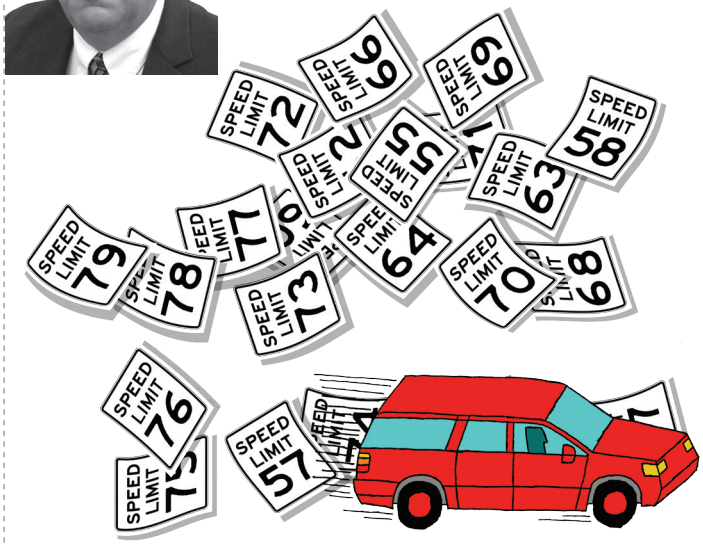
"The process has been well received by the public," Braceras notes. "We were grateful the lawmakers allowed us to take an engineering approach to this. What the study verified is that 85% of people will drive at a safe and reasonable speed. We didn't see the dramatic increase in speed people feared; we just moved the limit to a speed people were already driving. Many still assume a higher limit gives drivers license to drive faster but that's not correct. I was nervous at the start of the process but our engineers are absolutely focused on safety. I always tell people to trust the process."

Utah isn't the only state to stretch its legs in this speed race. In summer 2012, after extensive studies, Texas approved a speed limit rise to 85mph on a 41-mile toll road. Meanwhile, the Ohio Turnpike's first full year at 70mph instead of 65mph, from April 2011, registered six fatalities, the second-lowest annual total in its 50-year history. Other states are expected to follow, while similar proposals are emanating from Queensland in Australia, and from Canada.

British reserve

Conducting an in-depth study into vehicle speed on a particular stretch of road is one thing; raising limits across the board is quite another. Last year in the UK a fierce debate took hold when Philip Hammond, then Transport Secretary, claimed he was considering raising the national speed limit from 70 to 80mph as a means of encouraging economic growth. Opinion was instantly split.

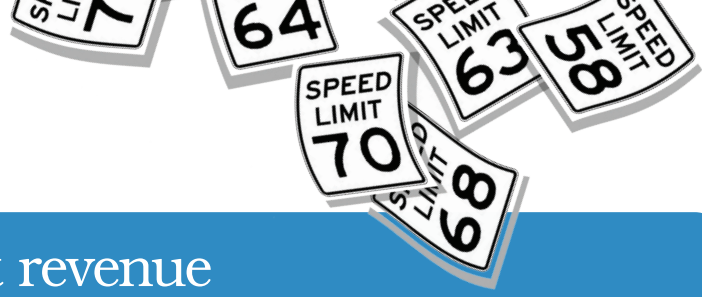
> Most drivers don't pay attention to posted limits but instead to the traffic around them. It's clear that most of our limits are posted well below the actual flow of speed
>
> **Gary Biller, president, National Motorists Association (NMA), USA**



Advanced suspension, high-tech tires and in particular, braking technology were cited as reasons why such a move was perfectly reasonable in this day and age. The Automobile Association backed the idea, albeit in a less blanket fashion.

On the other side of the argument a collection of anti-speed groups formed the 'No to 80' coalition and hurled figures at those in favor: 25 more road deaths per year, an extra £1bn (US$1.6bn) in healthcare and 2.2 million more metric tons of carbon emitted into the atmosphere. Even former F1 motor racing champion Damon Hill weighed in, stating that "most people don't know what they're doing on the road" and that the thought of a higher limit made him "shudder". In July 2013, the government axed the idea, suggesting it "wasn't a priority".

"Obviously, if you are going faster you are more likely to hit something," feels John Elliott, veteran UK transportation expert and Local Government Technical Advisor. "Everyone makes mistakes and if you are traveling 10mph faster, you are more likely to do so. Faster driving on a motorway also generates more aggressive behavior, which equates to less tolerance of delays and



lower speeds once you're off it. This is clear where fast roads end up in urban areas."

Elliott is also concerned that by expecting to travel faster, we make other sustainable modes of transport less attractive. "It should be noted the USA is a very different animal from the UK," he adds. "Over there you might be driving hundreds of miles from one city to the next along quiet roads with no access to a high-speed rail network. There isn't as much concern over fuel costs when compared with Europe, while environmental legislation is arguably less stringent than it is here."

The curious case of the autobahn

But speed kills, right? Well, yes – and no. Although today there are limits on only 40% of Germany's highways, the country's road death figures remain nothing out of the ordinary. They are higher than in the UK (5.6 deaths per billion kilometers driven versus 3.9 in the UK) but lower than the USA (6.57). Fatalities continue to drop. And although 30% of distances driven in Germany are on the autobahn, just 11% of all traffic fatalities occur on the country's high-speed roads – the chances of getting injured on an autobahn is seven times less than on other German roads.

"Just 5% of Germans drive between 200-250km/h [124-155mph] – and mostly at night," says Ferdinand Dudenhöffer, professor of Automotive Economics at the University of Duisburg-Essen. "The idea that everyone drives flat out on the autobahn is a myth. The average speed on rural highways is probably 145km/h [90mph], and around Munich and Berlin, it is 100-110km/h [62-68mph]." Nevertheless, to outsiders the concept of no limits remains shocking. Dudenhöffer likens it to the USA's right to bear arms and sees it as a part of what it is to be German. "To my knowledge, there is no reliable data that says having a speed limit means fewer injuries or deaths," he says. "If limits are too low people don't concentrate. It makes no sense to continue with legacy limits without thinking about changing them."

Lost revenue

Higher speed limits may have all kinds of knock-on effects, such as economic growth, more or fewer road traffic accidents, and increased greenhouse gas emissions. There is, however, an additional side effect that is unlikely to be welcomed in the corridors of power. "Most cities and states will have a line item in their budgets on the revenue side for traffic ticket income," says Gary Biller, president of the US National Motorists Association (NMA). "If speed limits are set properly, most tickets could be eliminated."

The NMA has calculated that the estimated US$5bn country-wide 'industry' could shrink by 80%, leaving a sizeable shortfall for city managers who will be forced to come up with new sources of revenue. And none are likely to be as 'easy'.

"Less than 5% of US drivers ever contest a ticket," Biller reports. "It's easy money to plug into the budget and not to have to worry about."

> The idea that everyone drives flat out on the autobahn is a myth. The average speed on rural highways is probably 145km/h [90mph]
>
> **Ferdinand Dudenhöffer, professor of Automotive Economics, University of Duisburg-Essen, Germany**

The Green and Social Democratic parties in Germany recently proposed a speed limit of 130km/h (80mph) for the autobahns

This cuts both ways, however, and the mood in Germany is one of change. An advisory limit of 130km/h (80mph) was recently introduced. If a driver is involved in an accident at or over this speed, they are deemed at least partially responsible. Last year the chairman of the Social Democrats, Sigmar Gabriel, said Germans should drive more slowly for safety reasons. Some members of his party disowned him, though he had the full backing of the green lobby. "The opinion of the population is changing," Gabriel says. "Germans love their cars but they also love the environment. Ten years ago no one wanted limits but today we're saying they're not so bad. It would certainly make autobahn driving more comfortable."

Perhaps notions of German efficiency and order are the key to the country's driver safety record. Or maybe it is simply a question of keeping to the right, overtaking on the left and driving at a speed that feels comfortable.

Last words

"There are trade-offs at all speeds," says Joshua Schank, president and CEO of the Eno Center for Transportation, a US policy think-tank. "Faster speeds can potentially reduce delivery times for goods and shorten commutes, in doing so contributing substantial economic benefits. But they can also induce sprawl, degrade the environment, increase fuel consumption and increase accidents. A 'safe' highway speed is entirely dependent on the facility itself."

Speed is only one factor behind road fatalities – road conditions, congestion, car safety, age of vehicle and roadside assistance all play a part. Perhaps the future in this area lies with toll roads, where a premium may be paid for higher speeds on quieter roadways. Meanwhile, common sense prevails in France, where the national limit of 130km/h (80mph) is reduced to 110km/h (68mph) in the wet.

People on both sides of the argument will remain unmoved by the others' viewpoints, and the same statistics are often used by both sides to drive home a contrary view. Is it safe to raise speed limits? In the opinion of this writer, the answer is yes, but with considerable qualification.

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Out with the old?

The hurdles facing UK traffic managers are both longstanding and complex. But, as **Andrea Day** reveals, new intelligence networks are coming to the rescue and helping to create new traffic data traditions

Photographs courtesy of INRIX, Highways Agency & Trafficmaster

Twenty years ago traffic managers relied on road sensors to provide insight into how best to manage UK roads, which included maintaining steady movement, safety and efficiency. Since that time, the number of vehicles across the network has greatly increased, reaching an all-time high of 34.5 million licensed vehicles in 2013, according to UK's Driver and Vehicle Licensing Agency (DVLA). More than ever before, traffic management is essential for maintaining UK roads.

Traffic managers today face a number of challenges when it comes to the maintenance of their networks though. A key issue is that data collection varies throughout the UK, making it difficult to communicate with bordering traffic managers and councils, such as the Highways Agency and Transport for London (TfL). Clear UK-wide monitoring is therefore limited and large-scale management strategies require the linking of road sensors throughout the UK, which comes with technical difficulties and at a high cost.

Sensor perceptions

Sensors operate alongside the road, monitoring the number, volume and speed of vehicles, but have many limitations. Traditional sensors are exposed to harsh environments on the roadside and can be prone to failure. Maintenance costs are high and repair work has to be carried out at night to ensure minimal disruption to road users. Limited coverage is a further problem, as sensors tend to be only on main roads and there isn't a widespread awareness of the knock-on effects that smaller roads suffer as a result of problems on main roads. These limitations have led to a demand for a better way to analyze the wider impact of traffic on UK roads.

(Main) **The National Traffic Information Service is the backbone of the English road network, consisting of 4,300 miles of motorways and major A-roads which carry one-third of all traffic and two-thirds of all freight nationwide** (Below) **Traditional traffic sensors may become a thing of the past if new, intelligent monitoring services become more common**

Intelligence networks

The future of traffic data collection lies in the demand for intelligence networks to provide managers with a more comprehensive picture across the country, including smaller roads. Such systems can provide seamless collection of data across the network and monitor the wider impact of traffic flow. This level of comprehensive coverage provides a cost- and time-efficient solution to the problems posed by sensors.

Traffic intelligence networks lower the cost of operations by ensuring that sensors are placed strategically. Currently intelligence networks add value to sensor data, providing real-time insights into incidents and smaller roads. Intelligent monitoring services such as INRIX's will continue to supplement other sources and may even become the primary source of speed, travel time, congestion and queuing information.

In 2013, INRIX can provide an average travel time on segments of the road, providing useful information on how that particular road is performing traffic-wise. This supplements the sensors set out to monitor the number count and speed of cars on the road.

As smart, real-time data gets stronger, the need for sensors will decrease. In areas where sensors are only required to provide information on speed rather than count vehicles – such as between junctions – sensors can be eliminated and replaced with a layer of traffic intelligence. The next

generation of smart traffic management platforms will integrate data such as INRIX's alongside information from vehicle and sensor data. This smarter system covers more roads than before with a significantly lower cost than traditional methods.

How do intelligent networks do it?

