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TECHNOLOGY INTERNATIONAL

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20 YEAR Anniversary

April/May 2014

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The future of V2X technologies, the UK's revitalized Humber Bridge, and much more!

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How cooperative systems could transform our transportation infrastructure – and our planet

PLUS

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Optimizing advanced camera technology for modern surveillance applications

Highways Agency CEO
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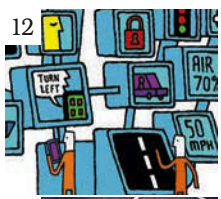
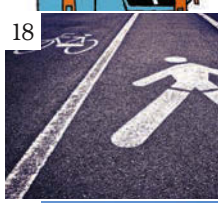
Cover story

46 Joined-up thinking

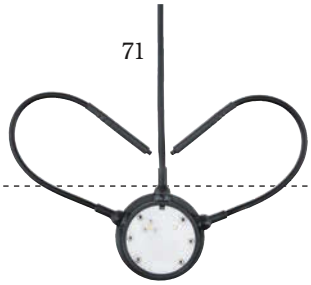
The transport sector needs to reduce its carbon footprint

Max Glaskin finds out how cooperative system technologies could minimize vehicle CO_2 emissions





Technology Profiles



Foreword

It was enough to make you choke. In April, health warnings were issued across London and southern England as pollution levels hit a record high. Winds carrying dust from the Sahara and emissions from continental Europe had mixed with local pollution to create a cocktail of heavy smog. People were advised to stay inside and avoid exercise, particularly those with lung and heart conditions. Some schools in London banned children from the playgrounds.

It was only a month earlier that the French government had imposed major restrictions on vehicles in Paris after air particulate measurements in the city exceeded safe levels for five days in a row.

The images broadcast by the media showing the Eiffel Tower obscured by smog reminded me of a trip I took to Shanghai. I remember how moped riders and cyclists weaved in and out of queues of cars pumping out black smoke, and how you could taste the fumes as you walked by buildings encrusted in gray film. It came as no surprise to hear that the Chinese government is now considering providing masks to Shanghai's residents to protect them from the city's toxic air.

While stricter EU legislation has seen the air quality in many European cities improve over the past 10 years, vehicle emissions remain a concern for public health. According to the Committee on the Medical Effects of Air Pollutants (COMEAP), long-term exposure to air pollution has an effect equivalent to 29,000 deaths a year in the UK – 15 times the number of people killed in traffic accidents.

The good news is that ITS could be the cure for this epidemic. In March this year I visited Intertraffic Amsterdam for the first time, where I was overwhelmed by the magnitude of the ITS industry. Traffic technology is clearly advancing very quickly and, with USDOT and NHTSA recently announcing that they will pursue connected-vehicle technology, these are very exciting times. In my mind there was no question that an article exploring cooperative systems should be our cover story (p46).

The latest test results from USDOT's AERIS program have confirmed that connected vehicle technologies have the potential to considerably reduce fuel consumption and emissions, in addition to saving lives and improving mobility. In light of the growing urbanization of Europe, these things are essential. Vulnerable road users are particularly at risk in today's cities (p18), but with V2X technologies advancing apace (p32), and intelligent surveillance solutions (p24) and cloud-based operations (p12) improving safety and efficiency, there seems to be no reason why the heavenly scenario depicted in the upper half of our cover's globe can't be achieved.

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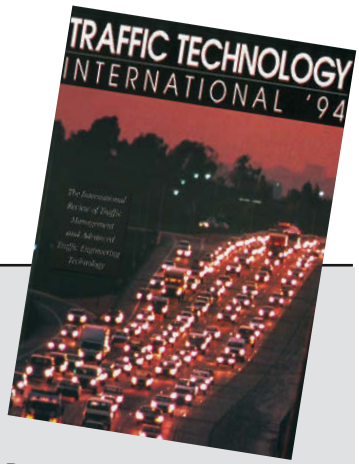
SEEING IS BELIEVING

Priced to clear

Of the many fields we've covered over the past 20 years, few highlight better the pace of technological development than road tolling. **Nick Bradley** continues his trawl through 12,000 pages of *Traffic Technology International* to pick out some road-pricing milestones...

1994

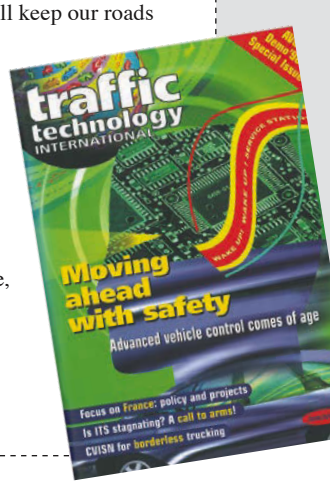
The Pilot Project on the Sydney Harbour Bridge was the first time that Electronic Toll Collection (ETC) techniques were tried in Australia. It was intended to demonstrate the effectiveness of remote electronic identification technology in the ETC application. Advanced video capture technology was also to be integrated with the ETC system for the purpose of toll violation enforcement. The main advantage of the Integrated Silicon Design (ISD) tag was the very low cost – less than A$20 for 10,000 quantities.



Twenty years is a long time in the life of one of the world's most iconic bridges. In our 1994 launch edition, Peter Lardner-Smith reviewed what back then was an Aussie first for this fledgling solution. SHB is now a few generations down the line. Indeed, recent planned toll collection upgrades hit a snag as recently as December 2013 when New South Wales' Roads and Maritime Services terminated its contract with its toll supplier for "failures to meet project milestones".

1998

Yet another technological milestone was achieved on April 1, 1998, in Singapore, with the implementation of the S$197m Electronic Road Pricing system. "The ERP is an exercise in changing the way we use our roads, with the intention that this new regime will keep our roads free-flowing," said communications minister Mah Bow Tan. LTA's CEO Liew Heng San said the system will be refined under Phase Two of the ERP: "In the future, for example, the In-Vehicle Units (IUs) will have more features and will be smaller."



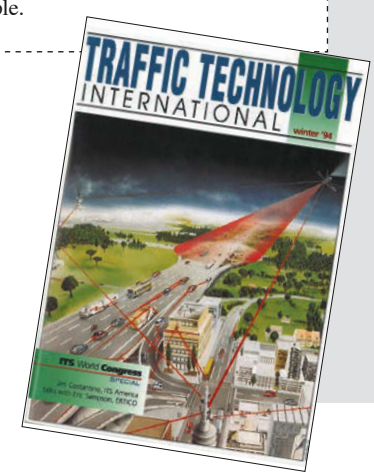
1996/1997

Just before Christmas 1995, a traditional time for announcing bad news when everybody is diverted by glad tidings and upcoming holidays, the EC slipped out a bombshell for the road transport industry and its customers. Innocuously titled *Towards Fair and Efficient Pricing in Transport*, it proposed, in effect, a radical policy of making road users pay for all the external costs they are judged to have caused. This sort of stuff has knocked about in academic circles for 50 years, but no one had dared to contemplate doing anything like it in real life…

A visionary? Maybe. EC transport commissioner Neil Kinnock dared – but didn't win. "The traffic problems we have today cannot be allowed to continue or the transport system will seize up," he warned prophetically six months after this December 1996/January 1997 edition was published. "The solution lies in improved transport efficiency and traffic management, faster network connections and investment in key infrastructure links. But central to realizing all this is the concept of fairer and more efficient pricing systems." Politicians are still fumbling around with the concept today!

1994

The third generation of the PREMID microwave tolling package made its debut on ÖSAG's Tauernautobahn, south of Salzberg. ÖSAG saw the Microwave Toll Debiting System as a pilot project and used it to prove the feasibility and reliability of a toll collection system based on 5.8GHz communication between the roadside and the vehicles. There was no doubt that the road toll systems of the future would incorporate the free-flow principle.



Integration, specialization – and more!

