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Has the urban transit bus had its day?

Bern Grush unveils his future plan for a society of driverless electric vehicles

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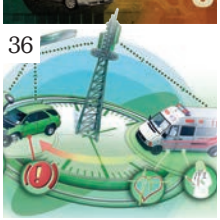

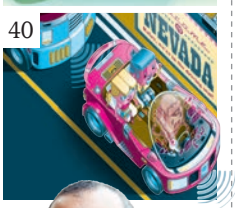

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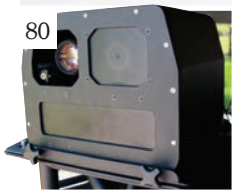

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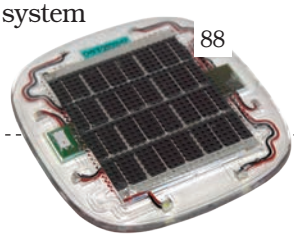

Foreword

A local authority error when I was 12 years old led to me being placed in the wrong academic year. The upside to this was that I spent a year less in school (which explains a lot, according to those close to me). [Cue the violins.] But it was sometimes tough being an extraordinarily gifted child prodigy – the reason I now give for this gap in education – especially when I had to watch on with envy as those around me experienced the adventure and independence that comes with obtaining your driver's license and getting your first set of wheels. When I eventually joined the ranks, 18 months after my mates in some cases, I needed little excuse to take 'Sherman', my Volvo 340, out onto the road.

Others will feel differently, but my love for driving hasn't really changed much in the 20 years since. I thought nothing of 10 hours on the Hume Highway from Melbourne to Sydney, for instance, or seven hours bouncing on pothole-ridden roads from Nairobi to Mombasa. And despite the monotony of five hours on I-15 from Las Vegas to Palm Springs, I lapped up every Mojave mile.

I wouldn't have enjoyed these trips as much as a passenger, though, whether of another human or in a driverless vehicle – a common thread in this issue (p40 and p46). But on my daily commute to work – 12 miles that can take 45 minutes? I could definitely use that time more productively…

More than ever, autonomous vehicles and functionality are science fact rather than fiction. Just this year I've driven a prototype BMW that has full-range ACC, from a standing start and back to a stop again. I've been 'driven by' a VW that safely overtakes for you; been in a Lexus with pedestrian collision avoidance up to 50km/h; a Prius that recognizes your mood and in the future could influence your behavior accordingly; and a Ford Taurus that knows well before you do that another road user is about to run a red light.

Safety, clearly, is the primary goal of driverless vehicles, but there are many more benefits that as early as 2019 could have huge impacts on the way road traffic is managed. This, to me, is a more intriguing aspect than whether robot cars are technically or legislatively feasible. These computer-controlled vehicles will drive more efficiently, in tightly packed schools, leading to fewer jams. Theoretically, this means we could build smaller roads – requiring much less than the current US$75 billion a year spent on the road infrastructure in the USA, for example. They could reduce fuel consumption drastically and result in fewer nasties being pumped into the air. They could even promote vehicle sharing, usher in user fees more quickly, and potentially eradicate the need for enforcement. Auto makers are adamant this vision will become a reality. But as a keen driver, the thought that my kids and theirs might not even need the license that I so coveted as a teenager is something of a shame. The frustrated traffic managers (and commuters) of 2012, however, may have a more educated opinion.

Nick Bradley, Editor

Traffic Technology International
UKIP Media & Events Ltd, Abinger House, Church Street, Dorking, Surrey RH4 1DF, UK
Tel: +44 1306 743744
Main fax: +44 1306 742525
Email: traffic@ukipme.com
www.ukipme.com

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S E E I N G I S B E L I E V I N G

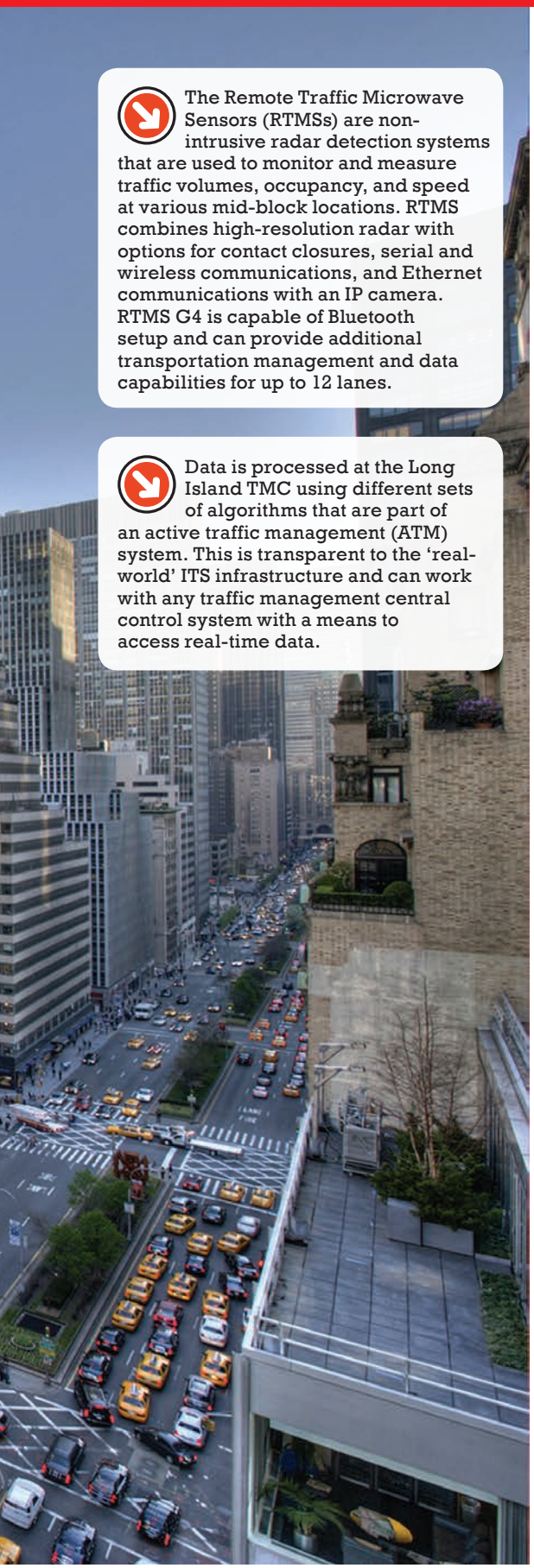
The ASTC Traffic Controller – which is based on the national Advanced Transportation Controller (ATC) standard – operates the traffic signals at 9,000 intersections in the city. Its Critical Intersection Control (CIC) software enables NYCDOT's centralized computer system to send command information to the controller to optimize signal timings. The ASTC also acts as the central data-collection system, gathering traffic information from sensors and transmitting this to the central system. In addition, the ASTC also includes Transit Signal Priority (TSP) features, allowing it to prioritize service to MTA buses and transit customers. This feature is not currently used in the Midtown area but is in the wider city.

The TransSuite traffic management software is integrated with Encompass RFID readers, microwave sensors, the adaptive control module, and other related equipment using the NYCWiN. One of TransSuite's roles is to control the ASTC controllers wirelessly. RFID readers for data capture were supplied by the same vendor, which assisted NYCDOT with traffic controller specification development, procurement and testing, as well as with the NYCWiN wireless router procurement.

New York minutes

An adaptive real-time congestion management system has sped up journeys through New York's Midtown district by 10% so far. **Izzy Kington** finds out how the technology works and how its use will be expanded

Images courtesy of Doug Hecox (FHWA), TransCore, Peek Traffic & KLD Associates



The Remote Traffic Microwave Sensors (RTMSs) are non-intrusive radar detection systems that are used to monitor and measure traffic volumes, occupancy, and speed at various mid-block locations. RTMS combines high-resolution radar with options for contact closures, serial and wireless communications, and Ethernet communications with an IP camera. RTMS G4 is capable of Bluetooth setup and can provide additional transportation management and data capabilities for up to 12 lanes.

Data is processed at the Long Island TMC using different sets of algorithms that are part of an active traffic management (ATM) system. This is transparent to the 'real-world' ITS infrastructure and can work with any traffic management central control system with a means to access real-time data.

The phrase 'New York minute' was coined to describe the slimmest fraction of time, a moment, because everything and everyone moves fast in the New York of our mind's eye. In reality, of course, New Yorkers often travel much slower than they would like to – 54 hours of yearly delay per auto commuter in the New York-Newark NY-NJ-CT area, according to the *2011 Urban Mobility Report*. In 2008, when the city was considering a congestion charge, Mayor Michael Bloomberg stressed the urgency of action: "We can't afford to do nothing about traffic-choking congestion, which is costing us billions and polluting our air."

After that plan was vetoed by the State Assembly (see *A mayor on a mission* sidebar), Mayor Bloomberg and the New York City Department for Transport (NYC DOT) looked to other ways of unclogging jams and reducing air pollution as part of a raft of 'green' and future-looking projects unfolding through the PlaNYC scheme, launched in 2007.

Efforts focused on the Midtown area. "When Midtown moves, New York City moves," says NYC DOT commissioner Janette Sadik-Khan. In mid-2010, the city began planning and installing equipment for a new scheme – Midtown in Motion – that was to usher in adaptive real-time traffic technology by July 2011. Hardware including 100 microwave sensors, 32 video cameras, and E-ZPass (RFID toll tag) readers at 23 intersections was installed over a 110-block area from 2nd to 6th Avenues and 42nd to 57th Streets.

The collected data from the sensors is sent via the Department of Information Technology and Telecommunications' high-speed, citywide New York City Wireless Network (NYCWiN) to the Long Island City TMC. Engineers there use the data to identify and alleviate choke points in real-time – using an Adaptive Decision Support System (ACDSS) and traffic management software called TransSuite to integrate and process the data, then update and transmit applicable signal timing patterns for each intersection.

Remote control

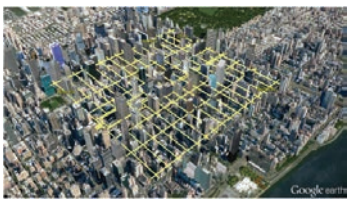
Midtown's signal patterns can be controlled remotely using networked Advanced Solid State Traffic Controllers (ATSCs), which replaced electromechanical controllers at half (6,200) of the city's signalized intersections. The aim is to achieve full, citywide roll-out (12,500 intersections) of the ATSCs, integrated with TransSuite, by the end of 2013.

As well as clearing problem areas on avenues, engineers can switch between a simultaneous signal progression, where all signals change at the same time, and a traffic signal progression, whereby drivers traveling at a constant speed encounter green lights as they move along the corridor.

> "I think the benefits of deploying the technology far outweigh the costs; it's not a very expensive system, it's something that any city can deploy and you can go as sophisticated as you want

The data generated is free for developers to use in the creation of smartphone apps. There are already apps for the public to report potholes and traffic issues

(Main) **Since Midtown in Motion was implemented in July 2011, average travel speed climbed in the trial zone from 6.5-7.2mph between 8am and 8pm – a 10.2% improvement**



The city that never sleeps

The Midtown in Motion project is not the first to address Midtown New York's congestion. In February 2009, a program called Green Light for Midtown was launched to "work with the grid instead of against it, correcting the complicated intersections that create traffic congestion," said Commissioner Janette Sadik-Khan. The focus was on simplifying Broadway, where traffic was found to move 20% slower than other avenues, with a knock-on effect to surrounding areas. Broadway was pedestrianized from 47th to 42nd Street and from 35th to 33rd Street; 7th Avenue was connected through Times Square with a fourth lane and 8% more green light time; and efforts were made to improve flow in Herald Square – by increasing green light times by 66% on the northbound stretch of 6th Avenue. Fire lanes were kept in Times and Herald Squares.

"In Manhattan, with its dense population and very close signal settings, the intersections are timed as groups, and we use progressions and offsets more than just individual cycle-split changes," explains John Tipaldo, director of systems engineering at NYC DOT.

Tipaldo reveals the area also uses fixed pedestrian crossing times and no pedestrian actuation, allowing "the predominant transportation mode in Manhattan [pedestrians] ample time to cross the street safely, on every signal and every signal cycle, without having to press any type of button". Other improvements include turn lanes to 53 intersections and turn signals at 23 intersections.

The reward for all this effort and investment was a 10% improvement in travel times in the testbed – as measured by the E-ZPass readers. GPS-based probes installed in taxis produced similar results. This was enough to prompt the NYC DOT to expand – in fact more than double – the testbed for a second phase, which should be fully operational this September. The area will cover more than 270 blocks, from 1st to 9th Avenues and from 42nd to 57th Streets, with an extra 110 microwave sensors, 24 traffic video cameras, 36 E-ZPass readers, and 200 ATSCs.

Looking even further ahead, Tipaldo says the NYC DOT would like to expand the scheme to the city's major arteries, beyond the Manhattan core. "In fact we've taken the first steps to obtain funding, but it's going to take us some time to get there," he says. The agency has also been approved for a grant from the Department of Homeland Security to use the same theory and equipment on coastal storm evacuation routes.

GPS taxi
data is used to record vehicle speeds for every day of the year. In 2010, the slowest day in New York was December 29, and the fastest was July 4

In terms of how all the technology might develop, Tipaldo and NYC DOT are keeping their options open. "We deal with all vendors and we're looking for the best and most efficient types of detection systems out there; we're not 'married' to what we're using," he says. "If there's a more efficient type of detector, the technology can be migrated."

What's innovative about it?

"It's the most sophisticated system of its kind in the nation," was Mayor Bloomberg's verdict on the technology. And he's not alone in his enthusiasm, with the project recently picking up a Smart Solution Spotlight award from ITS America. President and CEO Scott Belcher, who handed over the prize, says Midtown in Motion is particularly impressive for "the combination of traffic management technology, traffic signal prioritization for emergency and transit vehicles, and doing it in such a dense area".

TransCore integrated TransSuite traffic management software with its Encompass RFID readers

A key benefit, though, is the speed of response – even foresight – the system enables. "They're taking information not only from the immediate traffic signals but also from traffic further up the queue, and are able to adjust all of the signals based on real traffic experience over a long stretch of roadway," Belcher adds. "They've also been able to use that historic information to develop far more sophisticated algorithms to help them know how to adjust the traffic lights, how long to hold them, and what to do in the case of transit or emergency vehicles. So really [what's innovative] is the growing use of increasingly sophisticated data and using analytics to develop algorithms that allow you to not only manage the traffic that you're seeing, but more importantly to manage the traffic that's coming. And doing all that over a WiFi network is also innovative, because in the past you would have had to have built a whole infrastructure."

Transportation engineer Sam Schwartz, aka 'Gridlock Sam' (former New York City traffic commissioner), also believes it is the right solution for the city. "Until now, New York pretty much ran a progressive signal pattern, which works well under light to moderate conditions, but when traffic gets heavy, that type of pattern breaks down," he feels. "A pattern that reduces the vehicles in motion in a core area, as this does, is a better approach."

Clearly the technology is sophisticated, but Tipaldo is keen to stress the importance of

All Midtown in Motion data collected from the various sensors on the ground is transmitted wirelessly to the TMC in Long Island City

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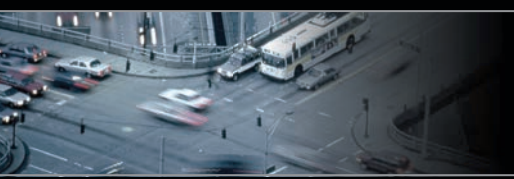

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A mayor on a mission

On Earth Day, April 22, 2007, New York City launched PlaNYC, a long-term roadmap with 127 initiatives designed to make the city more environmentally friendly and improve the welfare of the population – which was expected to swell by a million by 2030.

As part of this, a congestion charge plan was debated and tweaked for more than a year – but finally dismissed in April 2008 by the State Assembly. And although Mayor Michael Bloomberg lost this battle, he hinted he had not given up the war: "The problems congestion pricing could have helped solve are only going to get worse. And too many people from more than 170 environmental, labor, public health, and business organizations recognize the merits of congestion pricing and hopefully someday we will have more leaders in the legislature who recognize it."

A requirement built into PlaNYC from the start was that it would be updated every four years. The latest update was unveiled in April 2011, including 132 initiatives arising from 48 public meetings.

PlaNYC will not be a flash in the pan – in May 2008 Mayor Bloomberg codified the new Office of Long-Term Planning and Sustainability into law, to ensure its work will continue beyond his administration.

(Left) **FHWA administrator Victor Mendez discussing Midtown in Motion with NYC transportation commissioner Janette Sadik-Kahn at the announcement of the project's expansion in July** (Below) **The system's video screens at the Long Island City TMC**

people in the process. "Through the series of cameras that we've installed within the area, our operators visually confirm everything that the sensors come back with," he explains. "It's very important that in any type of system we deploy there's always a human element to verify that the implementations our algorithms recommend are really what we want to do."

Is it worth the money?

The first phase of the Midtown in Motion project cost US$1.6 million and the second is expected to cost US$2.9 million. A further US$2 million is also being invested in 200 new ASTCs.

Tipaldo insists it will cost much less than implementing a congestion pricing initiative would have. Rather than having to install new poles or gantries for the detection equipment, the mast arms on signal heads are used. "It's a question of optimizing the location of the antennae to get the maximum number of reads," Tipaldo confirms. "Because we're using a sampling procedure to estimate travel speeds, we don't need to get all the vehicles, as opposed to a congestion pricing system where you want to get everybody. We find sampling is sufficient to suit our needs and it saves us a lot of money."

The agency used to use a lot of in-ground sensors, but found they were not the best fit for this environment. "It was extremely difficult, if not impossible, to maintain them at the level that you needed to, due to utility cuts and just regular roadway wear and tear," Tipaldo comments. "So everything that we're usingis non-intrusive."

And without the wireless network and the new advanced solid-state traffic controllers already in place, Tipaldo believes the scheme would not have been practical right now.

Both Scott Belcher and Sam Schwartz believe adaptive real-time traffic systems offer great value for money. "It's low-hanging fruit," Belcher says. "I think the benefits of deploying the it far

outweigh the costs; it's not a very expensive system, it's something that any city can deploy and you can go as sophisticated as you want."

Schwartz's one recommendation for the New York agency to consider is enhancing communication with the public. "They don't realize why the signals are no longer staggered," he suggests. "They think something is wrong."

Other people, though, have renewed their call for congestion charging. "Tweaking the knobs so that traffic can go a bit faster will encourage more driving that will eat up much of the gain," says Charles Komanoff, a transport economist and Manhattan resident. "The city made a brave bid for systemic change with its congestion pricing try in 2007/2008. It's doing wonders with public plazas and bicycle lanes. But so long as drivers pay little or none of the delay costs they impose on each other, gridlock will go on and on."

For Tipaldo though, the aim right now is to maintain the 10% improvement rather than boost it, because the agency is wary of impacting pedestrian and bicycle movements. "New York is a very complex city," he concludes. "There are a lot of competing needs, and trying to accommodate all of our users is the most complex thing that we have to deal with. It's a very fine balancing act."

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Indelible marks

Manuela Flachi explains how COSMO will help raise awareness of the potential of cooperative systems in contributing to energy efficiency, in doing so paving the way for their large-scale uptake

While illustrating ways of exploiting the potential of future generations of vehicle ITS, the COSMO project is also testing in 'close-to-real-life' conditions some innovative ideas for a more sustainable urban environment, which could become an important component for the European Initiative on Smart Cities. The secret is to integrate cooperative functionalities within existing systems, in doing so offering a way of achieving energy savings, greater traffic efficiency, and a reduction in emissions all for a relatively modest investment.

COSMO, or 'Cooperative Systems for Sustainable Mobility and Energy Efficiency', is being coordinated by Swarco Mizar, and is aiming not only to demonstrate the systems' impact but also to quantify their advantages. Looking particularly at the effect on fuel and energy efficiency, the project intends to achieve this by setting up a range of cooperative ITS applications in three pilot sites. Their impact on environmental factors, traffic flows, and safety will be measured in order to be able to prepare detailed specifications and 'best practice' guidelines for future users.

(Above and main) **In the Vienna pilot site, LED streetlights are being used to draw attention to the roadworks at the entrance of the construction site during hours of darkness**

Complementary pilot sites

The pilot sites in Italy, Austria, and Sweden were carefully selected to produce complementary results, and include urban and motorway scenarios involving public transport as well as private cars. Since the 32-month project is already at the halfway stage, perhaps it would be useful to see what's been achieved so far…

Detailed plans for the pilot site installations and operation – plus a rigorous validation plan – have been drawn up, which provide the framework for measuring the impact of the traffic management applications on CO_2 emissions, energy consumption, traffic efficiency, and safety as well as user behavior. The demonstrations will help to provide concrete evidence of new opportunities for more sustainable transport.

The eCoMove initiative is another European project that's similar to COSMO, which is testing a number of 'Green ITS' technologies during its three years

The mission

COSMO is a 32-month (2010-2013) pilot project co-funded by the EC under the Competitiveness & Innovation Framework Programme – ICT Policy Support Programme.

The project is adopting a system-wide approach to the assessment of energy efficiency, measuring the effect of a range of innovative traffic management systems on fuel consumption and traffic emissions, but also considering the impact of the energy used by the equipment itself. Application areas being examined include eco-traffic management and control, eco-driving for private cars and public transport, multimodal real-time travel information systems, dynamic access management strategy, and eco-navigation.

Put to the test

At the Austrian pilot site, a number of different technologies are being examined in tests.

Thirteen LED streetlights from Swarco Futurit are located at the beginning of the road's construction site in order to increase the visibility of the lane deviation.

Two types of sensor have also been installed along the roadworks zone to measure travel times and to detect anomalies in the traffic flow. The first is based on the iTravel system, a solution for collecting and processing the road traffic data provided by Swarco. The system is designed to provide comprehensive traffic information in a cost-effective, powerful and open way. The solution consists of easy-to-install iTravel outstations connected to the iTravel central system. The second set of sensors is a wireless sensor network supplied by Sistra. Nine micro sensors (nodes) and three gateways for communication with the traffic center were installed; the collected data was analyzed and validated, in doing so providing essential input for the service roll-out.

Information for drivers traveling on the motorway is provided in various ways. One information channel consists of a mobile message sign supplied by Swarco Futurit, which is mounted on a mobile trailer and displays icons indicating 'Congestion Ahead' or 'Beware Roadworks', depending on the current conditions.

Running
until November 2013, Ecostand is supporting international cooperation for a common assessment methodology of ITS on energy efficiency and CO_2 emissions

In the Swedish pilot site, buses will receive a recommended speed depending on calculated 'time to green' in order to get through an intersection without stopping

In Austria, COSMO is testing a 'mobile roadworks kit', comprising high-luminosity LED streetlights, a wireless sensor network for traffic detection, a mobile trailer to display variable messages, and a smartphone application with real-time information and advice for drivers.

The kit is designed to be set up for the duration of the construction work, then dismantled and used again whenever and wherever required. The pilot site is on a stretch of the A2 motorway near Vienna – between Baden and Kottingbrunn – where an additional lane is being built. The objectives are to reduce congestion by smoothing the traffic flow and to increase safety by improving the visibility of the lane deviation zone. Project partners successfully completed the first installation and data collection during the autumn of 2011. The second stage of the tests will be carried out at the end of 2012.

Swede dreams

The focus in Gothenburg, Sweden, is on testing the impact of eco-driving for buses, and involves integrating an eco-driving application with the existing traffic control system so that they can exchange data. If drivers follow the indications given on their onboard display, they will benefit from a green light at the intersections and be able to enter the bus stop bays without having to queue. The system will run for at least six months in alternate weeks to permit in-depth evaluation with the system when switched on and off. Measurements will be made on the impact on travel times, traffic flow, and emissions, as well as the user acceptance.

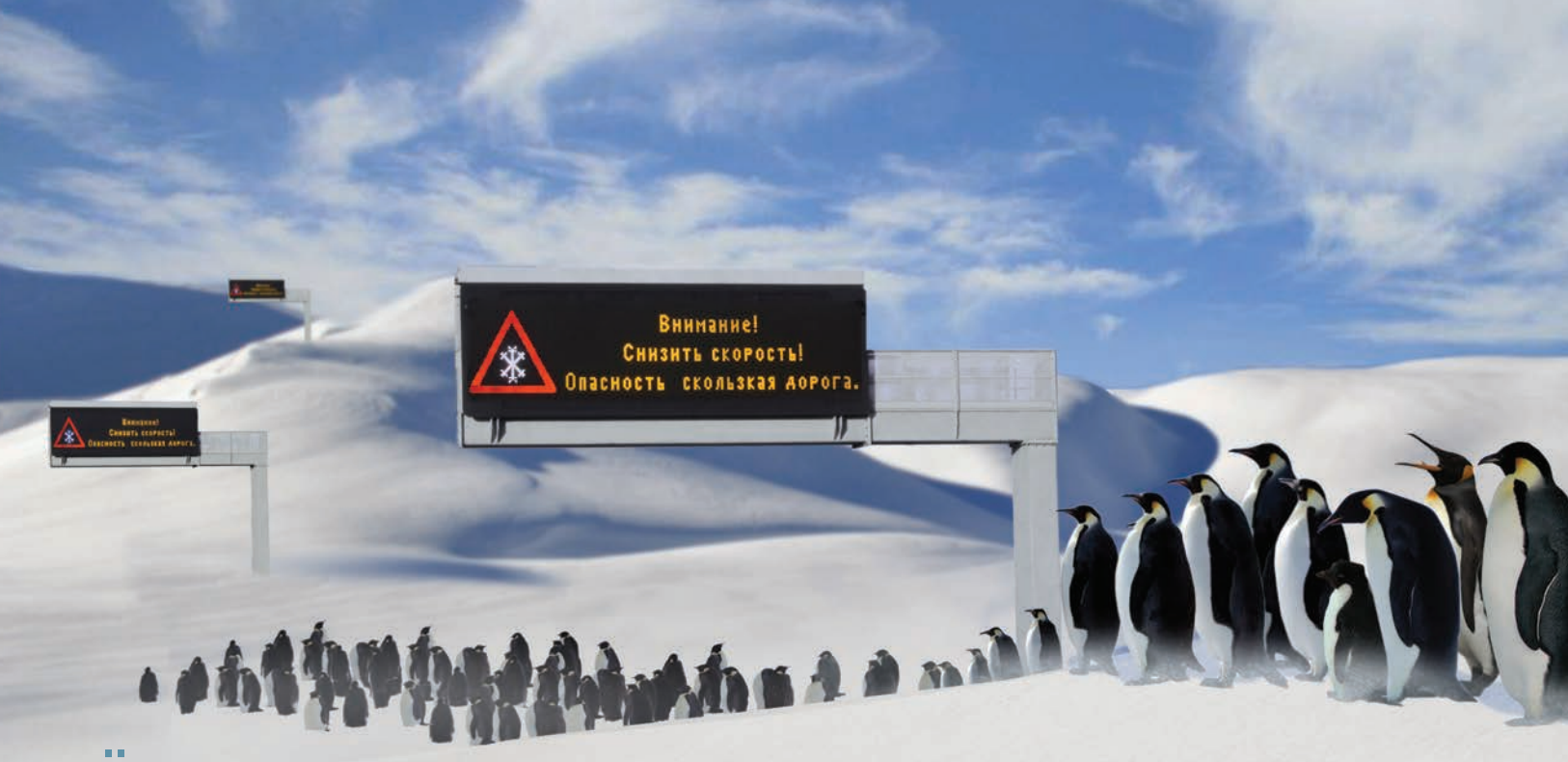
Italian influx

Last but not least is the pilot site in Salerno in the south of Italy. At the recent launch, a detailed roadmap for the tests was presented. COSMO systems are being installed at the University of Salerno campus, which has to cope with a daily influx of traffic generated by around 20,000 students and staff. At peak times, this results in congestion and wasted time as drivers search for parking spaces.

The goal in Salerno is to examine a bundle of cooperative applications, including eco-driving, multimodal guidance and traffic-adaptive streetlighting. A smartphone application, meanwhile, will recommend the 'greenest' solution to students participating in the study, who in turn will receive incentives (free coffees in the university bar!) for using the suggested parking lot and taking a shuttle bus. A campus of this size – akin to a small town – offers an opportunity to test the potential for behavior change in a controlled environment.

COSMO is being given high visibility at the forthcoming 19th World Congress on ITS (in Vienna from October 22-26, 2012), with the project team showing a video at the European Commission stand and presenting the results available so far, as well as running an outdoor demonstration in the exhibition area.

• *Manuela Flachi is a project assistant at ERTICO. For more information about COSMO, please email Gino Franco at info@cosmo-project.eu*



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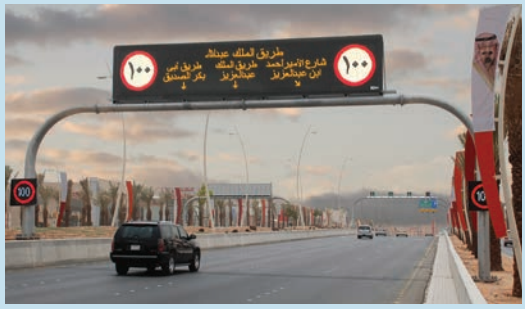

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Driven by distraction

At a recent tech day in Leipzig, Germany, a Tier 1 auto supplier unveiled its vision for the connected vehicle of the future. **Louise Smyth** was on hand to see if it can be brought to life

Images courtesy of Delphi

Sven Kopetzki heads up advanced engineering for Delphi and is currently occupied with developing the auto supplier's work on 'the connected vehicle as pathfinder for cooperative mobility'. The premise is simple: greater adoption of ADAS will save lives. "Cooperation by communication enables the next evolutionary step in advanced safety systems, leading to safer vehicles," Kopetzki says. "Communication between vehicles or infrastructure extends visual awareness beyond sensor range, provides more information, and gives drivers more time to react."

This latter point is key to much of Kopetzki's efforts. Until we have a fleet of autonomous vehicles, driver behavior has to be a prime consideration for any new technologies. "With a connected vehicle, drivers are better informed about their environment – especially in dangerous situations," he says.

Delphi's input into cooperative driver assistance systems spans solutions from antennae and driver interfaces to a multitude of in-vehicle sensors, part of a broader concept called MyFi that's being brought to life under Delphi's tagline 'Connecting with Safety'.

"Today's consumers love their electronics," adds Delphi's Rudolf Hemmert. "The attraction to smartphones and other portable devices is obvious. They're everywhere! Integrating entertainment, information, user experience and safety technologies, Delphi MyFi Connected Infotainment Systems allow drivers to enjoy the information and entertainment they expect while keeping their eyes on the road and their hands on the wheel."

So what exactly is MyFi? "It allows consumers to be connected to information and entertainment when they're in their vehicles," Hemmert continues. "And, when linked with safety sensor data, it mitigates driver distraction and provides alerts when certain unsafe conditions – lane drift, stopped traffic, drowsiness, etc. – are detected."

Hands-on approach

MyFi systems use technologies such as large touchscreens, voice recognition, text-to-speech, reconfigurable displays and workload management technology to tailor information available to drivers based upon their driving environment. Active HMI for driver monitoring is a prime example of a technology that fits within the MyFi concept. "This has three components: the workload manager, which collects and analyzes vehicle and driver information to manage the HMI; driver state monitoring (provides closed-loop control of the distracted driver countermeasures); and situation-based HMI, which enables the maximum safe utilization of infotainment system features."