Intelligent networks are constantly expanding as more drivers try to improve their experience on the road by buying a satnav or other navigation service. INRIX data goes out to the public in many different forms – the mobile app, traffic services embedded in vehicles as well as satnavs. In late May 2013, the company announced a strategic partnership to integrate INRIX traffic data in Lexus vehicles, providing smarter driving choices. As more vehicles become equipped with this system and it begins to become the norm, traffic managers can use this data to supplement current sensors and improve their knowledge of what's happening on the UK's roads.

Better informed public

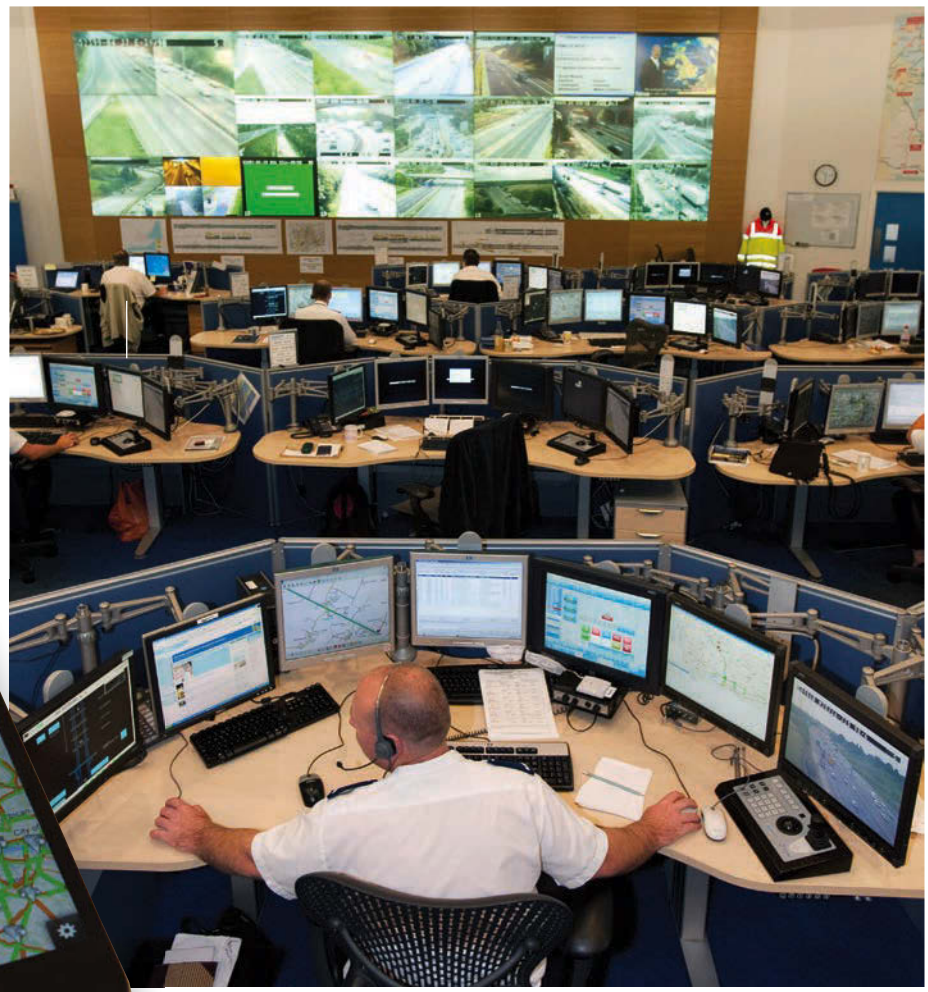
With the introduction of a layer of traffic intelligence, there comes better communication with the public. Networks such as INRIX include real-time traffic data alongside live updates from departments of transport, creating a more informed public who have the ability to choose the most efficient route for themselves. This personalization creates a better interplay with consumers as well as improving conditions on the road.

Automotive manufacturers such as Audi have recently announced the implementation of INRIX data and parking services in their cars, meaning that more drivers than ever before have access to smarter traffic insights. As more manufacturers sign up to this type of service, traffic managers will see the effects as congestion decreases and becomes more manageable.

And the bigger picture?

In 10 years' time, the sensors being installed today will be obsolete. Transport managers will need to evaluate which parts of the road network are most in need of sensors, what the sensors' primary purpose is (such as traffic counts in key locations, precision lane-by-lane detection along managed motorways, etc) and how intelligent traffic networks and next-generation sensors optimally complement each other for high-quality system monitoring in the most cost-effective manner possible. In some US states, in fact, this analysis is already taking place and the question being asked is 'What sensor systems do I need to supplement intelligent traffic networks?' This scenario is usually the other way round. This same analysis is likely to occur in the UK in the future as well, as intelligent traffic networks prove their worth. In doing so, this layer of smart traffic insight will increase efficiency on UK roads, and provide a more comprehensive wider view of the road network.

> In areas where sensors are only required to provide information on speed rather than count vehicles, such as between junctions, sensors can be eliminated and replaced with a layer of traffic intelligence



Photograph courtesy of the Highways Agency

(Main) **INRIX provides real-time traffic speed and travel-time information for the Highways Agency's NTIS** (Inset) **INRIX's Traffic app on mobile devices helps users to make smarter driving decisions**

• *Andrea Day is a senior analyst at INRIX*

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Stand out from the crowd

Just days after this year's Toll Excellence Awards winners were announced, **Timothy Compston** caught up with the four successful agencies that made a lasting impression on the IBTTA judges

Illustration courtesy of Lightspring

Selecting the winners of the IBTTA's Toll Excellence Awards was a challenge this year, given that so many of the submissions set very high standards in a diverse number of fields. "We never cease to be impressed with the quality of entries and 2013 was certainly no exception," confirms David Machamer, who chairs the Awards Committee.

The pick of the bunch

IBTTA executive director and CEO Pat Jones concurs, believing this year's successful applicants in the Customer Service, Operations, Social Responsibility and Technology categories to be indicative of the broader industry trends he is witnessing on the ground. "Transitioning to express lanes is a very good way of making better use of the capacity you already have in order to expand throughput and allow single-occupant vehicles to pass through," he says.

"Toll agencies are also now looking to incorporate green concepts from the design stage of their facilities, not just for roads but for their buildings as well," Jones adds. And something else he has seen evolve over the past 12 months is agencies' ability to adapt to (and remain resilient in the face of) unexpected events. "This was a major theme after Superstorm Sandy hit northeastern USA last October, with many transportation agencies and facilities directly impacted. The IBTTA even convened a forum and produced a report based on the lessons learned."

The ceremony is about to begin...

The Toll Excellence Awards recipients featured over the following pages will be recognized during a ceremony at IBTTA's 81st Annual Meeting & Exhibition, September 22-25, 2013, in Vancouver, BC, Canada. And in addition to the individual categories, the prestigious President's Award honoring the best of the best will be revealed.

The theme of the event is 'Moving Smarter: How Tolling Meets the Challenge', and there's a special focus on resilience and adaptation with a Resilience Around the World session (September 24) in which global experiences and procedures concerning the management of extraordinary weather events will be shared.

And with hundreds of industry thought leaders representing senior-level members, member agencies and their boards having the opportunity to network and participate in tracks ranging from technology, finance, administration and policy to customer outreach and communications, entrepreneurship and innovation, it's little wonder the IBTTA's annual shindig remains the tolling industry's must-attend event on the calendar. We'll see you there! >

• *For more information and to register please log on to www.IBTTA.org/vancouver*

Creating a positive customer experience

The Toll Excellence Award for **Customer Service** goes to the **Georgia State Road and Tollway Authority**

Georgia's State Road and Tollway Authority (SRTA) has driven ahead on customer service with the roll-out of an ambitious US$60m High Occupancy Toll (HOT) lane facility – the I-85 Express Lanes project – in the Metro Atlanta area, the specification of which is claimed to be a first for the USA.

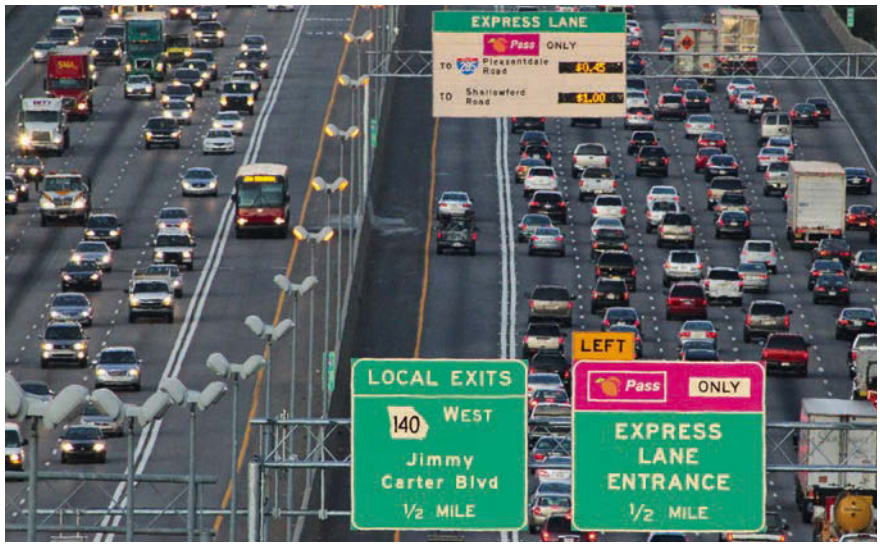
The initiative saw the conversion of an existing HOV lane to incorporate dynamic pricing and occupancy enforcement. To access the lane, motorists are required to register for a Peach Pass transponder, declare their status as toll-paying or toll-free (for cars containing at least three people), and place the transponder in their vehicle.

Enhanced customer service and choice were primary reasons behind the switch: "The premise was to deliver at least one lane in the 15.5-mile corridor in which people could have the option of a more reliable trip, including single-occupancy motorists who couldn't previously have taken advantage of the HOV lane," reveals Christopher Tomlinson, executive director of the SRTA.

According to Tomlinson, the original HOV lane that was open to carpools of two people or more, didn't function effectively during peak hours as there were simply too many vehicles. Compounding that, during the off-peak the lane was underused. "Part of the solution was to revise the occupancy level from two up to three people to keep the lane flowing," Tomlinson explains. "Of course there are a limited number of three-person carpools so we sell excess capacity by charging an appropriate toll for anyone who wants to enter with fewer than two people in their vehicle."

To feed the toll rate algorithm, data is collected via embedded loops in the road, transponders and microwave devices.

As to why Tomlinson feels the I-85 Express Lanes was singled out for IBTTA recognition, he cites a number of innovative facets not found on other managed lane projects elsewhere: "There is no physical barrier between the toll lane and the adjacent general-purpose lane, for example. To manage enforcement we have a patent on what we refer to as 'gantry-controlled access'."



(Left) **As I-85 was only the second toll road opened in Georgia in the last 20 years – and the state's first traffic demand management program – public education was crucial to position tolling as part of the solution to highway congestion**

> People want to know that if they sign-up and do things as they're supposed to, others aren't abusing the system or hitching a free ride

From a customer services standpoint, this electronic barrier to deter improper use is vital. "People want to know that if they sign-up and do things as they're supposed to, others aren't abusing the system or hitching a free ride," Tomlinson continues. "Our violation rate is only 6.5%."

Additionally, the SRTA chief points to the ease with which customers can switch between toll and toll-free modes. "You might be driving in the lane on your own one day but on another you may have three people in the car," he explains. "If that's the case, it's possible to change toll mode by calling into our customer service center, going online or registering occupation through a smartphone application. Our customers really appreciate this convenience."

Building extra lanes was never really a viable option, so a managed lane conversion ticked boxes for SRTA as well as for customers: "Quite honestly, even if we had the money, displacing established businesses and neighborhoods wasn't something we were prepared to do," Tomlinson admits.