Peter Jesty was a regular and highly valued contributor in our early days. The director of **Peter Jesty Consulting** nevertheless takes time out of semi-retirement to peruse one of his old masterpieces to see if we've learned any lessons…

The topic of your June/July 1996 article was system architecture and integrated transport environments. The subject of your 18-year-old article appears just as pertinent today – if not more so. What are your thoughts? True, the basic message is the same, but if writing the article today, I would use more topical examples. Before cooperative systems became a major interest, integration was a process that could be done – but didn't have to be done. Those who understand the possible extra facilities that can be obtained wish to do it, but many are still prepared to accept standalone ITS that provides basic services without integration. However almost all proposed cooperative systems require some form of integration to produce their services – and to achieve this successfully over a wide area, for instance such as in the European Union, an agreed pre-procurement, high-level system architecture will be required, in addition to the communications standards that have so far been created.

No doubt you've been amazed at the progression of traffic management since this article was published in 1996? As a road user especially? Traffic does flow more smoothly, although I sometimes wonder whether the average driver has noticed much difference! Navigation systems – especially if they can also receive traffic information – are particularly useful for individual drivers, but not necessarily for traffic managers. However, the management of speed is still haphazard, with drivers still often being required to spot the appropriate roadsigns, some of which can be changed between one visit and the next, in addition to all the other hazards that must be monitored.

You've not written for *Traffic Technology International* for many years, but we know you're an avid reader. What technologies stand out for you as having a discernible impact on how we manage our roads these days? For those that exist, the one that comes to mind is the Controlled Motorway – especially when combined with hard shoulder running or Active Traffic Management (ATM). In such situations, speed is managed in a clear manner to the mutual advantage of everybody. For the future, there are some interesting cooperative system applications being proposed, but I can't help but think they might also have some unintended consequences.

> "I believe we need more generalists, as well as a few polymaths who can think clearly – but 'out of the box'

What do you foresee as the major challenges for the traffic managers/engineers of the future? Integration, integration and integration! And here I am not referring to the use of one manufacturer's VMS with a different manufacturer's traffic management system, but the full integration of all the systems associated with all aspects of road transport management (and other modes, where applicable). This isn't so much a technology problem, however, as an organizational/business one. In my 1996 article, *It's architecture Jim, ...but not as we know it!* I looked toward a high-level framework that would show how this can be done (technically), and this has now existed in the form of the European ITS Framework (FRAME) Architecture since 2000. Although it has been used successfully on a number of occasions, this does require cooperation from all parties, which can be very difficult to achieve.

Fast-forward 20 years to 2034 and our 40th anniversary. How do you suppose our roads and the traffic picture will look? Will we be trying to answer the same questions as today? A few years ago I heard that it takes, typically, 15 years to go from a research idea to a fully commercial product, so this time period basically includes what is being considered at this moment in time. Clearly eCall will have settled down, but it is too soon to suggest how. Also, some cooperative systems will be available, but if my fears for them are correct, many will prove to be too complex for the average driver to comprehend, let alone use properly/successfully! Autonomous vehicles will be seen frequently in highly controlled environments but – for the reasons I expressed in my December 1997/January 1998 article, *A long way to go*, it will still be a long time before they will be available for use by the general public.

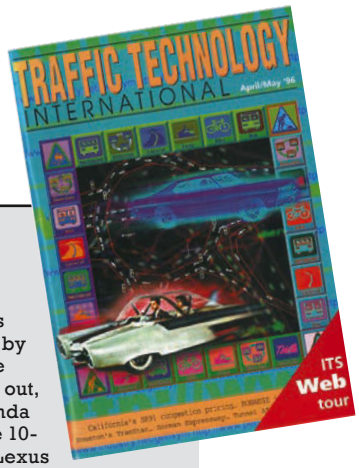
What are your major concerns for the traffic/transportation engineering professional going forward? Specialization! Once upon a time I was an academic – and academic courses tend to go from the general to the specific, so that one teaches an individual student more and more about less and less. In order to gain the best from ITS, it needs to be integrated – and this requires a working knowledge of *all* the aspects that should be integrated. As a minimum, I believe we need more generalists, as well as a few polymaths who can think clearly – but 'out of the box'.

Singapore has been a tolling pioneer for nearly 40 years. Its first foray into road pricing, the Area Licensing Scheme (ALS), was introduced in 1975. In 1998, as reported in our June/July issue that year, ERP replaced the manual ALS for Restricted Zones and Road Pricing Scheme for expressways. Head 16 years into the future and the Land Transport Authority is testing the use of GNSS – so no gantries and the potential for distance-based charges, which the LTA believes will be more equitable as charges will be computed based on the actual length of congested roads used by motorists. Still way ahead of the curve…

This article from our Winter 1994 edition was penned by Claes Claeson and Lars J Olsson from Combitech Traffic Systems of Sweden, which would be acquired by Austria's Kapsch in 2000. The latter continued to spread the 5.8GHz word and has enjoyed nationwide tolling successes in the Czech Republic and Poland to name just two. In fact, it has delivered almost 70 million OBUs worldwide and equipped about 18,000 lanes.

1996

Success can be measured in many ways, but by any definition the new toll road on California's State Route 91 was a roaring success. The '91 Express Lanes' – the commercial name of the turnpike – opened on December 27, 1995. It was met with an instant acceptance by the press and public. Almost immediately, gleeful commuters started reaping the benefits of the shortened drive time offered by the Southern California toll road. By the end of the first week, over 5,000 motorists a day were traversing the span.



Barely an edition has gone by without reference to so-called 'Lexus lanes' – applied by opponents to the '91'. As it turned out, just as many Honda drivers used the 10-mile tollway as Lexus drivers. And to this day, 18.5 years after this article appeared in the April/May 1996 edition, the tollway remains relatively unique as its lanes are entirely enclosed by the general-purpose freeway lanes run by Caltrans. A trailblazer in every sense of the word, the 91 Express Lanes is inspiring a new generation of managed lanes.

2008

"In describing the vagaries of progress, famed British politician Tony Benn once said, 'First they ignore you, then they say you're mad, then dangerous, then there's a pause – and then you can't find anyone who disagrees with you.' When it comes to tolling and congestion pricing in this country [the USA], we're just at the point where everyone thinks we're mad or dangerous. But soon we won't be able to find anyone who disagrees with us!"

We've had a lot of time for the ever-quotable Ken Philmus over the years, most recently interviewing the now Xerox exec in our April/May 2012 edition. He once managed the Lincoln Tunnel for the Port Authority of New York/New Jersey and in the above example, from our October/November 2008 edition, our 'Freedom Fighter' issued three pieces of advice that resonate six years on: "Congestion management is not just about more roads. It's about more roads in some places, smarter roads in other places, and linkage with mass transit in other."

2002

"The technology and the means to implement it have been around for some time but it took the investiture of [Ken] Livingstone as mayor [of London] to set the wheels in motion and turn the talk of a congestion charge zone for London into a reality. Whatever he is remembered for, the former Labour MP and leader of the Greater London Council will be rightly thought of as a brave mayor."

Can't argue with the sentiment of former *TTi* editor Kevin Borras in this extract from our interview with TfL's Derek Turner, published in April/May 2002. What's as true today as it was then is that a combination of political will and legislative framework – not merely technology – are key to pushing through such controversial projects. Which probably explains why so few have followed in London's [and Livingstone's] footsteps. The charge back then was £5 (today it is £10) and upon its 10-year anniversary in 2013, it had reportedly generated £1bn in revenue. Livingstone went on to introduce the Low Emission Zone on February 4, 2008, but was ousted from office in 2010, while his plans for the Western Extension of the congestion charge zone were eventually scrapped as per current mayor Boris Johnson's pre-election manifesto.

2010

The way in which the congestion charge or environmental tax in Stockholm was introduced was in [IBM's Eric-Mark] Huitema's eyes "textbook", kicking off with a six-month trial to demonstrate to the city's residents the positives of such a strategy. As a result, the general public felt engaged and consulted from the start – this wasn't a tax brought in through the back door.