Delphi, it seems, is far down the path to balancing the auto industry's desire to create safer vehicles and reduce accidents with consumers' need to be connected at all times – even when they're on the move.

The largest-ever field test of C2X has just kicked off in Ann Arbor, Michigan, with 3,000 vehicles hitting the road in the Connected Vehicle Safety Pilot

Comms options

Kopetzki and his team are assessing the merits of car-to-car communication versus mobile networks. Each has distinct pros and cons, depending upon the application they are to be used for. "Car-to-car (ITS G5) has properties that include a limited range (<1km) of fewer than 200 stations with multiple access over a few; ultra-low latency; no user fees; privacy as part of standardization; and broadcast transmission.

"On the other side, mobile communications (3G LTE) have properties that include: ubiquity communication range of >10,000 vehicles/base stations with multiple access for many; low latency; fees for network operators; centralized server necessary; and the potential for interoperability."

What sort of applications is each method best suited to? "3G LTE is appropriate when large amounts of data are to be downloaded over a long range," Kopetzki says. "Car-to-car communications are better suited for applications where small amounts of data are sent over a short range."

In terms of specific applications, mobile networks are best suited to infotainment, traffic information, remote navigation; software downloads, and remote diagnosis. Car-to-car communications, meanwhile, are better suited to intersection warning, forward collision avoidance, and lane change assistance.

> "Cooperation by communication enables the next evolutionary step in advanced safety systems

Made in Germany

In addition to the model deployment in Michigan, Ford has also contributed 20 specially equipped S-MAX models to a 120-vehicle fleet being used to test 20 experimental driver assistance technologies as part of a four-year research project known as Safe Intelligent Mobility – Testfield Germany, or simTD.

"Our participation in this research is pivotal to the delivery of the next generation of Ford driver assistance technologies that will globally benefit our customers, other road users and the environment," says Paul Mascarenas, chief technical officer and vice president, Ford Research and Innovation.

Pilot for the future

The eyes of the auto safety world will be on Ann Arbor for the next year, as the much-heralded model deployment finally gets underway. **Lloyd Fuller** spoke with a few of the participants before the groundbreaking tests

Images courtesy of Daimler, Ford & GM

August 21, 2012 could prove to be the most significant day in automotive and traffic safety history as almost 3,000 connected vehicles took to the streets of Ann Arbor, Michigan in the largest study of V2X technology ever to take place. If the year-long 'model deployment' delivers what many experts predict, in 2013 the USA's National Highway Traffic Safety Administration (NHTSA) could rule the technology be introduced into the fleet before the end of the decade. "It has the potential to be the ultimate game-changer in roadway safety," enthused NHTSA administrator David Strickland at a media viewing before the launch. "But we need to understand how to apply it in an effective way in the real world."

The model deployment is the second phase of the USDOT's 'Connected Vehicle Safety Pilot' – the major research initiative managed by NHTSA and the Research and Innovative Technologies Administration (RITA) Intelligent Transportation Systems Joint Program Office. As detailed in *Traffic Technology International*'s April/May edition, the tests are being conducted by University of Michigan's Transportation Research Institute (UMTRI). For the vehicle-to-infrastructure part of the program, 73 lane-miles of Ann Arbor roadway have been instrumented with 29 roadside-equipment installations. The Michigan college town was reportedly selected as a result of its traffic mix, variety of roadway types and characteristics, seasonal weather, and proximity to vehicle manufacturers and suppliers in the region.

5.9GHz
WiFi-based DSRC units exchange data such as vehicle location, velocity, acceleration and path history to prevent and/or mitigate crashes

> "It has the potential to be the ultimate game-changer in roadway safety

Reshaping the driving world

The test cars, trucks and buses – most of which have been supplied by volunteer participants as well as car makers such as Ford, Daimler and GM – are equipped with DSRC-based, 5.9GHz vehicle-to-vehicle (V2V) and V2I communication devices, the intention being to gather extensive data about system operability and its effectiveness in reducing crashes.

Mercedes-Benz Research & Development North America equipped eight Mercedes-Benz C-300 passenger vehicles and three Freightliner heavy-duty commercial trucks. GM, meanwhile, provided eight specially equipped Buick and Cadillac vehicles. "Participating in this program will help us and our research partners gain a more accurate, detailed understanding of V2V and V2I's potential safety benefits," confirms Nady Boules, GM global R&D director of the Electrical and Control Systems Research Lab. "It's essential that common standards and a security framework be established for these technologies so that vehicles from different automakers can communicate and interoperate with each other in a consistent manner."

GM (left) **is helping drive a critical phase of V2V and V2I communications technology alongside Daimler** (above) **and others**

"It will also help GM determine a timeline for introducing V2V technology on our vehicles, globally, in the second half of this decade," adds Hariharan Krishnan, GM R&D technical fellow for Perception and Vehicle Control Systems. "We think it'll take approximately another five years of market penetration for customers to truly benefit from the technology."

Earlier this year, the USDOT released data from a series of 'driver acceptance clinics' conducted during the first phase of the Safety Pilot. Nine out of 10 drivers who experienced V2V had a highly favorable opinion of its safety benefits and would like to have the various safety features on their personal vehicle.

So, with the general driving public clearly on side, it's now over to NHTSA to make a potentially enormous decision that will have an impact on American lives in the future.

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Research drive

The iTRAQ partners include Astrium Geo-Information Services, the University of Leicester, and De Montfort University, alongside Leicester City Council and Northampton County Council providing guidelines concerning user requirements and participating in the ongoing pilot trials.

The project is funded under the European Space Agency's Integrated Applications Programme. The first pilot trial was on a short road section in Leicester, involving two busy, major road intersections and demonstrated that significant reductions in delay time at traffic light intersections are possible if the light sequences are adjusted to follow the neural network predictions instead of the control algorithms currently in operational use.

A second study now under way in Northampton – and funded by the East Midlands Transport Innovation Network (iNET) – is extending the investigation to a larger road network as well as developing new software to speed up the data processing to a level required for operational use. Once these steps have been completed, the team expects to embark on a full-scale operational demonstrator of iTRAQ in 2013.

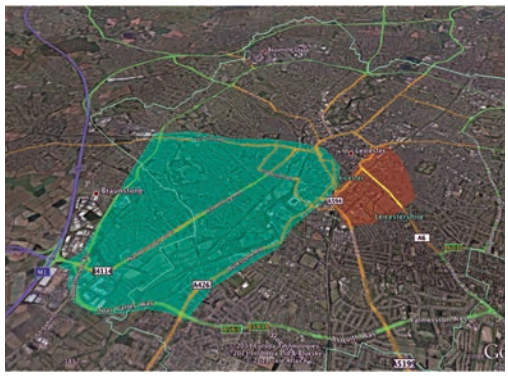
About

3,500 deaths (maybe up to 8,000) in London could be down to airborne pollution from traffic, says Professor Frank Kelly from Kings College London

Studying for success

The University of Leicester's **Professor Alan Wells** reports on the latest research that's investigating augmenting traffic flow and air quality information with near real-time data from space and in-situ measurements

Images courtesy of University of Leicester



The iTRAQ pilot test route, which involved two busy, major road intersections

Recent research into ITS offers new approaches to reducing journey times through congested city streets in ways that can also improve local air quality and create a healthier living environment. This research can also influence regional transport strategies and provide evidence-based support for greener environmental policies.

One such research project, known as iTRAQ, is a dynamic traffic management system for optimizing use of the road network and reducing traffic congestion while meeting growing demands from national governments and the EC to seek higher standards of air quality in urban environments.

iTRAQ is developing a new approach to traffic control by providing real-time adjustments to traffic light sequences in response to varying traffic conditions. It interrogates data streams derived from satellite navigation and remote sensing satellites, as well as the more conventional roadside sensors and cameras, and uses neural networks to find optimum traffic flow and minimum traffic pollution conditions through road junctions. Used as an add-on to existing operational traffic management systems, it has the potential to reduce congestion, shorten journey times, and improve air quality.

A wider view

The EC clearly recognizes the importance of research investment into ITS and related technologies. In its Horizon 2020 research plans, €31.7 billion is earmarked for tackling major issues affecting the lives of citizens and bringing results of research to market, within which urban mobility and innovative transport management systems are highly prominent.

There is growing recognition of the expertise in these areas in the UK's East Midlands, through the University of Leicester G-STEP academic-business partnership, the work of the East Midlands Transport Innovation Network and regional associations with MIRA and the TSB's Transport Catapult. Against this background the East Midlands has secured leadership of a new European Framework 7 project called 'THE ISSUE', which is a program within the Regions of Knowledge scheme. THE ISSUE focuses on traffic, health and the environment to achieve intelligent solutions for sustaining urban economies by bringing together innovative research-driven clusters to coordinate European research and technology development in six areas. These comprise ITS; transport impacts on urban mobility; transport greening; intermodal regional transport; safety and security of citizens; and associated economic, health and environmental impacts.

Led by the East Midlands, the core partners include Midi-Pyrenees and Aquitaine, France; Mazovia, Poland; and Molise, Italy. Each region has set up a three-way partnership between regional authorities, academic partners, and industry contributors working to draw together the industry and academic strengths in the regions and connect the research with the needs of managing traffic, transport, and air quality that the regional bodies are responsible for.

The next stage is to identify strategic research priorities for traffic, health and environment in urban economies based on the shared needs and expertise among the partner regions. New projects are expected to grow from coordinating these separate streams of research.

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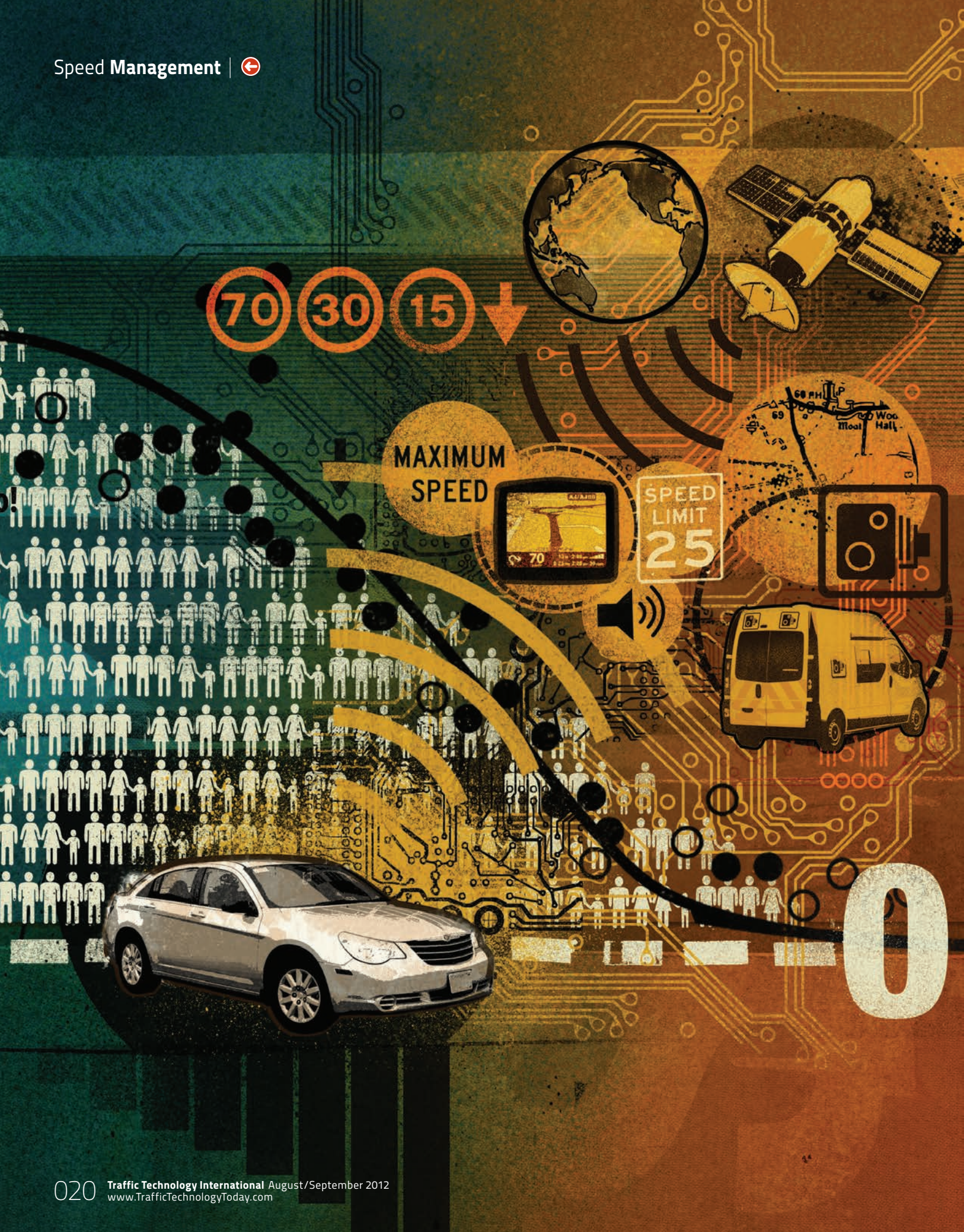
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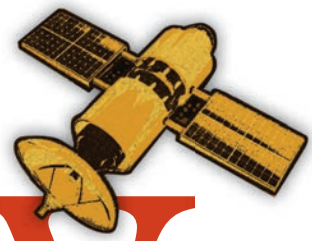


With an eye firmly on the electronic horizon, **Saul Wordsworth** reveals the strategies and technologies that could define the future of speed management

Illustration courtesy of Ian Dodds

Most people accept that speed kills but to what extent does it impact KSIs? In 2004, Göran Nilsson from the Lund Institute of Technology devised the 'power model'. Having modeled the impacts of changes in vehicle speeds, he calculated that a 5% increase in average speed leads to a 10% increase in injury accidents and a 20% increase in fatal accidents. Working in reverse, a reduction of just 1km of average speed an hour could potentially save 2,200 lives a year on Europe's roads alone.

Overall, speed is thought to be a contributory factor in up to 40% of all road fatalities. "But I still don't feel there's a universal recognition of the dangers," states Peter Kissinger, president and CEO of the AAA Foundation for Traffic Safety. "Here in the USA, for a lot of people 70mph is the new 55mph. As modern cars tend to be safer, drivers underestimate the dangers, but we still lose one life on our roads every 15 minutes."

In many European countries, road fatalities are leveling off. In the UK, for instance, numbers rose in 2011 for the first time in nearly 20 years, perhaps as a result of drops in funding (see *Budgetary crisis* sidebar on page 26). At the same time, the European Union has a target to halve road deaths by 2020.

Whether the solution is technical, strategic or behavioral, speed remains an emotive issue. One solution, however, is currently shouting louder than all the others. Intelligent Speed Adaptation, or ISA, constantly monitors a vehicle's speed in relation to the immediate speed limit, and reacts when the vehicle exceeds this particular threshold. What it does is shift the provision of information from outside the vehicle to inside. Although highly controversial, it has proven to be extremely effective.

Information from within

The technology has been trialed consistently during the past four years, most recently in the English county of Lancashire where 405 drivers had a basic ISA fitted for a period of nine months. "The results were pretty favorable," reveals Professor Oliver

Carsten at Leeds University's Institute of Transport Studies in the UK. "This was a low-cost system, nothing more than a standard satnav that beeps when you exceed the limit. Many existing devices have this feature but we had it on all the time and were data-logging on top of that. If you already own a satnav, it doesn't cost anything as long as the map behind it is accurate."

The EU recently recognized ISA's potential to improve the safety of Europe's roads – a stance endorsed by the European Transport Safety Council (ETSC). Its prerequisite for the implementation of ISA is the provision of a digital database of all European speed limits, so ETSC has called for the potential of ISA to be realized as a priority. "Many of those involved in the Lancashire trial requested to keep their devices and enjoyed having the technology on board," Carsten adds. "Sometimes political will is lacking and politicians think they know that the electorate wants to speed, which isn't always the case. Although progress at a European level has been a little slow, I believe it is only a matter of time before all mapping is in place and there will be a general deployment of ISA."

The potentially life-saving technology can be deployed in an advisory, voluntary or mandatory fashion. On an advisory setting, it can reduce injuries by 2.7%, on voluntary 12% and on mandatory – where the powertrain takes over – by an impressive 29%.

The right attitude

"It can change drivers' approach to speeding, acting as a kind of medicine to improve attitudes so that the experience of driving with ISA reduces the intention to speed," Carsten feels. "Almost every driver wants to know the speed limit, and it is not always clear," he says. "Car manufacturers will gain points on Euro NCAP, the European car safety performance assessment program, for having this kind of technology on board. We just need to ensure that all of the maps are coordinated at a national and international level."

(Right) **Ford's system helps drivers stay within limits and avoid costly fines** (Below left) **Large-scale ISA trials in the UK analyzed an advisory ISA system**

> **It can change drivers' approach to speeding, acting as a kind of medicine to improve attitudes so that the experience of driving with ISA reduces the intention to speed**
>
> **Oliver Carsten, Institute of Transport Studies, Leeds University, UK**

One simple way to ensure all mapping is regularly updated is via the internet. "Very soon, all cars will be online," suggests Claes Tingvall, director of traffic safety at the Swedish Transport Administration and the man behind the concept of 'Vision Zero'. "Having everyone on the web will make it much easier to know the correct speed limit, know where all of the roadworks are, and so on. Around 40% of all new Volvos sold in Sweden are now 'online' and I predict that eventually everyone will be."

Carsten believes that other systems will work in conjunction with ISA, particularly in-car cameras that detect speed signs and other road information (Ford's traffic sign recognition system has been its most popular optional extra over the past 12 months, for instance). However, these have proven to be most effective for temporary limits, with maps best for permanent signs and the two ideally working in tandem. Accurate mapping is also vital for solutions such as curve speed warning (CSW), which provides precise maximum speed recommendations to

Trending down

Every year, the European Transport Safety Council (ETSC) publishes a country-by-country analysis of road traffic fatalities in the EU. This road safety performance index (or PIN program) revealed earlier this year a slowdown in the average reduction in road traffic deaths across Europe. "Last year fatalities fell by only 3% compared with an average of 7% over the past 10 years (11% in 2010)," says Ellen Townsend, ETSC's policy director, meaning the EU risks missing its 2020 target of halving road deaths compared with 2010 figures.

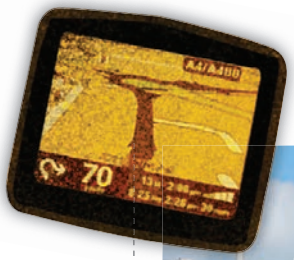
The commissioner of ETSC labeled the figures a 'wake-up call' and as an action plan requested all governments to submit their national enforcement plans. "The commissioner is concerned about cuts to public budgets and hopes these will not affect the work of the police. Hopefully his request should have a knock-on effect on the degree of effort made in the area of road safety."

drivers. Around 75% of those surveyed after the recent euroFOT project found CSW useful, especially in rural areas as it helped them drive "more defensively".

So what of the much-heralded C2X, which is surely a conflicting technology? "I think they will eventually merge," Carsten predicts. "In 30 years' time we are likely to have a situation in which nearly all speed limits are dynamic, varying by weather conditions, traffic congestion, emissions management, time of day, etc., so speed management will use I2V technology."

Auto advances

Ford's most popular driver assistance feature across its mid-range, the Speed Limiter, addresses the same problem but comes at it from a different angle, by enabling drivers to choose a maximum speed for their vehicle, meaning no involuntary breaching of speed limits. Confirming its popularity, more than



The risk of involvement in a casualty crash doubles with each 5km/h increase in free traveling speed above 60km/h, while a 5km/h reduction in speed can result in a decrease of at least 15% in the number of crashes

Twenty's plenty

The safety benefits of 20mph zones are supported by reams of international evidence. Because of this, **Kevin Clinton**, RoSPA's head of road safety, would like to see more of them on our urban roadways

The first widespread UK evaluation of 20mph zones, *Review of traffic calming schemes in 20mph zones*, was conducted by the Transport Research Laboratory (TRL) in 1996, which found that injury accidents in the zones were reduced by 60% and child injury accidents reduced by 67%. Importantly, the study didn't unearth evidence that accidents increased on surrounding roads as a result of drivers altering their routes to avoid the zones – as their critics predicted would happen. Overall traffic did, however, decrease by 27% in the zones, which was attributed to new bypasses built at the same time that took traffic away from the area.

From 1994, 20mph zones were widely introduced in Hull and by 2003, there were 120 zones covering 500 streets. The casualty statistics from the Yorkshire city showed a 14% drop compared with a 1.5% rise in the rest of the county and

> "The 24% increase in casualties on 20mph roads in 2011 is worrying, but it represents small numbers, especially when compared with casualties on 30mph roads

Humberside. In fact, within Hull's 20mph zones, there was a decrease of total accidents of 56% and in fatal and serious injuries of 90% – the biggest reductions being pedestrian casualties falling by 54%, child casualties dropping by 54% and pedestrian child casualties declining by 74%. More recently, in 2007, a review of 20mph zones in London discovered they reduced accidents by around 42% and fatal and serious accidents by 53%.

Commenting on the effectiveness of 20mph zones when official Department for Transport (DfT) figures were released this July, local transport minister Norman Baker said: "*British Medical Journal* research has shown a reduction in casualties and collisions of around 40%, a reduction in children killed or seriously injured of 50%, and a reduction in casualties among cyclists by 17%." The statistics did show that deaths and injuries in 20mph zones rose last year, though, from 1,827 in 2010 to 2,262 in 2011, while falling by 1% in 30mph areas.

"The 24% increase in casualties on 20mph roads in 2011 is clearly worrying, but it represents small numbers, especially when compared with casualties on 30mph roads [125,494], and is probably due to an increase in the number of 20mph roads," believes

220,000 Ford cars sold in Europe last year were equipped with the device, including 86% of Mondeos and 85% of S-MAX MPVs.

Research suggests that 90% of accidents are the result of drivers becoming distracted and inattentive. With this in mind, from 2014 Euro NCAP will include automatic emergency braking (AEB) system assessments as part of its star rating. AEB can reduce collisions by up to 27% by avoiding crashes or lessening their severity through driver warnings by supporting braking response and/or applying the brakes. The system uses radar, lidar and video to provide a comprehensive real-time image of the road ahead. Until recently the preserve of the luxury market, some volume sector manufacturers such as Mazda, Ford, Honda and Volkswagen may soon be offering AEB as standard.

Smile for the camera

"I foresee an increased use of average speed enforcement cameras in the future," says Lee Davey, business development manager with Redflex, a leading safety camera provider. "There will remain a role for single-point speed control but average speed checks are more desirable as they prevent surfing behavior – in other words slowing down for the camera then speeding up again."

Davey also believes that more sophisticated technology has opened up the market. "The advent of tracking radars is a modern

Kevin Clinton, head of road safety at RoSPA, a UK charity that's been at the forefront of safety worldwide for almost a century. "Most of the increase was slight injuries, again showing that when accidents do occur on 20mph roads, they are less severe.

"20mph roads – especially in 20mph zones that have traffic calming to make them 'self-enforcing' – are very effective at protecting people, especially children, pedestrians and cyclists, from being killed or injured," Clinton continues. "Lower speeds make crashes less likely and less severe when they do happen."

That road deaths and serious injuries on Britain's roads increased in 2011 after consistently falling for so many years needs to be looked at. "We need to understand why and to ensure that sufficient resources are devoted to road safety to make sure that one year's increase doesn't turn into a long-term trend," the RoSPA man concludes.

Pedestrians account for 24% of all road deaths in the UK, according to DfT figures – which is one of the highest percentages in Europe

> In the longer term, I think we'll move to more in-vehicle information to help drivers comply rather than focus solely on punishing them
>
> **Robert Gifford, executive director, PACTS, UK**

Daimler's Speed Limit Assist is able to work in real-time, analyzing images within a fraction of a second so as to provide drivers with the required information instantaneously

spin on a tried-and-tested formula and authorities are looking for more flexibility regarding enforcement that developments in radar technology can provide. Where in the past they may not have been able to deploy a mobile radar system in a specific location due to objects that might cause reflections in the radar, these days – through advanced algorithms or second radio antennae – we can filter out some of those things."

"We have evidence to show that our speed camera programs have been successful in the past," reveals Robert Gifford, executive director of PACTS, the UK's Parliamentary Advisory Council for Transport Safety. "We also have an indication in the report by Richard Allsop for the RAC Foundation of how many extra deaths we might see if the programs were halted. Over time, I expect average speed cameras will become more widespread as spot cameras become obsolete. But in the longer term, we'll move to more in-vehicle information to help drivers comply, rather than focus solely on punishing them."

Crossing boundaries

One of the reasons people speed is because they think they can get away with it, and nowhere is more true than in continental

Europe where crossing the border into another country may be a license to drive fast. "We ran a three-year program examining enforcement of traffic laws across the EU," reveals Ellen Townsend, policy director at ETSC. "This led to the adoption last November of a directive on traffic law enforcement entitled 'Information on Cross Border Information Exchange'. Authorities in one country will soon be able to access visitors' addresses for nine different road safety offenses, including speeding." This closes an existing loophole and from November 2013 transgressors will be fined.

Adhering to the standards

But is it really possible to 'standardize' road traffic safety? That's the aim of ISO 39001, the 'Road Traffic Safety Management' standard that's being launched at the end of this year and is intended to improve traffic safety and reduce fatalities. "It is applicable to all public and private organizations that interact with the road traffic system," confirms Tingvall. "Maybe one third of traffic flow is 'organized' traffic – that is, people on duty such as buses, taxis, trucks, and so on. They'll gradually have to adopt the new management standard as it will become part of the trade system, so if you want to offer me a transport service you need to have the standard otherwise I won't be able to trust that you're doing it in a safe manner. The quality of the taxi ride from Brussels Airport to the center of the city, for instance, could certainly be improved…"

At the heart of the standard is self-control. It will be up to individuals to manage their own speed, which is another step in the right direction and exerts an extra layer of pressure on Europe's drivers. "It puts the onus of speed management onto all organizations. It relies not on the police nor a Big Brother society, but on individual self-control," Tingvall says.

Budgetary crisis?

The future of speed management is very much dependent on a desire for change at the highest level. Although the likes of the ETSC and the EC continue to push, the lack of resources available in a recession-hit world is not the ideal breeding ground for confronting the issue.

"The current UK government coined the phrase 'ending the war on motorists' back in 2010 and it stopped both capital and revenue grant funding for cameras," reveals Robert Gifford, executive director of PACTS – the UK's Parliamentary Advisory Council for Transport Safety. "The government promised to publish a revised circular to local authorities to advise how to set speed limits, but we've been awaiting that for nearly 18 months and it seems to be a long time coming. We have no idea how many cameras there are, so at the moment we're in a state of limbo."

Overall KSIs in the UK rose by 2% in 2011, the first increase since 1994, figures that have traditionally fallen during a weaker economy. "This should have been a wake-up call," Gifford says. "Even though local authorities have a statutory duty to promote road safety and investigate road accidents, we don't know what the long-term impact of budget reductions will be on the ability to do that. The government may claim to have a 'strategic framework for road safety' but in the same document it says its priority is to cut the deficit, which appears to suggest cutting the deficit is more important than saving lives."

> ISO 39001 … puts the onus of speed management onto all organizations. It relies not on the police or a Big Brother society, but on individual self-control
>
> **Claes Tingvall, director of traffic safety, Swedish Transport Administration, Sweden**

(Left) **The speed enforcement system on the Hume Highway in Australia combines both spot and point-to-point solutions** (Below) **Transport for London's Road Safety Unit commissioned the development of an ISA with partner Technolution**

The last word...

But excess speed will remain a complex issue. In the USA, 94% of those interviewed said driving over the limit by 15mph was unacceptable yet 26% admitted doing so in the previous month. However, lowering limits is often unpopular, too. In Graz, Austria, for instance, there was a concerted campaign against the move to a 30km/h limit back in 1992, although after a two-year test phase most people voted in its favor. Early results were good but when enforcement fell, numbers did, too. A new English campaign, '20's Plenty For Us', hopes to reduce the limit for eight million people who live in areas that are committed to adopting a new speed for residential roads. Campaigners claims 80% of residents in test cases such as Portsmouth support the change (see *Twenty's plenty* sidebar).

"When it comes to speed management, cameras and speed humps can stir up society if used in an insensitive way," Tingvall concludes. "Variable message signs can of course be effective – as can the lowering of limits – but ultimately managing speed on our roads is going to move into cars. There will always be people who are upset, but if they have built-in support in their vehicle, there's a lot of evidence to suggest they'll actually use it." ○

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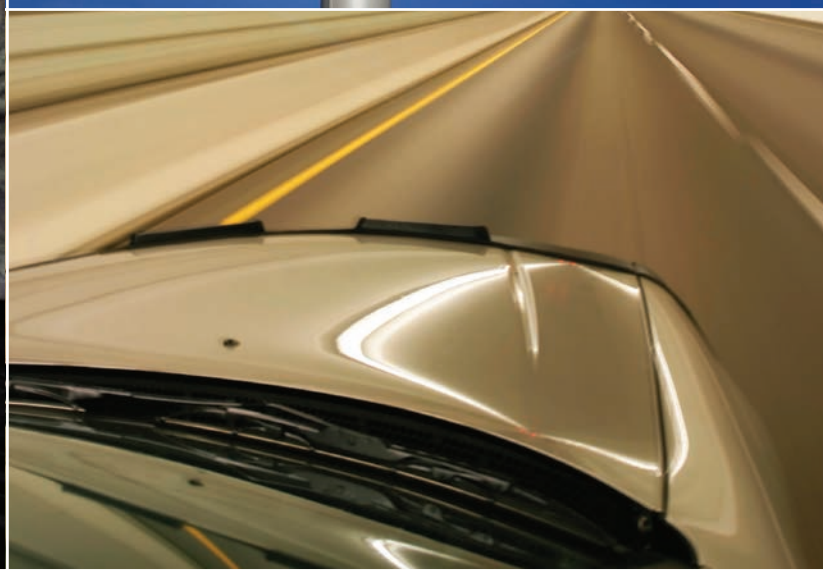

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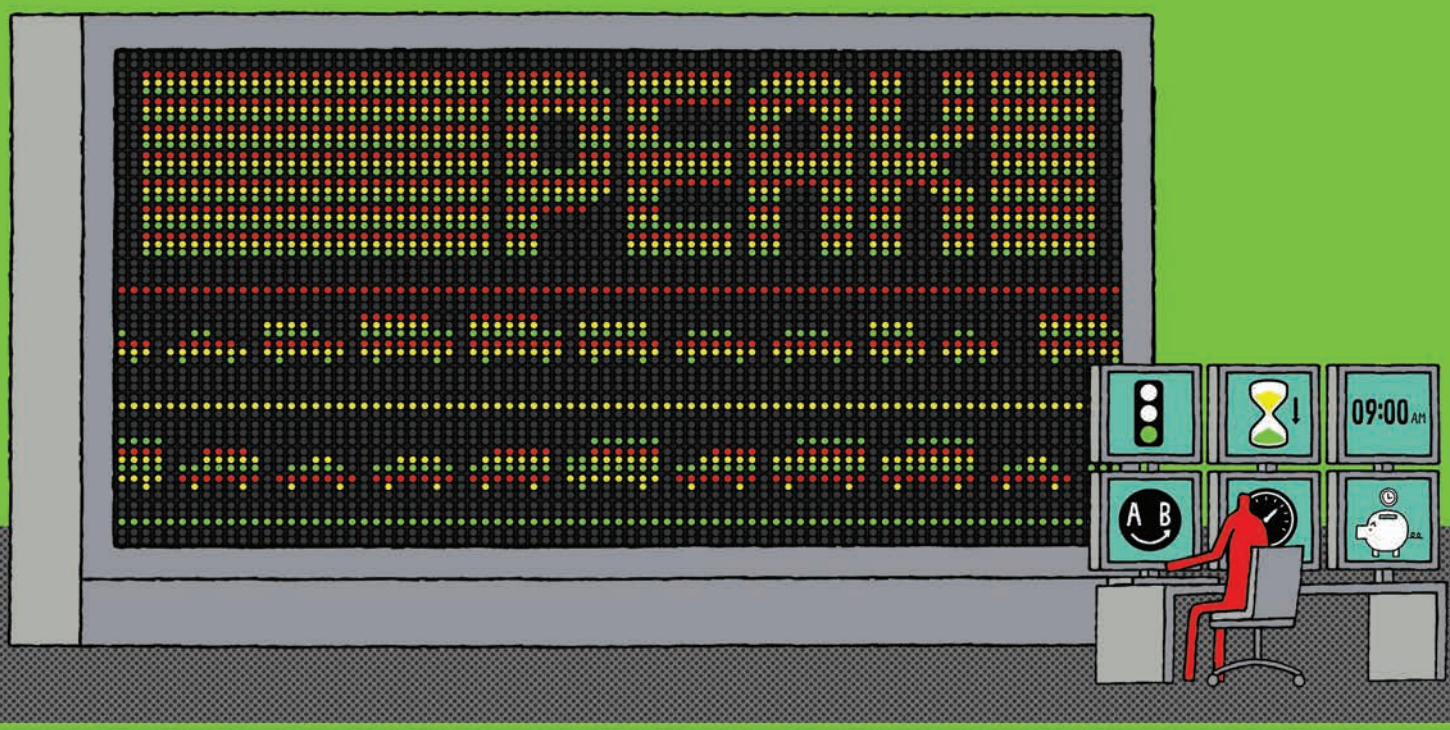
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Poetry in motion

DOTs worldwide are waxing lyrical about the graceful traffic flow offered by adaptive real-time signal control. **Timothy Compston** asks experts in the field if it's the best ITS that money can buy

Illustration courtesy of Tim Ellis

Adaptive real-time traffic control systems are set to be sky high on the agenda at the forthcoming 19th World Congress in Vienna, Austria, where the IBEC (International Benefit, Evaluation and Cost) Working Group is organizing a pre-congress workshop. One of the four planned sessions features speakers from Europe, the USA and Japan, and is encapsulated within the thought-provoking title, *Benefits of Adaptive Real-Time Traffic Control – The Most Cost Effective ITS Ever?*

Dr Alan Stevens, research director at the UK's Traffic Research Laboratory (TRL) and the driving force behind the IBEC session, believes that this approach stacks up extremely well on a benefit-cost ratio when compared to other forms of ITS. "I do quite a lot of evaluation of ITS products and services and when you find benefit-cost ratios of 1.2:1 and 2:1 and even sometimes 3:1, people say this is brilliant," he says. "The reality is that adaptive traffic control is potentially 10 times better than that. If you have some money to spend on ITS, in my view it is almost the best thing you can do."