But there have been a few hurdles to overcome along the way. "We received a fair amount of negative press in the first week relating to the pricing when there were only a handful of cars in the HOT lane and the corridor was congested," Tomlinson says honestly. "That was a mistake on our part as we should have based the calculation on the volume in the lane itself rather than the general-purpose lanes as well." Lessons were quickly learned however. "It makes it much sweeter to know that, ultimately, we overcame everything to make the I-85 project a success."

And as further back-up for why the scheme is an award-winner, Tomlinson cites a customer satisfaction rating today of much more than 80%, as well as the fact that 200,000 people have now signed up to the initiative, compared with the 75,000 who had enrolled by opening day.

Resilience in the face of adversity

In the **Operations** category of the Toll Excellence Awards, **Oklahoma Turnpike Authority** topped the class

For any toll road agency, a prerequisite is keeping all the elements of its infrastructure on-stream so that downtime and disruption can be minimized should disaster strike. A great example of operational resilience, recovery planning and implementation that caught the eyes of the Toll Excellence Awards judges this year was the reaction of the Oklahoma Turnpike Authority (OTA) after its 15,000ft² Pikepass Customer Service Center (CSC) in Oklahoma City and associated Pikepass store suffered a catastrophic fire on the evening of September 26, 2011.

Glen Branscum was involved in resolving the crisis as director of Pikepass operations at OTA and says the fire was so severe that it resulted in the complete destruction of the interior of the facility. "The roof caved in and due to the risk we weren't even able to walk inside for close to three weeks," he recalls. But despite taking out the physical home of the CSC, prior planning combined with the efforts of CSC staff ensured Pikepass revenue continued to be posted to customer accounts throughout the crisis.

One of the changes prior to the fire proved especially critical in this respect. "The CSC was regularly under Tornado alert, so with disaster recovery in mind we chose to partner with our Office of State Finance here in Oklahoma, which had just installed a voice-over-IP (VoIP) phone system," explains Branscum. "As the phone switch was located off-site, we knew that should anything happen to our facility, we would very quickly be able to restore phone services for our CSC. And that's exactly what happened. There was no need to change phone numbers and, in most instances, our customers didn't even know we'd experienced the fire."

The Pikepass store (far left) **was destroyed in the fire, but within 24 hours operations were up and running at an alternative site** (left, above) **The roof collapsed during the fire** (left and bottom)

> "If we hadn't had the redundancy in place with the back-up phone system, and all our databases and everything else, we couldn't have serviced our customers at all

The rest of the recovery operation revolved around where to physically relocate people. Branscum says the efforts in this regard are best showcased by the timeline of the disaster recovery activity in the ensuing hours and days. By mid-afternoon – only six working hours after the fire – customer service calls were being rerouted to 12 CSC agents housed in a short-term, alternative site. By the end of the next day all CSC agents had been relocated. And the following day a temporary, highly visible, outdoor store was up and running just 40m from the destroyed facility, while five days later a temporary indoor store was serving customers. In addition to maintaining customer service, Branscum suggests another critical consideration was employee job security: "Thankfully everybody was back working no later than two days after the fire, with most people back the very next day," he says.

Ultimately, the damage to the original CSC was so extensive that the only realistic course of action was a complete demolition and rebuild, a process that was completed by May 2012. The new CSC was fully occupied by early June 2012, eight months after the original incident.

So what message does Branscum have for other toll operators? Just appreciate the implications of not building-in resilience: "The reality is if we hadn't had the redundancy in place with the back-up phone system, and all our databases and everything else, we couldn't have serviced our customers at all, sent out bills or issued new transponders. We would have been dead in the water."

Interoperability – now and in the future

The hotly contested Toll Excellence Award for **Technology** went to South Africa's **SANRAL**

With technology playing a more pivotal role in the smooth running of toll roads, this category of IBTTA's Toll Excellence Awards is becoming increasingly hard fought. So it makes the fact that the 2013 gong was clinched by a first-time winner – in the form of the South African National Roads Agency SOC Limited (SANRAL) – all the more impressive.

A division of South Africa's Ministry of Transport, SANRAL's R6.2bn (US$630m) Open Road Tolling (ORT) project is considered industry leading in part due to a transaction clearinghouse and violation center that supports tolling interoperability nationally. Ultimately it allows users to have one tag and one account.

Alex van Niekerk, senior project manager for ORT at the agency, attributes SANRAL's success in the Toll Excellence Awards to the ambitious scope of the project and critically to the challenging technical requirements they were able to satisfy. "It was paramount that the technology employed on the Gauteng freeway improvement scheme [where the ORT effort is concentrated] would be operable on all toll roads in South Africa, and not just today but in the future as well, and that users would only be required to set up an account once," van Niekerk says. "And to that account they could then add multiple vehicles and a single tag whose specification would be suitable for any toll plaza integrating ETC."

Van Niekerk also emphasizes that there was a pressing need for concerted action in Gauteng, which he refers to as the "economic heartland of South Africa" and includes the country's largest city, Johannesburg, as well as the administrative capital Pretoria. "The problem for Gauteng Province, which has a freeway network of about 240km that falls under SANRAL's remit, is that we really reached capacity around 10 years ago. Compounding that, we have also seen very high traffic growth of 4-7% a year. Something had to be done."

> "The problem for Gauteng Province, which has a freeway network of about 240km that falls under SANRAL's remit, is that we really reached capacity around 10 years ago

Van Niekerk reveals there have been various attempts in the intervening years to find the necessary funds to improve the roads and to continue further freeway building, but it wasn't until a funding model based on the 'user-pay principle' was embraced that things really moved up a gear. And with the roads carrying upwards of 200,000 vehicles a day on busy commuter traffic routes, conventional electronic tolling was ruled out very early as a viable option for Gauteng. "Even when you have electronic tolling at a toll plaza it is still much slower in terms of throughput than ORT, where no stopping is required," van Niekerk notes. "The advances in freeflow tolling around the world made ORT the obvious approach to take on board and use as the Gauteng methodology."

On the front line of SANRAL's ORT effort are the ORT operations itself, which focus on everything from the roadside systems that generate transactions, to back-office verification of compliance. In addition there is the transaction clearinghouse where, as the name suggests, transactions are linked to an account and payments transacted. The final element of the ORT jigsaw is referred to as the 'violations processing center', which is geared up to manage overdue transactions.

At the time of writing, the Gauteng part of the system has been 'live' for the previous 12 months and although van Niekerk says that road users haven't as yet started to be charged, he anticipates this happening in the very near future. Beyond this, at a wider national level, the integration of the processing of electronic toll transactions at the Bakwena toll plaza – which is operated under a concession arrangement – and the central transaction clearing house started in September 2012.

SANRAL CEO Nazir Alli welcomed the Toll Excellence Award, saying it "underlined the excellence of the work the agency is doing on the national roads of South Africa, in particular the interoperability of the e-toll system on the GFIP"

A focus on environmental stewardship

The **Social Responsibility** Toll Excellence Award went to the innovative **E-470 Public Highway Authority**

An increasing number of toll road agencies are striving to put the brakes on rising energy costs as well as satisfying their social responsibility obligations by adopting economical and environmentally friendly sources of power. One of the projects that scores top marks due to the scale of its ambition and funding model has been implemented by Colorado's E-470 Public Highway Authority.

In 2012 the forward-thinking authority from the eastern edge of the Denver Metropolitan area completed what it thinks is one of the largest photovoltaic system installation projects

> We are in fact exceeding the amount of power we expected to generate. That gives us a reduced energy cost in terms of the present value and significantly an accrued balance of dollars that we can cash in at the end of the year

ever attempted by a toll road in the USA. And John McCuskey, executive director, E-470 Public Highway Authority (pictured right), is delighted with the project's recognition in the Toll Excellence Awards. He does, however, stress that a strong buy-in from the board was critical to moving things forward: "We have a board representing the cities and counties that essentially own our road," he says. "With their support, everything came together and

environmentally it was a sound decision. It was the right situation with our energy provider, the investors and the equipment – and it was at the right time."

The Solar Powered Toll Road project comprises a total of 22 sites of solar arrays along a 17-mile stretch of the E-470 corridor. Not only does the project meet E-470's desire to keep a lid on future energy cost rises as well as reduce its carbon footprint, but it has successfully achieved this with minimal financial investment.

"When this project was initially considered about five years ago, Denver was a hotbed for alternative power," reports Dave Kristick, deputy executive director and director of operations (top right). "We were going around from contractor to contractor to find out what was achievable. We were able to take advantage of our real-estate – others took care of the financing and installation – to derive the benefit for our electrical systems on this section of the road."

A key element that helped to make the project a reality was a solar power purchase agreement with Adamas Energy Investments, which was also willing to pay the US$2.8 million cost to equip and install the system. This offered stability by including a fixed energy cost during the first six years plus fixed increases for the remaining 14. In terms of concrete returns, already it is reported that E-470 managed to save US$20,000 in energy costs over the first year alone. "We are in fact exceeding the amount of power we expected to generate," confirms Kristick. "That gives us a reduced energy cost in terms of the present value and significantly an accrued balance of dollars that we can cash in at the end of the year."

Touching on the challenges that E-470 had to overcome along the way, Kristick feels that one of the largest revolved around logistics: "As a result of the extensive size, there were building permits and such that we had to get from different jurisdictions. The building departments were not as well versed in solar energy as they probably are today. There was also a learning curve about the legal underpinnings and the licensing agreements to allow private companies to use our real-estate for the solar arrays."

The message from E-470's McCuskey is that this is a feasible project for any other toll authority. "One thing that we toll authorities certainly have in abundance is real-estate and another is an electrical requirement to operate the equipment that is never going to go away. Even today, when the tax laws are a little different than say three or four years ago, very attractive opportunities to reduce operating expenses still remain, particularly for tolling facilities."

E-470 installed a network of solar-electric panels to power its signage (left) **and its headquarter building** (top)

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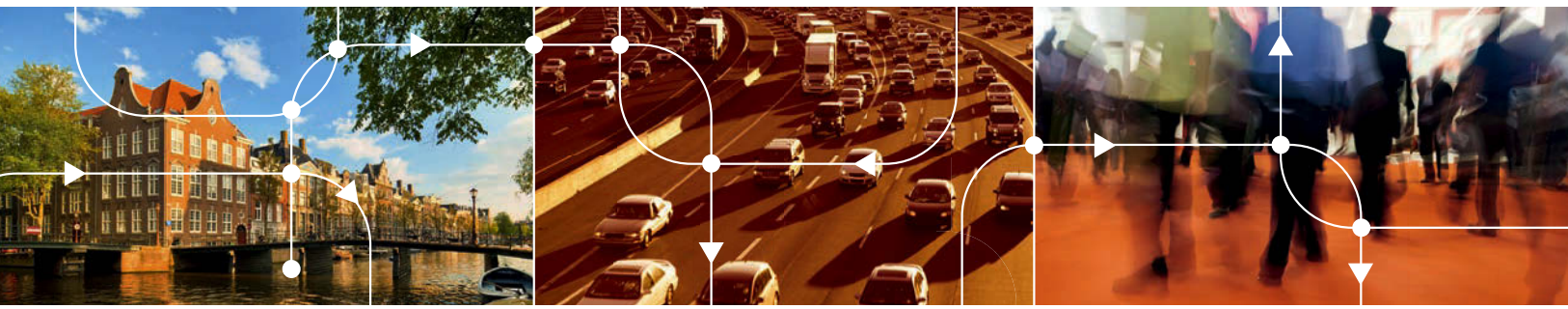

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ITS Australia CEO **Susan Harris** has been busy fostering a spirit of collaboration in the Australian ITS industry – and can't wait to share it with the world when the ITS World Congress comes to Melbourne in 2016

Interviewed by Izzy Kington

> The demonstrations are a real opportunity to demystify some of the technology and showcase some of the benefits

Susan Harris, who took over from Terry Warin as CEO of ITS Australia in September 2011, really believes in the power of collaboration to enhance the mobility, safety and sustainability of Australia's transport networks. "My key strength is bringing key players together," she says, "identifying opportunities for them to collaborate to realize efficiencies that they might not achieve on their own."