As reported in our June/July 2010 edition, Sweden's much-lauded *Trängselskatt i Stockholm* also led to an overnight 22% reduction in traffic. Moreover, 40,000 people switched to public transport, there was a 14% reduction in emissions in the inner city, and a 40% reduction in carbon dioxide. What was clever with this Swedish implementation is that the city didn't merely carbon-copy the London scheme – Stockholm looked at its local congestion challenges and addressed them in a solution tailored to its urban form. Gothenburg followed its lead in January 2013.

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Life savers

Lloyd Fuller looks at how some of the biggest players in the enforcement industry are applying the latest technology to improve road safety, while keeping traffic on the move

Truvelo UK's D-CAM digital enforcement camera has gained UK Home Office Type Approval for front and rear photography. Combined with road markings for secondary speed checks, D-CAM increases siting flexibility for 'speed on green' enforcement. Truvelo uses three in-ground piezoelectric sensors to trigger the D-CAM, which maximizes system accuracy. They also enable axle-based vehicle classification, which means the camera can select a lower speed threshold where required.

The D-CAM operates as a speed camera during the amber, green and amber-to-red grace phases, with single images used for speed offences. After the grace period, the camera switches to red-light enforcement mode and takes two images. The first shows true speed and the offending vehicle straddling the stop bar, and the second, taken 12-15m later, confirms an offence has taken place.

Did you know? A patented system that forms part of the Type Approval can monitor signal phases on new LED traffic lights

(www.truvelouk.com)

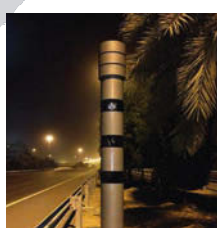
New dimension

Smartmicro's new radar-based traffic management product can be used for intersection management (stop-bar and advance detection), arterial management (traffic counting and classification) and enforcement (red light and speed). "The high-performance 3D tracking radars can now handle curved roads and bicycle classification, and have an Ethernet interface," says Dr Ralph Mende, Smartmicro's managing director. "The UMRR-0C range is a high-end radar platform comprising three models that will feature the 2DHD and 3DHD high-resolution technology required for the handling of dense traffic. A wide field-of-view and detection ranges of 500m are combined with superior vehicle-separation capabilities, enabling 100 and more objects to be tracked simultaneously."

Tech fact: **The radar technology is maintenance-free and works in most weather conditions**

(www.smartmicro.de)

Up close and prosecuted



Dubai Traffic Police has completed tests comparing Vitronic Poliscan speed enforcement systems to standard radar systems on one of the emirate's main roads. According to officials, the lidar-based Vitronic systems were six times more efficient than conventional technologies. The tests were part of a program to better police tailgating, which caused 532 traffic accidents, resulting in 22 deaths and 426 injuries in Dubai last year. Although no fines were issued during testing, Brigadier Saif Muhair Al Mazroui, deputy director of Dubai Traffic Police, says the tests show they are needed. In addition to tailgating offences, the systems also detect vehicle size and those with specific speed limits. "The safe distance varies, depending on the speed limit," says Al Mazroui. "The radar can spot drivers who cross this distance, just like a speed offence." Dubai Traffic Police has also activated a system that enables officers to record offences using a voice system via a smartphone app that was previously tested by police commanders. "We recorded 547 traffic offences in January and February," adds Al Mazroui. "It's a fast way to record offences, without the need for paper tickets."

Trial success: **Dubai Traffic Police will install 50 Poliscan systems this year and another 100 in 2015**

(www.vitronic.de)

Redflex's HADECS3 camera system has received UK Home Office Type Approval. It will be used by the Highways Agency for its Digital Enforcement Compliance System (HADECS) 'smart motorways' project. Cameras mounted to the side of the motorway automatically adjust to the new enforced speed limit to keep traffic flowing during busy periods. RedflexHadecs3 uses non-intrusive dual radar for the detection of speed offences in all weather conditions, with lane identification, vehicle position and positive vehicle identification.

A pole-mounted external aspect verification system monitors changes to the enforceable speed limit display and alerts the camera system to set new speed limit thresholds accordingly. Violation data is sent from the camera system via a data network to an evidence receiving and control unit in a remote and secure office, where the offence viewing and decision system decrypts and then

processes the violations for prosecution. Dual radar technology eliminates the usual radar anomalies and allows the system to operate at sites where traditional radar-based camera systems fail, while the two radars operate independently to verify speed measurement.

(www.redflex.com)

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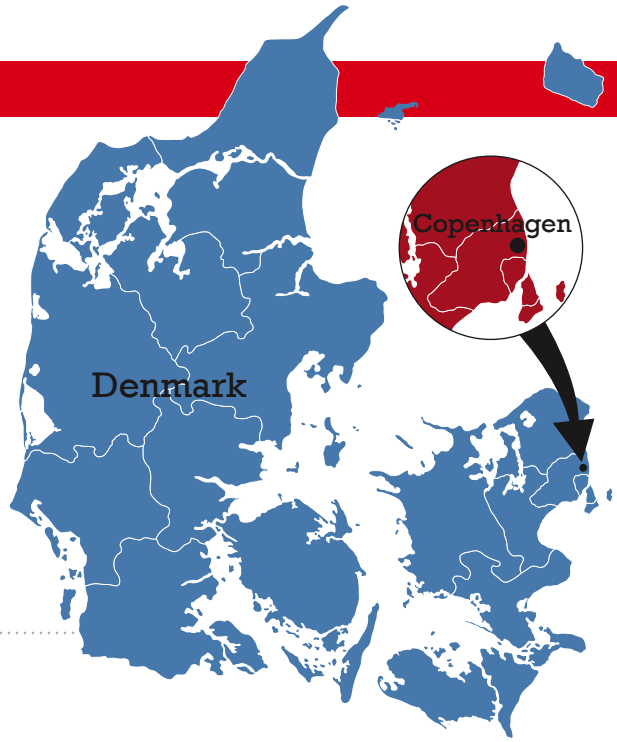
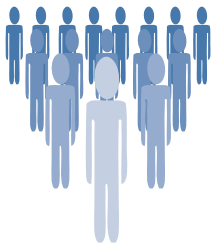
Chain reaction

Like most cities, **Copenhagen** is no stranger to congestion. However, with much of its traffic on two wheels, the road authorities in Denmark's capital city face unique challenges

Infographics: Louise Adams



Part of Denmark's Øresund Region, Copenhagen has a population of just under four million people



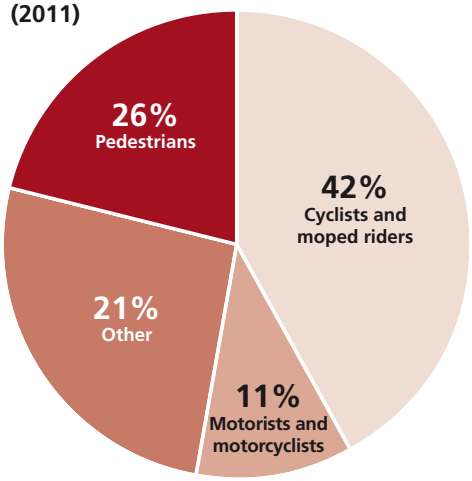
36% of Copenhageners cycle to their place of work or education every day. The city has a goal to increase that number to 50% by 2015

The number of bicycles in the city is approximately

650,000

and there are around 125,000 cars (this means there are 5.2 bicycles for every car)

Serious road injuries in Copenhagen (2011)



According to the *2013 TomTom Travel index*, Copenhagen is most congested on Thursday mornings and Friday evenings (the best times to travel are Friday mornings and Monday evenings)

In 2013, Copenhagen spent

Dkr250m

(US$46m) on improving conditions for cyclists in the city

To tackle cycle congestion, Copenhagen is investing Dkr1bn (US$185m) to create cycle superhighways. The 186-mile network will connect 22 suburbs with the city center