Where the adaptive approach really scores for Stevens in comparison to traditional fixed-time systems is in dense urban networks with a high level of traffic and congestion: "By coordinating traffic lights in an adaptive real-time way – and responding to traffic flows on different arms of the junctions – traffic can be organized very efficiently." The real reward, he goes on to suggest, comes from travel time savings for vehicles, whether they're cars, buses or trucks, and the wider economic advantages that flow from this.

When pressed to quantify the bottom-line impact of adaptive, Stevens points out that although it may cost around £50,000 (US$79,000) per junction to implement, the annual economic benefit could be in the region of £100,000 (US$158,000). He also cites London as a great example of what can be achieved in practice. There, Stevens reveals, with adaptive real-time traffic control systems in place, there has been in the region of a 12.7% average reduction in delays on junctions and up to 20% in some cases.

Asked whether there are any specific issues holding back the roll-out of adaptive traffic control, Stevens says that one potential Achilles' heel relates to the detectors employed: "Sadly we are still looking for a really good above-ground detector," he continues. "At the moment, the principal detectors are essentially loops so you have to cut those into the roads and run back the wires. This has to be done properly and there are associated maintenance requirements."

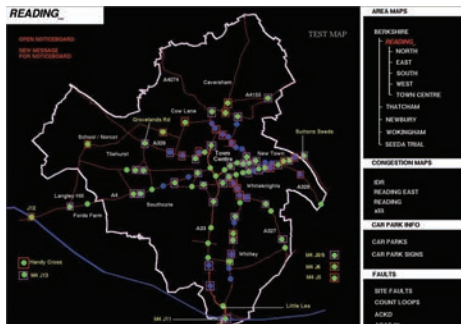
SCATS: an all-time high

Mike Holling, the COO of TransCore – a provider of adaptive real-time traffic control systems – says that in the USA alone, the installation of new and expansion of existing SCATS deployments is at an all-time high: "Atlanta's Cobb County just doubled its use of the system, and the San Jose and southern Bay Area agencies of California have made extensive deployments to combat growing congestion in Silicon Valley," he reveals. Alongside this, Holling says

the New Jersey Meadowlands Commission has begun what will be the fourth-largest deployment in the USA.

The increased demand in this area is being driven by a number of factors, in Holling's opinion: "Confidence or trust in the tools is a big one, along with decreasing implementation costs, compatibility with alternative detection technologies, and generally an increase in the unpredictability of traffic patterns at more times of the day."

In terms of the practical impact, Holling feels that the biggest return is experience in areas of heavy congestion: "When it normally takes two or three signal cycles to get through an area and adaptive shaves that to one or two, the reduction in delays can be considerable."



(Above left) **Adaptive control prevents drivers sitting needlessly at signals**
(Above right) **SCOOT map of Reading, UK**

Federal focus

One of the main speakers confirmed for the IBEC workshop is Jeff Lindley, associate administrator for operations at the FHWA. Although Lindley has yet to finalize his contribution, he hints that the take-up of adaptive signal control in the USA, the benefits and barriers associated with its application, and how the FHWA's Every Day Counts (EDC) initiative is being used to expand deployment, are likely to feature prominently.

When questioned about whether there is a greater drive now to implement adaptive signal control systems than when the technology made its first appearance several decades ago, Lindley replies in the affirmative: "Up until the past couple of years, our estimate would be that there were only around 60 adaptive solutions in the whole of the USA – a small installed base," he says. "Then we saw about 20 added in quick succession and, significantly, there are around 40 more on the books to be implemented."

Lindley explains that the doubling of the penetration of this technology – in a relatively short period of time – can in part be attributed to EDC: "Our administrator started this process a couple of years ago. We were seeking to actively promote technologies that had broad applicability, clear benefits, were ready to go and, importantly, hadn't been implemented to anywhere near their true potential. Adaptive was one of the approaches that fit the bill."

One piece of valuable collateral developed as part of EDC was a set of systems engineers' guidance for adaptive signal control: "Folks can use this document to walk themselves through the analysis to ensure that they are making a good investment."

In Lindley's opinion, adaptive solutions are particularly effective where traffic patterns are evolving or likely to be subject to unpredictable demands. Those who are investing in the technology are also attracted, he adds, by a desire to make their systems operate in a better, more active way. "At the same time, transportation agencies' resources have been flat or declining, so they're looking for something that offers this potential without being too expensive to implement. Adaptive signal control covers both of these bases."

Alongside this, detectorization has moved on to where newer adaptive control technology can take advantage of – and manage – detectors that already exist, in many cases helping to drive down cost. Lindley also reports a trend toward non-intrusive detection so there isn't necessarily the same reliance on the old-style loop detectors.

In terms of a benefit-cost ratio for adaptive signal control, the FHWA man says that this can range up to as high as 40:1 but naturally varies according to the situation and application: "To reach this, you can look at an implied value of time so reduced delays produce an economic benefit alongside less fuel and fewer emissions," he says.

Looking to the future, he sees the untapped potential of adaptive signal control in jurisdictions that have a smaller number of traffic signals, where they are keen to do a better job of controlling traffic on an arterial, smaller downtown or urban area: "We're not talking about the 1,000 traffic signal grid network in major urban centers – although there are products for that application," he notes. "The larger part of the market is really going to be smaller-scale projects and the systems that are targeted to their needs."

> If you have some money to spend on ITS, in my view this is almost the best thing you can do with it
>
> **Dr Alan Stevens, research director, Transport Research Laboratory, UK**

Third-generation solutions go Dutch

When it comes to adaptive real-time traffic control solutions, Ronald van Katwijk, senior consultant, mobility and logistics at TNO – the independent research organization – provides a Netherlands-specific take on how this technology is being rolled out, and the particular challenges that are being addressed by the Dutch through the adoption of third-generation systems.

Van Katwijk has also been invited to speak during the IBEC session in Vienna and as a starting point has his own thoughts as to what actually makes an adaptive

traffic control solution: "We often refer to predictive or anticipative control," he says. "Essentially you know what is coming toward an intersection and are better able to deal with – or anticipate – incoming traffic and do an optimization for a longer-term horizon."

Interestingly, Van Katwijk says that 85% of intersections in the Netherlands feature what he refers to as 'traffic-activated control'. "Here there are loops at each approach offering an element of reactive control by measuring what is there and only giving a green signal to directions or approaches that have demand."

Although activated control is adaptive in terms of what's happening at an intersection, it is still, essentially, reactive in nature, according to Van Katwijk: "Activated control doesn't for instance look at the entire intersection or encompass future planning so you are actually optimizing over, say, a two-minute horizon."

> The larger part of the market is really going to be smaller-scale projects and the systems that are targeted to their needs
>
> **Jeff Lindley, associate administrator for operations, FHWA, USA**

In relation to different adaptive solutions, the TNO engineer points to a distinction between second- and third-generation systems: "In my view, solutions such as SCOOT and SCATS are very much second-generation systems as they optimize for green splits – essentially how much green to give for each approach and the offsets between the intersections."

Focusing on so-called third-generation systems, Van Katwijk stresses that the major differentiation here concerns the fact that the technology is not confined to optimizing for groups of vehicles but rather can do this down to individual arrivals: "This allows

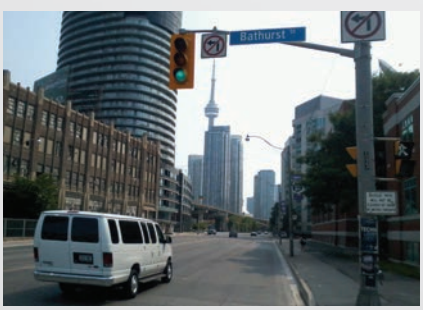
City slicker

City of Toronto Transportation Services' **Rajnath Bissessar** reveals how SCOOT has improved traffic flow through its capability to increase the use of the existing roadway capacities at signalized intersections

The city of Toronto, Canada's largest metropolitan area, is a long-time user of adaptive traffic control measures based around SCOOT, stretching back to 1992, so its insight into the benefits and perceived limitations of such a technological approach is invaluable.

The city currently has a split across its intersections of 85% traffic-responsive and 15% based around adaptive technology. According to Rajnath Bissessar, the manager of Urban Traffic Control Systems for City of Toronto Transportation Services, in the medium term the hope is to increase the proportion of adaptive to 25%.

> The initial evaluation of SCOOT highlighted travel time savings of as high as 34% on Lake Shore Boulevard



SCOOT was first installed as a trial and evaluated in three different signal networks in the Toronto Metropolitan area. Specifically, these were: the Toronto CBD with a dense grid of 42 signals; Lake Shore Boulevard – a major limited access commuter route of 20 signals that parallels a major urban freeway (Gardiner Expressway); and Yonge Street North, an unlimited-access suburban arterial network of 13 signals that includes an interchange with the Trans-Canada freeway (Highway 401). Evaluation studies have found that during peak periods, travel savings are in the region of 6-11% compared to previous timing plans.

Bissessar says that the city subsequently added a further six or seven routes, with the last major corridor installation being 12 years ago. In addition, new signals are being brought in where they fall within an existing corridor: "We now have 345 signals on SCOOT which is about 15% of our installed base of 2,200 signals," he confirms.

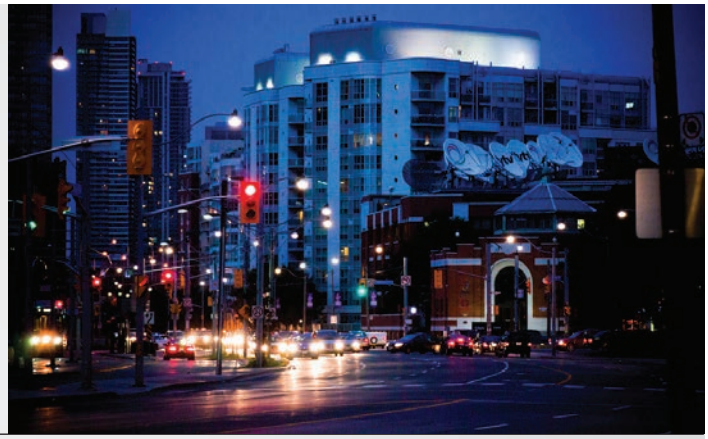
Based on Toronto's experience, Bissessar feels that the system has been especially

for a much finer-grained degree of control." When asked why this is an advantage in the Netherlands, he points to the separate roads infrastructure and signals for bicycle streams, pedestrian movements and vehicles: "We need more flexibility inside the controller to give green to all of these directions," he explains. "This is compounded by the fact that we don't typically have a grid-like road structure typical of somewhere like New York. There simply isn't the same opportunity to create synchronized signals."

SCOOT success

Gavin Jackman, traffic software manager at TRL, is also scheduled to speak about the topic of adaptive real-time traffic control systems at the IBEC brainstorming. With TRL being responsible for the R&D associated with the software kernel for the UK-developed SCOOT (Split Cycle Offset Optimisation Technique), Jackman is well placed to offer a view on the technology.

To put the take-up of SCOOT into perspective, Jackman reports that more than 95% of towns and cities in the UK alone are actively using the solution. A major success story for SCOOT has been in London where by 2014 it is anticipated that half of the signalized intersections will be covered. Around 2,500 of these are already operational with a further 500 scheduled to be rolled out post-London Olympic Games.



The city of Toronto has 15% of its signals equipped with adaptive control, and this figure is set to rise to around 25%

beneficial on main arterial corridors with long cycle lengths and a more linear network. He also reports a favorable impact on roads near major venues in the city, such as the Skydome: "The initial evaluation of SCOOT highlighted travel time savings as high as 34% on Lake Shore Boulevard."

An adaptive approach has, however, been more challenging for Toronto's downtown area given the grid network, shorter signal cycle lengths, and distance between signals that can be down to 100m: "This is especially true when the system increases the cycle length to minimize the delay to vehicles as this can create issues for pedestrians."

Toronto has now asked the IBI Group to evaluate its SCOOT solution and devise recommendations for its future use, which could encompass anything from providing transit priority to integrating non-intrusive detection – and even replacing it with another system altogether.

So what differentiates SCOOT from solutions such as SCATS (Sydney Coordinated Adaptive Traffic System)? SCATS has stop-line detection and is essentially optimizing for the next cycle along, based on whether there is still traffic sitting there or coming along the link. So it's on a junction-by-junction basis whereas SCOOT is focused on traffic across the network, trying to ease all traffic flow.

Jackman offers a caveat to this as he explains that, for SCOOT, it is now possible to prioritize specific major corridors at the cost of minor links: "The catalyst for this change came from a customer requirement from Transport for London (TfL) and the functionality is now in the SCOOT software kernel that can be offered to other users," he says.

Moving to multimodal

More widely, the TRL software expert explains that for SCOOT efforts are being concentrated on a wider range of transport or traffic functionality, basically a multimodal model, to better reflect the demands of today's road networks: "This builds upon existing features such as bus prioritization, which have already been successfully implemented."

Echoing Jackman's comments, Mark Bodger from Siemens Mobility points out that support for multimodal in the shape of SCOOT MMX, introduced at the end of 2010, has been an important advance: "The MMX release makes SCOOT much more flexible," he says. "There's the ability to optimize around pedestrians and to reduce cycle times during low-flow conditions."

In Bodger's informed opinion, what gives SCOOT an edge is that it is true real-time optimization rather than delayed: "Instead of looking at what happened over the past five or 10 minutes and then using that as a benchmark to select a predetermined plan, every time signals change to green, SCOOT is deciding what to do based on the traffic flows."

For Bodger, one attraction of adaptive systems more generally is the potential to achieve better performance from an existing traffic network infrastructure without necessarily having to build expensive extra lanes or change the physical geography of a city's streets.

A smarter approach in Atlanta

A landmark application of adaptive real-time traffic control in the state of Georgia has seen its Regional Transportation Authority partner with the City of Atlanta, Cobb County, City of Marietta, Georgia DOT, and the FHWA.

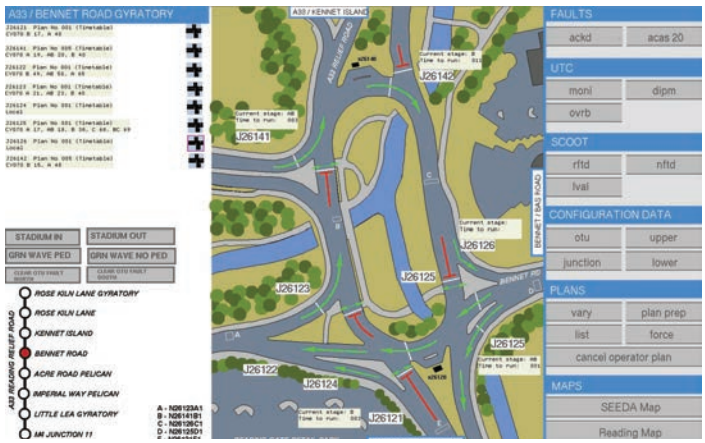
Completed in June 2010, the Atlanta Smart Corridor project involved the large-scale deployment of SCATS along the pivotal US41/Cobb Parkway/Northside Parkway. The SCATS solution covers 28 intersections and relies on real-time vehicle

counts to determine the most appropriate cycle time and optimized splits.

For Valentin Vulov, principal project manager at Georgia Regional Transportation Authority, a key feature was the cross-jurisdictional nature of the signal coordination: "What was important, given the regional nature of what we were doing, was the high degree of cooperation."

Reported benefits include a fall in vehicle travel time of 22%, reductions in delays by 40% and vehicle stops being cut by 34%. It is also estimated that the ITS investment has resulted in a benefit-cost ratio of between 23 and 28 with annual savings of US$6 million based on lower travel time and fuel consumption.

(Above left) **SCOOT controls signals across the world** (Right) **SCOOT's graphical user interface**



> Activated control doesn't for instance look at the entire intersection or encompass future planning so you are actually optimizing over, say, a two-minute horizon
>
> **Ronald van Katwijk, senior consultant, mobility and logistics, TNO, the Netherlands**

Fast-track deployment

Although adaptive real-time traffic control is by no means a new concept in the world of ITS – with roots stretching back over a number of decades – there is clearly an unprecedented ramp-up in interest, as evidenced by the IBEC seminar at this year's World Congress on ITS, as well as a rapidly expanding installed base. Now more than ever, DOTs and city authorities are seeking to actively manage traffic at intersections, especially on key arterial routes, in a way that allows them to ease congestion in real-time and, crucially, deliver a more favorable return on their investment.

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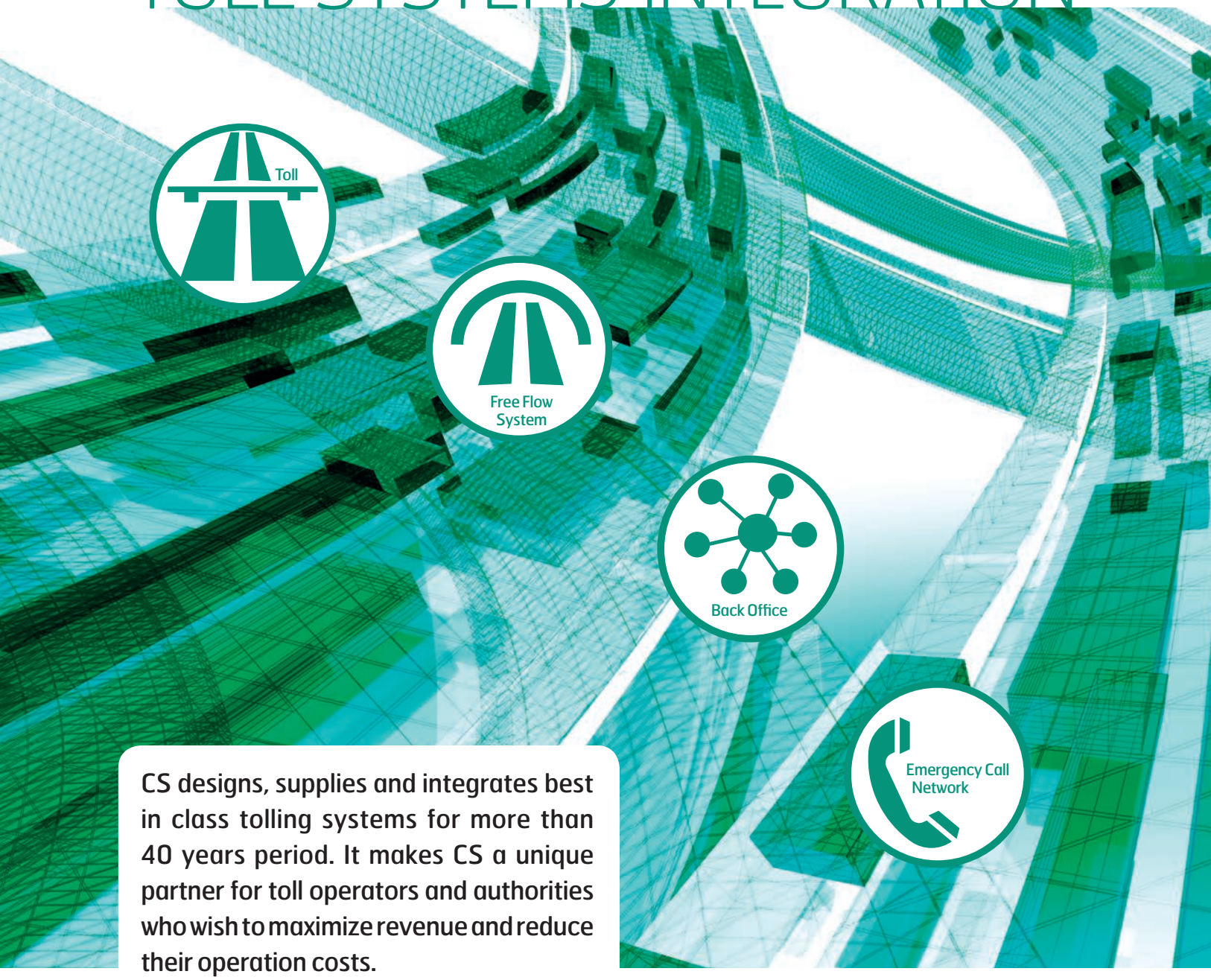

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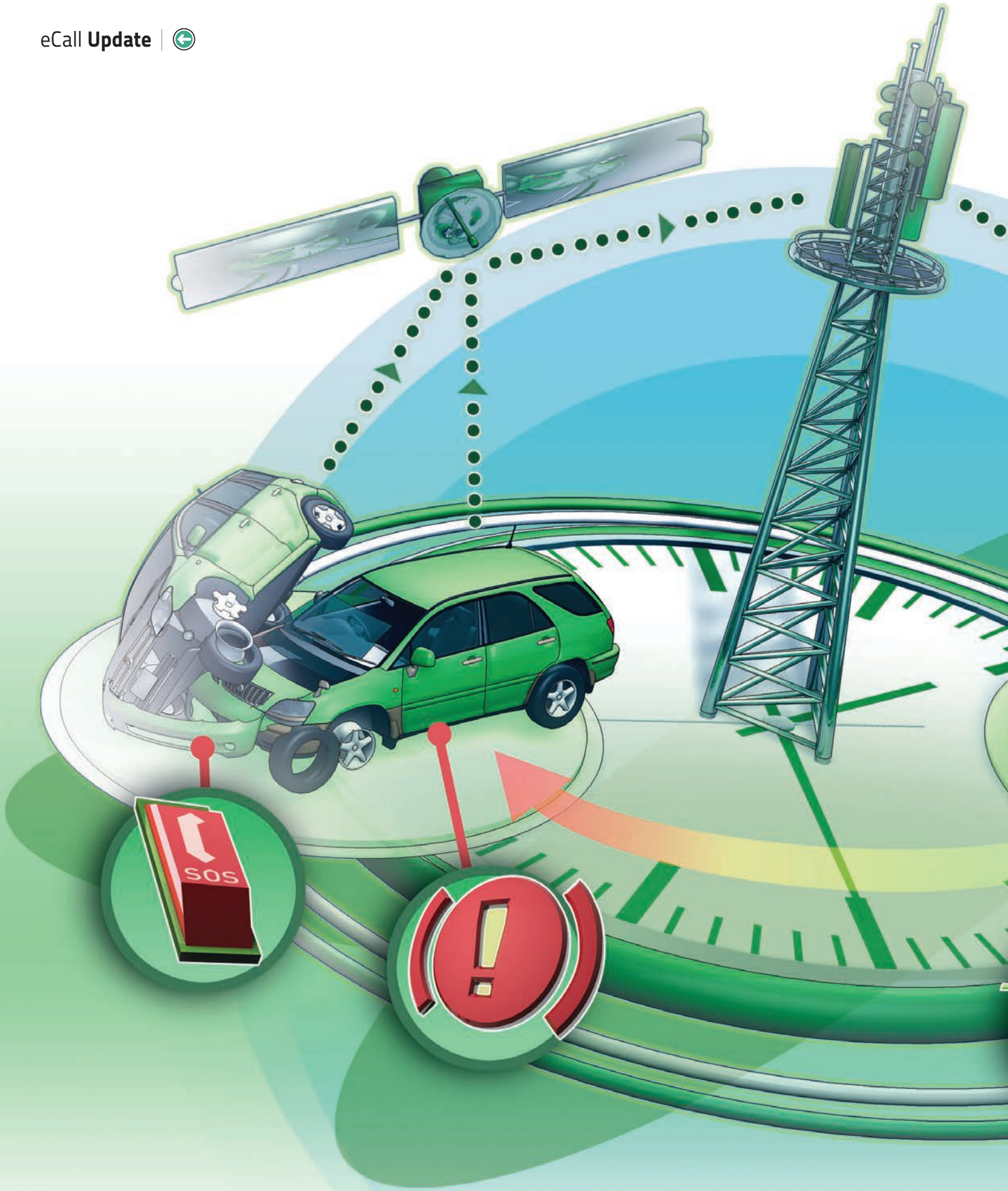
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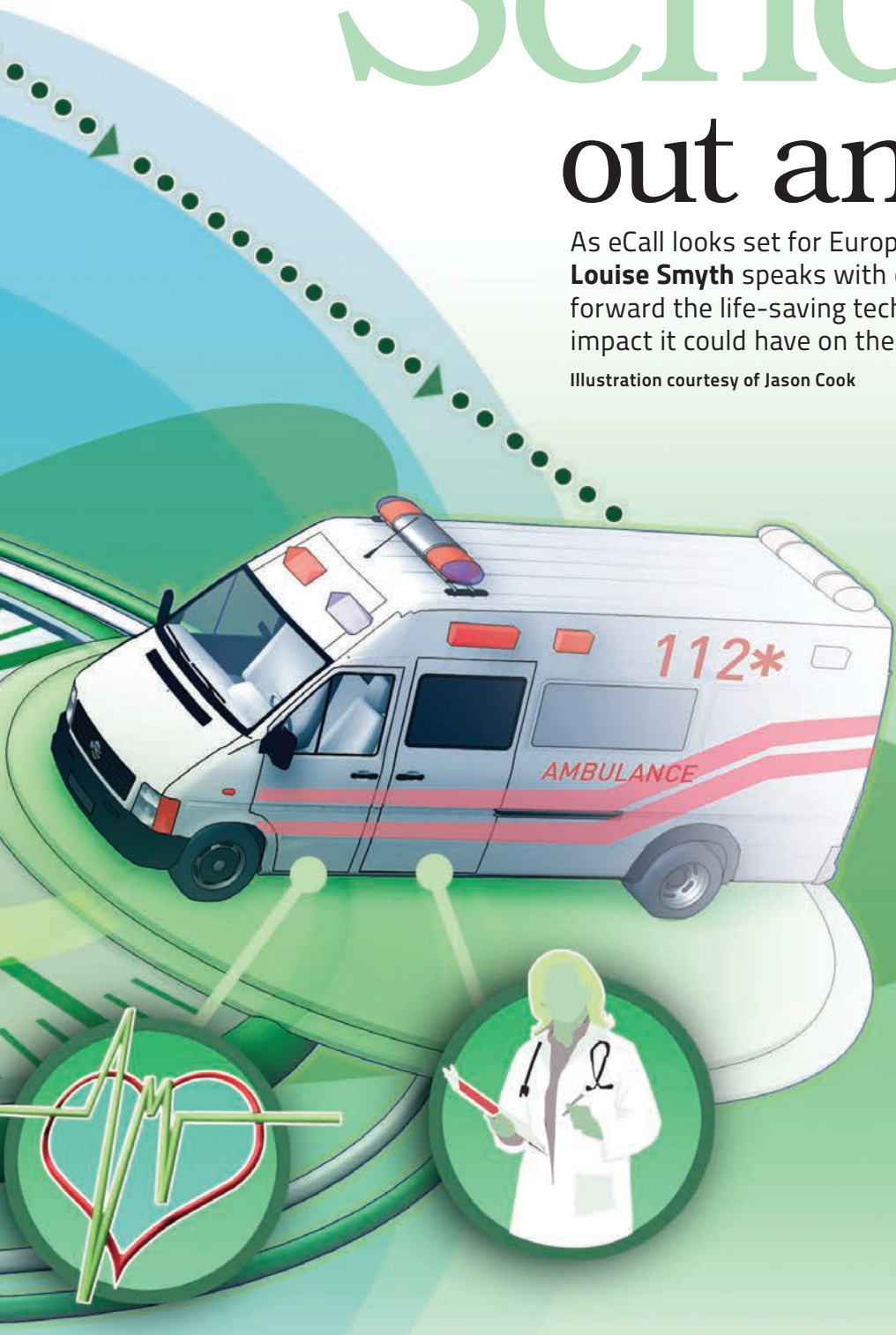
Sending out an SOS

As eCall looks set for Europe-wide deployment in 2015, **Louise Smyth** speaks with one of the experts driving forward the life-saving technology – and asks what impact it could have on the EU's Decade of Action targets

Illustration courtesy of Jason Cook



Following a lack of progress in introducing a European eCall system voluntarily, policy-makers in Europe have now backed plans to make the system mandatory on all cars built in the EU from 2015. At the coalface of ensuring the 2015 date is met is ERTICO, which has coordinated the research and development of eCall up until now. The association's HeERO (Harmonised eCall European Pilot) project is at the center of the drive, the aim being to conduct and coordinate a number of pre-deployment pilots that adhere to eCall's approved standards. Given the UK is yet to sign up to be part of the pan-European safety concept (citing costs reasons), it is somewhat ironic that the man leading the project is a Brit.