Financed through its membership, Australia's ITS association includes most of the country's state road agencies, many ITS suppliers, consumer organizations and academia. These members are served in two main ways – by organizing networking events (including the ITS Summit and an awards night), and by making sure technology is "front of mind for government decision makers when they're looking at transport infrastructure choices".

Talking points

"We have regular discussions with government leaders to ensure technology is an integral part of the solutions they deliver," Harris explains. "It's not always straightforward: when budgets are tight it's easy to cut out the technology element as it's not so visible. Our job is to make sure the benefits of ITS are always well promoted, so it's not cut out when times get tough."

Harris says the association also helps the government to sort the wheat from the chaff: "In a very rapidly evolving industry, the government needs to make sure that they're going with a solution that will work and that they can trust. They have lots of people suggesting new solutions; we help them to sort out who is worth talking to."

Next up on ITS Australia's calendar of events is the ITS Summit 2013, expected to draw 300 ITS professionals to Sydney on September 18-20. As well as a large exhibition and demonstrations, it will feature a program of 100+ speakers, including 20 presenting developments from other parts of the world.

Harris is particularly looking forward to hearing Dr Peter Sweatman (board chair of ITS America and director of UMTRI) on the Model Deployment in Ann Arbor, Michigan; and Dr Reinhard Pfliegl (co-chair of ITS Vienna 2012, and chair of the 19th ITS World Congress, AustriaTech) on cooperative FOTs and ITS trials in Europe.

It's an area of special interest to Harris in light of a recently revealed research project in New South Wales that will establish Australia's first testbed for cooperative ITS, on the highway from southwest Sydney to Port Canberra. "It's particularly focused on heavy vehicles as it's a dangerous stretch of road with a high level of incidents and a lot of freight vehicles operating to and from Port Canberra," she says. "So we're looking at V2V and V2I communication and the opportunities offered by cooperative ITS."

Other speakers at the summit will present the latest developments in live traffic information and managed motorway solutions – an area in which Harris believes Australia leads the world. "A national program has been rolled out to deliver the benefits of managed motorways to capital cities across Australia," she reveals.

Managed motorways are as beneficial as investing in an additional lane, Harris feels, but are cheaper, quicker to implement,

> We're one of the most urbanized populations in the world … large cities with big city problems such as congestion, pollution and livability issues

and reduce nose-to-tail accidents and emissions by eliminating stop/start traffic patterns. "The technology has been shown to deliver a 25-30% improvement in throughput on our major city motorways."

Opportunity knocks

Another area in which she believes Australia and ITS Australia have played a leading role is tolling interoperability. The country's tolling companies work together to ensure customers don't have to have a different tag for each state they drive through. And that's the sort of collaborative approach Harris wants to see more of. "We aim to bring players together to look at opportunities that might not happen in the commercial world otherwise," she says. Indeed, the association is working on establishing a cooperative research center in ITS. "This will look at partnering industry with government players and researchers to make sure that the Australian automotive technology industry continues to play a leading role."

Harris thinks Australia's strength in this area stems from both its strong research community and a set of unique challenges that forces it to be more innovative. "We've got the tyranny of distance," she laughs. "We're a long way from the rest of the world and we've got huge distances to travel between major capital cities. There are some very remote locations with limited access to certain technologies – while we've got good mobile coverage covering our major corridors, we don't have mobile coverage throughout the nation. On the other hand we're one of the most urbanized populations in the world, so we've got very large cities with big city problems such as congestion, pollution and livability issues."

Then there is the climate – some areas have harsh conditions that create extra challenges or different issues that need to be considered before some of this technology is rolled out. "In recent years we've also had bush fires and floods. Some of these hazards seem to be happening more regularly in certain parts of the country, so our road agencies are looking to leverage ITS technology to manage situations quicker."

Another challenge is the growth of the freight industry. "This is in line with the rest of the world," Harris says. "Depending on where you are in Australia, it's doubling every 20 years. It's a big challenge making sure that we can move freight while making sure passengers are able to move freely around the network."

On a positive note, though, Harris has seen a resurgence in the use of public transport, and wants to build on that by using technology to make it more convenient. "It's annoying having to wait at a bus stop, but if you know in advance when a bus is coming – for example, it's five minutes away and you need to leave the house now to get there on time – the inconvenience can be minimized. There's also an opportunity to provide more integrated information about the way we travel – whether walking between one mode of transport and another, driving a car or using public transport, technology can make it seamless."

Coming to Australia?

Harris and her team are currently preparing to showcase some of these technological solutions at the 2016 World Congress on ITS, to be held in Melbourne. "We've put together a number of committees to look after the event and we're starting to put them to work – be it making sure we've got the right people in attendance, creating a great social aspect or organizing some great demonstrations and showcases," she says.

"In some ways it's hard as technology is moving so rapidly – we want to display the latest things but we're not sure yet what they will be in three years' time! So we're working with our members to make sure we can put on some great demonstrations, and we're also keen to work with others in the World Congress circuit so they can build upon their displays in the lead-up events. The demonstrations are a real opportunity to demystify some of the technology and showcase some of the benefits."

Harris will be promoting the Melbourne event at the 20th World Congress on ITS in Tokyo (October 14-18). "We'll have an Australian pavilion with a number of our members, so please come to our stand, say 'hello', pick up a koala, and I'll show you a sneak preview of what you will get to see in Melbourne in three years' time."

Life in the fast lane

The pace of technological evolution that ITS Australia must contend with in organizing technological showcases for the World Congress on ITS in 2016 is illustrated by how much has changed since Australia last hosted the event, in Sydney in 2001. "It's more multimodal and interconnected, so rather than having silos of different transport modes, technology is much more pervasive and integrated," Harris says. "We have smartphones now – technology is in the hands of consumers. A consequence of this is that consumers have higher expectations, so if the technology's not right it will be quickly discarded. We can also now give motorists information in their vehicle, so rather than a central command and control model, we have the opportunity for things to be more divulged, with more efficient decisions being made at local level."

Harris is also excited about future developments. "We're really on the road to a revolution in road safety," she says. "We're changing from an era where cars are being made safer and safer to protect us against accidents, to perhaps – in the next 10 or more years – moving into an environment where we're preventing accidents from happening in the first place. I hope we can leverage technology to get an appropriate balance in our lives – that we get economic development while having very livable communities; safe and sustainable cities."

Career path

Susan Harris has nearly 20 years' experience in the transport and supply chain industries. Since graduating from Melbourne Business School with an MBA, she has worked in a variety of roles, including consulting for SKM, Landleaf and Henderson Logistics. Before taking the helm at ITS Australia, she worked on more than 100 transport projects, including development schemes in Malaysia and smart freight solutions in the Port of Melbourne.

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Electronic police for China's roads

READER ENQUIRY NO. 501

Much has changed since the very first traffic light was installed outside the Houses of Parliament in London in 1868. Traffic volumes have risen inexorably, meaning our transportation systems have had to improve constantly to keep up with the growing numbers of road traffic participants all around the world.

Enormous growth rates in China

Between 2001 and 2006 alone, China, for example, has seen traffic spike from approximately 82 million to 150 million drivers.[1] With many novice drivers out on the streets, and many non-motorized participants struggling to find their way along and across busy roads and between speeding vehicles, traffic education has become an important topic in the Chinese government's action plan to improve driving safety on its roadways. Although a main challenge is to improve the quality of training, enforcement plays an equally important role in road safety initiatives and is therefore vital for advancing this educational process.

Logistic challenges and cultural implications

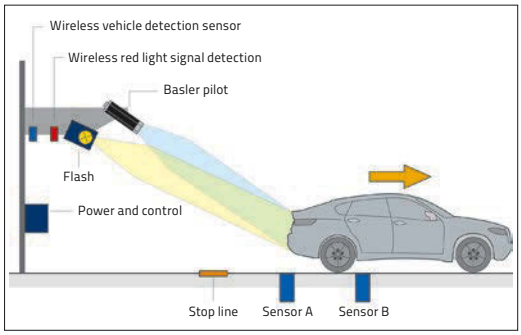
Traffic safety laws are not easily enforced. Drivers of motorized vehicles often dominate the road, failing to yield to more vulnerable road users such as pedestrians, cyclists and motorcyclists.

(Main) **Vulnerable road users are especially at risk when drivers disobey traffic rules** (Top right) **Basler's pilot camera is used for red-light enforcement**

Need to know?

China's huge traffic growth has led to a poor safety record that needs to be reversed

- China is rapidly realizing that a key way to improve road safety is to enforce existing traffic laws
- Intersections are especially fraught with danger, making them one of the locations that benefit both quickly and significantly from the use of enforcement technology



The three pictures taken from behind are scanned by an ALPR algorithm to identify the driver of the vehicle

Speeding and disobeying traffic signals are also common, causing almost 20% of driver offenses. This not only hinders traffic enforcement efforts in general but also creates considerable problems for the Chinese health system. Injuries constitute China's most serious and costly health problem. By current estimates, between 500,000 and 1,000,000 people are killed or permanently disabled on Chinese roads every year, with millions more hospitalized. Injuries, fatal or not, often mean losing the breadwinners in families, which are then suddenly thrust into poverty. Propelled by enormous growth rates, road traffic accidents have become the leading cause of death in China. Aggressive driving, failure to yield the right-of-way, disobeying traffic signals, poor road safety design and low levels of enforcement were named as the major causes of traffic-related injuries.

Tackling red light offenders

As one of the most common violations is disobeying red light traffic signals at intersections, this problem in particular calls for automated, vision-based solutions that help trace the offenders. 'Electronic police' is the name given to a camera surveillance system installed above the road lanes at intersections to monitor and detect vehicles failing to stop for a red traffic light signal. If the vehicle doesn't come to a complete stop at the marked stop line, sensors in the ground detect its movement and trigger the cameras to take three pictures of the vehicle and its license plate from the rear. The images are then forwarded to a computer and scanned by a license plate recognition (ALPR) algorithm that automatically reads the license plates. The results are subsequently sent to the corresponding traffic police department, which can check them against a blacklist database of suspicious vehicles. After that, the police identify the owner or driver of the vehicle and send out a citation.

The cameras used for this application have been equipped with a customized filter and special firmware to solve the critical issue of red color

appearing orange in images. An integrated continuous white balance feature, meanwhile, provides color accuracy in images taken in twilight and darkness. Gigabit Ethernet is the recommended interface for this application as a result of its technological flexibility around bandwidth, cable length and multicamera functionality. It enables cable lengths up to 100m and data rates up to 100MB, creating a perfect fit for this particular setup.

Multiple initiatives toward a single goal

Enforcement setups such as this one are not only aimed at punishing traffic offenders but also designed for the overall purpose of raising and improving public awareness of – and compliance with – road safety standards and rules. Together with targeted initiatives to improve road traffic safety through vehicle testing, driver education and post-crash safety measures, traffic enforcement in its various forms aims at one overall goal – to avoid serious injuries and save lives.

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As details of the National Security Agency (NSA) spying revelations come to light, I can't help but think how ITS plays a role in the surveillance of our everyday lives. The other day I found out that in New York City license plates are read on some of the city's bridges to catch oversized trucks. Well I'm sure the plates of everyone else crossing those bridges are also captured and stored on a computer somewhere. While the use of ALPR is routine in other countries, such as in the UK, it's not as common on this side of the pond, so news of its use in NYC caught me unawares. That got me thinking about the different ways we're watched in public while on the road. Please don't get the idea that I'm the Edward Snowden of ITS, but if people knew how extensively they're monitored by traffic authorities, I'd wager they'd be quite surprised as well.