26

On average, 800,000 miles were cycled in Copenhagen every day in 2012

Copenhagen has 346km of cycle tracks, 23km of cycle lanes and 42km of green cycle routes. The city's Nørrebrogade is said to be the most popular cycling street in Europe

76% of Copenhageners said they felt safe cycling in the city in 2012

19% said they felt partially safe

5% felt decidedly unsafe

Source: *City of Copenhagen*

It is estimated that the city has about 50,000 public parking spaces for bicycles

Copenhagen plans to reduce the number of road accidents by

50%

by 2020 (this will mean 110 fewer deaths and serious injuries)

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Leap of faith

Amid widespread concerns over privacy and security, **David W Smith** talks to the experts who argue that the adoption of cloud-based ITS is an essential step in the journey toward better, safer roads

Illustration: Tim Ellis

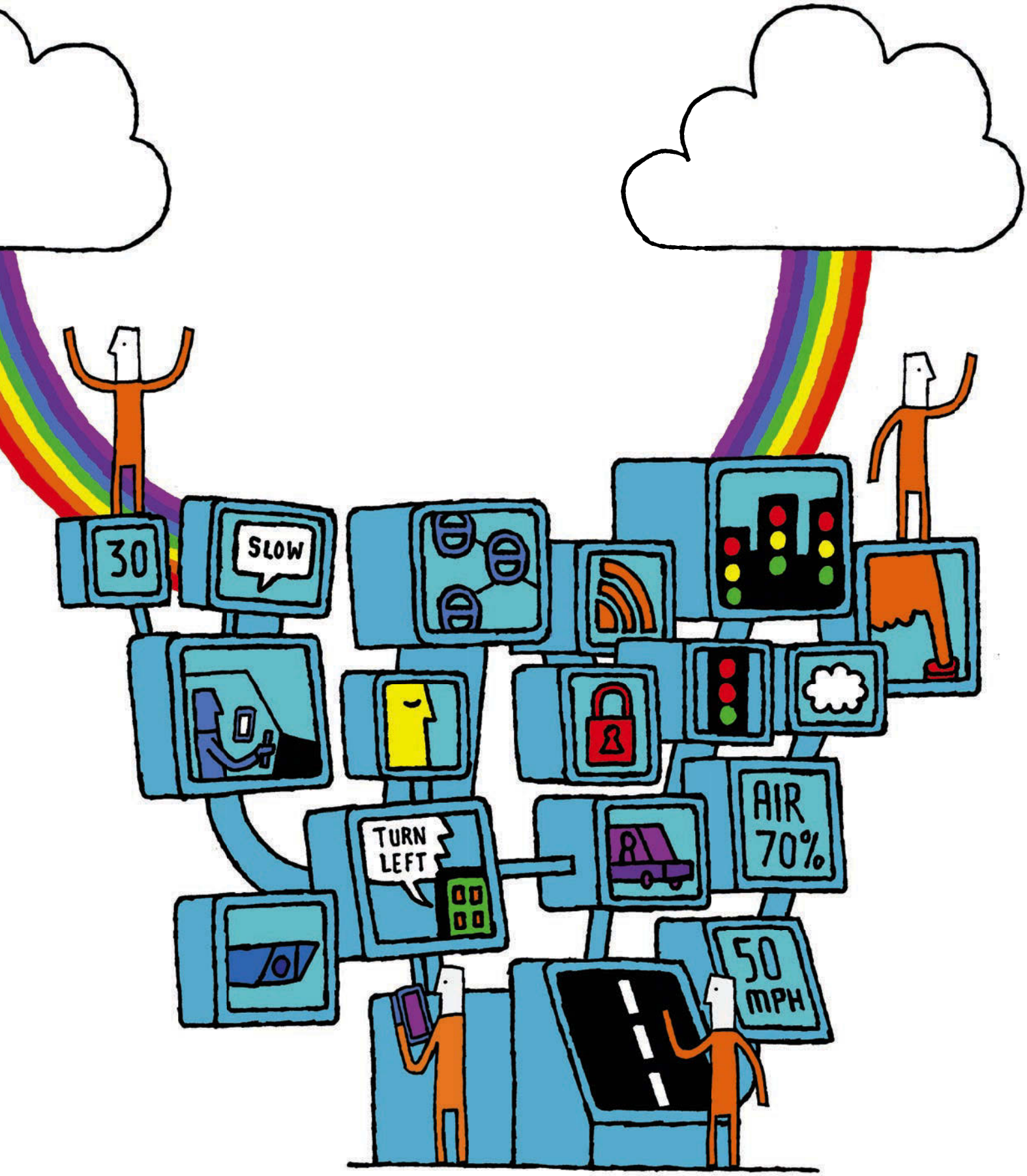
The conservative mindset of many state DOTs in the USA can make them wary of storing vital data in the cloud. Although the advantages of cloud storage are becoming more obvious, manufacturers of cloud-based ITS are still battling entrenched suspicion, according to Ted Trepanier from INRIX, a global provider of cloud-based traffic data.

Trepanier, who is the director of product management for traffic platforms, says the biggest source of anxiety for DOTs is security. "DOTs are spending public money, and concerns about data security are legitimate," he explains. "But hacking stories almost always involve private systems. A public agency's servers are no more vulnerable than those of a professional company in the cloud."

Alongside security fears runs a reluctance to relinquish control of data. "That's a trust issue," says Trepanier. "DOTs have always known where their data is. When they contract out services, they worry about what happens to data if the cloud-based company goes bust. We give assurances that we are financially sound and also that the data can be made available to other companies [in the event of the company's closure]."

Trepanier says that the INRIX systems work more efficiently and cost-effectively in the cloud. "You could do it without the cloud, but it would be really expensive to build private systems, and DOTs don't have that kind of money," he adds.

INRIX's largest client is the I-95 Corridor Coalition of state DOTs that has coordinated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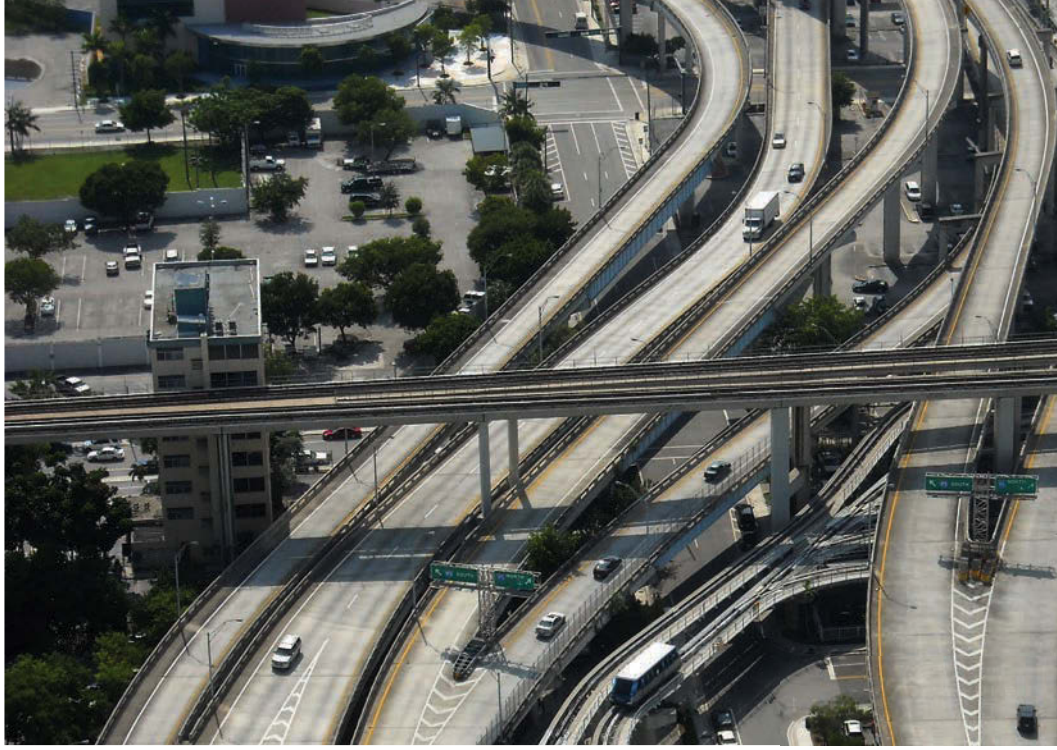


traffic operations along the 1,917-mile eastern seaboard from Maine to Florida since 2008. The network covers some 7,000 freeway miles, and more than 20,000 freeway and arterial miles. According to North Carolina DOT, previous approaches to gathering traffic data had a lifetime cost of US$50,000 per mile, whereas INRIX data delivers more coverage at 25% of the cost.