Prequels to eCall

Andy Rooke served as an officer for the UK's Sussex Police for many years, specializing in roads policing and road death investigations. He became aware of the potential of ITS in the late 1990s when it was in its fledgling stage in the UK. In 2002, the country's police force was involved in a European-funded research project called eMERGE, described by Rooke as "the Granddaddy of eCall". Concluding in 2004, eMERGE was superseded with GST RESCUE, in which the details of how such a concept should operate were essentially thrashed out. Rooke himself left the force in 2006 to join a traffic management company, but last October received a call from ERTICO asking if he'd head up the HeERO project. "I grabbed it with both hands as it was an opportunity to finish off something I'd already started," he enthuses.

His role as project manager sees him providing strategic direction and, in Rooke's own words, "sorting out any problems along the way". It also involves ensuring that the nine pilot sites within the HeERO 1 project continue to function and subsequently ensuring that the dissemination of eCall continues until it is ready for deployment in 2015. Now is a busy time for Rooke, as the second round of live testing for eCall is about to kick off across eight of the nine pilot sites. Rooke and his team are also in the middle of negotiations with the EC for the HeERO 2 project, for which papers for another six pilots were submitted in May.

States of emergency

Andy Rooke says that feedback from the emergency services has been overwhelmingly positive, aside from one notable concern. "That's how the manual eCall will be managed," he explains. "If you have a push button in a car, we know curiosity alone will lead to a number of false activations, despite the fact that it's a covered button, says 'SOS' on it, and you have to press and hold it down.

"People are undoubtedly concerned about this, but the phenomenon is hardly new. The emergency services have been dealing with prank calls, pocket-dialing from mobile phones, and so on, for years already. And the Dutch police and the UK's BT in particular have some very robust systems for dealing with these types of situation. We are aware of the concern and we know we need to manage this issue and get it right."

How will it function?

By participating in all of this work, Rooke is able to offer a very accurate explanation as to how the European eCall system will function. "There are three specific elements – the in-vehicle system, the use of a mobile phone network, and then there is the PSAP (public safety answering point)," he says. "The eCall in a vehicle can work in two different ways. Firstly, you can get a manual activation (a push button inside the vehicle), which is either for a medical emergency in the vehicle or a good Samaritan call – so if you witness a collision somewhere, you push the button and make the automated 112 call.

"It can also happen automatically, i.e. machine to machine," Rooke continues. "There are a number of defined parameters within a vehicle for events that will trigger an eCall: in the simplest terms, this would be airbag deployment. You can also couple it with things such as airbag deployment with electronic brake distribution, seatbelt pretensioners going off or fuel cut-off."

Once the vehicle has determined it's been in a collision, it does two things. "It starts to make contact with the mobile network," Rooke says. In-vehicle systems forming part of eCall are dormant, an important feature that guarantees privacy. "The SIM knows where it is but it's not actually physically on the network," he explains. "Imagine when you switch your mobile off and then reboot; it can take some time to work out which network it wants and then register on it, whereas this is almost instantaneous. Once in the process of opening a communication channel, the machine starts to assemble a 'minimum set of data', which includes the vehicle's VIN, the time and date, fuel type, possibly how many passengers are on board and the three most recent geo positions."

This last point is what's known as 'breadcrumbing' and is used to provide information in case of crossover. "If a vehicle is traveling north, has a collision, crosses the carriageway and ends up facing to the east or the west, you can see its trajectory," Rooke says.

The other important piece of data included in the minimum set is what's called an 'eCall flag'. "The vehicle makes the 112 call and the eCall flag tells the mobile network that it is in actual fact a proper eCall and that there is data attached to the voice channel, so the communication gets priority across all networks," Rooke explains. "It picks the strongest network and switches to the PSAP, which has a machine that accepts that and sends a tone back to the car – a bit like a fax tone. The vehicle knows 'I've got a connection; I can now send this burst of data'. That then gets transmitted to the PSAP and once received, the voice channel opens and the operator can speak with the vehicle."

System integrity

But while all the above is fine in theory, how robust is the system? "We're getting good results but that's not to say it is without refinement," Rooke says with an air of cautious optimism. "We're working to published CEN and ETSI standards. What hadn't happened prior to HeERO was getting these standards tested in the real world, so now we are in discussion with the relevant bodies and are able to say 'These parts of the standard need a little tweak'."

> In the testing we are carrying out we're getting good results, but that's not to say it is without refinement
>
> **Andy Rooke, project manager of HeERO at ERTICO, Belgium**

One would also suggest that more 'tweaks' will be on the cards in the short-term, with a move away from the seemingly archaic 2G communications that the current system relies upon. Not so, according to Rooke. "The decision has been made that it will remain with 2G. All sorts of discussions are going on about 3G, 4G, etc., but for the near-term, we will be sticking with 2G."

Aftermarket devices

However, Rooke does reveal that while the current focus is on an in-vehicle eCall system for all new type-approved vehicles, he's also investigating the issues surrounding aftermarket eCall devices. "In the new HeERO project, discussions on this issue will take place," he says. "It's already been done in the USA, with GM's OnStar system, and you only have to do a Google search to find a retrofit eCall solution that's included in the rearview mirror."

Systems such as these sound like an ideal way to equip an entire vehicle fleet far more quickly than waiting until drivers upgrade their cars, but Rooke has a big concern about going down the

aftermarket path: "You have to ensure that what you buy is fit for purpose," he warns "HeERO 2 will look at this because although there are published standards, there's nothing that actually says 'This is the service you should provide and this is how you should install'. If we get to a situation where aftermarket-type devices are the way forward, there needs to be a robust certification process, in a similar vein to the one taking place for cell phone handsets."

Whatever the future path, eCall's life-saving potential is evident. It's been estimated that a pan-European system could save around 2,500-3,000 lives a year, although Rooke admits it's a tricky figure to calculate. "The number of lives saved is a very difficult question to answer, but if I approach this from my policing background – that if you can dispatch the right emergency resource to the right place at the right time – your chances of success in terms of achieving a good outcome go up exponentially. We're looking to reduce the number of fatalities to serious injuries and serious injuries to slight.

"A fatal crash is essentially a random event with so many diverse circumstances converging to make it happen that you need to look to the point where you can influence the outcome," he continues. "If you know you can dispatch an emergency response to the right place and en route the emergency services know what vehicle it is, everyone is better equipped to manage that event, to ensure the best possible outcome.

(Above left) **HeERO is delivering a set of reports on eCall implementation and best practices to accelerate the deployment of the service in the EU**
(Above right) **Getting an immediate alert in the event of an accident and knowing the exact location of the crash site cuts emergency services' response time by 50% in rural and 40% in urban areas**

Knowledge is power

"I was talking to the Czech fire service recently and they said that just knowing exactly what car it is would help them immensely. If we can tell them 'It's a Ford Mondeo manufactured in the first quarter of 2010', they then know exactly where to cut that vehicle. Modern vehicles are like bombs on wheels – if firefighters cut into the wrong place, they can potentially trigger an explosion. So with a system that informs them where to cut, extraction times tumble. Likewise, knowing how many occupants there are in a vehicle means the ambulance service knows how many ambulances to send. The more sophisticated systems will tell what type of accident they've had so you can predict the types of injuries you could potentially be dealing with, which could subsequently determine which hospital victims might need to be taken to in order to receive the very best specialist treatment."

Rooke is keen to make such a vision a reality – and then some. "If I could do anything, it would be to firstly get eCall successfully completed in Europe with all member states signed up and equipped, ready to go for 2015," he says. "My next goal is then to extend this to the more vulnerable road users – cyclists and PTW riders.

"Ultimately, though, the lasting legacy I hope eCall leaves is that in the future there are fewer instances of police officers getting out of their cars to take that long walk up a path to knock on the front door of a next of kin to tell them the person they thought was coming home isn't. I've had to do it and it's horrific, so that's a massive driver for me."

Added value to the service

Dealing with road accidents quicker has obvious knock-on effects for traffic management, and Andy Rooke explains that ERTICO is slowly making members aware of such benefits. "When I first took on the project, one of the things was to look for value-added services," he recalls. "The way it was couched in the proposal was aimed at a commercial environment – so what money can be made on the back of it? In reality, not a huge amount. But if you look at it from the point of view of managing a strategic road network – and from the perspective of those companies that gather vehicle probe data – you now know you've got an event at an exactly defined point, you know at least one vehicle is involved, and even if it's not a true crash you know the car isn't moving anywhere as its airbags have been activated. All of this being automated will make a huge difference. You can predict how long delays will be, set the VMS to re-route traffic and inform drivers, turn cameras to look at the reference point, and disseminate information via traffic message channels. eCall has huge merits for road operators."

State of play

Driverless cars at last appear to be nearing a deployable reality, with Nevada offering a legal proving ground. **Richard Yarrow** speaks with some of the car makers looking to turn science fiction into fact

Illustration courtesy of Lee Hasler

The US state of Nevada cemented its place in the history books this March when its Department of Motor Vehicles issued the first license for an autonomous car, a Google-owned Toyota Prius. The first to achieve this milestone, the Silver State is now expected to become the global center of excellence for R&D into automated transport.

For and against

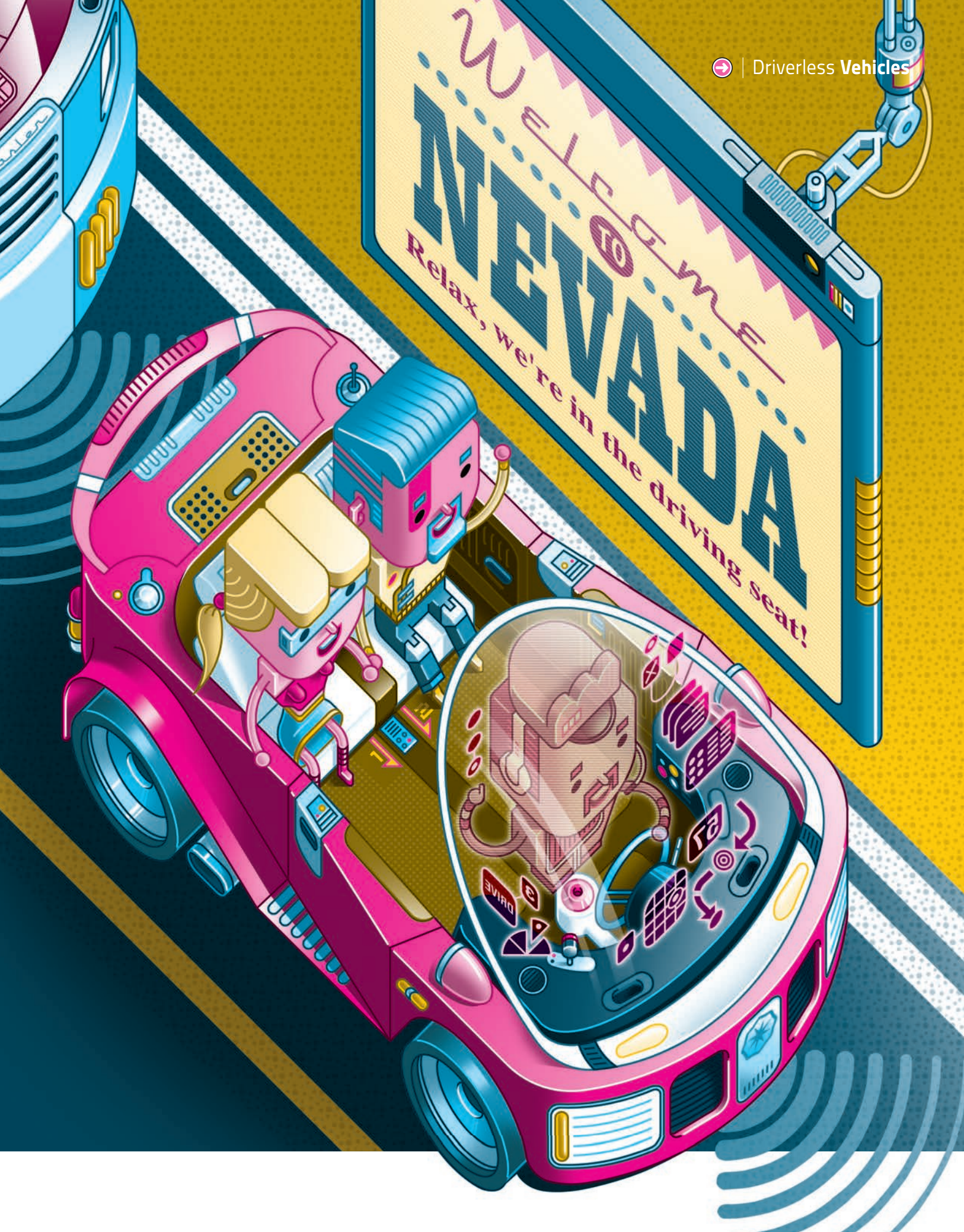
The advantages of 'driverless' technology are many, including but not limited to fewer crashes, increased lane capacity, reduced congestion, lower peak zone parking requirements and potentially even personal transport for the visually impaired. But the safety implications of hardware and software glitches, user error, and even sabotage are life-threatening. The first accident involving one of these cars will be front page news, while there are still huge safety challenges to be addressed.

Publicly, at least, Google appears to be at the forefront of the technology but is keeping relatively tight-lipped about its activities. General Motors is another key player as a result of its work on the various DARPA Challenges and joint ventures with the Pittsburgh, Pennsylvania, USA-based Carnegie Mellon University.

Sensor directions

Some of the underlying technologies behind automated driving are going into GM's 2013 Cadillac models, including full speed range adaptive cruise control and collision-imminent braking. Jeremy Salinger, innovation program manager for GM R&D, said development work on those – to make the sensing technology more accurate – was an ongoing process. Making them reliable for the lifetime of the vehicle so they don't need to be part of an annual maintenance check is also key. "Semi-autonomous vehicles are GM's focus and cars with that technology will be available later this decade," he comments. "We don't see in the near future they will be able to go driverless; we're working on cars that will be able to drive for substantial distances by themselves, but still require the driver to remain attentive."

The GM engineer doesn't view 'climb-in-the-back-and-take-a-nap' systems as anything other than a long-term option. "It's something customers will want, but it's hard to say how long that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THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2011

(Above) **Sebastian Thrun was in charge of the Stanford Racing Team for the DARPA Grand ('Stanley') and Urban ('Junior') Challenges, but is also the brains behind the Google car** (Left) **Continental completed more than 6,000 miles of highly automated driving on public roads in Nevada earlier in the year**

will take," he feels. "Our 'vision zero' safety concept is that we want vehicles that have no accidents, and once you get to that point people will be able to treat them like trains. For now it's about lightening the load, not allowing the driver to tune out completely."

All aboard... the road train

The SARTRE project is taking a different approach in that drivers 'platooning' in one of its road trains won't need to look where they're going. "The safety advantage is that we're removing the driver from part of the driving task during part of the journey," explains Eric Chan, chief engineer at Ricardo UK, lead partner in the initiative. "It's intended for long motorway sections, allowing the driver to be distracted so they can browse the web or send texts."

An abbreviation of 'Safe Road Trains for the Environment', SARTRE envisages a lead vehicle operated by a professional driver followed by a string of others acting autonomously. The first real-world test took place on a motorway outside Barcelona in May. Chan says going to sleep won't be an option for users and that devising a way to prevent them from doing so is under discussion, but is likely to be some form of driver-monitoring system, coupled with a radio link between the professional driver and the cars in the following pack.

Part of the SARTRE brief is that any road train should operate without changes to today's highway infrastructure. To that end, it's considering how to deal with other vehicles, particularly if they come between two that are part of the train. "During normal platooning, the gap is 6-8m and a typical car is just under 5m, so fitting a vehicle in would be difficult," Chan continues. "However, there are times when the gap is larger, such as when a vehicle leaves the platoon. If another vehicle comes in, the platoon will continue but with increased space as a safety margin. When that vehicle leaves, the gap will close up again."

SARTRE works with any following car using the one in front as a reference point. If it can't because something is in the way, it switches to automated lane guidance then reverts when the rogue vehicle has gone.

Although it's not specifically part of the current research project, also on the table for any production version would be consideration for road users other than cars and HGVs. That includes everything from motorcycles and pedestrians – for example, if traffic has become stationary and people have exited their vehicles – to a wild animal running onto the carriageway.

Highly automated (not autonomous)

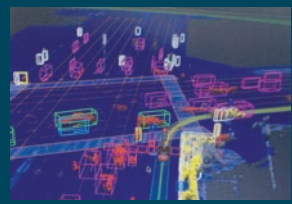
Google isn't alone on the roads of Nevada, with engineers from Tier 1 auto component supplier Continental recently completing a two-week, 6,000-mile endurance test of highly automated driving, including time on the crowded streets of downtown Las Vegas. The technology in the VW Passat test vehicle is based largely on knowledge gained through involvement with the winning vehicle in the DARPA Urban Challenge of 2007, which was equipped with various close-to-production technologies, including one long- and four short-range radars, plus a stereo vision camera. Electric power steering and brake systems control vehicle movement.

Matthias Strauss, ADAS project engineer in Continental's chassis and safety division, says that – like GM – it is focusing on highly automated rather than fully autonomous driving. "We see these systems primarily being used in lower speeds and during monotonous tasks such as in traffic jams. For these scenarios, a technical implementation of, say, Traffic Jam Assist would seem to be feasible within the next few years."

In discussing some of the challenges from Nevada, Strauss admits that when the environment was too complicated for the

In the eyes of the law

Nevada's decision to grant licenses for driverless car research means many OEMs and Tier 1s will base themselves there. European roads can't be used due to the 1968 Vienna Convention, which specifies that anyone sitting behind the wheel must be in control at all times. But Ricardo's Eric Chan foresees difficulties. "Even Traffic Jam Assist – which enables automated steering at low speed – breaks the existing rules and I don't know how they're going to get round it."



Even if the autonomous system can be overridden by the driver – for example with the touch of a foot pedal or the steering wheel (which is the case with SARTRE) – as the law stands at the moment, it's illegal. This issue is being considered as part of the project, although it's not a key element.

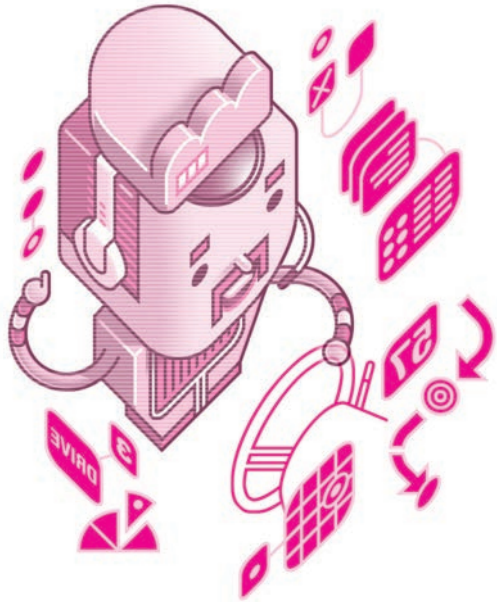
Henry Bzeith, head of infotainment and telematics at Kia Motors America, says the legality or otherwise of autonomous cars isn't yet on the radar with local and federal government. "OEMs are expending lots of energy on the driver distraction issue but I don't see a lot of effort on the legal side," he states. "OEMs are working on getting the technology right – it's not reached a critical mass where the liabilities are being discussed."

Younger drivers and autonomy

New technology of whatever type usually appeals to the young. But with autonomous vehicles that presents a problem. In short, it won't lead to de-skilled drivers because they won't have had enough time behind the wheel to build skills up in the first place. As MIT's Bryan Reimer explains, "They are the tech-savvy ones who will want to use it, but their desire to connect outweighs their thoughts and decision-making."

"The digital generation doesn't care too much about cars and they have less emotional attachment with the vehicle," insists Kia Motors America's Henry Bzeith. "Yes, they will be receptive to this technology and how they use it is something we need to be concerned about."

Bzeith accepts it's true that their skill level will never increase if they grow up with autonomous vehicles, but argues that perhaps it's not a de-skilling issue if everyone is headed down the same path. "Maybe there's no need for any of us to be a skilled driver anymore as there won't be a need for it."



Passat to comprehend – such as where road markings couldn't be detected or if corners were too tight – the system switched itself off and the driver was asked to resume control. If that doesn't happen, the car slows gradually to a stop. Strauss's aim was simply working to reduce the times when driver intervention would be necessary. "The experiences gained through this testing will help to enhance our ADAS systems and they will improve with time," he says.

Redefining driver training

But is getting the technology right the biggest pothole on the road to autonomy? Bryan Reimer is a US research scientist at MIT's AgeLab and believes solving the hardware and software issues, as complex as they might be, is the easy part. He cites the use of automation in aviation as an example of how it's already a success in real-world applications. "The issue is getting drivers to trust the technology and understanding their behavior change as a result of it being there," Reimer explains. "Aviation authorities have admitted it's reducing pilot skill and they're now treating it as an issue – learning about it and the consequences, and redefining pilot training. In a car, we're not yet considering how it will affect a relatively untrained population as there's no stick to motivate them to learn. How are we going to get people to understand the limitations to the system? When do you trust it? When don't you trust it?" De-skilling is one problem but autonomy will also have an impact on those with little skill to draw upon in the first place (see *Younger drivers and autonomy* sidebar).

Dr Dieter Zetsche, chairman of Daimler AG, also believes the technological challenge is not that great. "It's either remote control or you give the cars the sensors to understand their environment," he says. "We have driverless cars on our proving ground for safety work, but the biggest challenges are the liability and legal issues."

Cadillac's system (dubbed Super Cruise internally) is powered by a host of sensors, cameras, radars, and a GPS unit

> We have driverless cars on our proving ground for safety work, but the biggest challenges are the liability and legal issues
>
> **Dr Dieter Zetsche, chairman, Daimler, Germany**

Reimer agrees and says that for us to have autonomous vehicles, we have to rewrite the rule books. "Who is responsible when a car hits a pedestrian? Engineers will tell you it's not going to happen but it will. Is it the driver? He's going to say the car was supposed to stop. The OEM? Or the Tier 1 that produced the system?" At the moment, the Vienna Convention makes the driver culpable, not something the auto industry will be keen on changing any time soon (see *In the eyes of the law* sidebar).

Part of the problem will be that different OEMs' autonomous systems will vary in how and when they can be used, which has the potential to confuse consumers. "Ford has announced it's working on Traffic Jam Assist for bumper-to-bumper low-speed driving but others are looking at high-speed driving," Reimer reveals.

The MIT man argues no one is directly addressing this issue with research, but the onus is on everyone – academics, OEMs, Tier 1s, and government – to pool together to ensure the benefits of autonomous driving can be realized. Much more can be learned from complementary domains such as aviation and rail, he feels. "A bunch of different solutions means a bunch of different interfaces. How do we learn to interact with each of them? Quite frankly, there is no easy solution to that."

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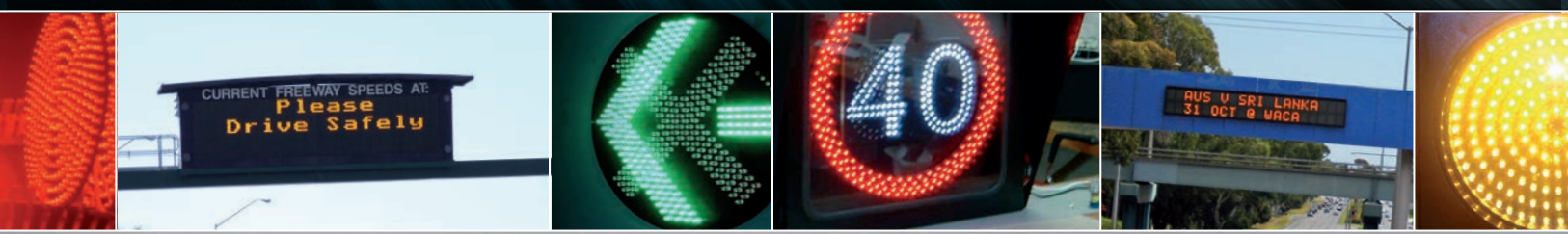

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Kiss your bus goodbye!

Loved by many planners, the urban transit bus is outsized, ungainly, disdained, and underused. Its function is critical for cities but its physical and network form is increasingly undesirable. Fortunately, predicts **Bern Grush**, it won't be needed much longer...

Illustration courtesy of Ben White

The city bus is a critical urban resource. Transit systems, including buses, stimulate economic development, create jobs, get people to work, reduce traffic congestion, foster more livable communities, boost real-estate values, ensure safety, and enhance mobility for those who do not (or cannot) drive. Under the right average load circumstances, they reduce energy consumption and are easier on air quality measures. But such conditions are seldom met in the USA, and it has been argued by Thomas Rubin that relative to the personal automobile, public bus transit doesn't reduce greenhouse gas emissions either.[1]

Crucial factors

Regardless, autonomous rubber-tired transit remains crucial in those urbanizations expecting or promoting densification, reduction of personal automotive travel, aging-in-place and other lifestyle shifts enumerated in *The Great Inversion*.[2] Inversion describes the reversal of the multi-decade trend for family, money and maturity to move to the suburbs. Some of this is younger people who are slower than previous generations to own personal vehicles; older people embarking on their post-driving years; and those wishing to adopt a car-free or car-sharing lifestyle. This matters as a portion of these people will consume more public transportation – and many hope this portion will be significant.

The car, too, is a vital urban resource, stimulating economic development, creating jobs, shortening travel times, increasing job reach, providing more choice of housing location (a countervailing 'livability' argument among some demographic cohorts), boosting real-estate values (albeit sprawl), and enhancing mobility for those

who can afford them. Measured by its mass adoption rate relative to the bus, the car is currently the more critical resource.

The automobile is also undergoing far more rapid innovation and, as Rubin points out, is currently the cleaner environmental performer per passenger mile (in the USA) compared with the bus. As we expect to move toward increasing energy efficiency for the private automobile, the car-bus comparison will increasingly favor the car, unless there is a dramatic upswing in off-peak bus ridership. An increase in bus use may be what planners and urban advocates wish, but that is not what we are seeing.

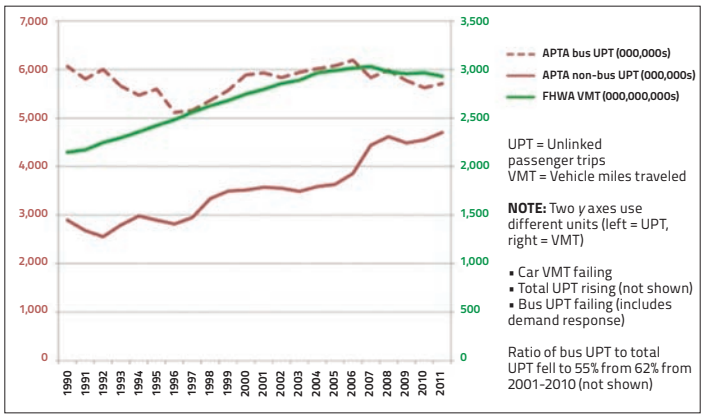
Not so much to choose from...

Although it's inconceivable going forward without shared, urban transit systems, the 50-passenger city bus is an endangered species. With few exceptions – NYC is notable – bus transit use continues to erode in the USA (see graph below). They're getting more expensive to buy and operate, and are getting heavier as alternative propulsion systems are adopted. They've also lost a few seats as wheel wells intrude into seating areas to lower floors for accessible loading, and over the past decades they have generally been getting emptier still.

The car has even more problems though. It was associated with 369,000 deaths in the USA from 2001 to 2010. Around 50% of its total lifecycle footprint is in its manufacture and another portion in its disposal. And it burdens us with an additional, even larger problem that's wildly mismanaged: parking. The average car is parked more than 95% of its useful life – if you count parking a useful activity – and the fully accounted carbon footprint of parking infrastructure far outweighs the aggregated footprint of all of our automotive driving.

Giving over a large portion of urban space to storing privately owned cars also distorts urban land values and rents, harming lower-income earners and pushing them further from the urban core. But

(Right) **When we have 100% driverless roadways, complex traffic management scenes like this will become distant memories – as did the 19th century scenes of horse and carriage congestion**
(Bottom) **Bus unlinked passenger trips (UPT), as distinct from bus revenue miles, continues to fall even as total transit UPT grows and automotive VMT is flat. Is the bus dying?**



Ehrenhalt describes inversion as wealth moving back to the center, so to the extent he is right, the bus is further threatened as its use is negatively correlated with wealth. Again, the bus loses to the car.

The advantages of automobility may have plateaued – they are certainly tarnished for many – but they will not be wished away, and we are likely to continue seeing an outsized number of personal passenger vehicle trips. The big question is, can we make those trips with fewer vehicles and with less parking?

According to the 2010 Federal Transit Administration's (FTA) National Transit Summaries and Trends, transit revenue miles (all types) increased by 18% between 2001 and 2010. Growth, in order of increase, was experienced by vanpools, light rail, demand response (including taxis) and commuter rail. Bus revenue miles increased the least – only 5.3%. This is comparable to the nationwide increase in automotive VMT of 6.1% over the same period. Bus use is in relative decline even as its costs climb. What appears anomalous is that from 2001-2010, bus revenue miles increased 5.3% (FTA) while bus UPT fell 4% (APTA) with all of the fall in 2008-2010. That could mean fewer people use the bus, and now live further from their jobs – i.e. the plight of lower-income workers in a recession. It's also been suggested that transit riders, especially bus riders, are last hired and first fired. Either way, it's another loss for the bus.

Where from here?

The bus's problem is that it's large, has fixed routes, needs to service non-uniform demand, arrives infrequently, is underused, expensive to purchase and operate and is the modality of last resort. But the car is unsafe, congested and smothers our cities while waiting for its owner to move it to its next parking location and is the modality of first choice. And both buses and cars are hard on the environment.

But to make matters worse, innovation in bus design is dwarfed by that of the personal automobile. As buses in the USA run with an average of only nine passengers, the environmental advantages of the rush-hour bus are as much overshadowed by the increasingly cleaner automobile as they are negated by the near-empty off-peak bus. Reducing off-peak bus operations – to which cash-strapped transportation authorities now resort – encourages further car use and further erodes the bus's role. Both bus and car use are dominated by positive feedback cycles, and both are driven by the car's success. Each automotive advance widens the gap so the 20th

century bus can't win in the 21st century city without government coercion. In any case, the 21st century city will remain dominated by the 21st century car, so how can we fix the 21st century bus?

With an environmental focus, attention has been lavished and hope pinned on the electric vehicle (EV), which is expected to make automobility more sustainable, i.e. environmentally less harmful. It will also make automobility yet more desirable, again favoring the private automobile in the bus-versus-car debate. This will redouble the positive feedback loop for automobility and worsen road and parking congestion. If the EV is deployed in the same urban environments, with the same driver mentality, using the same road and parking facilities, and under the same driving and parking regulations, it would simply continue the bully tradition of its IC engine predecessor, albeit with fewer emissions. The greater problem is that automotive engineering needs to look past the singular focus on the automotive powertrain, or congestion will get worse.

> The advantages of automobility may have plateaued … But they will not be wished away

(Bottom right) **Shared, driverless cars would spend more time on the road and less time parked, meaning that we would need many fewer cars for the same volume of VMT**

Sebastian and Google

But an added, companion technology will play a larger and even more effective role than fleet electrification in addressing the combined weaknesses in the competing systems of autonomous private vehicle and city-bus transit: the driverless vehicle.