Perhaps the poster children, if you will, of privacy concern on the road are red light and speed enforcement cameras. Usage of such devices has grown steadily as traffic enforcement officials have found them to be an effective means of deterring moving violations. Several recent studies, such as one conducted by the Insurance Institute for Highway Safety in 2011, have confirmed that red light cameras do have a positive overall impact as right-angle collisions tend to drop in locations where one is installed. However, despite statistics largely proving their benefits to society, privacy rights advocates argue their personal privacy is infringed upon by these devices. While not nearly as intrusive as ALPR, your personal whereabouts are indeed noted somewhere if you've ever run a red light or driven over the posted speed limit.

Another ITS technology being scrutinized for privacy concerns is ETC. E-ZPass is used by millions of drivers in the USA, most of whom use the service as a way to breeze through tolls along bridges and highways. But what most people don't know is that the technology is also being used to collect data on cars – and possibly their drivers. Recently, NYC's DOT quietly began installing electronic devices at several busy intersections throughout the city, to record when cars equipped with E-ZPass transponders pass beneath. Although the agency claims they're collecting 'aggregate' data, just how detailed the data collected is unknown and civil liberties advocates have already begun voicing their concerns.

Early in my career, circa 1972, I was involved in an Origin and Destination study in Manhattan. We captured license plates visually and sent postcards to car owners. This did lead to at least one divorce when a wife got the card that her husband was spotted crossing the George Washington Bridge when he told her he was elsewhere! While our intentions were innocent, our study had such unintended consequences that it is something I am always reminded of when contending with issues of privacy on the road.

There's no question that ITS has improved our lives in countless ways from more efficient traffic networks to increased safety. But as surveillance technology has advanced over the years, we've also sacrificed much in regards to our 'privacy in public'. It's important as professionals in the field of ITS that we take a step back every once in a while and evaluate the impacts that such technology may have on our private lives.

> As surveillance technology has advanced over the years, we've also sacrificed much in regards to our 'privacy in public'
>
> **Sam Schwartz, Sam Schwartz Engineering, USA**

Austrian users' experience of cooperative ITS services

READER ENQUIRY NO. 502

Cooperative services are expected to become the ultimate solution for individualized, real-time traffic information in the near future. But most of the projects dealing with C-ITS focus mainly on technical feasibility, with user acceptance taking a backseat.

In contrast, the Field Operational Test (FOT) Testfeld Telematik Austria (TTA) project – a study of cooperative services in an urban environment in Vienna – is concerned with the validation process of cooperative services from the user's point of view. Testfeld Telematik is an Austrian initiative of 14 partners led by ASFINAG. The focus of the study was the parallel communication architecture and an open platform concept, with a network based on ETSI G5 and GSM/UMTS standards,[1] between a traffic control center and end-user devices. The complete transmission chain with two communication technologies in the urban FOT-TTA was extensively tested and validated in partnership with the Car2Car-Communications Consortium at the 19th World Congress on ITS last October.

User input

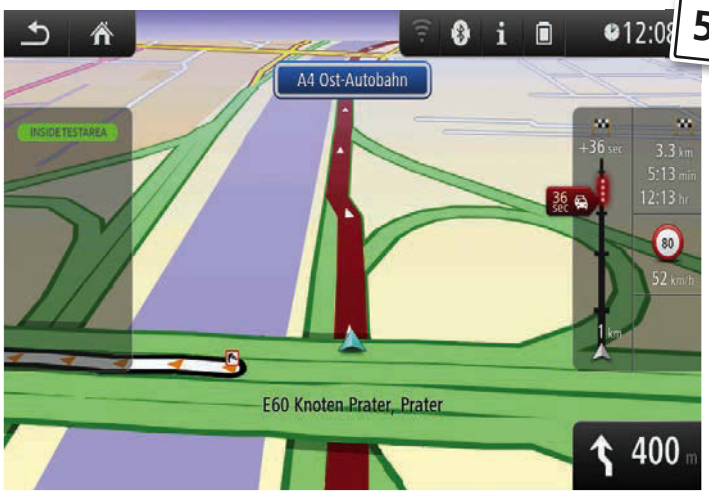
During a cooperative mobility demonstration at the event, visitors had the chance to experience the services live in a test drive through Vienna. The setup of the TTA project supported not only two communication technologies but also the delivery of C-ITS on three types of end-user devices: an aftermarket personal navigation system; a smartphone solution; and a fully integrated vehicle platform solution for the production vehicles of a major OEM. This approach to the layout and technical structuring of the FOT meant user involvement strategy was an important activity for all partners involved. In fact the testing and validation of user acceptance at different levels for C-ITS services is key to creating a service that not only works on a technical level but will also be accepted by users.

In the urban FOT-TTA, 10 cooperative information services were provided to a large number of users over a period of weeks to evaluate user acceptance levels and to clarify technical questions concerning the roll-out of cooperative systems from a road infrastructure operator's perspective.[2] The information services provided in the TTA project were: in-vehicle signage; hazardous location notification; traffic jam warning; roadworks warning; weather warning; information on flight delays; park-and-ride information; traffic light signal phasing and timing; green light optimum speed advisory; and current traffic situation data.

The project mainly covered the motorway intersection A2/A23-A4-S1 in the Vienna area, including links to public transport. Information was gathered at ASFINAG's traffic control center and transmitted as TPEG (transport protocol experts group) messages to the end user over two different channels (Figure 1). As already stated, aftermarket navigation systems, smartphones and an integrated in-vehicle solution were the three devices studied.

Messages were sent via DSRC from the TCC to roadside units (RSUs) in the test area, which then forwarded the data to the vehicles used in the FOT. These were equipped with in-vehicle gateways to receive the messages and pass them to the end-user device. In addition, traffic lights were equipped with RSUs that transmitted signal phase and timing (SPAT) information, as well as data on green wave speeds, to be communicated to the vehicles.

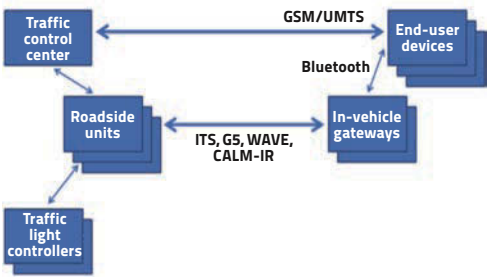
For end-user involvement and testing, all three device



Need to know?

Safer, more efficient and environmentally friendly mobility for Austria's road network

- Raising public awareness and confidence into the benefits of cooperative systems
- Researching and testing telematics services with a focus on interoperability of roadside infrastructure, traffic management and different end-user devices and in-car systems
- A platform to highlight Austrian high-tech ITS



(Clockwise from above) **Pictures from the three end-user devices in the FOT – TTA (integrated vehicle device, PND and smartphone)** (Figure 1, left) **Overview of the Testfeld Telematik components and ITS architecture**

categories were made available to test participants, with their reactions to the C-ITS services measured and evaluated via online questionnaires immediately afterward. Having road-tested the C-ITS services for many weeks, users reported their personal impressions and levels of acceptance.

And the verdict?

Two main conclusions were drawn. Firstly, due to the high number of partners in the delivery chain and the different use-case approaches previously described, the task of asking users how they want to consume cooperative ITS is essential to finding a user-friendly approach for future C-ITS services in Europe. Secondly, the preferences of the user also depends on which mobile devices they usually employ and how adaptive these are to their personal mobility habits. Initial reactions from the FOT-TTA prove that C-ITS could offer an interesting way to improve existing information services and mobility.

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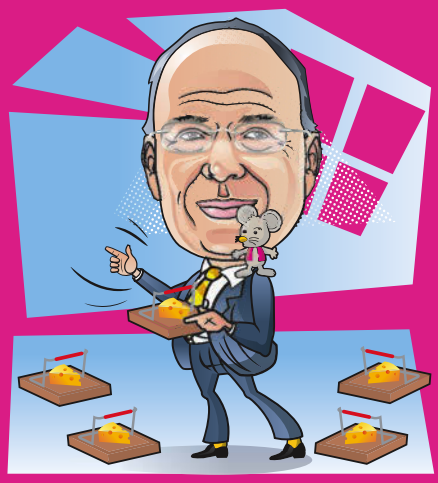

Larry Yermack

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It's almost clichéd to say that the pace of change has rapidly accelerated. We can all cite examples of how much more quickly the world is moving after just one decade of the 21st century: we live with a global 24-hour news cycle; we're all wired and expect instantaneous news and an equally swift response.

Can you even remember letters or handwritten thank you notes? Today we expect responses in hours and sometimes minutes. The speed of communications dictates the speed of response, with corporate and governmental bad behavior dealt with within days. With any misstep punished quickly, public officials have much less room to move.

Not only has the pace of change accelerated but the change itself is also often disruptive to the established way of doing things. According to Wikipedia, a disruptive innovation is "an innovation that helps create a new market and value network, and eventually goes on to disrupt an existing market and value network … displacing an earlier technology". We are not so much building better mousetraps as looking for different ways to deal with mice.

Just one aspect of this is the changing transportation customer. My 22-year-old daughter is a part of the first generation to have always had a computer. She grew up with them the way my generation grew up with TV. As she got older, she moved from desktops, to laptops to a smartphone and now an iPad. Her life went along with her technology – so much so that she is part of the social-media generation that 'lives' her life online.

Let's then take a look at a public agency response to this trend. Toll agencies designed Customer Service Centers according to how older users wanted to experience them. But as the customer base starts to shift to the younger generation, they have very different ideas of how they want to communicate with companies and how they provide feedback about whether or not the service provided was acceptable.

When a '20 something' says they 'talked' to someone, they mean they sent them a text. They have less need to actually talk to a CSR but they do expect to be able to access their account 24/7, wherever they may be. Many companies utilize live 'chat' as a way to talk to customers; it's less expensive than one-on-one phonecalls as operatives can manage several chat lines at a time.

This generation is comfortable with a website but also expects to have an app for their smartphone or iPad to manage all the functionality that the website offers. Oh, and let's not forget that they are much less concerned with privacy.

Existing customers aren't going to go away but the new ones expect to interact on their devices, just the way they grew up. How can public agencies with their built-in processes move at the necessary speed to meet the demands of the emerging customers? Frankly I don't think they can and they'll need to rethink their relationship to private sector providers. They're going to have to outsource much more than they ever thought – or they'll end up being consumed by new customer demands.

> We are not so much building better mousetraps as looking for different ways to deal with mice
>
> **Larry Yermack, Wendover Consult, USA**

Powerful GigE cameras for ITS

READER ENQUIRY NO. 503

Precision imaging plays a critical role in the success of ITS, ranging from speed and red light monitoring to traffic flow control and tolling. But finding a camera platform that incorporates the extensive feature set required to deliver high-caliber images in these demanding applications is not as easy as it sounds.

At the very least, a traffic and transportation imaging system platform must be able to withstand harsh environments and capture images at very high speeds and resolutions while targets (vehicles) are in motion. They must also be expected to multi-cast image data to multiple PCs for simultaneous data analysis when imaging is performed for more than one application at a time (e.g. traffic flow control and license plate recognition).

One of the big challenges for ITS image systems integrators is determining the best way to obtain crisp, clear images, regardless of varying and often uncontrollable lighting conditions in applications such as those already cited. Illumination of an image area is crucial to reliable image capture yet fixed lighting conditions are impossible to obtain in many traffic and transportation environments. As a result, the camera platform used in these applications must be intelligent enough to adapt to changeable conditions in order to produce the high-quality images needed to successfully identify speeding vehicles or take clear pictures of toll violators' plates.