"The core states around Washington DC are small, but traffic problems are big and cross boundaries," says Trepanier. "Congestion in Virginia, Maryland, Washington DC and North Carolina is interrelated so there's a need for cooperation. We have a monitoring site where they can see what's happening, and manage incidents and special events. It can provide information for drivers on the web, or on roadside signs."

The system makes archived data available for analysis. "When we compute speed and travel time on every segment every minute, we save that data," Trepanier continues. "Planning agencies use it to gain insight into recurring problems and the costs of delays."

Housing these services in the cloud saves money for the I-95 Corridor Coalition. "They don't need to buy servers, or pay for maintenance, or create back-up copies, all of which is expensive," says Trepanier.

"There's another layer of efficiency as we can often use the same data to service more than one customer. It spreads the cost of hosting and building analytics. And it's quick to implement – an agency can be up and running in two days."

The cloud also enables providers to throw extra processing power at a critical problem for a short period. "In-house computing power is limited by the number of servers in your rack, but with a cloud-based service you can bring on triple the number of servers for a few minutes and then scale it back down at the flick of a switch," explains Trepanier.

Connected data

Professor Brian Smith from the University of Virginia's Center for Transportation Studies says the cloud is the ideal place to house data from connected vehicle applications. Smith and his team are working on prototypes that could later be commercially produced.

> "Too many companies and DOTs believe they can just invest in hardware and a few tech guys, and pray that magic happens along the way"
>
> **David Ly, CEO and founder, Iveda, USA**

Photo: Virginia Tech

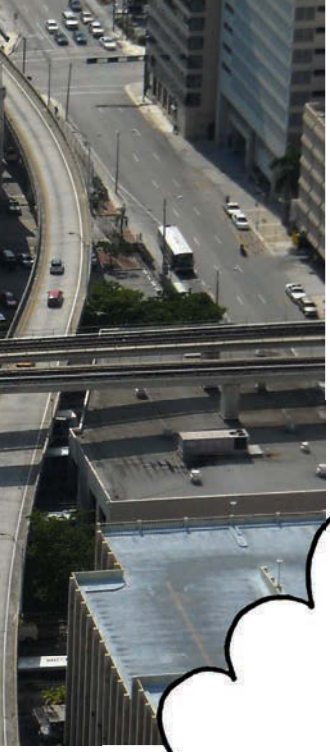
(Above) **Cloud-based systems are helping to gather data about the I-95 corridor**

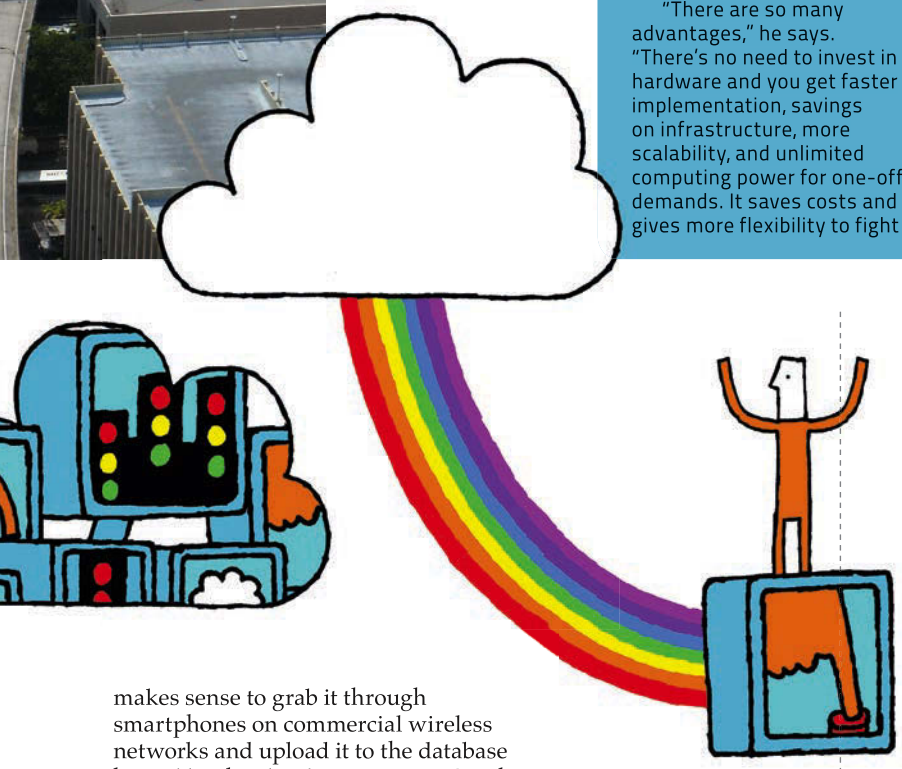
(Left) **Connected-vehicle equipment at the I-66 test bed in Virginia**

"Virginia is the lead state for a pooled fund study – run by 12 state DOTs – into connected vehicles," Smith says. "The university helps Virginia to test applications that enable DOTs to operate their systems. Numerous things can be done in a less costly, more efficient way with connected vehicles."

One application currently under review assesses the condition of pavements (road surfaces). "We can use connected vehicles and accelerometers to gauge pavement roughness, which helps DOTs plan which sections to rehabilitate," explains Smith. "DOTs already do this – Virginia has a US$2m contract with a company that uses specialized vans to collect roughness data – but with connected vehicles, you gather more comprehensive data at a fraction of the cost. It's the kind of practical application that might drive the head of a DOT to use the application."

The cloud is a convenient place for gathering this type of mobile data: "If I am collecting vertical acceleration data from vehicles, it





Speed and efficiency

Eric-Mark Huitema, IBM global manager smarter transportation, expects private clouds to replace all customer data centers in the next few years.

"There are so many advantages," he says. "There's no need to invest in hardware and you get faster implementation, savings on infrastructure, more scalability, and unlimited computing power for one-off demands. It saves costs and gives more flexibility to fight traffic jams and gets traffic free-flowing again. All of our systems are now available in the cloud and we see a trend to using it more."

In Eindhoven, in the Netherlands, the municipal government is reducing traffic congestion using a cloud-based IBM fee-paying traffic management solution.

"The system reduces the length and frequency of traffic jams, cuts CO_2 emissions, and improves fuel efficiency for commuters," Huitema explains. "It also helps keep citizens informed about the cost of each trip."

Meanwhile, the city of Cologne expects to reduce traffic congestion by 10% using cloud-based IBM ITS software that analyzes near-real-time information in order to warn transportation managers of impending congestion.

"It enables them to take preventive action to keep traffic flowing," says Huitema.

makes sense to grab it through smartphones on commercial wireless networks and upload it to the database hosted by the cloud server," says Smith. "Then I can analyze it in the cloud to get my roughness estimates for each section."

A further use of connected vehicles is to provide information for connected message signs. "DOTs put up signs about accidents ahead, or poor road conditions, but it's not scalable," Smith continues. "With the connected vehicle environment, as a traveler moves through the system, his smartphone monitors locations. Any time the driver is in the zone of a message sign, the phone provides an audio reading, which is less distracting for the driver. The phone could also read signs aloud in Spanish, or other languages, as a lot of people don't read English in the USA."