Inventor Sebastian Thrun describes the value of the Google Driverless Car from a safety perspective, because machines (when perfected) do not make the number and nature of mistakes humans make. And from a congestion perspective (when pervasive), as machine reaction times would allow us to reduce headway so that current road infrastructure could carry (according to Thrun's assertion) twice the traffic.

He also imagines you could take a driverless vehicle to work, disembark, then send it home to take the kids to school. That would save a parking spot, reduce the family car count by one, but generate more traffic. It is also naïve to assume that a significant number of families could schedule a couple of jobs and a school or two so cleverly that a single vehicle would readily work out. Although some driverless vehicles will certainly be privately owned (and parked 95% of the time), this technology will have its most dramatic

Dr Paul Sorensen

Dr Sorensen is a researcher and associate director of the Transportation, Space, and Technology Program at the RAND Corporation

The vision of driverless cars replacing buses is intriguing, appealing on many fronts, and perhaps inevitable. With the rapid rate of progress being made by Google and others, it's not difficult to imagine that the technology required to support fleets of self-driving vehicles will be in place by 2025. Far less clear, though, is whether our regulatory systems will be able to adapt by then. Developing a legal framework to address liability issues should be a priority for policymakers.

In addition to supplanting underutilized bus transit, it seems likely that autonomous vehicles will result in a merging of car-sharing and taxi service as well (with the former advancing to replace the latter). The resulting service would be cheaper than a taxi – no need to pay for a driver – and more convenient than current car-sharing, with the ability to be picked up and dropped off anywhere.

Driverless car-sharing would also eliminate the high fixed costs of auto ownership, to be replaced by higher marginal costs for each trip. For current vehicle owners switching to car-sharing, this would create an incentive to reduce total vehicle travel, potentially helping to mitigate traffic congestion. This effect is uncertain, though, as driverless car-sharing could also increase vehicle travel among those who do not currently own a car.

And it would be an excellent market for EVs. The cost of electricity on a per-mile basis is much less than gasoline or diesel to power a conventional vehicle, but EVs also cost much more and offer relatively limited range between recharging. The ideal application for EVs thus involves relatively short trips between recharging opportunities combined with high annual mileage to amortize the vehicle price premium – very different from the travel patterns of a typical prospective owner, but just what you would see in a fleet of shared autonomous vehicles serving urban mobility needs.

> Automobility is a sociological force, and the driverless vehicle will end up being much more about society than about technology

advantage for shared vehicles – especially taxis, vanpools, jitneys and other demand vehicles that now require dedicated, expensive and imperfect drivers.

The driverless jitney

A fantasy since at least the 1939 World's Fair, the driverless car has a strong pedigree. It was funded in numerous university research programs since the 1980s, with more than US$1 billion invested into the European Commission's road safety-focused EUREKA PROMETHEUS Project on autonomous vehicles from 1987-1995.

Thrun started his robotic car research in 2004, entering the DARPA Grand Challenge prize competition for the driverless vehicle. A year later, Thrun's Stanford team beat Carnegie Mellon's team by a slim 11-minute margin over seven hours. Two more entries followed 10 and 15 minutes later. Although several other groups are making headway in solving this problem, the DARPA margins alone say there is ample room for competition and innovation and that Thrun's achievement is one whose time has come. We can count on this – with or without Thrun's undoubted genius and tenacity.

Driverless society

Most see the automobile as technology – whether cool, horrific or just utilitarian. But automobility is a sociological force, and the driverless vehicle will end up being much more about society than technology. The car we have known structures our cities, accelerates environmental harms, organizes us demographically, breeds obesity, isolates communities, provides greater job reach and opportunity, expands lifestyle choices, influences attitudes and entitlements, and many things we often lose sight of. It even indirectly justifies wars, hence ironic that the US$2 million DARPA prize Thrun won in 2005 was from the US Department of Defense.

(Top left) **Sebastian Thrun was director of the Stanford AI Lab (SAIL) in California and won the 2005 DARPA Grand Challenge along with the Stanford Racing Team and 'Stanley'** (Below left) **Thrun would later go on to help develop Google's much-publicized Driverless Car**

The first response to the self-driving vehicle is usually fear of not being in control. Thrun points out that the tolerance for accidents while under driverless control will be far less than that under human control, and we know that all 369,000 of the US traffic deaths in the decade ending in 2010 involved human control. The driverless vehicle will have to evidence a near-zero accident rate for millions of miles in all sorts of conditions before it becomes pervasive. This may take another five to seven years. Thrun himself said, "The car will be ready when the car is ready," as he pointed out that his team still needs to address driving in snow and avoiding obstacles such as a mattress in the roadway.

The second response, 'Not for me – I enjoy driving', may be true but three things will change this attitude. People who give up driving will have more time for other work, social or leisure activities while traveling – already a reason the iPad generation prefers public transit. Secondly, those in driverless cars will notice trips are more time- and power-efficient due to constant optimization. But most importantly, insurance rates will be lower as death and injuries fall dramatically.

The third response – 'It'll never be allowed' – is evaporating as one state,

Professor Phil Charles

Phil Charles is professor of Transport at the University of Queensland, Australia

Although similar in terms of standard of living, Australia has many differences to the USA – a much lower population density and tax base; vehicles, labor and fuel are more expensive; and there are fewer freeways.

In the eight-year period to 2008, public transport (bus and rail) grew by 24.9% in Australian capital cities due to many factors, primarily increased investment by governments into public transport service levels and increasing road congestion.

Urban public transport is about moving large numbers of people. Current systems and technologies need to evolve to be effective into the future. Having large buses serving fixed routes and providing services that don't match demand must change – and in Australia they are. Different types of services, routes and frequencies are being deployed to match demands with much success.

There is no simple answer to the challenge of moving people in major urban areas. A combination of large buses (200-seater buses are in regular use in Brisbane), regular-sized and smaller buses are needed to match demand. Frequency of services varied according to demand, with greater use of demand-responsive services during certain times of the day and in specific areas.

Increasing patronage requires improved levels of service – one major shift available from technology is providing comprehensive, accessible and real-time information on services. Reliability of services, smooth interchanges and comparable travel times to the car are critical.

Work patterns should change to spread the demand and avoid the 'super' peak periods, developing dispersed employment activity centers across the city, to move away from a few concentrated business districts.

Reports of the death of public bus transport are greatly exaggerated!

Nevada, has provided the first license for one of these machines as of May 7, 2012.

2020-2030

Once the EV becomes a staple of our urban transportation fleets, self-driving EVs (SDEVs) operated by entities such as Zipcar, Hertz or Yellow Cab – and by our municipalities – will soon form the bulk of non-rail public transit in most cities, with large-format buses relegated to increasingly specialized roles. They'll cluster around charging stations or battery swaps. They'll automatically respond to calls then return to a charging station or continue to another call. They'll self-distribute and self-assign based on distance, residual charge and customer demand. Time and energy use would be optimized subject only to customer service performance. Vehicle sizes might range from 2-10 passengers and likewise be optimally assigned. Vehicle load-balancing among operators would further optimize energy and congestion. SDEVs would also know when to take themselves to maintenance bays.

Depending on willingness to pay, some riders might specify 'no sharing' or an upscale vehicle; others the opposite. In the event of sharing, the vehicle would be able to divert from a direct path to pick-up or drop-off a passenger along a route (shared taxi). This would be constrained by pre-agreed performance criteria, with penalties involving reduced fares or future credits – '30 minutes or free', for instance.

Today, large groups of people are constrained to use specific routes. Breaking these into smaller groups provides more room for optimization, each passenger traveling fewer miles as routes become more effectively optimized segments. No one need wait through a 10-mile trip to complete a seven-mile journey (an unconsidered aspect in assessing the relative footprint of bus use). SDEVS can stop in many more locations for both pick-up and drop-off, with your front door effectively becoming your own bus shelter in bad weather. They can also be constrained to paved, marked roads to ensure safety.

In the SARTRE project, on the roads outside Barcelona, Volvo recently used three vehicles that drove autonomously following a truck for 200km at 85km/h

(Right) **Many auto execs believe the industry is on the cusp of welcoming vehicles that make the idea of keeping both hands on the wheel an anachronism**

> Self-driving EVs … would soon form the bulk of non-rail public transit in most cities, with large-format buses relegated to increasingly specialized roles

Variable trip pricing can spread peak-hour loads, so there would be no need to replace traditional buses on a seat-count basis, meaning the 50-seat bus that carries 70 riders for 60 minutes each day would need far fewer than 50 seats in replacement.

Most SDEV trip segments would be relatively short. They'd connect with both light and heavy rail lines and could connect at SDEV hubs for cities without rail. Alternatively, convoys of SDEVs could complement or replace light rail, reducing the cost of mid-volume transit while greatly increasing its flexibility. For rail fans, some SDEV trips could even be intercity, using platooning. These would feature three to four vehicles and would reduce headway space in the urban core – and intersection controls can be managed to favor transit convoys as they do now for buses. On the highway, of course, dozens or hundreds of vehicles could be convoyed.

Personal safety would be managed by video cameras, and motion and sound detectors. Labor costs per passenger mile would drop, but a dramatic increase in passenger miles would counter that to retain employment numbers. The big loser would be parking. But unless municipalities change the parking model, it's already a loser.

Communities of 100 families could set up a mobility co-op with 30 vehicles and a charging station – access restricted to families and guests, and mileage-based user fees assessed at the cost of operations and debt retirement. A new type of daily self-reorganizing carpool would evolve. With social media, travelers can list preferences – non-smoking, female-only, etc – to find strangers to share. Such agglomerations would blur the distinction between mass and personal transport, providing most of the benefits and fewer of the downsides of each.

The skeptic will no doubt find fault with the enthusiasm for such a vision but the optimist is more likely to see opportunities. Vitally, there is no reason to think that the public transportation of 2025 should be any less changed than the automobility of 2025. Innovation, cost, convenience and consumption preferences will drive these changes more than will sustainability. The driverless vehicle can soon align these forces to move in the same direction.

• *Bern Grush is the principal of Bern Grush Associates, Toronto*

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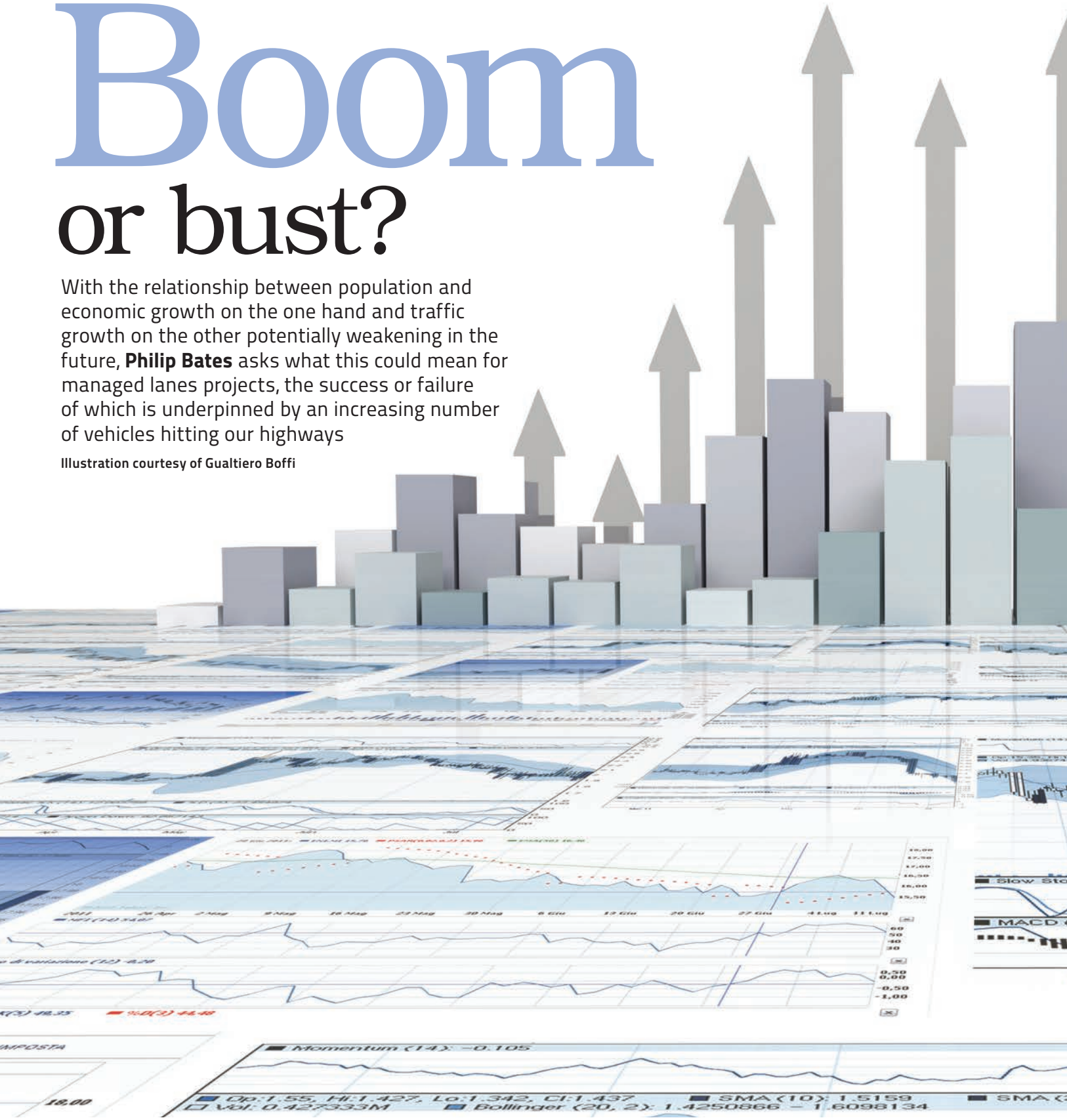
Boom or bust?

With the relationship between population and economic growth on the one hand and traffic growth on the other potentially weakening in the future, **Philip Bates** asks what this could mean for managed lanes projects, the success or failure of which is underpinned by an increasing number of vehicles hitting our highways

Illustration courtesy of Gualtiero Boffi



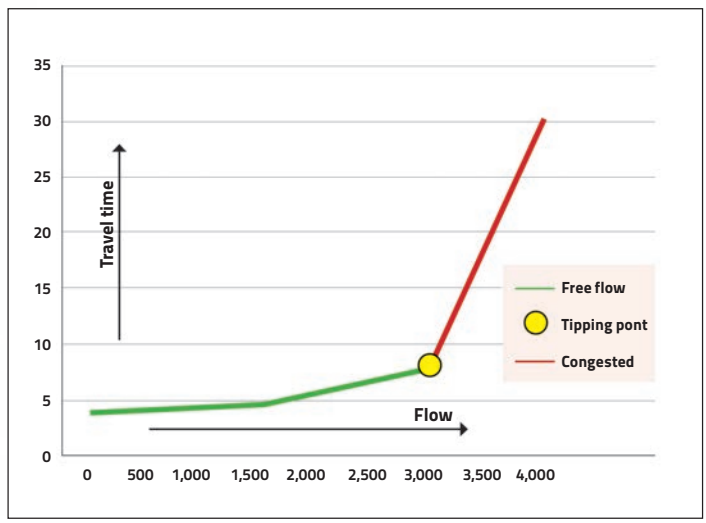
Around the globe, highway authorities are struggling to balance the ever-growing public demand for highway capacity with declining budgets resulting from increasing unwillingness from the public to pay higher gas taxes. This has given rise to the concept of 'managed lanes'. In the USA, the country that has most enthusiastically embraced this concept, there are a number of high-profile projects, including the Washington DC Beltway (495 Express Lanes) and the North Tarrant Expressway in Texas.

Defining managed lanes

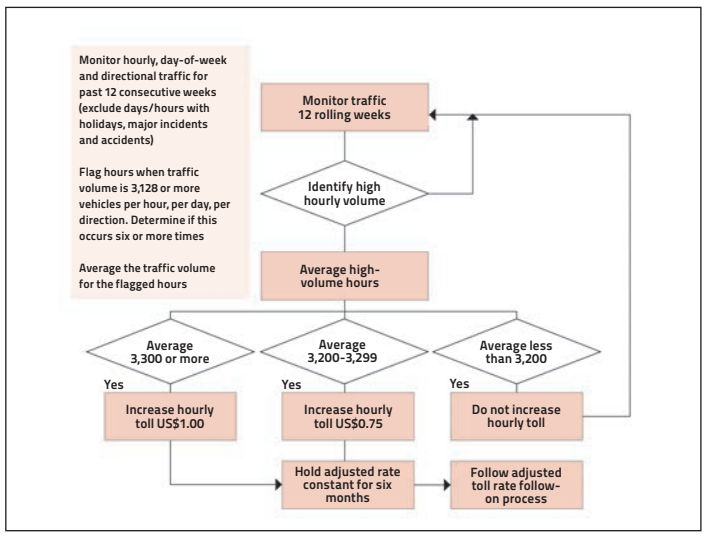
Although many different definitions of managed lanes have been presented, there appears to be two common themes. First, they are 'freeway-within-a freeway' facilities but with the managed lanes physically separated from the general-purpose lanes. Second, use is controlled using a combination of tools and techniques to achieve uncongested conditions for users of the managed lanes. The methods adopted to achieve the desired uncongested conditions are subdivided into three broad groups – pricing, vehicle eligibility, and access control. Given public sector budget constraints along with a growing interest in public-private partnerships, it is perhaps not unsurprising that demand management by 'pricing' has attracted most attention recently and is the area addressed here. We'll also focus on new-build schemes rather than HOV-to-managed lane conversions.

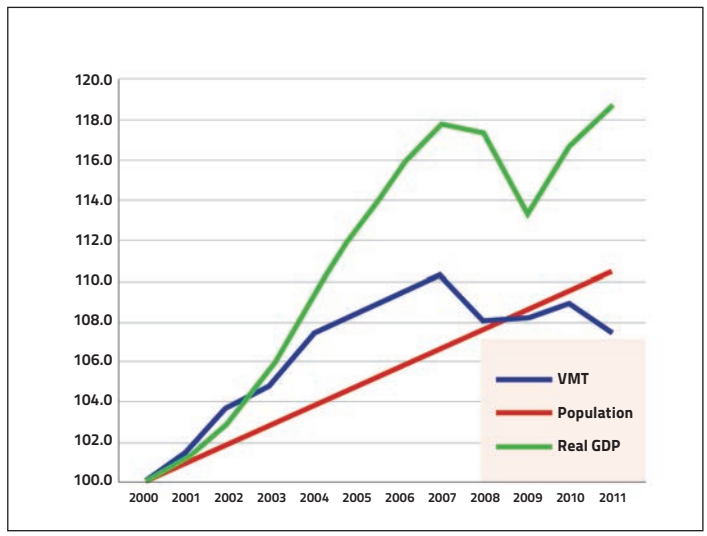
At first glance it isn't hard to see why managed lane schemes have attracted so much interest – they seem to answer so many problems faced by highway agencies.

For example, they provide additional capacity that is 'locked in' or 'future-proofed' – that is, no matter how high



(Figure 1) **Volume/Delay function**





(Figure 2, above left) **Toll policy monitoring process on SR 91**
(Figure 3, above right) **Real GDP, population and VMT for the USA**

demand gets in a corridor, in theory the various management techniques – and in particular price – can be used to ensure that, for those trips that are particularly urgent and/or important, a reliable and quick journey time can be provided via the managed lanes.

They can easily be combined with initiatives that actively encourage multi-occupancy vehicle use (be it HOV or transit), in doing so further increasing overall 'person' capacity in a corridor.

And payments from users can make a significant (if not full) contribution to the costs of building and maintaining the new capacity, easing the pressure on stretched public budgets.

The growth imperative

Success will usually rely on one fundamental assumption: traffic growth. Although it can be argued this need for future growth is true of all new infrastructure, the nature of managed lanes makes this issue far more important, as the pricing methods used dramatically increase the relationship between traffic growth and revenue growth.

On SR91 in California, for example (the 'Granddaddy' of US managed lane schemes), revenues increased from US$28.9 million in FY2003 to US$44.2 million in FY2006, largely as a consequence of increasing toll levels in the peak periods. But to understand this process, one needs to go back to transport planning basics. The relationship between the volume of traffic on a road and the amount of delay for a driver is not a linear one, seen in the classic 'volume/delay function' of the type shown in Figure 1.

What this means is that at low traffic levels, the addition of more traffic on a highway has little or no impact on the speed of traffic. However, there comes a point where the flow on a highway gets so high that traffic flips from freeflow to congested. Beyond this 'tipping point', delays rapidly build up.

Let's consider the situation where a new managed lane scheme has been built and is about to open. To keep the math simple, we'll assume there are four existing general-purpose lanes, and the managed lane scheme involves the construction of two tolled lanes parallel (or a 50% increase in corridor capacity). On the day the managed lanes open, users are faced with a choice: keep using the general-purpose lanes or switch to the managed lanes and get a fast and reliable journey time.

> Once traffic levels on the general-purpose lane have risen back to the 'tipping point' between freeflow and congestion, revenues can increase five times or more faster than traffic growth

Of course, it takes a while for drivers to 'rebalance' their choices, but critically it only needs a relatively small transfer from the general-purpose to the managed lanes for the general-purpose lanes to improve dramatically. So tolls on the managed lanes need to start at a low level to attract users.

However, as traffic in the corridor starts to increase again, three things happen. The delay and unreliability on the general-purpose lanes start to increase back to old levels, so more people move to the managed lanes. The tolls on those lanes then also have to increase because the amount of traffic needs to be limited to a level that ensures

The digital age

Talk of the 'cyber culture' impacting on traffic levels may sound fanciful and marginal to the majority of the population, but let's look more closely. In 2008, around 65% of US households had internet access and the number has continued to grow. The number of cell phone users rose from 34 million in 1996 to more than 200 million in 2006. In 2006 there were around 75 computers for every 100 people in the USA. If such technology, combined with a service sector-oriented economy, meant only four days in an office and one day at home – instead of five days in an office – this would clearly reduce traffic significantly. Add to this 'commute' effect the impact of shopping on the internet and home delivery of goods and groceries and you start to see why traffic growth might be slowing. It seems unlikely that this process has run its course yet.

Changes in societal structure

Although economic growth was undoubtedly the main driver behind traffic growth in the past few decades of the 20th century, social change also contributed to the rate of growth. It would appear that today there may also be some underlying changes in society that might be starting to reverse the traffic growth trend. In the last decades of the millennium, household size steadily declined. Two dwellings each with one person generate a lot more car trips than one dwelling with two people. However, there is evidence this trend is stopping with the average household size appearing to level off at around 2.6 people per unit. There is also the 'graying' of the population. The post-World War II Baby Boom resulted in a spike in birth rates. Since then, rates have been declining. The age group that drives the most – 20 to 44 – has seen a reduction in its share of the population since 1990. Meanwhile, the 45 and over age groups, who drive less and less each year, have grown proportionally. As life expectancy increases and birth rates continue to drop these effects are likely to strengthen in years to come.

they continue to run freely, irrespective of how bad the general-purpose lanes get.

In fact, once traffic levels on the general-purpose lane have risen back to the 'tipping point' between freeflow and congestion, revenues can increase five times or more faster than traffic growth. This process can be seen through the 'Toll Policy Monitoring Process' on the SR91 in California (Figure 2).

But surely traffic growth isn't a concern in countries such as the USA? After all, traffic levels may have dropped recently due to the economic recession but with a return to population and economic growth in the future, there must undoubtedly be growth in car traffic. Perhaps the recent past can be used to test this hypothesis.

The graph in Figure 3 shows real gross domestic product (GDP), population and vehicle miles traveled (VMT) growth for the USA over the past 10 years (all three values indexed to 100 in the year 2000). What you see initially (2000 to 2004) is that traffic and GDP are closely correlated (as in previous decades), but around 2005 these relationships noticeably weaken. Meanwhile, VMT peaks around 2007 and then declines, which was ahead of the economic crisis, which started in 2008. From 2008 onward, VMT has been relatively flat, despite the economic recovery in 2010 and 2011, and the year-on-year increase in population over the whole decade. VMT in 2011 declined despite population and economic growth.

(Top left) **Picture shows the 495 Express Lanes in Virginia, USA**

So why might traffic no longer grow, even if the economy has recovered and the population is still growing? There are probably a number of compounding factors, as detailed in the sidebars.

It is important to stress that one can get very strong local traffic growth within an overall framework of macro stagnation or even decline. Managed lanes tend to focus on congested urban corridors, and their promotion as a project means the corridor has, at least in the past, undergone strong traffic growth.

Perhaps it is just the data?

Another issue might of course be that measures such as GDP increasingly don't reliably reflect what we think they do (such as wealth). Perhaps the old traffic and economic growth relationships do not work anymore because one of the parameters, GDP, has changed. The most common definition of GDP is "the market value of final goods and services produced domestically in a year". It is worth noting that economies experiencing an economic bubble – such as a housing or stock bubble, or low private-saving rates – tend to appear to grow faster (in terms of GDP) owing to higher consumption. People mortgage their futures for present growth. It seems plausible that at least some of this structural break between economic growth and traffic growth also reflects this phenomenon.

> Perhaps the old traffic and economic growth relationships do not work anymore because one of the parameters, GDP, has changed

The first point to note is that every scheme needs to be judged on its merits. Even if overall traffic levels are static, it is likely this picture is underpinned by rapid growth in some areas and large decline in others. Forecasters must assess projects on a case-by-case basis.

It would also be wrong to conclude that road traffic in the USA is going to stop growing. However, the relationship between population and economic growth and traffic growth does appear to be weakening.

The implications of this for the managed lane projects under construction is yet to be seen but the outcome is likely to have implications and lessons learned for transportation policy in the USA over the next decade.

• *Philip Bates is a director at Buro Happold and is based in London, UK*

Transit

The USA has always been seen as a car-based society. However, cities across the country have increasingly been embracing transit as part of their development strategies. Federal statistics show trips by transit increased by 10% between 2002 and 2010, while VMT only increased by 5% over the same period. Again, given the continuing expansion of transit systems across US cities and the associated construction of high density transit-orientated developments, this effect is also likely to increase into the future.

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Three-pointed star

Where no road even existed a few years ago now lies one of the most advanced cashless toll roads in the world. **Rick Purnell** meets the cast behind North Carolina's US$1 billion blockbusting Triangle Expressway

Photography courtesy of J. R. Fenske

The most expensive transportation project ever awarded in North Carolina may never have happened without tolling. In fact, using traditional budgeting processes, the Triangle Expressway would have remained a dream at worst – or at best would have come along a quarter-century from now.

The US$1 billion, six-lane, 18.8-mile facility is a continuation of the I-540 loop around Raleigh in the Old North State. When completed it will improve accessibility to western Wake County and Research Triangle Park while reducing congestion on the existing routes that serve the region. One of the challenges for operator North Carolina Turnpike Authority (NCTA), a division of the North Carolina DOT (NCDOT), was that the first half of the loop had already been completed as a non-toll highway, so municipal officials served by the incoming portion felt shortchanged and initially opposed construction. Gaining stakeholder support was essential to the project's support and eventual approval. Thus began NCTA's first public outreach efforts, with activities consisting of building a coalition of local transportation advocates who – years before – had rejected the concept of the Triangle Expressway being a toll facility.

(Main) **When completed the Triangle Expressway will save commuters up to 40 minutes round trip of congestion-free travel every day**
(Right) **Although an agreement is still yet to be reached, NCTA hopes to be fully compatible and accept E-ZPass accounts later this year**

David Joyner is NCTA's executive director and in 2005 was given the task of developing new ways to fund and deliver congestion-relieving projects. It was clear to him and his team that the first project under his watch had to be a hit. "What else are states to do?" he asks. "We can't put up 'no vacancy' signs – there has to be a viable alternative for building mega projects, and I don't know of any other solution other than some form of a user fee."

Spreading the word

Working with NCDOT, NCTA launched an educational campaign that targeted municipal planning organizations, mayors, chambers of commerce and other influencers. The essential sales tools were the realities of the day.

"By using traditional funding sources, it would take 25 to 35 years to construct the Triangle Expressway," Joyner explains. "If tolled and built today, it would not only be paid for but the tolls could actually be removed within the same time period."

Spencer Franklin, project director for HNTB, which serves as the NCTA's general engineering consultant (GEC), says the transportation demand was strong. Combined with the funding


540
NC QUICK PASS
OR
BILL BY MAIL
EXIT 67

realities, that gave the project the needed clarity to gain support and move forward. This was going to be a toll road or it wouldn't be built at all.

Cashless risk pays off

The authority worked with its GEC and with traffic and revenue experts, financial gurus, legal advisers and other engineering firms to manage the entire scope of the project. This included putting all the pieces together, bringing decision points to the NCTA team, then helping personnel understand how each decision affects every other moving part of the project.

More often than not, those pieces can make for tough choices. Advisory teams are just that – not decision-makers – which places a heavy burden on an agency that may be new to tolling but has to know enough to ask the right questions and then make the difficult legal, financial and technical decisions.

The team struggled with the cashless decision. Cash toll plazas were included in the original plan because, at that time, electronic toll collection wasn't as advanced as it is now. "We believe this was the first Greenfield project ever to be financed without cash collection," Franklin says. "But it wasn't a decision we came to quickly."

The team first considered the toll plazas, which were big, expensive and had potential environmental impacts, and quantified the actual costs of each element. Once that was complete, another firm estimated the amount of 'leakage' that would occur with an AET system. When the two numbers were compared in the plan of finance, it was a wash. "We'd lose as much money as we'd save," says Franklin. It was decided that the best course of action was to proceed with automated electronic tolling. "It was the right decision for this project. Tolling technology has improved greatly and it's a much more accepted practice," he adds.

(Top left) **Groundbreaking in more ways than one on the Triangle Expressway** (Above) **NCTA evaluated various advanced ETC technologies, seeking a system that would spur statewide adoption**

(Bottom left) **The project's cost is more than US$1 billion and is the single largest transportation infrastructure project in North Carolina's history**

Joyner agrees, stating that running multiple scenarios helped his team understand how the two options would affect the project's revenue and financing. Now, AET systems are in place across the USA and Canada. The Alliance for Toll Interoperability is currently drafting legislation for toll interoperability for agencies in the northeast, upper midwest and south including the E-ZPass Interagency Group and Florida's SunPass.

The AET decision has quickly proven to be the right one. As of June 30, 2012, both traffic volumes and sales of transponders, at nearly 21,000, are higher than projected. "Things are going so well that we are pinching ourselves," Joyner enthuses.

Southeast shootout

During the development of the Triangle Expressway project, NCTA put out an open call to all camera and ALPR software

Being first takes a long time

In seven years, the NCTA has grown into a fully functioning tolling agency that is breaking ground in construction and use of ETC on the Triangle Expressway:
2002: NCTA created;
2005: David Joyner hired as first NCTA executive director;
2006: FHWA approval allowing tolling of the project;
2007: MPO approval supporting project, FHWA Reevaluation report, design-build (D-B) contract advertised;
2008: Environmental assessment, NCDENR 401 Water Quality Certification, US Army Corps of Engineers (USACE) 404 permit, credit rating agency meetings, state legislations authorizing the project and annual appropriation, FONSI, D-B technical and price proposals submitted, categorical exclusion for tolling existing portions of NC 540, D-B price proposals opened, traffic and revenue study completed, investment grade credit rating received, NDDENR 401 Water Quality Certification;
2009: USACE 404 permit received, TIFIA loan agreement executed, toll revenue and state appropriation bond sales completed, D-B construction contracts awarded, groundbreaking, ETC/back-office system contract and operations services contract awarded;
2010: ITS and ETC contracts awarded;
2011: Customer service center opened, Phase I opened;
2012: Phase I toll collection begins, Phase I completed, Phase II opened, Phase III opening scheduled for December;
2012: Completion scheduled for July.