The feature-rich Genie TS GigE Vision Camera range from Teledyne Dalsa fulfills all these needs and more, with three features in particular (auto brightness, multi-slope and multi-exposure) enabling it to adjust to the range of lighting conditions found in traffic management applications to process sharp, detailed images.

Need to know?

Genie TS combines the latest image sensor with a newly optimized camera platform

- Offers resolution from VGA up to 12 megapixels with extremely high-quality resolution and frame rates as high as 300fps
- True global shutter functionality for crisp, smear-free images of high-speed action
- Feature set allows to serve multiple functions simultaneously, reducing system deployment costs and complexity

The power of meta data

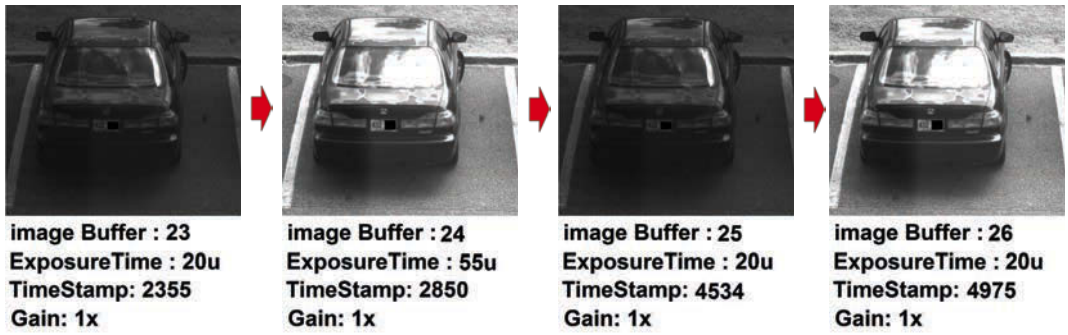
This new smart camera draws from a wide range of meta data functions when making processing decisions under various lighting conditions (Figure 1). In this respect, it serves as a toolbox with a powerful and comprehensive feature set that allows the camera to be customized for each application.

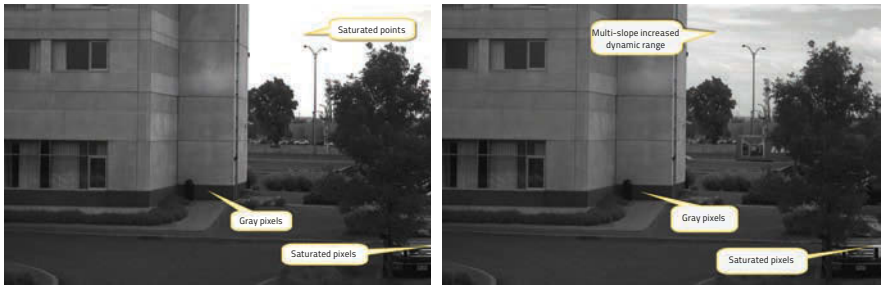
An integrator can choose to use any one of auto-brightness, multi-slope and multi-exposure to ensure that images boast ideal clarity, even under highly variable lighting conditions. Each method achieves the same ultimate goal of providing the highest quality overall image, but equally integrators can choose their own preferred path to reaching that goal.

Auto-brightness: Leveraging the auto-exposure control (shutter speed), auto-gain (AGC) and auto-iris meta data functions, the auto-brightness control in the camera can compensate for extreme lighting variations.

Multi-slope: This function offers a non-linear response to greatly extend the dynamic range of a scene, which optimizes image capture from sun to shade (Figure 2), essentially increasing the sensor's dynamic range in cases where some part of the image would be over-exposed (i.e. saturated). Normally, an

(Figure 1) **The meta data information associates current camera values with each buffered image, allowing the Genie TS to provide an optimal final view**





(Figure 2) **The Genie TS multi-slope mode is used to effectively increase the sensor's dynamic range (far left shows multi-slope off; left shows multi-slope on)**

image sensor has a linear relationship between light intensity (number of photons) and the digital gray level number (DN) output. In some cases however, the proper exposure for most of an image will also include areas that are fully saturated (over-exposed).

The multi-slope mode enables the camera to respond in a linear fashion over the majority of its dynamic range (user-defined range) and then automatically reduce sensitivity for a set period of exposure time – essentially delaying the sensor saturation point. *Multi-exposure*: Setting different exposure times for different images and then combining them into one image allows users to perform Wide Dynamic Range (WDR) imaging (short and long exposures combined into one photo, or the sequence of images processed separately to determine which gives the best accuracy for the detection algorithm being used).

From the ground up, the Genie TS camera platform been engineered to cater to the needs of the ITS sector and it delivers on all fronts. Compact, lightweight and versatile, with onboard processing, gigabit Ethernet networking capability and ruggedized for harsh environments, it is also powered by the latest image sensors, including Teledyne Dalsa's own advanced CMOS devices.

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The concept of 'transportation as a service' permeates modes, technologies and time. It is the basis of the carriage or taxi industry, manifests itself for certain populations with paratransit and has been called in a very formal incarnation 'demand responsive transit' or DRT.

The idea is alluring but the implementation has always been a problem – costs of on-demand transportation have been exorbitant. However, the inexorable march of technology has resurrected the concept. Nowadays, smartphones, connectivity and on-demand, near-real-time route choices are available. The USDOT, for example, is investigating 'connection protection' – a crowdsourced method of holding a connection given enough passenger demand. And it's getting better: taxi services and livery vehicles are available on demand (via smartphone). Smartphones and localization technologies also provide technological underpinning for the logistics necessary to fuel a growing shared-vehicle industry.

For me, discussion of this concept culminated a few weeks ago, at least for now, and because it had to by definition (with this column being due). Anyway, transportation as a service was invoked during a plenary talk at a vehicle automation/self-driving cars conference. Transportation as a service can now be found with incarnations of personal rapid transit or group rapid transit, now often called automated transit networks (ATN). Some call these vehicles pod cars and some change that vision very slightly and call them city mobile cars. Regardless, the general concept is that your car is a robot with dog-like properties. You figuratively call it and it literally comes to you. With ATN, you may share your ride along a fixed guideway, *à la* amusement park but at a larger scale. (ATNs work well at public transit facilities, connecting modes where moderate distances between connections are required.) There are other concepts that call a robot car to you over greater distances.

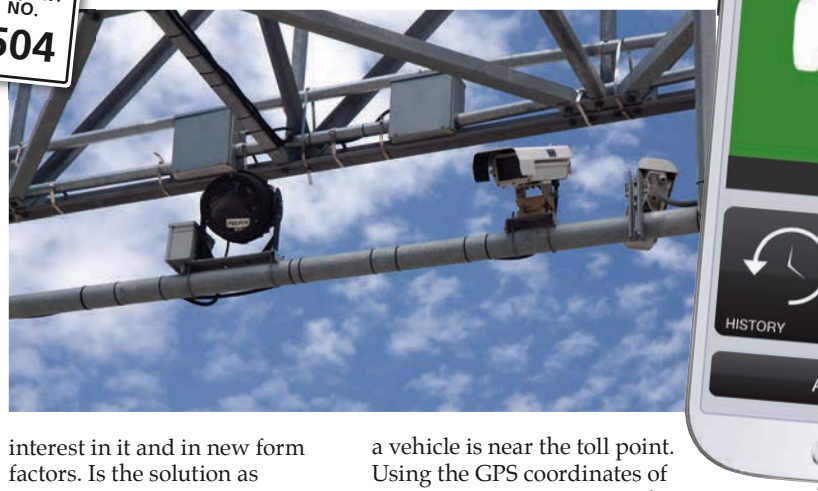
A perspective – okay, my perspective – is that transportation as a service can be universal with particular manifestations tailored by distance and density. Consider a congested urban area where ATNs would work well in conjunction with transit terminals. Furthermore, consider a newly built city center where robot cars might come at your beck and call, driving ever so slowly and mixing with pedestrians. In outlying areas, imagine a smartphone as a terminal that summons local DRT circulators that in turn feed fixed transit routes. These routes would have connection-protection services. Smartphone-based real-time information on service availability and smartphone-based on-demand summons of the transportation service would enhance the overall offering.

Of course one would either pay by subscription or pay as you go. And in the end, the 'smart car' would only be part of the stitched fabric. You need not own it – instead, you can summon and use it.

> Consider a newly built city center where robot cars might come at your beck and call, driving ever so slowly and mixing with pedestrians
>
> **Jim Misener, transportation and technology consultant, USA**

Smartphones inspire rethink of ETC

READER ENQUIRY NO. 504



Much like the evolution of the desktop computer to the tablet, the tolling sector has witnessed consistent innovations in collecting tolls. The goal of toll operators and the tolling industry is to make toll collection more efficient and reduce congestion at toll plazas, reduce the number of uncollected tolls and improve revenue assurance. Over the past 25 years, that's evolved from staffed booths collecting cash, to accepting payments electronically via the toll tag, to AET where account holders pay via their toll tag and others are sent an invoice for their trips.

The mobile revolution

Alongside this evolution in ETC has been a revolution in mobile technologies. More than half of the 225 million mobile phones in the USA are smartphones – a phone with an OS, internet connection and the ability to download and run apps.

Smartphones warrant a rethinking of a central element of ETC – the toll tag. For people who drive cars and those who operate toll roads, smartphones enable new forms and functions. Their pervasiveness means a toll tag may no longer be intrinsic to toll collection. For operators, it's not about allowing customers to use smartphones to pay for tolls – but how soon…

There are, however, a few obstacles facing smartphone tolling revolutionaries. A powerful one is the desire to preserve the status quo. From retrofitted cash lanes, to ORT with cash lanes, to AET and now HOT Lanes, toll tags are ETC's common denominator. So how do we get past this?

Firstly, smartphone tolling doesn't automatically mean GPS tolling. There's a persistent, often negative, association between smartphones, GPS and tolling – and not only as a result of concerns about Big Brother. From the toll operator's perspective, it's more self-centered and pertains to a key ETC rationale already mentioned – revenue assurance.

For any new tolling solution – including GPS tolling – two questions shape an operator's interest in it and in new form factors. Is the solution as accurate as my RFID system? And in terms of identity, who do I invoice – and related to that, how much does that cost me? If the solution cannot assure revenue – or do so as cheaply as the current approach – it's difficult to justify. The reason for that is simple: toll facilities have management and boards with fiduciary responsibilities (including bond covenants) so shy away from perceived risks.

The challenge to overcome is that a smartphone-based solution must perform an equal or better job at addressing accuracy and identity concerns, and be at a point where it positively impacts cost, revenue and performance.

Need to know?

A new and potentially disruptive alternative to collecting tolls electronically with tags

- A smartphone-based tolling solution combining payment 'app' and RFID tag on a smartphone
- Works with the reliability, accuracy and security of a traditional transponder, but adds a feature-rich, customizable GeoToll app
- Enables regional and national interoperability
- GeoToll will soon publish its accuracy results to the tolling industry

GeoToll's aim is to provide toll operators, their customers and integrators with an innovative and robust mobile phone-based toll payment technology

The smartphone solution

GeoToll's mobile payment solution exploits the phone's GPS functionality but not to locate the vehicle in the lane as it passes under the gantry – a source of concern for operators as GPS accuracy is insufficient to identify a vehicle in a specific lane. In that case, toll operators that adopt a GPS solution still rely on photo imaging and reconciliation – a costly process they would rather avoid.

GeoToll users receive an RFID sticker tag to affix to their smartphone. The solution also uses GPS to recognize when a vehicle is near the toll point. Using the GPS coordinates of an operator's toll gantries, the location-aware smartphone wakes-up the integrated RFID toll tag and downloads and dynamically assigns an ID to the smartphone when the driver enters a new toll region using a different standard. This enables device-based interoperability, as opposed to multiprotocol readers. The GeoToll-enabled smartphone communicates with the RFID reader in the same way as a standard toll tag. The use of proven RFID tolling technology therefore addresses any concerns about accuracy.