The connected vehicle applications are assessed at testbeds across Virginia. Each one has more than 50 roadside equipment units and uses a large fleet of instrumented vehicles, including cars, motorcycles, a motor coach and a semi-truck. They are the primary research points for the Connected Vehicle/Infrastructure University Transportation Center (CVI-UTC), a consortium that includes the University of Virginia's Center for Transportation Studies along with Morgan State and Virginia Tech. The roadside instruments send data to the cloud about congestion, road conditions, emergency vehicles and pavement roughness.

"DOT paranoia about the cloud is understandable, but the question is, at what point do the benefits and security provisions get to a sufficient comfort level?" asks Smith. "The reality is that with smartphone applications, the best place to put data is in the cloud as it can be grabbed from a wireless network anywhere, at any time."

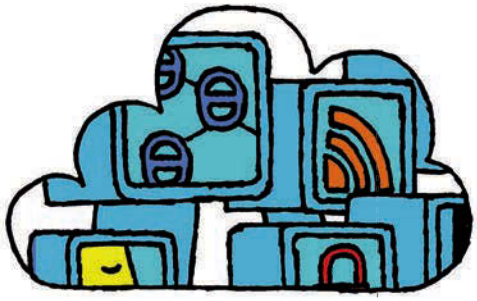
Although CVI-UTC tries out applications with in-vehicle technology, Smith speculates that smartphones could already do much of the work. "Devices don't necessarily need to be embedded in cars," he says. "I believe that the devices we use to check Facebook can help DOTs provide better services, which has huge implications in terms of the investments they make. Should they be buying new message signs? I'm also seeing changing attitudes to the cloud. As DOTs get more used to it, they won't find it so shocking and economics will drive their thinking."

Bird's-eye view

David Ly, CEO and founder of video surveillance provider Iveda, agrees that DOT resistance to cloud storage will melt away. He says that the future of video surveillance is in the cloud rather than with box-based systems involving cables, chops, hard drives or even VHS tapes.

"Too many companies and DOTs believe they can just invest in hardware and a few tech guys, and pray that magic happens along the way – but it's inefficient," Ly says.

(Below) **Connected vehicles and accelerometers can be used to gauge pavement conditions**



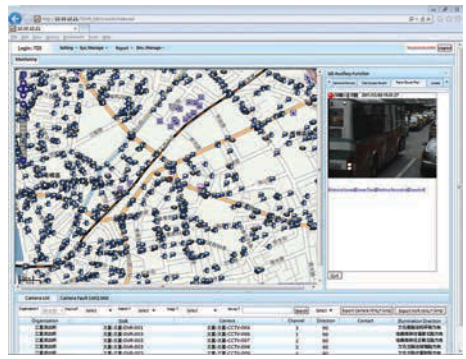
"The cloud has evolved in support of IT and the same is true of video surveillance. If you can have all the research and development done for you, and systems built for you, it makes your life as an end user easier. The old box systems are not scalable, whereas we can pull together video streams from thousands of cameras in multiple locations into a single command-and-control center. It is imminent that all video will be in the cloud."

Iveda's largest contract is with New Taipei City, in Taiwan, through its subsidiary MEGAsys. New Taipei City's SafeCiti surveillance system comprises more than 13,500 cameras integrated into one centrally managed platform. The system has benefits for police forces, but also for remote surveillance of traffic.

"They use it to monitor the flow of traffic in real time," explains Ly. "After distress calls, they are able to instantly share live video data with first responders. Putting the data in the cloud makes it easier to archive and review."

Ly claims that cloud-based video surveillance could be of great value for DOTs in the USA, but the concept faces an uphill battle for acceptance. "Some people cry intrusion of privacy if you point a camera at the moon – in case people see them smooching in the reflection," he says. "But video surveillance is not about intrusion of privacy; it's about responding efficiently if a car hits a pole. You need to make quick decisions about how many fire trucks to send."

The second major concern for DOTs, he says, is security in the cloud. "But the cloud is flexible now and DOTs need to realize they are not sending their data to 'kingdom come'. There are now private, public or hybrid systems. A DOT can define its own cloud – where it exists, its size, and whether or not to build security walls."



(Right) **A patrol route plan and flee scope search on New Taipei City's SafeCiti surveillance system**

Air support

In the UK, the private research consultancy Transport Research Laboratory (TRL) is working on a project funded by the European Space Agency to produce new cloud-based software for traffic authorities. The uTRAQ (urban traffic management and air quality) software for monitoring traffic includes ground-based air quality and weather data, as well as satellite data. It is being designed to dovetail with TRL's SCOOT urban traffic control system, which coordinates signal operation in designated areas. Although uTRAQ does not need to be in the cloud, the heavyweight computation means savings will be substantial.

> Ground-based data sources can be anything from air quality monitors to floating cars using GNSS sources
>
> **Chris Kettell, TRL, UK**

TRL researcher Chris Kettell says the research is cutting edge, as urban traffic management systems have not previously used weather and pollution data. "Ground-based data sources can be anything from air quality monitors to floating cars using GNSS sources," he details. "Our software provides information about air condition – especially oxides of nitrogen from diesel vehicles, as they have large implications for human health. We're also looking at the influence of cold, wet and snowy weather. We can help authorities to profile the effects on driver behavior, emissions, delays and congestion. That information opens a lot of doors for authorities, as they can have an evidence-driven approach to policy."

A powerful tool

The UK's Transport Research Laboratory (TRL) launched a cloud-based version of MAAP, its road traffic collision data software, last year. TRL says MAAPcloud has been designed to enable flexible deployment, so that police forces, local authorities and other road-safety stakeholders can share the system's data and reduce costs. This also creates opportunities for cross-border and regional collaboration.

TRL says that moving the entire MAAP system online enables authorized users to access powerful analytical tools from any PC, not just those with pre-installed software. Data is made available to all relevant members of the road safety partnership as soon as it is released. This includes the latest collision and casualty figures.

Cardiff Council used TRL's MAAP software for a number of years, but transferred to MAAPcloud last year.

"It's quick to access and simple to use, enabling a variety of experienced and less experienced users to log on to specific areas," explains Steve Irish, from Cardiff's Transport Projects team. "We control who can log in and what they can access.

"You can toggle between sections and quickly obtain accurate and reliable data on where collisions are taking place throughout the city," Irish continues. "The Cluster Analysis function enables us to pinpoint specific issues that are arising. We can see the number of collisions, where they are, how they happened and, from that, look at the contributory factors."

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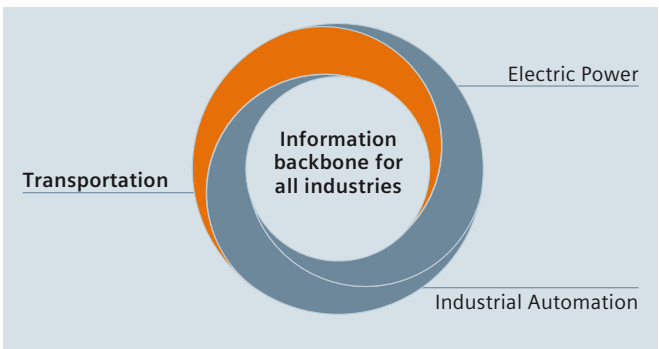