> The facility is working just as designed … Things are going so well that we are pinching ourselves
>
> **David Joyner, executive director, North Carolina Turnpike Authority, USA**

suppliers, the purpose being to invite those interested to participate in a video 'shootout'. Tests were set up in North Carolina, the results of which became the basis for the specs for TriEx's current system. A second shootout took place at an abandoned airport earlier this year. NCTA brought in vendors from around the world to show how their systems might work. These employed GPS and other advanced technologies, which complements NCTA's search for the next range of services.

Building a state's first toll road using AET exclusively might have led to second thoughts, but market demographics, customer types and the surefire win needed for it to succeed all meshed smoothly. This project had all the right attributes to become the NCTA's first tolling project, starting with the location. Research Triangle Park is a high-tech business park, similar to a campus setting. The average employee has a post-college graduation and an average income of more than US$100,000. There's no housing in the Park, so everyone commutes. Employees in the area are educated, highly tech-savvy and place a high value on their time.

Forward-thinking financing

AET isn't the only first for the Triangle Expressway. In July 2009, NCTA closed on the most complex financing package in North Carolina's history: US$270 million in toll revenue bonds; US$353 million in state appropriation bonds; and a US$387 million federal Transportation Infrastructure Finance and Innovation Act loan. It was the first time the state had secured such a loan.

"Although there was a lot of work to be done, making the AET approach successful revolved around the integration of three primary components," says Franklin. "The business rules, the toll enforcement legislation and the toll system technology."

It works

Most involved with the project agree that one of the main reasons the Triangle Expressway has been so successful so early was because it made sense as a toll road and it was developed as a toll road. "We've seen projects positioned as toll roads simply because there was no other way to fund them. That strategy doesn't work," Franklin feels.

Also, extensive public outreach with MPOs, elected officials and neighborhood groups helped those in the area know what was going on and why. Teamwork, technology and talking with each affected group helped the Triangle Expressway be a first on many fronts for North Carolina, according to Joyner. "These tremendous efforts in teamwork have paid serious dividends in helping North Carolina launch its first successful toll project."

• Rick Purnell is a freelance writer based in the USA who specializes in transportation technologies and transportation funding issues

A legend in the transport sector, **Fotis Karamitsos** discusses ITS, policy and the frustratingly slow move to real progress

Interviewed by Louise Smyth
Photography courtesy of DG MOVE

The European Commission's Fotis Karamitsos has a rather longwinded job title, which given he works for an entity that to outsiders is swathed in an air of intriguing complexity, is possibly par for the course. He's currently director within the Directorate-General for Mobility and Transport – or DG MOVE for those among us who take comfort in acronyms.

Degrees in civil engineering and transportation planning – and a stint at the World Health Organization tackling issues in Greece (his home country) such as pollution control in Greater Athens – have stood Karamitsos in good stead for life in the Commission, whose administration dictates that even if somebody specializes in one area, they must move around and gain experience in others.

Hence the 25-year transport veteran has a varied CV, and not just in road traffic. "Back in the day, I helped to develop the first model of the European driving license and established the first European road safety year, which resulted in road safety being introduced as a chapter in the Treaty," he reveals. "Subsequently I moved fields, working with industry on PROMETHEUS. I started the DRIVE program, which later became Advanced Transport Telematics; I also helped to create ERTICO and eventually we started work on the role of GNSS in transport, leading to Galileo."

Having left his mark on these legendary projects, Karamitsos then swapped ITS for an altogether different mode of transport: "A number of serious accidents and their consequent oil spills led to the creation of the European Maritime Safety Agency (EMSA) and drawing upon my past ITS experience, we established SafeSeaNet, the first pan-European system for monitoring maritime traffic using telematics."

Shipping forecast

Whether road or sea, then, what is it about mobility generally that's maintained Karamitsos's passion for all these years? "It's the fundamental element of growth in Europe, and what we do is so close to the citizen – it covers all the social dimensions of road safety and affects people's daily lives," he says. "Mobility is also critical for business. We've said for years that transport

Legislate to accumulate?

The ITS sector has to some extent had a fractious relationship between industry and policy-makers, and Karamitsos is well aware of both sides of the debate – the 'chicken and egg' scenario related to ITS deployment and legislation. Is the latter the most important thing to getting these technologies out on the roads? "It's one of the basic building blocks," he suggests. "In the experience across other modes of transport, legislation has helped a lot. In road transport, for a long time we didn't have any practical legislation – we had only voluntary things. Now, with the ITS Directive, legislation will show up the results of how the uptake of ITS technologies will be happening. There's also another dimension in that if you introduce legislation, you get the ministers and European Parliament much more engaged in the whole discussion. Then of course if a piece for proposal is on the table you get everyone mobilized around it. I saw that very clearly when the Action Plan and the Directive were first proposed: Parliament and many ministers got excited and this helped to get more visibility at a national level afterward."

is the blood circulation of the body of Europe and telecoms are its nerves. If we want the interconnecting of Europe then we need a good transport system and mobility or we'll suffer. It's important we maintain the flow of goods and people – and with regard to that, there's always a new challenge, so you never get bored!"

Despite his lack of boredom, anyone working in transport for a number of years will tell you it's hard to not become frustrated. Karamitsos's previously listed transport achievements spanned the 1980s and much of the 1990s before departing for maritime, so on his ITS homecoming he recalls a distinct disappointment. "I came back to the transport field in 2001 and then to ITS only four or five years ago and found that – 15 years after leaving in the first place – not much had really happened at a pan-European level. True, a lot of things that we started to research back in the 1980s and 1990s have found their way into the vehicle but we don't really have a single pan-European system that works, as we have in the maritime sector."

So why has road transport lagged behind? "I think it's because we let the market alone develop such technologies," he continues. "So each player had a small application they were trying to develop and they concentrated on expanding their portion of the market without appreciating the European or global market is so much bigger. Just contrast this with railways where we have a European traffic management system or aviation where we have the Single European Sky."

Clearly, there are much greater levels of legislation in air, maritime and rail than we have in road transport, although Karamitsos cites another reason why integration has been lacking in the road traffic domain. "In all these other areas, the number of factors is relatively smaller than we have in road transport. We have too many users, operators, industries – too many disparate situations and for many years, none of the players had any of the obligations they have now when legislation is introduced. We only wrote the first proper piece of legislation for road transport in 2008, the Action Plan, and now we also have the ITS Directive, which was adopted as recently as 2010.

> It's important we maintain the flow of goods and people – and with regard to that, there's always a new challenge, so you never get bored!

Built environment

Green ITS is being hailed by many as the future of long-term sustainable transport, yet Fotis Karamitsos is not entirely convinced 'going green' will live up to its billing. "We shouldn't exaggerate the impact of Green ITS," he cautions. "Generally, I think ITS will have a far more significant effect on reducing accidents and in making traffic flows and logistics operations much more efficient. Those benefits will then allow you to look at improving environmental performance: by avoiding congestion, you reduce emissions and so on.

"In-vehicle technology is where we'll see the real gains in becoming more environmentally friendly. We're collaborating with our energy colleagues on developing new alternative means of fueling transport to reduce our dependence on oil. So from that point of view, new types of EVs coupled with a proper recharging infrastructure have great potential. But you can integrate that with ITS: the next generation of ITS or telematics will interconnect with EVs. After all, if you drive an EV, you need to know in real-time where you can charge it. Integrating that information helps with both 'greening' tasks and traffic management."

"If you compare the two, the Action Plan is more or less about when we have to do things across the 24 different areas, but what invariably happens is that the European Parliament and the individual countries then turn around and say, 'We shouldn't do the same with the Directive; let's just focus on a few of the points'."

And that's exactly how it panned out with ITS Directive 2010/40/EU, which by 2015 must put into place the specifications, standards and guidelines to start deploying pan-European systems encompassing six key areas. These include EU-wide multimodal travel information services; EU-wide real-time traffic information services; data and procedures for the provision – wherever possible – of road safety-related minimum universal traffic information (free of charge to users); harmonized provision for an interoperable EU-wide eCall; information services – safe/secure truck parking places; and reservation services. Karamitsos will continue to oversee the entire rollout as acting deputy director general.

"Although eCall is undoubtedly a success story, it was also the first thing we were bound to deliver within the plan," Karamitsos admits. Things are also progressing well with respect to multimodal travel information, with the DG MOVE man recently attending a meeting in Cyprus between the telecoms and transport ministers designed to tackle the perennially thorny issue of data access. If the industry proves unable to reach a conclusion about this between itself, legislation could help to ensure transport data sharing doesn't become a hurdle to systems deployment.

Money talks

Financial incentives are also being adopted to encourage greater cooperation between players. "Alongside us defining standards and specifications about how to do things, we're saying to people, 'Okay, so you want the resources to develop something on the road – we'll give you those but you have to use these specifications'," Karamitsos explains. "As they've already collaborated to develop the specifications, it's necessary and logical they then use them afterward."

Standards aside, when asked to describe his ideal vision for how European roads should look by 2020, Karamitsos reflects on his previous life in ITS to suggest a development we ought to see. "I'll propose something crazy that we might not achieve by 2020 but we should have it by 2030," he says. "Back in the 1990s, we had the CHAUFFEUR project within DRIVE, in which we electronically connected three or four trucks from different vehicle makers. Not much has happened on that front since, so I predict we'll start thinking about electric roadtrains, for freight before anything on the passenger vehicle side. The idea would be to have electric engines with overhead or inductive energy supply from the road surface and trucks will be able to move while being totally free of pollution. They can connect with other trucks and then when they approach local distribution, they can go back to being powered by batteries and remove themselves from the train to distribute their loads.

"From a bigger picture perspective, the advantage is that if you can have transport that is noise- and pollution-free, then why not utilize these vehicle trains and the spare capacity on our motorways for overnight deliveries? Such a vision improves traffic management and makes better use of our existing capacity for all players – logistics companies and passenger car drivers alike."

However, Karamitsos accepts that even if work on this commenced right now, it would take until 2030 to penetrate Europe's entire truck fleet. So, realistically, what will be the biggest change on our roads by 2020? "I think we'll have much more integrated traffic management and information systems," he envisages. "Users will know before they start their trip everything they need to know about jams and alternative routes. We'll have a full multimodal information system and individual vehicles will have many new safety features. I also believe the role of organizations such as ERTICO could be revitalized in terms of bringing the partners together – not for research but to facilitate deployment."

And for DG MOVE itself, Karamitsos says there are two things he and his team are looking forward to. "The first is how we can make the trans-European network much more ITS friendly via legislation. The ITS solutions and funding for them are there – we proposed them – we just have to make sure they remain there until the end of the delivery process. A second focus for us is the interconnection of the management and information systems between modes, so next time there's a volcanic ash cloud, we'll have a viable workaround!

"Being the appropriate legal instrument to finance ITS and in parallel work toward multimodal information systems and logistics applications for freight are huge priorities for us. Let's hope we don't have more on our plate than we can handle!"

> The role of organizations such as ERTICO could be revitalized in terms of bringing partners together – not for research but to facilitate deployment

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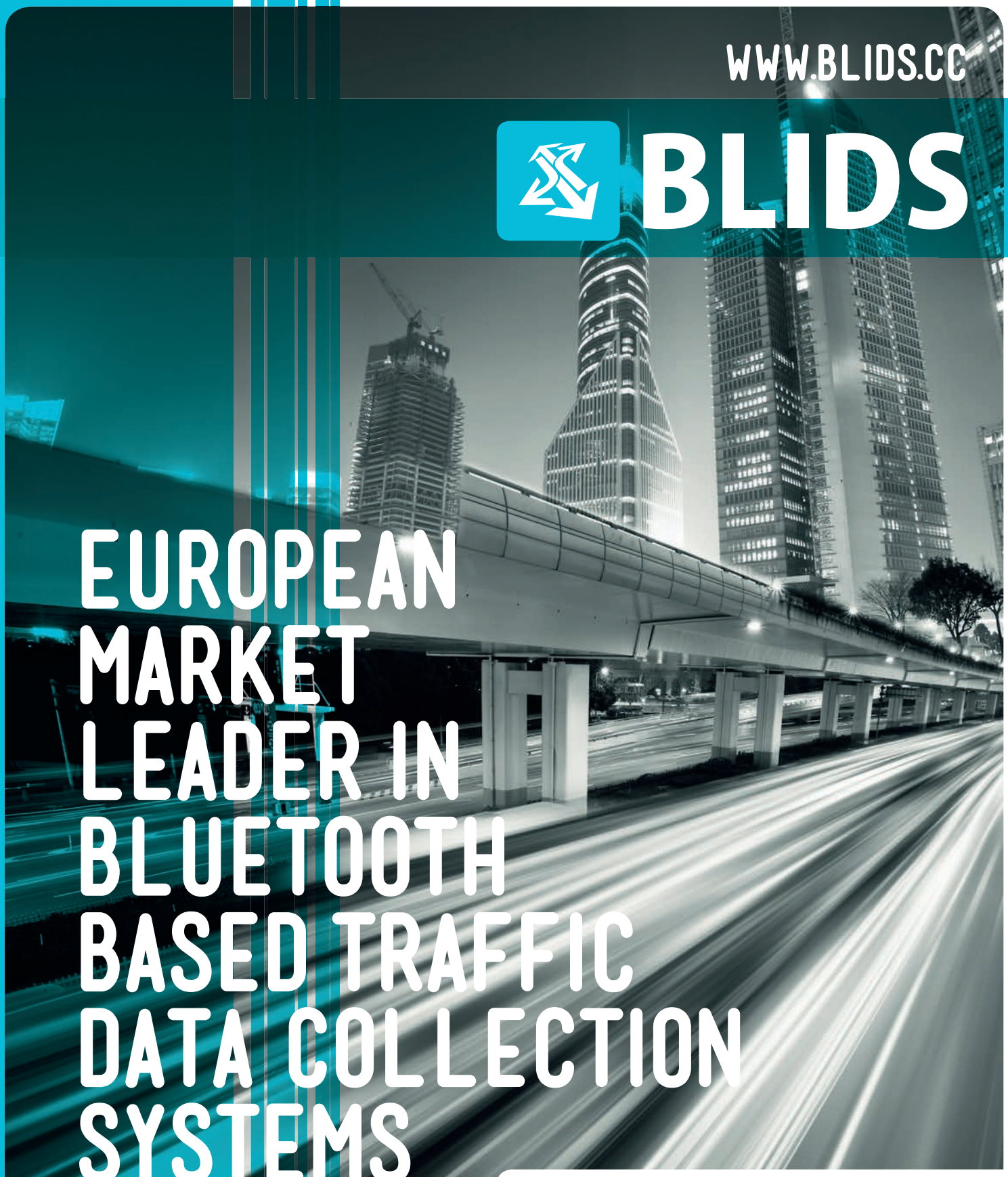

EUROPEAN MARKET LEADER IN BLUETOOTH BASED TRAFFIC DATA COLLECTION SYSTEMS

19th **ITS World Congress Vienna,** Austria
22 to 26 October **2012**
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TS092 Sensor detection system Urban applications
Thursday 25. October 2012, 14:00-15:30 Business Suite 2 Room
EU-00083, *Traffic counting at intersections by bluetoothtechnology*,
Susanne Roggendorf DTV-Verkehrsconsult GmbH,Germany

TS079 Decision support techniques
Thursday 25. October 2012, 14.00-15.30 Stolz 1 Room
EU-00143, *BLIDS - A Bluetooth-based traffic data collection system supporting international Traffic Management Plans*,
Daniela Augustin ASFINAG, Austria

Contact: c.c.com GmbH, Teslastrasse 4, A-8074 Grambach, Austria, +43 316 409590

As Vienna prepares to host the World Congress on ITS, we meet Austria's transport minister, **Doris Bures**, to grill her about ITS, smart cities, and more

Interviewed by Tori Read

Austria is somewhat of a jewel in the ITS crown, having invested more than €200 million in R&D – faith that is now being repaid. "We see it as an excellent driver for economic growth, and many of the leading ITS providers are located here and contributing to our economy," reveals the country's federal minister for Transport, Innovation & Technology, Doris Bures, ahead of the 19th World Congress on ITS (October 22-26, 2012). "But we will all reap the rewards as these technologies leave our labs to improve transport in the real world."

Get smart

With Austria's successes in ITS very well documented, what is it that makes it such an ITS hotbed? "Intelligent transport is crucial to the overall successful running of any city or country, but more than anything it helps you prepare for the future in a smarter manner," Bures explains. "Deploying ITS is simply the smart way to deal with the many challenges all cities face. And it just so happens that Vienna is pretty good at it – and in actual fact was named the world's smartest city in a list compiled by Dr Boyd Cohen, the American climate strategist.

"Given the scarce resources and emissions limits, one of our biggest challenges in Austria is finding the balance between easy mobility for people and goods and sustainability in the transport system," continues Bures, who became Austria's transport chief in 2008. "System planning and operations must be optimized to meet these demands, hence why we've launched the Austrian ITS Action Plan – consistent with European standards – which focuses on ITS to help us move smartly."

There are three areas that she considers to be the most important issues in this regard. "Firstly, ITS must focus on the user. Systems must be easy to use, helpful, and they must also increase safety," Bures suggests. "It should also be borderless – not dependent on language, region, make or model – which means that standards are essential to ensure compatibility." These must not restrain innovation, though, she is keen to stress. "And ITS must also play a role in increasing sustainability so that these technologies in the pipeline will have a definite place in the future."

Road safety is a topic about which Bures has long been banging a drum, largely as driving is the preferred mode of transport in Austria – its safety has to be given priority. The 50-year-old politician is pleased to report good progress on this in recent years though: "Targets were set in 2002 for 2010 that we would halve the number of fatalities on the roads while at the same time reducing the number of road injuries by 20%. We actually reduced the number of fatalities to 523 in 2011, the lowest rate since records began in 1961." Maybe some words of advice should be offered to her UK counterparts where KSIs increased for the first time since 2003.

Multimodal approach

Austria's road safety success story doesn't mean that other modes of transport are being ignored however – far from it. The end user is given equal consideration no matter what mode of transport they choose, which makes sense in a country where the car rules and other modes have to be encouraged to relieve some of the strain on the roads. The latest fruits here involve the development of a high-quality, comprehensive and cross-modal transport information system, designed to provide users with the information they need, when they need it. "Verkehrsauskunft Österreich (VAO) is a very significant project, creating the technical and organizational principles for a multimodal, real-time information system," Bures reveals. VAO will go into live operation in 2013.

As well as better harmonization between various modes of transport, Bures is keen to foster more cooperation between industry and policymakers. The latter have a responsibility, she believes, to create a sustainable, environmentally friendly and socially responsible transport system, despite the rapidly increasing demand on mobility systems everywhere. "Expanding sustainable transport is a step in the right direction, and we have been doing this in Austria for some time now by investing in public transport, cycling and sustainable development," she continues. "To bring ITS into the game, we need all the players to work together. Technologies must be compatible with each other, and the best way to ensure that they will be is to introduce national and international standards, such as the European ITS Directive. The Austrian ITS law was introduced to the Council of Ministers on June 12 and is currently in the process of parliamentary approval – the ratification of which should take place this year – and will create a framework for the support of a coordinated and coherent introduction and deployment of ITS."

Come together

Bures appreciates the importance of looking for inspiration beyond Austria's borders though – whether in the form of sharing knowledge on an international or even at a cross-border level with neighboring countries. "It's key if we are to make progress in the technology of tomorrow," she insists. "One of our pilot projects, Co-Cities, focuses on cooperative systems in transport, by which travelers can receive live travel and traffic advice. A special feature is the addition of a feedback loop, which allows mobile users to report back to

> Collaboration is key if we are to make progress in the technology of tomorrow

Electric drive

When asked to assess the impact that 'green' ITS may have, Doris Bures offers a considered response. "ITS will prove to be incredibly useful in terms of environmental sustainability. E-mobility solutions, such as electric bikes and cars, reduce pollution and the consumption of disappearing fossil fuels, and are therefore much more environmentally friendly than their traditional counterparts. The pemporA project addresses the problem that there is no navigation system on the market for electric vehicles. This new satnav system is designed to make drivers feel at ease, work around the limited range of the vehicles, and ensure a seamless multimodal journey. The system includes in its calculation the positions of the charging stations, the road characteristics, and specific information for multimodal trips, thereby allowing the user to get to the destination as quickly as possible."

TMCs to keep the information up to date." Running in several cities, the cross-border standards within the In-Time project's Commonly Agreed Interface (CAI) were imperative.

"The plan is to extend the number of cities that install the CAI and connect it to the TMC for a regular feed of data and information, leading to a faster, more reliable validation process for cooperative traffic information services by using a 'reference platform', and to make transport information services more attractive and appealing to users in urban areas."

No doubt Co-Cities will be a big topic of discussion in Vienna at the ITS industry's annual shindig, although Bures is particularly looking forward to the Ministerial Round Table. "High-level political leaders from all around the world are coming together to discuss transnational collaboration, and we'll end that with the endorsement of a declaration on ITS."

ETSC's chief executive, **Antonio Avenoso**, explains why – even in times of austerity – road safety must remain top of our working agenda

Interviewed by Saul Wordsworth
Portrait photography courtesy of Bea Uhart

> Because these deaths are scattered across a continent, we seem to accept that they are a by-product of transport and the price we pay for moving around

Antonio Avenoso is a man with an enviable resume. Aside from his degree in political science from the University of Pavia in his home country of Italy, he has an MPhil in European Studies from Cambridge. After a period of working in railway safety for the European Commission, he joined the European Transport Safety Council (ETSC) in 2001, and in 2008 – and at the age of just 34 – he was made executive director.

In keeping perhaps with someone who works in the slow-moving field of road safety, Avenoso displays great patience. Our interview slipped, yet he took my call while on holiday, his wife and children in the next room, with impeccable grace and good humor. "I do not mind," he says. "It is my job."

His job, as he puts it, is to manage several large-scale road and transport safety programs as well as monitor and advise national and European policymakers on transport safety measures. All of this is underpinned by the ETSC's mission statement: to reduce the number of deaths and injuries in transport in Europe.

"From our humble beginnings in 1993, we have established ourselves as Europe's pre-eminent road safety organization," he says. "We now have 45 members who decide policy and ensure that everything we say and do is based on the solid foundation of science and research – and not 'finger-in-the-air' stuff. We use the knowledge of our members – universities, research centers, transport safety organizations – to inform policymakers. The ETSC also has a pool of 250 experts who lend their expertise and brains from time to time. We are translators if you like – translating scientific fact into policy recommendations."

The Council is funded through the EC via a bidding process but is supported by members who pay a small fee, as well as national government organizations such as the Swedish Transport Administration and corporate sponsors.

"We only take on corporate sponsors in an ethical fashion," Avenoso maintains. "They know they will not be allowed to influence our decision-making process."

The numbers game

On the day we speak with Avenoso, he is preoccupied with a number. "My greatest concern is 85," he says. "This is the tally of people who lose their lives every day on Europe's roads. If a medium-sized aircraft crashed every day and there were no survivors, it would be headline news. Yet because these deaths are scattered across a continent, we seem to accept that they are a by-product of transportation and the price we pay for moving around. That's before we even think about the number of people who have been seriously injured."

> Road safety needs to be higher on the agenda. We must help reinforce the notion that it is an investment and not a cost. Ultimately, road safety pays itself back

A priority for Avenoso is to address this figure. For him, the big killers on the road are speeding, drunk driving, and the non-use of seatbelts, in that order. Drug driving and the use of cell devices also feature, but don't make the top three.

He recently presented at the 15th anniversary of Euro NCAP, Europe's New Car Assessment Programme, on the subject of autonomous emergency braking (AEB). "This can address distraction, prevent whiplash injuries, and save lives. However, AEB is not my priority technology right now. That is Intelligent Speed Assistance (ISA) and seatbelt reminders for all – but the likes of AEB, lane departure warning systems, and so on all have a role to play. For us, it's not either or – it's either and."

The demon of speed

Avenoso remains fixated on speed – not just excessive speed but inappropriate speed in bad conditions – and worries that we continually overestimate the benefits of haste. "Going 10km/h faster doesn't help you gain much time on the road but it makes a huge difference in terms of risk. If we could reduce the average speed on Europe's roads by only 1km/h, we would save 2,200 lives a year."

ETSC's executive director has focused recently on the lack of progress made in slowing down fatalities on Europe's roads. In the UK, road deaths are actually rising. "In our quest for Vision Zero, this is worrying," he acknowledges. "The concept is there to guide road safety and its practitioners, and it's important that it's supplemented with numbers – you need a good balance between the target on one side and achievability on the other. This provides the challenge to motivate, but if it's too ambitious people will stop working toward it. You may have a vision and a target but need a strategy. This is what member states need if they want to reduce the number of road deaths."

Avenoso says the cost-benefit ratio for speed enforcement according to the EC recommendation is 1:5, assuming that 5,800 deaths and 180,000 injuries could be prevented every year in Europe

According to Avenoso, though, the greatest challenge facing the safety community today is lack of resources. To tackle this, he knows the ESTC has a role to play in reinforcing the science of road safety and lobbying decision makers.

Return on investment

"There are cuts everywhere and it's not good. Road safety needs to be higher on the agenda. We must help reinforce the notion that it is an investment and not a cost. Ultimately, road safety pays itself back."

Back in 2001, the European Union published the *European transport policy for 2010: time to decide* white paper that set safety targets that were never met. How is Europe going to meet the demands made by the UN's Decade of Action for Road Safety – that of preventing five million road traffic deaths by 2020? "The key is action," he says. "Work by objectives and don't just pay lip service to road safety. Make sure you understand that the time is passing quickly and measures need to be taken for the medium and long term but don't delay the measures that can be taken here and now. These are measures that can save lives tomorrow."

A day in the life

Antonio Avenoso's day begins in earnest at 8.30am when he arrives at the office, checks his emails, and responds to the most pressing ones. Throughout the day he has meetings with colleagues to see what progress they're making with their own projects as well as appointments with politicians from a national and European level to discuss the road safety topics *du jour*. His day pauses at 5.30pm to collect his kids from school, but once they're tucked up in bed, he works into the evening and night.

When asked what he likes to do in his spare time, he responds, "I'm not really sure: I don't get much of it!" Much of his time is spent traveling and presenting at conferences to explain the position and importance of the ETSC. When time allows, though, he loves being at home with his wife and kids. "This is my second job," he quips. "Unpaid!"

Greatest hits

ETSC was behind much of the advocacy work that led to vehicle frontal and side-impact directives. "We have strongly supported the development of Euro NCAP, which rates cars by giving them stars on the basis of their safety performance," Avenoso reveals. "We also pushed for the adoption of a numerical target to cut the number of road deaths, which has been very effective – working without a target isn't scientific. We've also been able to add the issue of serious injuries to the safety agenda – prior to our recommendation people only talked about road deaths. I'm also pleased that we're credited with raising the profile of work-related road safety in the EU, which until recently has been akin to the neglected child of safety."

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The ongoing war against road traffic congestion

Congestion and road accidents are almost as ancient as the wheel itself, and improving the safe travel of goods and people has been a constant aspiration of humankind for centuries.

Technology-driven solutions to improve the flow of traffic on major roads and make better use of existing infrastructures are not new. Ramp metering technologies for instance – aimed at regulating the flow of traffic entering a motorway to optimize journey time and safety – have been in place in the USA since the early 1960s and in a number of European countries since the 1980s. Back then, the technology consisted largely of a set of induction loops and traffic signals triggered by simple algorithms.

Over time, these algorithms have been refined, signaling technologies improved – in particular with the introduction of various forms of variable message signs (VMS) – and video-based enforcement technologies have been rolled out. With the development of Controlled Motorways in the UK in the 1990s, the concept of ramp metering at junctions was extended to the active management of traffic on the main carriageways. The basic principle of Controlled Motorways is to adapt the mandatory speed limits to traffic conditions using congestion-detection solutions, variable speed limit signs, and enforcement cameras to ensure compliance. Although the journey time benefits of Controlled Motorways were limited, they've certainly contributed to improving safety on motorways, in particular the safety of queuing traffic.

But the use of technology reached a pinnacle with the introduction of Managed Motorways in countries such as the Netherlands, France, Germany and the UK. Managed Motorways largely relied on the same technologies used for Controlled Motorways but also introduced the sequential and dynamic use of the emergency lane under certain traffic conditions, in doing so combining the benefits of Controlled Motorways with the ability to dynamically increase capacity through the use of the emergency lane. The Highways Agency introduced its first Managed Motorway scheme on the M42 around Birmingham in 2004. During the first six years of implementation, there were no fatalities on that section of road compared to several in the six years prior to deployment.

Need to know?

Throughout the history of travel we have been plagued by congestion, so what options do we have left to beat it?

- The merits of ramp metering, Controlled Motorways, and Managed Motorways
- Assessing the efficacy of modern traffic-busting initiatives
- What happens next? We cannot build our way out of congestion, so what choices do we need to be making now to ensure a jam-free future?

Using lessons learned from the M42 project, England's Highways Agency is in the process of introducing a new generation of Managed Motorways on the M25. This new approach, also known as ALR (All Lane Running) relies on the permanent use of the emergency lanes, thus losing the dynamic element introduced with previous generations but reducing reliance on technology.

The French experience

In France, the dynamic use of the emergency lane started in 2005 on a highly congested section of the A86 motorway around Paris. The project resulted in a 10% capacity increase, improved journey times, and improved safety as well.

READER ENQUIRY NO. 501

(Main image) **St Nazaire Bridge** (Above) **The UK's M25 motorway, which orbits London** (Left) **The A48 in France**

High-occupancy lanes

Another way of increasing the capacity of a motorway is to favor high-occupancy vehicles (carpool and buses) in areas prone to congestion. The concept was introduced in the USA in the early 1970s with dedicated lanes for carpool drivers. On the A48 motorway in France, the emergency lane has been opened to regional buses during the morning peak since 2007, so improving the reliability of bus journeys and generating a shift in favor of public transport. The same approach is now being rolled out in other major French cities.

Options to dynamically use road infrastructure are unlimited. It is possible to address complex pendulum traffic configurations by rebalancing available capacity from one direction to the other. Such a tidal flow system was implemented recently on the St Nazaire Bridge in France, where three carriageways are allocated dynamically to the direction with the higher demand.

A number of other innovations are being developed, including in-vehicle Managed Motorways, platooning, or even driverless cars. In-vehicle Managed Motorways are the logical extension of Managed Motorways, where roadside infrastructures are replaced by onboard information systems displaying the road configuration to the driver in real-time. The principles of platooning consist of gathering vehicles in orderly and controlled convoys or road trains. This could represent a big opportunity to improve journey time and safety and has been investigated in Europe (SARTRE project and German lead project KONVOI) and in the USA (PATH initiative).

Driverless cars are another futuristic concept in the process of becoming a reality. A fleet of prototype driverless cars combining onboard video cameras, radar, and position sensors is being tested by Google. Ford is also testing an auto-pilot prototype that uses a camera and radar behind the rear-view mirror, to be used in traffic jams and aimed at improving journey times. Such technologies could appear on our roads as early as 2017.