There are further benefits for toll operators, too. GeoToll permits the BYOD (bring your own device) approach, which precludes the need for operators to procure, manage and replace transponder inventories. In addition, toll operators don't need to procure costly upgrades to their lane systems to meet a new, arbitrarily selected, protocol standard.

As to the industry's valid concern about identity, users download the GeoToll app and are asked to establish an account and provide payment information to GeoToll. This populates a back-office system managed by GeoToll, or optionally by the toll operator. In the event a user's phone is off when crossing a toll point,

(Far left) **GeoToll uses an active DSRC system to improve its readability from gantry equipment, even with passive variants such as 6C, Title 21 and ATA** (Left) **The GeoToll app features the ability to prepare, format and print expense reports with mileage, tolls and other travel expenses**

end-of-day reconciliation of transactions will identify the GeoToll account before it enters into the costly image-review process. GeoToll will then remit payments for all transactions on an agreed-upon schedule, hence toll revenue is assured.

To remain innovative and achieve additional cost savings, the toll industry must consider incorporating the most universal consumer electronics product in history – the smartphone – into their business model. First, the BYOD approach eliminates substantial costs associated with maintaining a traditional tag base. Second, the use of RFID ensures accuracy and revenue. Third, while a GeoToll user may not be a direct customer of a toll operator, they are a customer of an entity the operator can identify, contact and bill. With this triumvirate, the GeoToll mobile payment solution can keep the tolling industry innovative as its role in solving the USA's transportation challenges continues to grow.

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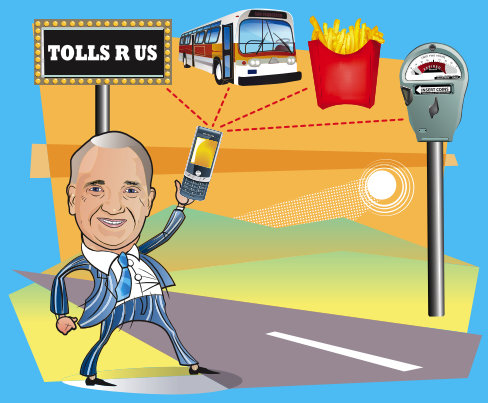

J J Eden

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Regardless of the industry, change is inevitable – but adapting to change isn't easy and it doesn't happen overnight. Can you remember life without Apple and Microsoft, where IBM and Compaq ruled the PC world? Or the advent of video technology and how much has changed since the Betamax-VHS war?

Tech gurus must update software and hardware, abandoning old familiar processes to meet the ever-changing needs of consumers. Ops and marketing must evaluate business models and make key decisions designed to shift the market away from their comfort zone. Finance and investors must take calculated risk. And at the end of the day, the end user or consumer must accept and use the product or service.

I've previously discussed the changes happening in tolling technology – the innovation of ETC and the growing controversies surrounding protocols and standards. As a result of these changes, the business model is evolving. New tolling technology enables overhead gantries and non-stop pass-through at interchange points. Instead of a physical cash exchange, customers are billed electronically and automatically. This increases the risk of toll leakage but also offers great opportunities.

Over the past couple of years, interest in our business model has grown in other industries. A mobile payment account now appears lucrative to large banks and corporations looking to capitalize on the billions of dollars available from industries such as tolling, parking, fast food and transit. Add the ability to cross-market between business segments and it becomes a very lucrative business.

It wasn't all that long ago that tolling was a cottage industry. Everybody knew everybody, all the way to the top – including every agency, vendor and consultant. With a more financially lucrative business model in place, we are now seeing interest from major corporations outside the traditional toll sector, including Google, Apple and others. Even the 'old time' integrators have been acquired by major corporations.

On the political side, we've seen several toll agencies being absorbed by their state DOTs – some officially and some just by strong political influence. Managed lanes are now being studied by most DOTs in the USA, with consultants scrambling to establish a base to address this new market. Meanwhile, the discussion continues over whether these projects are ITS or tolling.

So is this all good or bad for the tolling industry? Will we see Tolls R Us sponsored by Google or DOTs running user-fee agencies combining these markets? When electronic toll collection was introduced it was opposed by many – as is all-electronic and video tolling today. As a whole, it's something we've been asking for decades. When E-ZPass was originally bid, we expected large banks to supply the service and charge us a fee, but that didn't happen and the model evolved differently. Today's model presents the opportunity for tolling to be combined with other commercial markets.

Some will argue that this could be a disaster for the toll industry and reduce our service levels, while others would say this is what's best for the public good – reducing our operating cost while providing a better service for the next generation of the traveling public.

Regardless of where we end up in one, two, five or 10 years from now, it will be a change that will require vision and compromise from everyone. For what it's worth, I believe we'll embrace the needed compromises and implement the changes that benefit our customers – and help the toll industry continue to grow.

> Will we see Tolls R Us sponsored by Google or DOTs running user fee agencies combining these markets?
>
> **James Eden, director of tolling, AECOM, USA**

Integrated risk management for European tolling

READER ENQUIRY NO. 505

Eurotoll is a leading European provider of subscription contracts for heavy goods vehicles (HGVs) using the infrastructure network as well as existing electronic toll systems on most European toll road networks. But the negative effects of the recession in Europe have led it to revisit its trade credit risk management model. Working with Tinubu Square, the company has implemented credit management processes that provide real-time visibility into trade credit exposure, reduced cost of credit and the number of accounts in arrears and optimized credit insurance premiums and coverage.

The challenges

Eurotoll's direct toll road network covers more than 18,640 miles of freeways, tunnels and bridges and also secure parking in France, Spain, Italy, Austria, Slovakia and Poland. It also works with partners in 27 European countries for services related to controlling toll costs for 10,000 customers, including 70% of the 25 largest European freight companies. In 2011, it issued four million invoices totaling more than €500m (US$645m) for tolls and its value-added services.

(Above) **Tolling operations are reaping the gains of an improved way of performing credit risk management** (Below) **Tinubu's risk management software**

The company's services help to optimize fleet management by controlling travel costs and in doing so enhance the competitiveness and profitability of customers' transport and logistics operations. An example of this is the work it conducts to help customers assess the impact of road taxes on their operations.

Need to know?

European heavy goods vehicle tolling credit risk management is being streamlined via a new, advanced system

- With the use of an integrated risk management platform, Eurotoll is able to assess the credit risk associated with each HGV toll customer
- Tinubu Square was able to offer Eurotoll a number of compelling reasons to adopt its solution
- Eurotoll has been able to reduce accounts in arrears

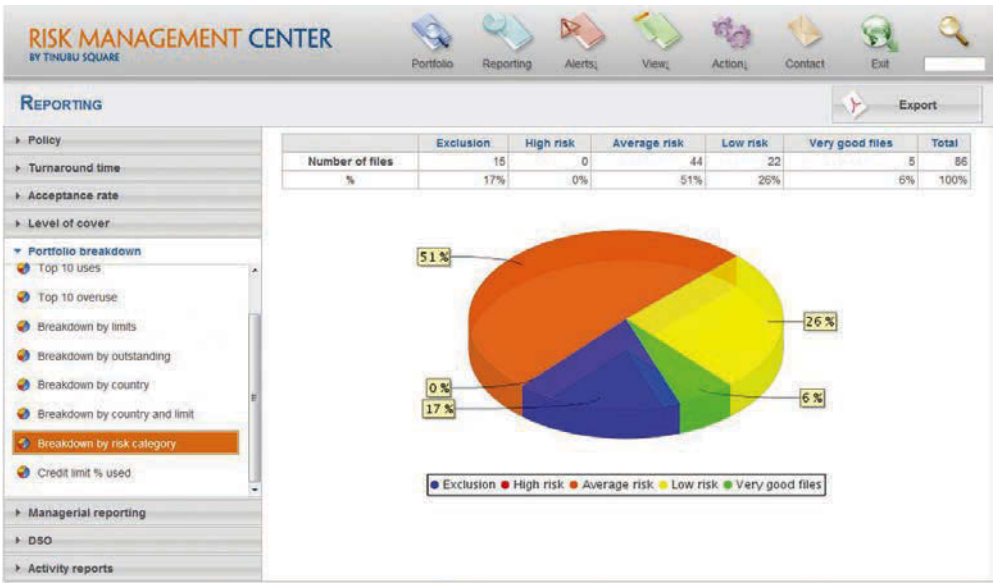
This has become increasingly important since the Green Levy came into play this July. This applies to all vehicles weighing more than 3.5 metric tons on a network of 9,320 miles including national and departmental roads, and will cost an estimated €0.12/km, depending on the vehicle's emission class.

It was against this complex financial backdrop and because it was cognizant of the effect the economy was having on Europe's transportation sector that Eurotoll decided to revisit its trade credit risk management model. At the time, it relied only on credit insurers and general financial information about customers, which didn't provide the visibility to track changes in their financial position and creditworthiness in a timely manner.

The solution?

In 2010, following a tender, Eurotoll chose Tinubu Square's Credit Risk Intelligence solutions featuring the cloud-based Tinubu Risk Management Center (RMC SaaS) platform, the Tinubu Credit Intelligence service and the Tinubu Risk Analyst service.

Eurotoll was particularly attracted to the Tinubu Risk Management Center as a result



The software offers a number of ways to visualize results, such as a breakdown by risk category

of the quality of information available and because it offered numerous benefits.

The first plus-points were functionality, ease of use and the ability to interface with Eurotoll's existing systems. Being cloud based, Tinubu RMC is straightforward to implement and will work seamlessly with systems on a wide variety of platforms without affecting their performance or requiring complex integration.

Secondly, the online Tinubu Credit Intelligence service was an attractive option as it provides on-demand, up-to-date customer risk profiles customized to Eurotoll's specifications. It also integrates the latest financial and credit intelligence about customers with Eurotoll's credit strategy and internal client data via the RMC. And it allows the company to quickly qualify the current credit status of existing and potential customers, leading to speedy decision-making.

The Tinubu Risk Analyst on-call service was another key benefit. This offers expert risk opinions; advice on risk issues; risk monitoring for individual companies, groups of companies, and countries; and constant dialog with Eurotoll credit managers. This specialized service means Eurotoll can rely on experienced guidance as necessary.

A final benefit was competitive pricing coupled with value-added services. "We wanted a partner capable of providing more specific and timely customer credit and financial information, optimally, on a daily basis," comments Philippe Duthoit, general manager of Eurotoll. "Tinubu Square fully understood and had the solutions to support our objectives."

Analyzing the benefits

Using Tinubu Credit Risk Intelligence solutions, Eurotoll established efficient management of its trade credit risk with real-time visibility across all exposure. Tinubu RMC and Credit Intelligence provided the tools to implement more effective credit management within the organization on a daily basis. Eurotoll uses the RMC platform to manage policies, limits, alerts, claims and, especially, to assess the risk associated with each customer on an ongoing basis. "Our teams submit between 10 and 20 cases per day and the Tinubu RMC allows us to treat these requests within 30 minutes," explains Duthoit.

Tinubu Risk Analyst enhances the company's new internal controls with customer monitoring and on-call expert consultation. The relationship between Tinubu Square and Eurotoll is based on the continuous sharing of information. Regular contacts between the companies' analysts continually update Eurotoll with the latest financial information available on customers. Among the data that this service can provide is risk portfolio analysis; detailed information on buyers and a financial overview of specific customers; credit recommendations, risk analyst opinions and monitoring of risks; and a daily report on risk portfolio changes and KPIs attached to specific criteria. "With Tinubu Square, we can make quick decisions based on reliable financial information," Duthoit adds.