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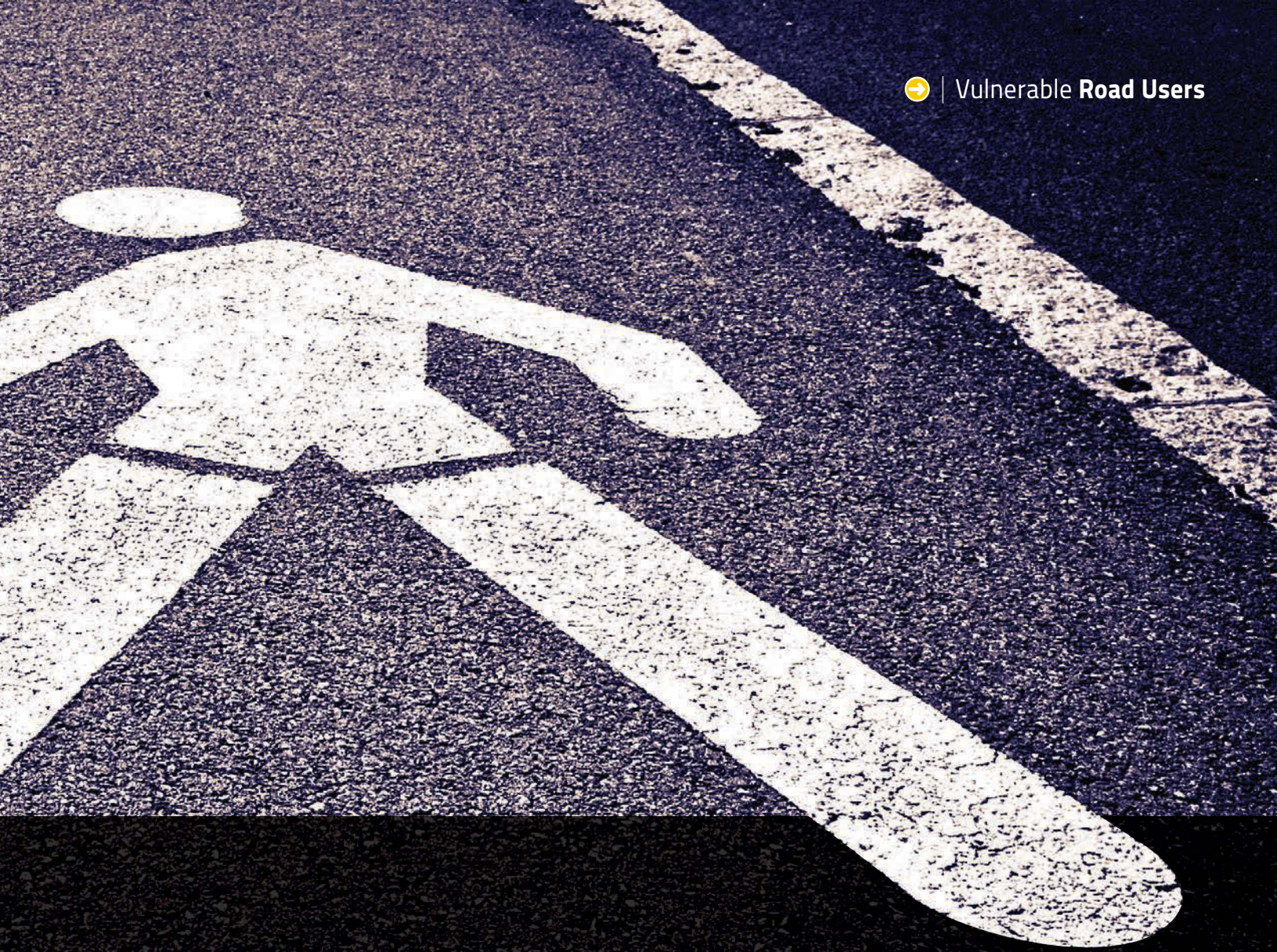
A fine, fine line

As the growing population of pedestrians and cyclists in urban areas creates new challenges for road authorities, **Lauren Ansell** finds out how three major cities are addressing the vulnerability of these road users, and prioritizing their safety and mobility

Photo: pio3



With rising obesity levels a major concern for many western countries, governments are actively encouraging the public to ditch their cars in favor of healthier, more sustainable lifestyles. The number of people choosing to walk or cycle is growing daily, which is great news for the environment, as well as public health, but with many road networks built for vehicles, getting from A to B can be very dangerous for today's vulnerable road users (VRUs) .

Reports published by the World Health Organization (WHO) show that VRUs accounted for 48% of all global road traffic fatalities in 2007, while in 2010 they accounted for 50%. According to WHO, of the estimated 1.24 million global road traffic fatalities in 2010, 270,000 (22%) were pedestrians. Also killed that year were 62,000 cyclists (5%) and 276,000 moped and scooter riders (23%).

While these figures confirm that VRU safety is indeed a huge concern worldwide, it is important to note that there can be substantial variations in the type and frequency of VRU accidents between continents and countries. A nation's wealth, quality of road infrastructure and culture are inevitably influential factors.

"Motorized two and three-wheeler riders account for more than half of traffic fatalities in Laos, Thailand, Cambodia, Malaysia, Dominican Republic and Benin," reveals Margie Peden, coordinator of the unintentional injury prevention team (UIP) at WHO. "Meanwhile, pedestrians account for more than a third of traffic fatalities in Uganda, Pakistan, Costa Rica, Mauritius and Guyana."

According to Peden, several factors influence these figures. "In terms of infrastructure, the roads in many countries are not designed to prioritize the needs of pedestrians," she says. "Also, the long distances between people's homes, workplaces, schools and shops mean long-distance trips for VRUs and there has been a failure to ensure that the roads and vehicles connecting these places are safe."

There are also notable contrasts between rural and urban areas, with the risk proving to be much higher in cities, where VRUs are subject to frequent and close interaction with motorized road users.

According to the European Commission's 2013 *Targeted action on urban road safety* report, each year 11,000 people – about half of whom are pedestrians and cyclists – die from road traffic crashes in EU urban areas. Many more are seriously injured.

The report also identifies that progress in reducing road fatalities has been below average in urban areas, which is a concern in light of Europe's growing urbanization.

In order to accommodate more VRUs traveling alongside vehicles within the confines of an urban environment, cities need to invest in intelligent systems and infrastructure that enable their mobility without compromising on safety.

UK trials

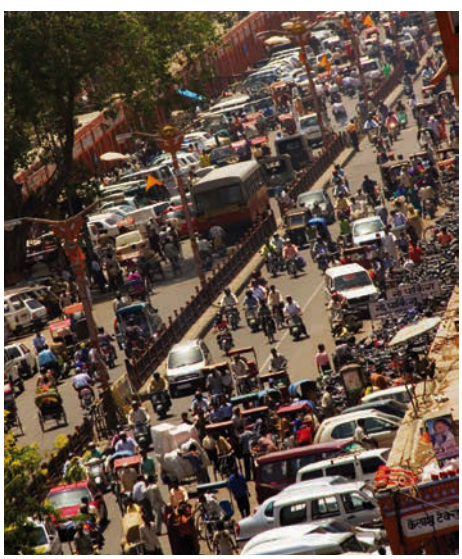
While the number of car occupants killed and seriously injured on London's streets has declined since 2010, the number of collisions involving pedestrians and cyclists has increased, against the long-term trend.

"It's not entirely clear why this has happened," says David Davies, executive director of the Parliamentary Advisory Council for Transport Safety (PACTS). "There is a lot of speculation about increased distraction from cell phones and about drunk pedestrians, but we believe other factors are at play."

The number of cyclist deaths in London hit a five-year high in 2011, with 16 killed in the capital. A spate of collisions in November 2013 then saw six cyclist fatalities within the space of two weeks.

"This increase in casualties is broadly in line with the increase in cycle traffic," says Davies. "It's self-evident that it is risky being on two wheels, without the protection of a metal cage and air bags, while mixing with heavy traffic, but the 'safety in numbers' effect has not been delivered as expected, and we need to know why."

The safety of VRUs is being taken very seriously by Transport for London (TfL) and the city's mayor, Boris Johnson. In February 2014, they released *Safe London Streets – Our Six Road Safety Commitments*, which sets a target to reduce the number of people killed and seriously injured by 40% by 2020. According to the report, VRUs currently account for 80% of the 25,000 serious and fatal road collisions in the city each year.