All of these solutions and variations of them will continue to help make the best use of existing infrastructures in years to come. But with the economic climate hopefully improving and the resulting traffic growth, they will at best buy us a few decades of relative improvement on the busiest parts of our road networks.

Once every possible option has been explored on the offer side, the focus will turn to the demand side, starting by improving the quality of the information provided to potential road users. New fit-for-purpose phone apps and value-added travel projections will not eliminate congestion, but by providing reliable information to travelers and offering relevant alternatives, motorway operators will be able to influence travel demand.

Congestion charging

Last but not least, future congestion-busting solutions will have to consider the use of congestion charging to influence demand. Applying charges to road users depending on traffic conditions at the moment of travel is being implemented in many countries. So as not to re-introduce physical obstructions in the form of traditional toll plazas, electronic charging is becoming the norm in the majority of new projects. Most recent schemes have also benefited from the progress made in recent years on the performance of automatic license plate recognition (ALPR) solutions.

What's in it for me?

An interesting alternative to congestion charging is incentive schemes whereby regular users are offered compensations for using alternative ways of transportation or for rescheduling their travel. Such rewards can take the form of a financial incentive (as in Rotterdam), collection of 'green' points that can be used in registered shops, or even the participation in a daily lottery (Stanford University). Unlike congestion pricing, incentive schemes such as these are entirely voluntary and the only technology usually required is a smartphone.

Congestion is unlikely to ever be eliminated completely. But calling upon mature or innovative technologies to improve the capacity of existing infrastructures and reduce demand is – and will continue to be – the only real option available to road operators.

Contact

Egis Projects
+33 1 30 48 48 09
contact.egis-projects@egis.fr
www.egis-projects.com

Ni-MH batteries drive revolution

READER ENQUIRY NO. 502

Effective traffic management relies on the collection of reliable, detailed and up-to-date data on traffic flows. This is driving the roadside deployment of a growing number of increasingly complex data collection and transmission devices, as well as other equipment such as variable message signs (VMS). All this kit needs a reliable source of electrical power. However, even for installations where a local grid supply is available, providing this connection can often be expensive due to the need to excavate holes and trenches. There can also be extended project delays as suitable permissions are obtained to divert traffic while the work is carried out.

There has therefore been considerable interest in providing autonomous power supplies for roadside equipment based on solar photovoltaic (PV) panels operating in conjunction with a rechargeable storage battery. With the right combination of PV panels, batteries and charger/back-up electronics, this approach is now proving its capability to provide highly efficient, reliable and cost-effective operation in roadside installations, even with relatively low levels of insolation (solar energy).

Building on this experience, a third approach to powering roadside equipment has emerged. Again, it relies on storage batteries, but instead of being charged by a solar panel, the battery draws off-peak power from a convenient local source, such as a streetlighting column.

The mains power – typically at 220V or 110V – is connected to a suitable charger for the battery voltage, usually 12V or 24V. The battery is charged overnight using lower-cost 'night-rate' electricity and discharges during the day to power the data-collection equipment.

(Above) **Saft's latest PV battery** (Right) **An example application**

Need to know?

As we re-think how to power our ITS kit, one company is offering a new approach

- How best to power roadside equipment has been a longstanding talking point. New advances in nickel-metal hydride (Ni-MH) batteries are opening up new options for autonomous power supplies
- Following on from success in solar streetlighting projects, one vendor now wants to bring its technology to the ITS sector
- Benefits of Ni-MH batteries include small size and the extended service life they offer

A demanding application

Initially, this might seem a perfect application for a battery, with a regular and predictable pattern of charging and discharging over 24 hours – especially when compared with the considerably more variable duty experienced by a battery in a solar PV system. In reality, this application is extremely demanding on batteries as the deep daily discharges significantly reduce their life.

Conventional lead-acid batteries struggle to perform well under this daily cycling regime, which results in significant over-dimensioning to achieve a satisfactory service life. Effectively, a lead-acid battery capable of providing around 10 days of autonomy in a PV system, that only requires one day of reserve capacity, has to be specified in this application.

Greatly reduce battery size

Saft has developed an attractive alternative approach with its advanced nickel-metal hydride (Ni-MH) batteries that have already proved their capability in solar streetlighting (SSL) projects. The main benefit of the Ni-MH batteries is that they offer an extended service life – even when subjected to daily discharge cycles approaching 100% – which enables the lead-acid battery to be substituted by a Ni-MH battery that's around 10 times smaller.

Furthermore, Saft Ni-MH batteries can be charged and discharged in extreme temperatures – from -40°C to 70°C – which makes them suitable for virtually any outdoor environment, however aggressive. They are also sealed for life and completely maintenance-free.

Lower overall costs

One of the arguments often used against the adoption of new battery technology is its high initial purchase cost. It is true that on a cost-per-watt-hour (Wh) basis, an Ni-MH battery will be around three to five times more than a traditional lead-acid battery. However, in this particular case, the major reduction in size makes the Ni-MH the most cost-effective option right from the outset. Over their respective service lives, the lead-acid battery will last three to five years and will require regular maintenance, while the Ni-MH battery offers maintenance-free service for a life of up to 10 years. When the total cost of ownership for each battery is considered, the case for Ni-MH becomes extremely compelling.

Contact

Saft
+33 1 49 93 19 18
snb.info@saftbatteries.com
www.saftbatteries.com

Sam Schwartz

sschwartz@samschwartz.com

The annual National Traffic Scorecard conducted by Inrix, a traffic data provider, was recently released and reported that traffic congestion in the USA decreased by a startling average of 30% in 2011. While a struggling economy and high fuel prices are among the likely primary causes for the decline in traffic volumes, there's no way they could account for a 30% drop in congestion. Although I recognize each percent drop in traffic volume on a congested road yields a multiple of that in congestion relief, it still wouldn't reach the magnitude of 30%. And then I started to think of my own driving experience.

I am a lover of maps and shortcuts – I've spent hours looking at maps and devising shortcuts – and I've even written a book, *Gridlock Sam's Shortcuts*, published by Fodors in 1992. So when GPS came along, I had the attitude that it was for novices – not advanced drivers such as myself. But a few years ago I bought a car with GPS. I didn't use it much in the beginning and when I did, I argued with it; I knew better. As time went on, I realized that little box knew a few things I didn't. And the version I had included warnings of traffic jams ahead. If I learned of a jam, I could drive around it before I was in the middle of it. My hours spent in congestion have dropped by perhaps as much as 10% as a result of GPS.

Another ITS technology that I find reduces my vehicle hours traveled (VHT) is the advanced variable message sign (VMS). I often find myself driving in Long Island, New York and can choose the Long Island Expressway, Northern State Parkway or Southern State Parkway for east-west travel. If the VMS reads 'LIE congested ahead', I switch over to the Northern State Parkway. And if there's a jam ahead over there, I divert to the Southern State Parkway. Again, my VHT and consequently hours of congestion are reduced by perhaps 5%. It is possible that we have reached 'critical mass' in the use of ITS devices so that we are finally seeing the fruits of some 30 years' of investments.

However, there are still many not fully tapped opportunities with ITS technology that can have a significant impact in reducing traffic congestion. For example, in many major cities, such as New York City, finding an on-street parking spot can be quite a hassle. Circling the block for parking is an all-too common affair, which can contribute to the local traffic congestion – not to mention waste a lot of time and gas. It has been estimated that a third of the traffic in many central business districts (CBDs) is the result of drivers looking for parking spaces.

What if someday there was a way to keep track of on-street parking spaces and have the real-time parking data available via a cell phone application or a personal navigation device? Simply load up the parking app and have it search for the nearest open spot. Guess what? That day is here. Los Angeles is one of many cities using ParkMobile to find a spot and pay for parking. The overall savings in time and gas and reduction in local traffic congestion would be considerable. And this is just with more efficient on-street parking. One can only imagine how much traffic congestion will decline with the arrival of self-driving vehicles and other more advanced ITS technology.

So, my challenge to the industry is how do we quantify these gains? If a congested city goes from 10% GPS devices in cars to 90%, does congestion drop 10, 20, or 30%? If the majority of drivers have smart parking devices, will we put a big dent in the circulating traffic? If the drop is substantial, does this mean we can avoid building new roads by maximizing the efficiency of our networks? I sure hope so, seeing as we can't maintain what we already have.

> I didn't use my GPS much in the beginning and when I did, I argued with it; I knew better
>
> **Sam Schwartz, Sam Schwartz Engineering, USA**

Junction modeling tools

Dynamic life in cities, gridlock on the roads. Due to the ever-increasing amount of traffic, this scenario is part of our daily life, in particular during peak hours. However, if you take a closer look at it, you will notice that traffic rarely comes to a standstill along the route, but almost always at junctions. It is therefore worth studying them more closely.

There are different types of junctions. At some of them there is priority to the right, some of them are priority or signal controlled while others are coordinated via roundabouts. In urban areas, junctions have an immediate impact on traffic flow, which means that they need to be thoroughly planned and designed. This challenging task can be handled with PTV Visum – a tool to assist planners in all aspects of traffic engineering. "Our transport planning software enables users to model junctions with ease, yet at a high level of detail – both in terms of geometry and control," states Dr Johannes Schlaich, director PTV Visum product management and services.

Known for their tendency to create traffic bottlenecks, it is worth taking a closer look at methods to improve junctions

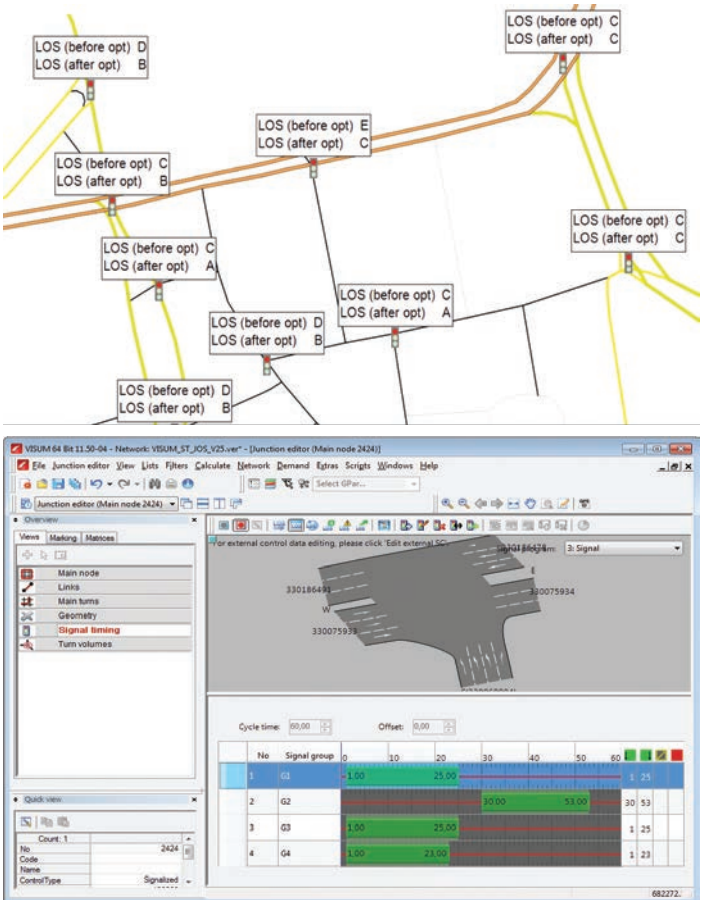
By means of the junction editor, users can, for example, precisely model lane turns and lane pockets and develop signal programs. "Those who use the add-on module Vissig for the latter application can create several signal programs for a single controller, manage daily signal programs as well as edit and modify the signal details," Schlaich continues. The junction modeling options, in turn, have become manifold. When assigning traffic, for instance, transport experts no longer have to model nodes without impedance or only with turn impedances related to the type of junction and capacity. They now have the ability to use Intersection Capacity Analysis (ICA), a method for precise node impedance calculation. Overall, the more detailed the modeling, the wider the range of planning and assessment options will be.

Meeting standards

The *Highway Capacity Manual* (*HCM*) – which is published by the USA's Transportation Research Board approximately every 10 years – includes the procedures for calculating junction performance, among others. Based on this internationally recognized standard reference, PTV has developed ICA, which meets all criteria listed in the latest manual, published in 2010. "For example, ICA shows you the average waiting time for vehicles at each junction within the road network, even differentiated by each turning movement," Schlaich explains. This is a very useful option for reporting: with a single mouse click all results appear in an Excel worksheet. Weak points can therefore be analyzed in the network and users can look at the changes to infrastructure for each junction. Would it be worthwhile, for instance, to change the number of lanes and the lane allocation to the turning movements?

ICA also provides particular added value to traffic assignment. The ICA assignment takes the interdependencies between turning volumes into account, and thus provides highly realistic results regarding route choice. Waiting time for permissive left-turners, for example, depends on the flow of oncoming traffic. In contrast to volume-delay functions, the ICA assignment allows users to take these situations into consideration.

READER ENQUIRY NO. 503



(Left) **Level of service before and after the optimization with the RIO method**
(Below left) **Junction editing in PTV Visum**

Normative planning

Junction modeling, ICA and ICA assignment form an integrated package, enabling users to now also optimize signal control effectively. To this end, PTV has developed the RIO method. "RIO stands for Road Intersection Optimization and combines for the first time normative transport planning and traffic engineering aspects," says Schlaich. It is an innovative method for fixed-time signal control optimization.

Traffic light control at a junction or a sequence of junctions used to be analyzed on the basis of turning volumes in order to then create the signal programs. However, this approach has not led to optimum results as it does not provide a consistent image of the entire traffic flow. The RIO method, though, is based on a demand-driven transport model and focuses on origin-destination flows, for which the traffic engineer provides the desired level of service. As a result, traffic flow can be analyzed and optimized for a much larger area, such as an entire city. Signal optimization itself is based on three steps. First, green time is optimized at a single junction, followed by cycle time and offset. "Maximum volume-capacity ratio of all turning movements is minimized when optimizing green time," says Schlaich. "In doing so, green time is fairly distributed according to demand." Based on the traffic flows from the ICA assignment, PTV Visum optimizes the green times and then determines the optimal cycle times.

Optimization of green times and cycle times has an effect on the individual junctions, which in turn leads to individual, uncoordinated signal controls. In addition, the adjacent junctions need to be harmonized and the offset between signal times has to be optimized. "In Visum, offset time optimization is based on the flows of the assignment," Schlaich reveals. The software optimizes the offset times so the total waiting time is reduced to a minimum. It isn't necessary to enter any coordination directions manually as Visum automatically recognizes them from the ICA assignment. The results may be analyzed and edited in the signal time-space diagram. For instance, the number of stops can be reduced for more eco-friendliness.

But what makes this type of optimization attractive? "Today many cities lack the resources to carry out regular updates for signal control programs," Schlaich adds. But with RIO, updates can be performed easily and rapidly, which means better signal control programs when it comes to adapting to urban planning measures, event planning, or construction work. Users are able to test several scenarios of fixed-time signal control before implementing any changes. Integrating Scenario Management into Visum also allows them to manage the different scenarios. And it goes even further: "Using Visum, you can also create base plans for vehicle-actuated signal control," says Schlaich. Vehicle-actuated programs are developed and checked with PTV Vissim software, and PTV has developed the ANM interface to ensure export efficiency – perfect conditions for fine-tuning signal controls. ○

Need to know?

Exploring the latest developments designed to make life easier when modeling traffic junctions

- PTV Visum is a leading software for traffic analyses, forecasts and GIS-based data management
- It consistently models all road users and their interactions
- It is used for a range of applications, such as: transport masterplans, bottleneck analysis, road development, and analysis of engineering applications

Contact

PTV
+49 721 9651 300
info.vision@ptv.de
www.ptv-vision.com

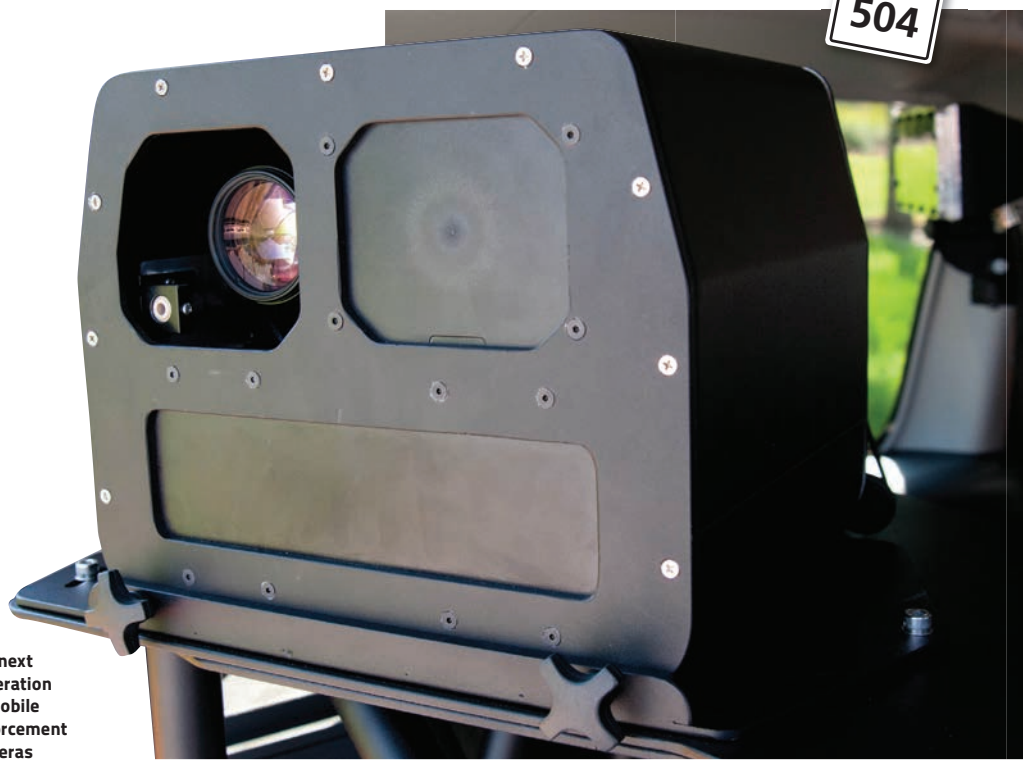
A logical progression for mobile camera enforcement

READER ENQUIRY NO. 504

Automated enforcement has proven to be an effective way to reduce accidents and improve safety, while mobile enforcement has been successful in changing driver behavior as a result of its unpredictability. Using varying locations makes it harder to predict where and when enforcement will occur. Rather than slowing down for a fixed camera and then speeding off again, drivers tend to comply with the speed limits across the particular region.

Along with its high level of effectiveness, mobile enforcement is preferred due to its ease of setup and cheaper costs. Most mobile programs place the camera systems in (or on) a vehicle parked at the side of the road, a simple and cost-effective way for authorities to commence an enforcement program to then build upon.

Recent Auditor General reports in Australia have supported the use of mobile enforcement, and even went as far as to state it should be extended to more locations and at night to increase effectiveness further. But radar and laser enforcement has been limited in the past due to reflectivity issues so it hasn't been possible to enforce in the types of locations put forward by the reports.



The next generation of mobile enforcement cameras

Recent advancements in radar technology courtesy of the R&D team at Redflex Traffic Systems, though, have overcome these deployment limitations, with the company having developed the next generation of radar technology that will lead to major improvements in the performance of mobile enforcement systems. This latest radar eliminates reflectivity issues, allowing cameras to be deployed in built-up areas and in all weather conditions. The system has a prosecution rate that is five times that of a standard setup, positively identifying offending vehicles in the correct lane and using secondary speed verification to maximize prosecution.

The entire Redflex camera system is mounted in the rear of the vehicle and controlled from the driver's seat

The improvements in performance have been well documented but what's often overlooked is that the new system also brings advances as to how the vehicle is fitted out with the camera equipment. In this case, it is streamlined, which improves the installation process and increases operator efficiency and safety.

Better integration

The accurate integration of enforcement technology into vehicles is just as important as the technology itself. Traditionally, installation was carried out by the end user, which often led to compromises on system performance and vehicle design rules, with lengthy delays and extravagant costs the norm. Redflex enforcement hardware is now offered with an installation kit, making the task of installation a straightforward process.

Previously, fit-outs to accommodate other mobile systems have required major modifications to the vehicle due to bulky operating equipment. The front dashboard had to be modified, compromising the vehicle's safety rating. The operator was required to sit in the passenger seat, which posed issues if they needed to drive off in a hurry.

With Redflex's experience in enforcement technologies, the development of vehicle

Need to know?

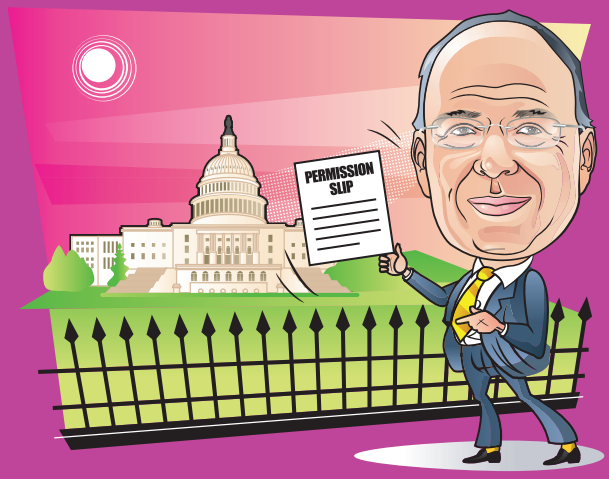
Experience in enforcement has led to new approaches to mobile equipment

- Mobile enforcement encourages safer driving behavior due to drivers being unable to predict where cameras are located
- A historical challenge has been how best to set up and mount mobile camera systems
- One vendor is offering a new method of deploying mobile systems – one that improves system efficiency, streamlines costs and also makes camera operators safer

installation kits for its technologies was a logical progression. Rather than being mounted externally on the vehicle – or on a tripod at the roadside – the entire camera system is precisely mounted in the rear of the car. Operators don't have to leave vehicles to set cameras up as they're controlled using a wireless tablet, enabling them to remain in the driver's seat, thus easing safety concerns. With noted attacks on camera operators and vehicles in the past, such improvements to safety are a welcome advance for the enforcement industry.

Contact

Redflex
+61 3 9674 1800
media.enquiries@redflex.com.au
www.redflex.com



Larry Yermack

lyermack@gmail.com

I have always believed in the dream. When I was in college I believed that if we sang loud enough, we would end the war in Vietnam. Years later, when I began my career, I believed that we could transform traffic flow with E-ZPass, and I mistakenly believed that cell phone probes would overhaul traffic management. But I always believed in the dream. This spring I learned about the latest dream at a conference sponsored by IBTTA and others in Jersey City. It was a well-attended and enthusiastic conference. Today's dream is Mileage Based User Fees, or MBUF. (Why, oh why, do we ever let engineers create acronyms?!)

MBUF would expand road charging from toll roads, bridges and tunnels to virtually the entire road network – or as far as it can be politically stretched. Payment for using the road network could be parsed very finely, with different rates for different types of vehicle or different types of roadway. With the USA facing a transportation funding crisis and the recently passed Surface Transportation Bill offering no long-term solution to rising needs unmet by a level gas tax, a new idea is desperately needed.

The good news is that there are several experiments under way or about to start. North Carolina and Virginia have USDOT permission to toll the interstate and Oregon has been running an important pilot to test many of the concepts key to MBUF. Unfortunately, what cannot be tested is a path to a nationwide implementation. What will it take to make this dream a reality?

Will experiments demonstrate enough success to generate widespread support that will lead to Congressional action? It would be too much to expect the Congress – this hopelessly fractious Congress – to require user charging as a replacement for the gas tax. What we got in this last Surface Transportation Bill was some limited possible expansion of tolling. So the best we can hope from Washington is permission for states to employ their own road user fees. However, permission alone is likely to lead to a completely balkanized approach with checkerboard implementation and no interoperability.

Can the few early leaders work together to establish national interoperability from both a technical as well as institutional approach? Can the early adopters establish vehicle and mileage measurement technology that is non-proprietary? Can they lay the foundation for national account interoperability? Can they create an E-ZPass of MBUF implementers? Let's hope that they look beyond their own project to the future national program and let that be their guide.

It's early in the MBUF day but getting very late in the funding day. I always believed in the dream and I still do. Transportation funding needs to be solved at the local level; it's the only level that works.

> So the best we can hope for from Washington is permission for states to employ their own road user fees
>
> **Larry Yermack, Wendover Consult, USA**

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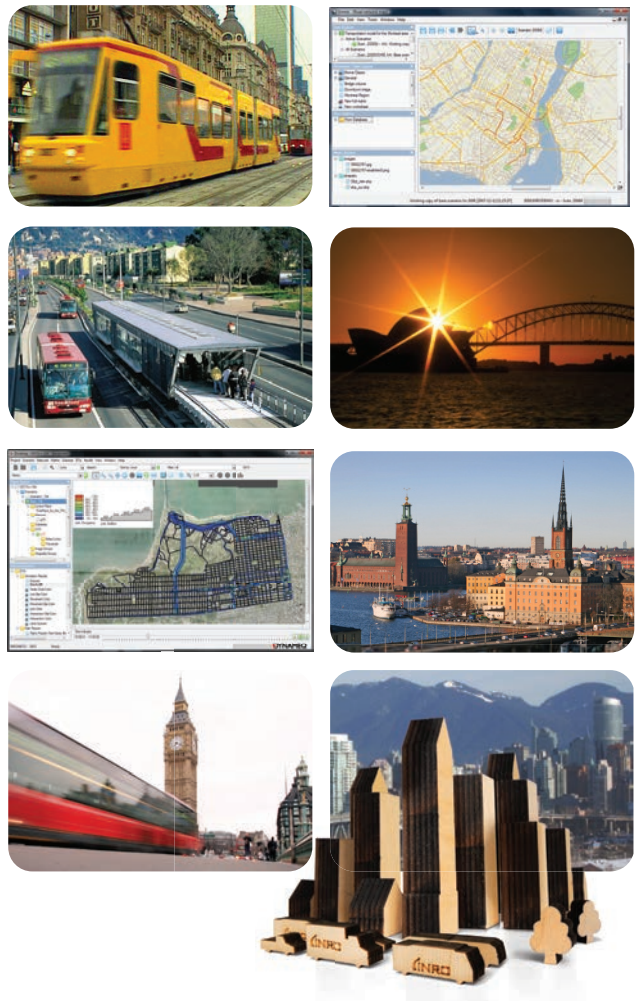

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Expanding toll system capabilities

READER ENQUIRY NO. 505

With rapidly advancing technologies, increasing traffic and the growth of more complex road systems, the question is not whether to modernize an existing toll system – but when. Replacing an entire system from the ground up is hugely expensive – and in some instances may not be feasible. But a system constructed with expansion in mind will help enable new functionalities by being built to accommodate new hardware and software, new systems and components, and more lanes and additional types of lanes.

As the pace of technological change and the expectations of patrons move forward, expandability becomes increasingly important as a cost-effective alternative to total system replacement. If a tolling authority needs to upgrade from manual toll collection to AET, for example, being able to expand its existing system would certainly be preferable to a complete system replacement.

In 2010, TRMI Systems Integration accomplished such an expansion at the Wabash Memorial Bridge in Indiana, USA. Manual toll collection at the bridge's single toll plaza was costing the state more than 30 cents of every 50 cents collected. TRMI removed the toll plaza and converted the system to AET, dramatically reducing the cost of collection. Knowing that some motorists may be slow to adapt to AET, the system was designed so that if someone drives over the bridge without a transponder tag, Indiana Department of Transportation (INDOT) can toll them via license plate readers.

When a vehicle crosses the bridge, high-resolution violation enforcement system (VES) cameras capture images of the front and rear license plates. The VES images of any vehicle that crosses the bridge without a transponder are reviewed by an INDOT customer service representative who enters the license plate number and state into the AET system database. License plate numbers of violators are stored, and they are sent notices of violation.

(Left) **The Golden Gate Bridge** (Below) **Online toll account management**

Need to know?

There are various options for expanding toll systems, so it pays to take expert advice

- Building systems with future expansion in mind avoids the need to replace entire systems from the ground up
- Ultimately, for toll system operators expandability equals cost savings
- The move to AET is a prime example of the trend for expansion
- Being able to offer customers online account management is another cost-effective addition to existing systems

Initially, a fully automated back-office system was contemplated, but traffic volumes and violation rates didn't justify the costs. The new system will fully support this upgrade at a later time, including integration of a fully automated back-office system that supports video tolling and automated invoice generation.

Online account access

In early 2011, the city of El Paso, Texas, wanted to offer toll systems customers using the Zaragoza and Stanton Street bridges the ability to maintain their accounts online. Within two months of receiving the work order, TRMI integrated a new server for OLA (online accounts) into the existing system and launched a website so customers can log in and make payments via PayPal. In a further expansion, TRMI is currently in the process of designing and installing a multi-faceted upgrade to all 15 lanes (and two pedestrian lanes) of the system. The upgrade will utilize the newly installed OLA and integrate with TRMI's new plaza and maintenance online management system (MOMS).

Also in 2011, TRMI was awarded a change order contract to expand the toll system of the Golden Gate Bridge in San Francisco, California. By reconfiguring some of the system software and upgrading lane controller hardware, the company is converting a mixed-collection system into full AET without having to rebuild from the ground up.

Building in expandability not only makes it less expensive to provide new functionality to an older system; it enables the addition of many options without requiring a complete overhaul. In keeping with customers' needs for reasonably priced expansion, TRMI provides them with the original software source code along with a dedicated build-machine as part of final delivery. This allows maximum flexibility and a wide choice of options when an upgrade is needed, something that virtually all toll systems need now – and are likely to need even more frequently in the future.

Contact

TRMI
+1 845 626 8655
lformato@trmi.com
www.trmi.com

Getting more for less in the field of traffic data collection

READER ENQUIRY NO. 506

Within the current economic climate, the need for more is accompanied with a requirement to pay less. Municipal authorities, local government, and police forces worldwide are actively seeking ways in which to save money while continuing to provide effective services.

A recent major report, *Services shared: costs spared?*, commissioned by the UK's Local Government Association and produced by Drummond MacFarlane, provides analysis of five high-profile shared service arrangements. The report gives a detailed insight into the £30 million (US$47 million) savings that have been achieved through sharing back office functions such as IT and legal, and teaming up to deliver frontline services such as waste disposal and road maintenance.

Such resource sharing is equally possible in today's traffic data collection market; flexible, cost-effective solutions are becoming more available. The ability to share resources and use one or more devices to simultaneously collect data for more than one agency provides a very efficient solution.

(Above) **CA Traffic's Evo8 ALPR camera** (Right) **The Black CAT traffic monitoring outstation system**

Need to know?

The need to do more with less is prompting some inspired thinking from ITS vendors

- Resource sharing is a proven way to increase value for money and ITS experts are having to respond to this need
- The traffic data collection market can reap the benefits of systems sharing and integration
- How multiple agencies can benefit from combining ITS components

This market has a long history. Early traffic data collection devices were designed simply to meet the needs of the local authority market. Today's traffic data collection customers are moving toward increasingly sophisticated devices to meet their need for accurate and reliable data.

In the UK, the market has seen an increase in upgrading sites for automatic data collection via GSM. Instation management systems send an alert if there is a problem with the classifier, minimizing loss of data, and avoiding the need to go to the site, saving time and reducing staff requirements and health and safety risks.

Customers worldwide are moving toward collecting vehicle by vehicle data, with records for each individual vehicle rather than binned data. Emerging markets such as South America and China, which are seeing huge economic growth, have a need for intelligent traffic information management.