As a result, Eurotoll has identified specific benefits. It has reduced accounts in arrears and reduced its cost of risk. And based on the reporting from Tinubu Credit Risk Intelligence solutions, the company has been able to implement a program of credit insurance more adapted to each customer's specific activity, leading to the optimization of Eurotoll's credit insurance costs and coverage.

"Each of our customers has its unique requirements, and Eurotoll had a need for all three of our corporate solutions," notes Pierre-Emmanuel Albert, founder and general manager at Tinubu Square. "Eurotoll has benefited not only from the way the solutions dovetail with each other but also their integration with the company's own internal systems and customer information. This has generated valuable intelligence that has led Eurotoll to realize tangible and very timely results, and we are delighted to be working in such a close partnership with the organization across Europe. ○

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Non-intrusive traffic detectors

READER ENQUIRY NO. 506

Traffic data – information about speed, density, travel time between any two points, as well as the types of vehicles utilizing the roads – can be acquired from various sources. The spread of Bluetooth-enabled cell phones, for example, sparked the development of Bluetooth-based travel-time measurement systems. Similarly, advances in video detection prompted the spread of ALPR for travel-time applications (and for many other applications in countries without stringent privacy protection laws). Essentially, all systems that derive the speed or vehicle class/type, etc, from such sources are secondary systems. The traffic detectors produced by ADEC Technologies do not fall into this category. All of its products are primary systems in that they measure speed and vehicle class at the roadside and in real-time.

The majority of ADEC's detectors operate only on a single lane of traffic. The TDD1-MW detector, for example, is a simple Doppler radar that's available in two versions, which differ only in their detection range. The device incorporates a simple contact closure output that signals when a vehicle is approaching or departing from the detector. The maximum detection range is either 30m (TDD1-MW30) or 75m (TDD1-MW75). The device's configuration is set using an IR remote control that is specifically designed for it. As well as the traffic direction selection, the nominal detection range and minimum speed threshold for detection to occur can also be configured. Typical applications include green-phase requests for temporary and permanent traffic lights.

The TDC1-PIR detector, meanwhile, is a highly accurate traffic counter with radar-like speed accuracy, length-based vehicle classification and ultra-low-power consumption (<10 mA at 6V). It uses multiple passive infrared (PIR) zones parallel to the traffic direction that act as a break-beam system. Designed for applications where low power consumption and accurate data are imperative, the detector makes the traffic data available via RS485 to any compatible data aggregator.

Both the flexible mounting height (5.5-18m) and the large voltage supply range (5.5-30 VDC) make this device a popular choice for both solar-powered and grid-powered installations. It can be mounted overhead or at the roadside, for example on a streetlight pole.

A third type of detector from ADEC, the TDC3 series, combines multiple sensor technologies to provide highly accurate vehicle information, in particular a vehicle's speed, length and class, the latter of which is extracted from its length and height profile. The TDC3 family of detectors also includes models for distinguishing up to eight vehicle classes, namely motorcycles, cars, car with trailer, vans, trucks, trucks with trailers, semi-trailers, buses (coaches) plus one 'unknown' class, called 8+1 classification. The TDC3 is available for classification from two to 8+1 classes. It boasts a proven classification accuracy of 80-98%. All computation occurs in the device, and the traffic data is available via RS485 databus using a rather simple request/response protocol.

Typical applications include variable maximum speed control, temporary breakdown lane usage, wrong-way driver detection, queue detection, etc.

The bottom of the TDC4 detector, which is one in a range of traffic detectors from ADEC

Last but not least

Finally, the TDC4 family of detectors augments the features of the TDC3 series by integrating a snapshot camera. It's called 'snapshot' because the system is designed to use existing communications infrastructure that doesn't permit video streaming. Instead, it is configured to detect the appropriate conditions when an image should be taken. When those conditions arise, the camera can be used to conduct wrong-way driver notification and queue detection.

Of course it is also possible to take a photo at any time upon request to gain a visual understanding of the situation at the site. Most importantly, the transfer of the JPEG image via RS485 doesn't interfere with the transmission of traffic data. ADEC's commissioning software includes a neat configuration tool to set up the camera and experiment with its functionality.

Need to know?

Innovative product development is fueling the demand for non-intrusive detectors

- The burgeoning market and industry demand for non-intrusive methods of conducting traffic detection is encouraging systems suppliers to up their game
- One well-known expert in this sector now offers a broad range of detectors suitable for various ITS applications
- A recent advance has seen a camera incorporated into a detector to offer users a snapshot of the action

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Building a case for average speed enforcement

READER ENQUIRY NO. 507

Around 1.24 million people die in road traffic accidents every year, according to the World Health Organization. The WHO also states that the probability and severity of a crash is directly proportional to average speed, hence measures to reduce excessive speeding such as speed enforcement using cameras and associated automated devices are critical to ongoing road safety efforts.

Although speed enforcement effectiveness depends on a number of factors, European research nevertheless shows that automatic speed enforcement strategies can reduce crashes by 15-20%.

Point-to-point speed enforcement

But some researchers believe that fixed, visible speed cameras can lead to dangerous traffic situations with some drivers approaching enforcement zones suddenly decelerating, only to speed off again after they've passed the camera. Point-to-point speed enforcement largely negates this erratic behavior.

This relatively new method of enforcement uses digital camera technology and ALPR to identify every vehicle entering and leaving an enforcement section, with average speed measured over a known distance. The rationale is that this encourages drivers to reduce their speed along an entire section of road, resulting in huge changes in driver behavior, which is evidently preferable to the rapid braking and accelerating that can occur at some fixed camera sites.

Additional benefits associated with point-to-point speed enforcement include more homogeneous traffic flows and increased traffic capacity resulting from reduced vehicle speed variability. This can also have a knock-on reduction in exhaust emissions and air pollution as well as increased fuel economy and reduced wear and tear on vehicles.

Average speed enforcement has also been shown to be effective in workzones, which can be a dangerous environment for contractors, with drivers having to react to narrow lanes and changes in road layout. Preventing excessive speeding in such areas is a DOT priority.

Redflex technology in action on Australia's Hume Highway

The wizards in Oz

Evidence to support the use of speed enforcement is easy to come by. Research from Australia, for instance, shows up to a 90% reduction in vehicles exceeding the speed limit from speed enforcement generally. Meanwhile, a report by the Queensland University of Technology finds several road safety benefits associated with average speed enforcement, including high rates of compliance with speed limits, reductions in average speeds and reduced speed variability between vehicles, as well as reductions in fatal and serious injury crash rates.

The Hume Highway in the state of Victoria is one of many success stories, where both spot and average speed systems are combined and have shown to be effective in reducing both speeding and the accident rate on this busy stretch of road.

Numerous other studies also prove the case for point-to-point enforcement. Researchers in Austria evaluated its use on an 80km/h motorway stretch running through a tunnel and calculated that after two years of operation fatal and serious injuries were reduced by 48.8%. Similar results were also reported in the Netherlands where the number of speed offenders declined to fewer than 1% of total users on a section-enforced stretch of motorway. And data from the UK shows consistent reductions in the KSI rate of between 33-85% on roads where point-to-point systems had been deployed.

Studies conducted the world over show speed enforcement works. But point-to-point enforcement is more effective, as it reduces speed over a specific distance rather than at a single location. And it's that fact that has led to a number of jurisdictions to seek out point-to-point enforcement solutions with a view to deployment in the foreseeable future, in doing so further driving the safety benefits that have been achieved by previous generations of technology.

Need to know?

Recent advances are proving the merits of average speed enforcement

- An average speed system works by comparing the distance between two points and the time it would take to travel that distance legally
- In the Redflex point-topoint system, vehicle details (including image and time) are recorded at each point and are later correlated at a central server to determine the average vehicle speed, with incident files created for speeding vehicles

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With it being awards season in our industry, which project or technology of the past 10 years would you give the 'Most Valuable Deployment of the Decade' – and why?

Answer the Burning Question via our LinkedIn group page at www.traffictechnologytoday.com

Tweet your response to @ttieditor

"The most valuable deployment of ITS exemplifies the definition and purpose of ITS, which is the application of technology to meet needs, and not the other way around. The concept of Transportation System Management and Operations (TSMO) is indeed just that: integrating facilities, systems and control under one traffic management umbrella. Hence, my criterion of what constitutes an exemplar project stems from the rubric of one project, maximum effect – and it would be a TSMO project since, again, TSMO projects are most significant. The most significant project of that ilk is the San Diego (USA) region Integrated Corridor Management (ICM) system, which ties modes, routes and control into a unified corridor network using real-time data, near-real-time modeling tools and predictive algorithms over a 20-mile section of I-15 and the transportation facilities in and around that freeway, to include arterials. The deployment is here and now: it begins this year. But the lessons learned from this integration of ITS data, tools and technology will last well beyond this year."

Jim Misener
transportation and technology consultant, USA

"I'm actually torn between two particular technologies! Firstly, the satnav... This changed the ITS industry and made in-vehicle technology commonplace. Although route guidance had been a possibility since the late 1980s, widespread deployment required sufficient technical maturity from positioning systems, digital mapping and real-time data as well as routing algorithms, electronics and display technology. More than anything, the satnav is widely appreciated, even by non tech-savvy drivers. However, for sheer scale of impact, I'd have to go for adaptive real-time traffic control (ART) systems. In a session that I organized during the World Congress on ITS in Vienna last year, ART was described as possibly the most cost-beneficial ITS ever! Systems such as SCOOT (Split Cycle Offset Optimisation Technique), a tool for managing and controlling traffic signals in urban areas, really do help to manage congestion, balance the needs of all road users and keep our urban areas moving efficiently."

Dr Alan Stevens
chief scientist and research director, TRL, UK

"It's difficult to pick just one project from the past 10 years, but the E-470 Public Highway Authority in the US state of Colorado has to be a top choice in any voting. E-470 is a 47-mile tolled beltway that runs along the eastern perimeter of the Denver metropolitan area, passing along the western edge of the Denver International Airport. In 2010, E-470 went completely cashless through its deployment of all-electronic tolling (AET). While other tolled highways were born as cashless facilities (for example, the 407 ETR in Toronto, Canada, and CityLink in Melbourne, Australia), E-470 is the first traditional toll highway – one that included both cash and ETC – to eliminate cash as a payment option on its facility. This was an important milestone that demonstrated to other hybrid toll facilities (cash and ETC) that it is possible to become an entirely cashless operation. Most major toll operators today are planning to make their operations cashless in the coming years. E-470 also received IBTTA's Toll Excellence Award for Social Responsibility in 2013 after installing a network of solar-electric panels to power its signage and HQ." (*See p60*)

Patrick Jones
executive director and CEO, IBTTA, USA

"The London Congestion Charge, announced in Ken Livingstone's mayoral manifesto, began in 2003. It is enforced by fixed cameras at the boundary and inside the charging zone, which record vehicle registration details using ALPR. As an area scheme rather than a cordon scheme, charges apply to vehicles circulating within the zone, whether they cross the boundary or not. Upon its introduction, congestion fell 26%, traffic by 17-31%, and journey time and reliability improved. Congestion was not displaced elsewhere as was widely predicted – there was minimal change in traffic on adjacent roads. Other benefits include more people using public transport, reduced vehicle emissions, new cycle routes and improved road safety. Critics cite its high running costs, but it was a pioneering scheme using new technology and was over-engineered to preclude legal challenges. Overall, it's been extremely influential, inspiring the equally successful Stockholm scheme, and is undoubtedly the way of the future for other congested cities."

Dr John Walker
honorary secretary, ITS(UK) Road User Charging Interest Group, UK

Readers are invited to answer the Burning Question for the October/November 2013 issue:

What types of weather data does your traffic management center collect and use, and how are these information sources utilized in your operations?

email answers to:
louise.smyth@ukipme.com

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