Today's traffic sensors take many forms, but the core requirement for counting and classifying vehicles has long been best served by the ever reliable inductive loop.

What improvements can be made within these types of instruments to deliver the market requirements for resource sharing?

Designers and developers are always looking to make their machines more robust, flexible, and more capable. Recent improvements in micro processing power have helped. The market requires cheaper hardware with increased functionality and more accuracy: competition is keen.

Data collection system manufacturers are looking to the future in terms of providing synergy by linking technologies, introducing new technical innovations, integrating into UTMC systems, and even reaching back to infrastructure installed for basic counting locations.

All this looking forward has caused developers to look backward as well. A recent innovation is classification from a single loop: although the results are not quite as good as the traditional two-loop layout, it does give the client an upgrade path for all of its single loop count sites. Accuracy of 92% on classification is achievable – a valuable data increase for the network manager.

Multiple-use solutions

Current developments allow manufacturers to offer products with more than one use, enabling customers to get more information out of the product for the same money. This also offers greater opportunities for resource sharing – and not just for data collection systems; ALPR data can also be disseminated to several agencies.

By integrating its Black CAT traffic monitoring outstation with its Evo8 ALPR camera, controlled by the Catalyst instation, CA Traffic has developed a speed/weight violation system that supplies weight, count and classification, and ALPR data for each passing vehicle. This data can be transmitted to multiple back office systems, as well as to a VMS to warn drivers of overloaded vehicles.

In another project, an 11 camera journey time system in Aylesbury, UK uses Black CAT and Evo8 to deliver traffic data to the local authority for journey time information, and license plate information to the police for surveillance and security.

Key to this data and resource sharing is the development of integrated systems that allow data to be sent to multiple clients. CA Traffic products are modular and are integrated at manufacturing level to allow them to be easily combined.

Such integration can be taken even further, to deliver a 'mini ITS' system that meets the needs of all users, from basic data collection to integration with VMS, ALPR, and back office systems to provide queue length monitoring, traffic monitoring, ALPR data, journey time monitoring, and speed and weigh-in-motion enforcement.

For authorities where resource sharing is an option, combining systems reduces the need for duplicate infrastructure and offers a flexible, highly effective cost-sharing solution.

Contact

CA Traffic
+44 1296 673000
ks@c-a.co.uk
www.ca-traffic.com

misener_james@bah.com

One view of a car is that it's a conveyance for a road user, fitting into the physical and logical transportation system with other road users, such as pedestrians and bicyclists or even buses and commercial trucks. That system is presumably a controlled network of roads. Hmm. A grid, perhaps? The image evokes for me a chess board. Is this a chess game? The question to the Grandmaster, therefore, is what is a car? The King? The Queen? A pawn?

Considering that this is a Smart Car column, let's try to make the car the most important piece on the board, working in a Knightly way with the other pieces. Moreover, the Smart Car is both a King and a Queen. Please, no jokes, save mine, about androgyny…

As the King of the board, we wish to capture the traffic; we wish to be swift in accomplishing our transportation objective; we wish situational awareness on both the tactical (concerning nearby road users) and strategic (dealing with traffic and other environmental knowledge all the way to the destination) elements of the game. And, of course, we wish to be Kings of our domains, so we are in paladin fashion, safely and efficiently transported in comfort. The Smart Car, connected to the environment, with the luxury of information and appurtenances that abet our safe and comfortable mobility, translates our metaphoric chess player into a supreme transportation system user. Not-so-smart cars represent different chess pieces. Some are pawns. Some are better off, with different levels of functionality, depending on the degree of telematics content within the car.

In this chess game, our Kingly and Queenly car is reduced in effectiveness if there is of course no Grandmaster, or smart infrastructure, but instead a lesser player. The more in tune and communicative and the more of an understanding of the chess board the player has, the better the piece; otherwise, our car with its high degree of royalty will move Pawnwise, one square at a time and certainly in greater danger than if it was a more noble piece.

So, fair chess player – or infrastructure owner-operator – what should you do? Become a Grandmaster! Yes, it's easier said than done to become Bobby Fischer. It takes years of hard work and investment. A supreme toolbox of strategies (for example, demand management incentives) and tactics (for example, arterial signalization or limited access road lane control), and a nearly intuitive way to assess and recommend, then facilitate, tactics and goals for all your players, those royal pieces who are quite mobile and those lesser pieces. Certainly, the metaphor becomes stretched too far here, as the road operator doesn't sacrifice pawns; rather, the goal is for all the pieces to arrive safely and on time.

Hear ye, hear ye, Smart Car driver, smart road operator, King or Queen of your domain and Grandmaster of yours: work together, work smartly and work toward the destination of controlling your boards with the tools, equipment, strategy and tactics. Plan ahead, and plan to checkmate.

> As the King of the board, we wish to capture the traffic; we wish to be swift in accomplishing our transportation objective
>
> **Jim Misener, executive advisor, Booz Allen Hamilton, USA**

Certified for speed enforcement success

Speed enforcement has long been a contentious issue. Although sections of the public consider speed cameras merely as revenue-raising tools, many studies show that fatalities drop at locations where speed cameras are installed. Yet governments seem to be on the back foot justifying these programs due to the hysteria whipped up by either the media or opposition political parties. Currently, the two largest states in Australia have their respective Auditor Generals investigating their speed enforcement programs due to public pressure and politicking.

So what can governments or jurisdictions do when confronted by the media or opposition political parties? The first step is to ensure confidence in the speed enforcement program and the technology in use. This can be achieved with an independent certification program that includes laboratory testing against the manufacturer's specifications or standards, site acceptance testing and a rigorous routine verification program.

The role of annual laboratory certification in this testing program can be underestimated and the reasons for certifying a device after it has been decommissioned can be overlooked. Laboratory testing provides a controlled environment that allows a trained calibration engineer to put the device through its paces using equipment such as spectrum analyzers, radio anechoic chambers, and laser delay generators. This leads to scientific results that are both repeatable and traceable to international standards.

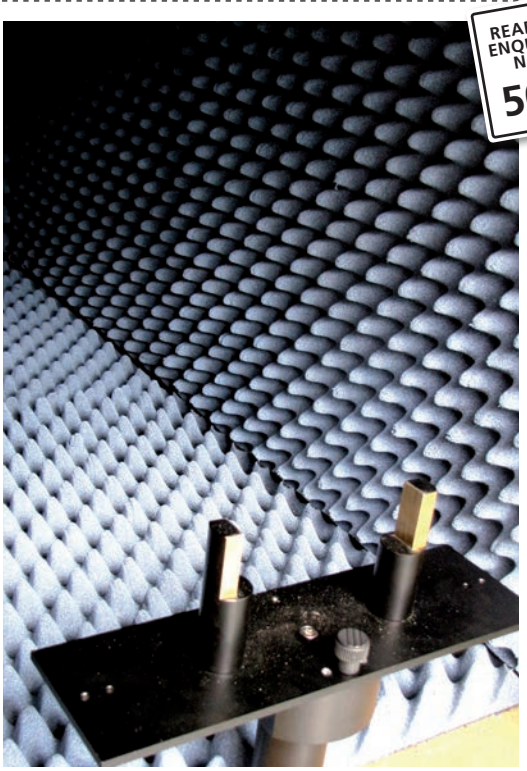
The critical starting point for jurisdictions is to select a laboratory that is independent of both the device manufacturer and the jurisdiction authority or government. The next step is to confirm that the laboratory has ISO/IEC 17025 accreditation.

The ISO/IEC 17025 standard assesses the competencies of technical personnel, effectiveness of the quality management system, and that test methods are validated, proficiency-tested against other laboratories, and are fit for purpose. Knowing that accreditation has been bestowed by a specialist technical assessor is a major step for ensuring governments feel confident about their programs.

Consumer confidence

Once a laboratory has been short-listed, it is time to confirm its scope of accreditation: does it cover the specific areas of testing required, does the reported uncertainty of measurement meet the needs of the jurisdiction, and does the laboratory have signatory status in the required areas? The final step before selection is to visit the laboratory and go through its testing regime first hand. Building up a relationship with lab personnel is beneficial toward an enforcement program's success. The laboratory will be able to offer more than just reported results. It can help investigate future technologies, application issues of specific devices, and give information on trends such as frequency drift or a radar's power deterioration over time.

So why is this certification a must? Only in a lab environment can you investigate and measure power levels accurately, confirm that the critical transmission lobe position of a mobile radar antenna is correct, simulate vehicle speeds to a high degree of accuracy, and confirm that the device is in good electrical condition. This is only a sample of what can be performed in a lab, yet it is what gives jurisdictions the confidence to confront the media and defuse the misinformed with scientific evidence.



READER ENQUIRY NO. 507

SGS has established its laboratory as a Center of Excellence

By using an independent, accredited lab, governments can rest assured that the technology is sound and the results are accurate, allowing them to focus on political, not technical issues.

Taking a global perspective and to assist its clients further, SGS has established its laboratory as a Center of Excellence for speed enforcement equipment within the SGS group. It is accredited and holds signatory status in the four speed measurement technologies: radar, lidar, inductive loop, and piezo. This allows SGS to be at the forefront of R&D through a worldwide collaborative information exchange program.

Need to know?

Speed enforcement programs: why annual laboratory certification is an absolute must

- The importance of accuracy and reliability of technology as a basis for improving confidence in the enforcement program in place
- Governments are bowing to external pressure, which is not necessarily in the best interest of the public
- Rigorous testing necessary to dispel public fears fanned through media speculation

Contact

SGS Australia
david.laizans@sgs.com
+61 3 9896 0100
www.sgs.com

Critical need for reliable power

READER ENQUIRY NO. 508

Simply searching the internet quickly highlights the fact that power grids around the globe are increasingly subject to failure. In a recent case, the world's largest blackout left at least 620 million people without power in India, causing widespread traffic jams and stranding train passengers. Of the 780 traffic signals in the national capital, barely 90 functioned, leaving the commuters stranded in unending traffic snarls.

In the USA, a power outage during afternoon rush-hour clogged roads and rails near downtown Dallas, Texas. With the power out, the train signals and crossing arms were rendered useless, causing a 45-minute traffic mess.

These cases serve to illustrate the immediate and significant impact power outages can have on traffic flow. Yet in nearly all incidents, traffic planners can avoid this fallout by investing in a purpose-designed back-up battery system that will keep traffic flowing safely.

The equipment that backs up the power for a typical intersection is located outdoors. It is subject to wide temperature swings, dust and condensation, and infiltration by rain, snow and insects. In spite of these difficult circumstances, a quality power backup system must be reliable, provide power for what can sometimes be long durations, and ensure the quality of the power is acceptable to keep the intersection operating. To provide this level of service in the face of tough environmental conditions, there are three key considerations to be addressed.

First, the most prevalent type of backup power is an uninterruptible power supply (UPS). An indoor UPS typically operates between 0-40°C, a range that is inadequate for most intersections. An outdoor UPS often has a range of -40 to 74°C. For additional protection, the outdoor units use conformal coating on their printed circuit boards (PCBs), and are designed not to overheat – even when the electronics are covered in dust. Moreover, outdoor UPSs employ large surge protectors that offer better protection to voltage surges. Lastly, the battery charge in a typical outdoor UPS can provide back-up times of eight hours or more.

Need to know?

Power grid failure can have catastrophic effects for ITS: how can we beat the blackouts?

- When grids go down, traffic comes to a standstill and accidents often occur. The challenge then is to keep power running to ITS equipment during blackouts
- Outdoor UPSs are able to withstand the challenging environments associated with traffic management applications
- Line-interactive UPSs offer the best way to achieve continuous operation of traffic intersections

Issue of power technology

Another important UPS issue is the type of power technology. The line-interactive UPS is lower in cost, has a wide input voltage range, and is efficient in its use of utility power. The double-conversion UPS offers zero transfer time but is less efficient and more expensive. Also, due to its continuous operation, the double-conversion UPS has a shorter MTBF. For traffic applications, the seamless transfer time of line-interactive UPSs will enable continuous operation of the intersection. That lower cost and higher reliability provide distinct advantages for intersections.

(Above) **Alpha battery back-up system (small enclosure in center of photo) in operation in Port St. Lucie, Florida, USA**
(Right) **Alpha outdoor traffic enclosure featuring UPS module and batteries**

Second, the batteries that provide the power during an outage are very important. Outdoor-rated batteries last longer than traditional UPS ones. Preferred UPSs dynamically change their battery-charging algorithm to accommodate the current environmental temperature to keep the battery operating in the optimum temperature range.

Third, the type of enclosure that houses the UPS and batteries is essential to a fully functional intersection. For outdoor UPS installations, the preferred housing is a NEMA 3R-rated enclosure, which ensures the enclosure offers protection against snow, rain, and sun exposure, and minimizes the chance for bugs to infiltrate and contaminate it.

Experience counts for a great deal when it comes to such a vital cog in the road management wheel, and Alpha Technologies has been providing back-up power for intersections across the world for more than 35 years.

Contact

Alpha Technologies
+1 604 436 5900
sales@alpha.ca
www.alpha.ca

Ridding our roads of the ghosts in the system

READER ENQUIRY NO. 509

The idea of a ghost driver on a motorway is terrifying for anyone but the risk of wrong-way drivers is present at many other sites as well. The Danish company Geveko ITS has been testing its ghost driver warning system successfully, and is now looking to spread it to more locations and thereby increase traffic safety.

In 2010, a total of 198 ghost drivers were registered in Denmark. The Danish Road Directorate recently analyzed the reasons for the phenomenon following interviews with police and ghost drivers in 100 incidents, the findings of which were very interesting. Drivers with deteriorated abilities in orientation and perception account for almost half of the ghost drivers registered. One third enter the motorway by an exit lane, and the majority had no intention of getting on the motorway. Many just got confused on large roundabouts, while a little less than 10% returned to the motorway from a service station, driving down the exit lane by accident. Interestingly, only one third of drivers found out that they were actually driving in the wrong direction before being stopped by police. And two thirds of ghost driver incidents take place in the dark, the scary bit being that in a little less than half of all the analyzed cases, the ghost driver was involved in accidents that caused injury or death.

If you talk with road authorities, ghost drivers on motorways are not the only problem. People driving in the wrong direction in motorway service stations, laybys and picnic areas is a similar problem that needs to be addressed. Although the speed is not as high as on motorways, as it also happens in the dark, the risk of accidents is acute. The need for clearly showing wrong-way drivers their error is clearly imminent, but what can the road authorities do?

(Left) **Wrong-way driving** (Below) **Geveko ITS's ghost driver warning system relies on intelligent road studs** (shown Right)

Need to know?

Ghost drivers are a top safety concern for road authorities. What technologies can help prevent such behavior?

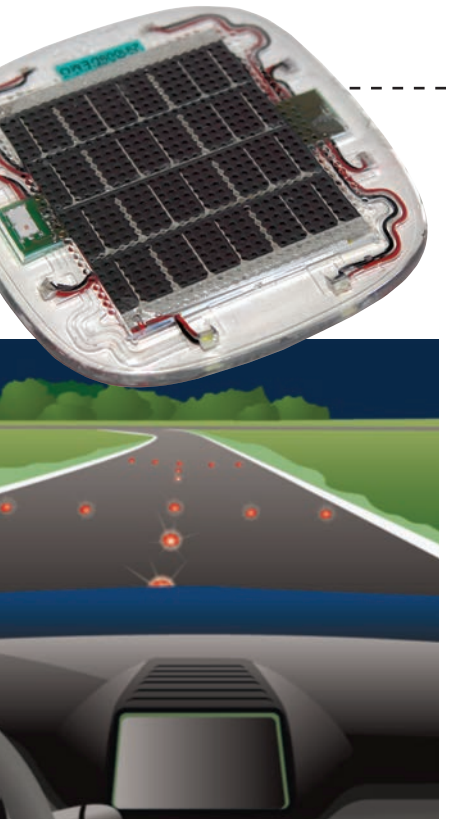
- Ghost drivers are often the cause of severe accidents, so better warning systems need to be deployed to help prevent these accidents
- Although metal spikes can play a useful role here, they have several significant flaws that reduce their efficacy
- Intelligent solar road studs can alert drivers to their behavior and prevent them from causing accidents
- One ITS expert has devised a ghost driver warning system

Available technologies

Which technologies can provide a satisfactory level of protection from wrong-way driving? Road signs are the most traditional initiative, and in some cases signs have been combined with lights or sirens placed in metal structures above the road. These signs are not noticed in the dark, however, while installing cabling for lights is costly. Another solution is to install mechanical barriers such as spikes, but in some cases these have been known to puncture the tires of those driving in the right direction too. And the key issue with spikes is that the moving parts need to be maintained regularly in order for the system to stay functional.

Other available solutions include new types of 3D road marking from Geveko. Placed on the road, right in the eyesight of the wrong-way driver, they are highly visible to those who unknowingly drive the wrong way.

The latest solution, though, is Geveko's ghost driver warning system, which consists of intelligent solar road studs that can detect traffic moving in the wrong direction and start a bright running and flashing light toward the driver. This way, the wrong-way driver is likely to notice his fault, stop and turn around. The system is standalone, easy to install and as an option it can communicate with traffic information systems to provide real-time traffic data. Another option is to combine the LED-Guide with a 3D camera



that can detect wrong-way drivers, and even transmit real-time images for surveillance or prosecution.

Why wait until the accident happens?

The Geveko ITS system has detected two ghost drivers on the 10 ramps in Denmark where it has been installed, so the potential for increasing traffic safety is certainly there. Maybe now's the time for other road owners to take action to prevent wrong-way drivers on their motorways, service stations, laybys and picnic areas – the technologies to do just that are ready to be deployed.

Contact

Geveko ITS
+45 24 29 56 99
info@gevekoits.dk
www.gevekoits.com

Grush Hour

bg@berngrush.com

A key unintended effect of many parking policies is to diminish choice. I use 'diminish' in both senses: parking policies may give us fewer choices but more often they bias our choices in ways we may not recognize.

An example is employer-subsidized parking. If I have cheap or free parking at my place of employment, I am more likely to use my car. Although I haven't been denied the choice to use transit or a bike, having free or cheap parking makes choosing these other modalities yet more unlikely.

Another example is street parking that is dramatically less expensive than nearby garage or lot parking. Although I still have the choice to use garage parking, the low cost on the street encourages me to cruise around – an average of 3.5 minutes according to parking guru Don Shoup – to find a cheap spot. Again my choice is biased by a parking policy.

A third example is a policy that permits monthly parking passes (rather the lack of a policy that forbids the practice). Given a choice of a discounted monthly pass versus paying the full daily rate, it is easy for me to purchase the pass. This means that if choosing among driving, bike or carpooling, I would be more likely to choose to drive.

There are individual remedies for each of these. Regional or municipal governments could mandate a 'parking cash-out' – an equivalent subsidy to all employees to offset employer-subsidized parking. Parking cash-outs may be used for transit, bike, shoes, gas money toward a carpool, or offsetting internet costs for teleworkers, and reduce the automaticity of driving for some people. This increases each employee's choice, and still provides for employer-subsidized parking, but balanced with non-parking subsidies.

Cruising for street parking can easily be managed by setting prices so that there is a 15% vacancy rate for parking spots. This is another Shoup solution. You may not need to match nearby garage prices (garages and lots have a different role to play than street parking does, anyway).

Monthly parking is a bit tougher as it makes sense to know you have a spot for your vehicle if driving into your office each day, or if we're talking about the multi-unit building you live in. It is, however, possible to replace monthly passes with a parking loyalty or bulk purchase program. Rather than purchase a pass for a calendar month, purchase 200 hours of parking at a bulk rate and there's no need to spend it all in a particular month. This would free-up some people to make divergent modal choices, as the value of the pass doesn't tick away if they choose not to drive.

There are numerous ways to make parking policy fairer and more responsible to the environment and to our cities. As well, tweaks to parking policy, such as I have described, are not nearly as politically toxic as road-use charging, but can – if deployed thoughtfully – lead to similar congestion-reducing results. Unfortunately, many of them are not as obvious as road pricing.

> Tweaks to parking policy are not nearly as politically toxic as road-use charging
>
> **Bern Grush, principal, Bern Grush Associates, Canada**

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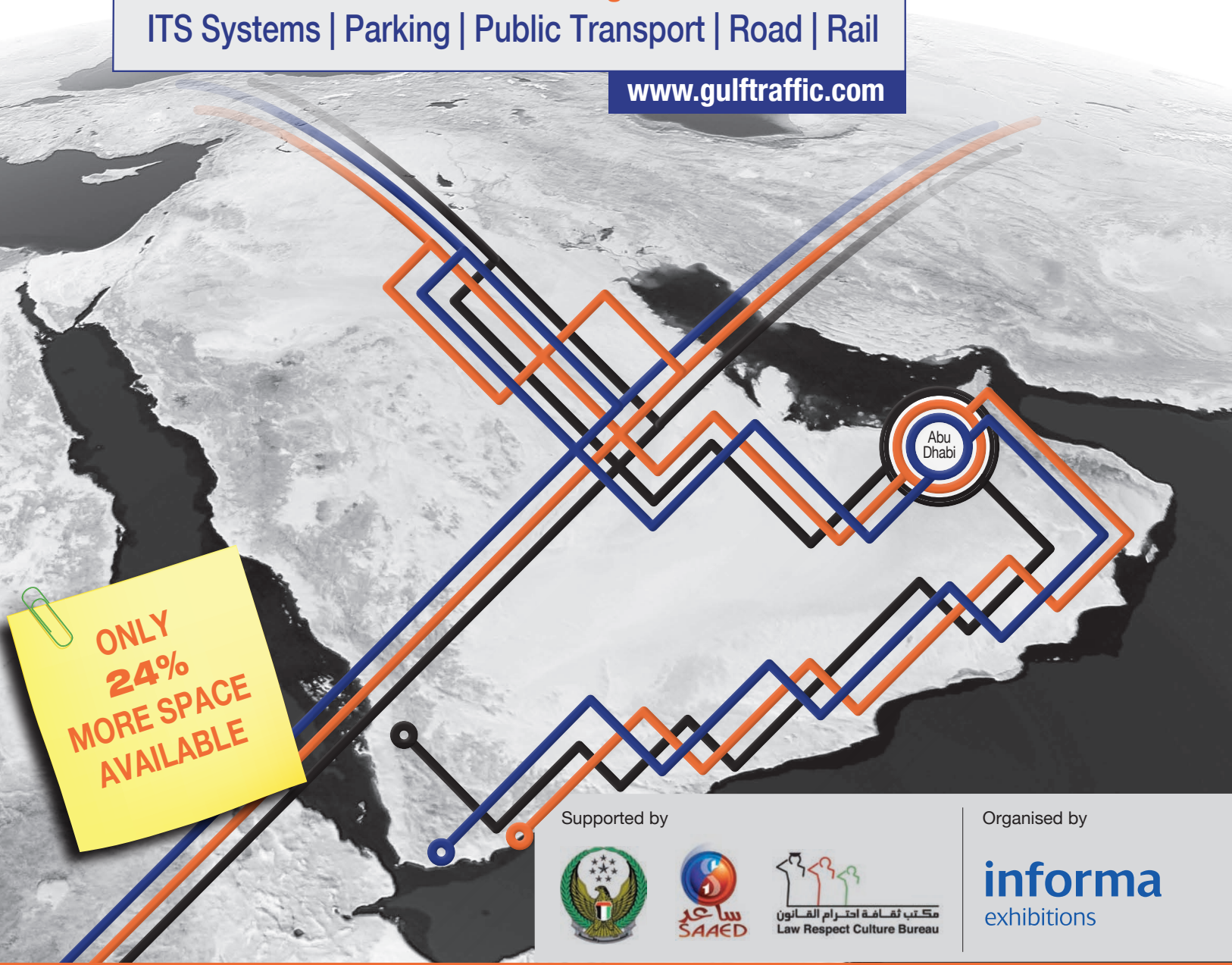

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Intelligent algorithms make the difference

READER ENQUIRY NO. 510

Sensor technologies have made huge progress in recent years, to the extent that precisely sensing traffic is no longer a challenge. Whether it be floating car data, video with machine vision, radar, laser scanners, or traditional technologies such as induction loops, it's now not a matter of lacking technologies but only a matter of the effort you're willing to invest. Yet some issues that are of particular interest for development and implementation of ITS remain. How can all the available data and information be optimally transformed into 'intelligent' actions? How can one achieve the best leverage with the already available information and sensor data? And what sensors and information are really necessary (and with which level of precision) to control a certain set of actions for intelligent traffic control?

As in many other industries and fields of application, the functionality and performance of modern traffic control solutions is primarily determined by the embedded software and control algorithms – the heart of intelligence. With that in mind, ANDATA applied all of its expertise from the fields of artificial intelligence, data mining, simulation and process development from different applications to develop a new approach for intelligent traffic control from scratch. The result is a comprehensive, decentralized control solution inspired by bionic concepts. The overall task of urban and interurban traffic control is divided into smaller and much simpler subtasks, dramatically reducing the complexity of the problem. Being disciplined and neat with the interfaces, a cascaded control network of arbitrary size can be arranged in the form of a modular construction kit. Similar to ant colonies or bee hives, decentralized intelligence emerges from the proper interaction of the basic units. A single ant (corresponding to the new traffic control unit) is not a brainiac, but it simply follows its set of clear and simple rules. In this way the colonies of ants and bees constitute a quite intelligent virtual organism. Intelligent traffic control can be built effectively in a similar way.

ANDATA will present its new approach at the World Congress on ITS this October.

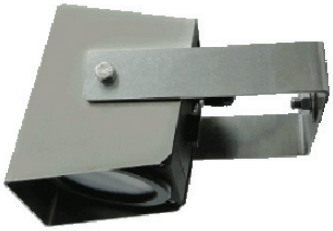
Contact

ANDATA
+43 6245 74063
andreas.kuhn@andata.at
http://traffic.andata.eu

US partnership for detector manufacturer

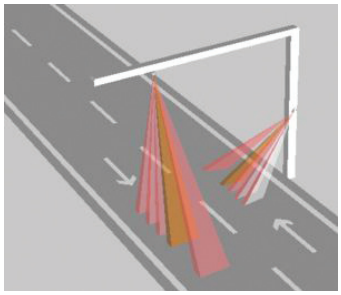
READER ENQUIRY NO. 511

ADEC Technologies has a new distributor in the USA after the Switzerland-based manufacturer of non-intrusive traffic detectors entered into a partnership with Transportation Equipment & Services, a North Carolina-based manufacturers' representative that supplies traffic technology systems for state DOTs and the transportation industry. The company is adding ADEC's TDC1-PIR (Traffic Data Collection-Passive InfraRed) detector to its product line-up, which is able to supply comprehensive traffic data, including individual vehicle class, speed, length, occupancy time and time gap, provided via RS 485 databus. The traffic detectors employ multiple PIR detection zones and give a combination of static and dynamic detection channels that form a total of five detection zones. The thermal radiation contrast of a vehicle moving into – or through – the detection zones is compared with the background radiation of the road surface, which correlates to the passage or presence of a vehicle. The sophisticated signal processing transforms the sensors analog data into digital information for each event without the need for external computing equipment.



"We had to apply some modifications to the device to achieve full compatibility with the traffic controllers commonly used in North America," explains Andreas Hartmann, marketing manager at ADEC Technologies. "While customers here in Europe retrieve the data primarily using the serial interface, the typical interface in the USA is a simple contact indicating the presence or absence of a vehicle. This partnership is essential to our growth strategy, by making available our road traffic detection products, combined with the excellent customer care tradition of our partner."

"We believe the ADEC TDC1-PIR is perfectly suited for our intersection control applications for presence detection for single traffic lanes, including left turning vehicles," adds Mark Holland, consultant at Transportation Equipment & Services. "We're pleased to have been able to bring on board a high-caliber manufacturer such as ADEC Technologies."



Contact

ADEC Technologies
+41 55 214 24 00
sales@adec-technologies.com
www.adec-technologies.com

With safety cameras seemingly deployed less and less, how will we deal with speed management on our roads in the future?

"One place to start is to establish consistent logical speed limits in the first place. Inconsistent speed limits on the same roadway were/are often set to raise revenue – i.e. deliberately develop 'speed traps'. Where the roadway is otherwise 55mph, communities choose to drop the speed to 45 or 35mph in an effort to raise money, not improve safety. Of course, one can argue that 35 is safer than 45, which is safer than 55, and if everybody went 25 on our interstates we'd have fewer fatal accidents as well! It's important to set logical and reasonable speed limits in the first place, design streets and pedestrian crossings to make them safer, and use common sense and logic in the process. Enforcement of meaningful speed limits is a reasonable thing to do – as long as we avoid the 'nanny state' perspective of catering to the lowest common denominator. How many accidents are caused by people 'driving a nice, safe speed' in the far lane – blocking mergers, exits, and causing people to shift around them? I favor reasonable speed limits and look at average speeds rather than spot speeds. Freeway speeds should be higher!"

Robert Rausch
vice president, TransCore ITS, USA

"We need to make it as easy as possible for drivers to choose to drive within speed limits. There are many ways of doing this, including speed awareness courses to educate drivers, and road engineering measures such as 20mph zones and 20mph limits. But let's not forget safety cameras are an effective way of persuading drivers not to speed, and thus reduce KSIs, so it's essential their numbers are not reduced too much. ADAS will help, especially ISA that warns when drivers are exceeding limits and in its ultimate form prevents the vehicle from doing so. The design of speedometers could also be improved to make it easier for drivers to see when they're speeding. Employers can also help by ensuring their working practices (journey schedules, etc) do not inadvertently encourage staff to speed when driving for work. Many drivers simply unintentionally exceed limits, often without realizing it as cars give drivers little sensation of their speed, so it's easy to creep above limits."

Kevin Clinton
head of road safety, RoSPA, UK

"Speed management is more than just enforcement. Cameras are a good enforcement tool but they will only partly help to achieve the ultimate policy goal of normative compliance, where drivers recognize that slower speeds in urban areas are safer ones and voluntarily behave accordingly. Cameras need to be supported by two other aspects of implementation: roads that send clear signals to drivers about the kind of speed that is appropriate and information in the vehicle telling the driver about the speed limit on the road concerned. As we begin to see more of these approaches, cameras become less needed. The big yellow box is, after all, just a visual reminder to the driver that something went horribly wrong at this spot in the past. So, let's not get hung up on the camera as the only solution. A consistent message to the driver about the need to drive more slowly is much more likely to achieve success."

Robert Gifford
executive director,
Parliamentary Advisory Council for Transport Safety, UK

"Many of the current systems were installed on a flawed business model and have been a victim of their own success. Although it is acknowledged that speed detection devices were designed to act as a deterrent, the first part of this century saw them used not for compliance but for revenue generation, which failed to address the remedial action required to modify driver behavior rather than impose a fiscal punishment. Many road safety and enforcement agencies have now recognized the damage done by this strategy, and are offering educational diversion for offenders in the first instance and then targeting prolific offenders. Technology advances in enforcement have also had an effect on driver behavior especially where systems were installed with a defined income predicted. Where will all of this lead? In-vehicle systems will start to take over the role of the speed camera, encouraged by bodies such as insurance companies, which could view this as an option to encourage better driving and lower premiums."

Andy Rooke
ex-police officer and ERTICO's HeERO project manager, Belgium

Readers are invited to answer the Burning Question for the October/November 2012 issue:

How will the advent of the Connected Vehicle transform the landscape of road weather management?

email answers to:
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