(Above) **London commuters cycling in rush-hour traffic** (Left) **Vulnerable road users share the streets with motorized vehicles in Jaipur, India**

> **The roads in many countries are not designed to prioritize the needs of pedestrians**
>
> **Margie Peden, coordinator of the unintentional injury prevention team (UIP) at WHO**

Notably, TfL has recently completed the first phase of its Pedestrian Countdown program. This technology, which tells pedestrians how long they have left to cross the road once the green pedestrian light has gone out, has been installed at 550 pedestrian crossings in 30 London boroughs. Expansion across the capital is planned for the coming years. The mayor and TfL also recently announced plans to trial new pedestrian crossing sensors. The Pedestrian Split Cycle Offset Optimization Technique (Pedestrian SCOOT) uses advanced video-camera technology to detect how many pedestrians are waiting at the crossing. It then automatically adjusts the traffic-signal timings to extend the green pedestrian light when large numbers of people are waiting. If TfL meets its target to increase the number of walking trips in London by a million a day by 2031, it is essential for these intelligent crossings to be working effectively.

"There is tremendous pressure on the transport system as a result of increased population, jobs, visitors and construction," says Davies. "Enabling people to get about safely on foot or by bike has to be a priority. The long-term approach should be the 'safe system' strategy – five-star roads, vehicles and road users – where mistakes are not punished by serious injury or worse. This means safe speeds on a consistent and comprehensive basis, greater provision for cyclists and more effective policing. Health and safety principles need to be extended from the workplace to the roads, and in some areas, large-scale pedestrianization may be the only safe option."

Pedestrians first

A spate of seven pedestrian deaths in New York City in the first 12 days of 2014 had the local media speculating that this could be a deadly year for pedestrians. According to official NYPD figures, pedestrian fatalities and serious injuries have been on the rise in the city, with 168 deaths and 11,978 injuries reported in 2013.

On February 14, 2014, NYC mayor Bill de Blasio unveiled a set of proposals to improve street safety in the city, pledging considerable police resources and capital to eliminate traffic deaths. New York City's Vision Zero Action Plan, which is rooted in the Swedish

Vision Zero approach, will notably involve stricter enforcement of speeding, including the potential for a system that could pause a taxi meter if the driver exceeds the speed limit, and the expansion of red-light and speed-tracking cameras. The speed limit throughout the city would meanwhile be reduced from 30 to 25mph.

"We refuse to accept the loss of children, parents and neighbors as inevitable," de Blasio said at a news conference. "We are focusing the full weight of city government to prevent fatalities on our streets. This will add up to much more than changing intersections or issuing violations. It's about each of us taking greater responsibility every time we get behind the wheel or step out on the street. Our lives are literally in each other's hands."

New York has already proved that it is dedicated to prioritizing VRUs. Sustainable Streets, the 2008 plan released by the New York Department of Transportation (NYDOT) kickstarted a wave of projects engineered to maximize public safety, with the aim to halve the number of traffic deaths by 2030. In the ensuing years, the city has become internationally recognized as a leader in safe-street design, with traffic fatalities decreasing by 34% in some areas.

"The city has created large numbers of bicycle lanes, enabled pedestrian traffic-signal phasing, increased pedestrian crossing times, built pedestrian refuge islands and fencing, installed traffic enforcement cameras, and constructed traffic calming treatments," describes Richard Retting, principal director of safety research at Sam Schwartz Engineering, which has worked alongside NYDOT on numerous safety initiatives. "We have also seen an increase in the intensity of roadway lighting, improved traffic signal timing and physical measures to reduce vehicle speeds."

It is clear that much has already been achieved. Indeed, overall traffic fatalities in New York fell from 701 in 1990 to an all-time low of 249 in 2011. However, according to the Vision Zero campaign, vehicles still seriously injure or kill, on average, one New Yorker every two hours.

"Ensuring the safety of VRUs in New York is very challenging," admits Retting. "The city has a consistently high volume of traffic, there are a lot of wide streets in residential neighborhoods and we have a growing population of older adults. Ongoing safety projects aim to address these issues, however. The Neighborhood Slow Zones initiative, for example, aims to lower the occurrence and severity of crashes in residential neighborhoods by reducing the speed limit to 20mph and adding safety measures such as speed bumps. In October 2013, NYDOT announced that Neighborhood Slow Zones will be implemented in 15 communities across the city over the next three years.

City of cyclists

Amsterdam is famous for its commuters on two wheels, and, along with Copenhagen, the city is widely recognized as one of the most cyclist-friendly cities in the world. It is estimated that 57% of Amsterdamers use their bicycles on a daily basis, and with the most recent figures calculating 881,000 bicycles in a city of 799,000 residents, there are more bicycles than people.

With such a high proportion of VRUs, Amsterdam is constantly investing in solutions to make sustainable transportation safer. However, though the number of fatal road-traffic accidents in Amsterdam has declined considerably over the past 50 years (from more than 100 victims per year, to around 15), the number of serious injuries has risen. Perhaps unsurprisingly, cyclists account for 56% of those injured on the city's streets – the largest proportion by far.

"In 42% of cases, accidents are caused by mistakes related to right of way," explains Eric de Kievit, senior consultant for traffic and transport research for the City of Amsterdam. "Although these accidents are often a result of human error, we have identified opportunities to reduce accidents by improving the road infrastructure and layout. For example, in some places we have decreased the speed limit and in others we have highlighted who has the right of way."

> "The 'safety in numbers' effect has not been delivered as expected, and we need to know why"
>
> **David Davies, executive director, PACTS**

While road-traffic accidents are also often the result of motorized vehicles speeding and driving through red lights, the city has found that VRUs also frequently fall victim to inadequate road infrastructure.

"Single-vehicle accidents can be caused by anything from bollards to loose paving slabs or soft verges," de Kievit explains. "Last year we removed 2,400 such obstacles."

Amsterdam has already come a long way in improving road safety. The number of black spots, for example, was reduced from

(Above left) **Pedestrian crossings at an intersection in New York City** (Right) **Dedicated cycle lanes in New York separate cyclists from motorized vehicles**

(Above left) **Cycling is the preferred method of transport in Amsterdam**

167 in 2001 to 66 in 2009. However, the city is also struggling to keep up with a growing number of VRUs and, despite efforts, the number of collisions has remained constant.

"We have seen a spectacular increase in bicycles, mopeds and scooters over the past few years," says de Kievit. "All these road users are fighting over limited space."

There has recently been a notable increase in the number of serious moped and scooter collisions. "With mopeds and scooters only used for 1% of all journeys in Amsterdam, the proportion of seriously injured riders is striking [15%]," adds de Kievit, adding that the number of mopeds in the city increased from approximately 8,000 in 2007 to more than 30,000 in 2013. "As moped riders are not required to wear a helmet, these vehicles are very popular with young people aged 16-24."

According to de Kievit, this is most vulnerable type of road user. "These youngsters have a low risk perception; they seek adventure and they drive vehicles that can easily exceed the speed limit," he says. "Our research indicates that 81% of riders regularly exceed the speed limit of 25km/h [16mph]."

Forward thinking

In 2012, the city of Amsterdam released its *Strategic Plan for Road Traffic Safety*, with the aim is to reduce serious road injuries by 25% over the next 10 years. "By 2020, the number of serious injuries must decrease from 120 per 100,000 inhabitants [average for 2007 to 2009], to a maximum of 90 [average for 2017 to 2019]," says de Kievit. "The target for 2015 is a cap of 105 serious injuries per 100,000 people."

> The proportion of seriously injured moped and scooter riders is striking
>
> **Eric de Kievit, snr consultant, traffic/transport research, City of Amsterdam**

A major part of the plan will see greater separation of VRUs and motorized traffic. The city already has 248.5 miles of bike paths, which are largely governed by the *Duurzaam Veilig* (Sustainable Safety) plan, a national vision that was introduced by the Netherlands government in 1992. One of the most important principles of *Duurzaam Veilig* is to reduce the potential for conflict between slow and fast moving traffic, but according to de Kievit, 23% of the 50km/h (31mph) routes on the regional cycle network still do not comply with these guidelines. "Twice as many road-traffic accidents occur on these sections," he reveals.

Other important principals of the vision include the expansion of residential zones, speed reduction measures at potential conflict points and reducing conflicts at junctions.

"Generic measures need to be implemented over a broad proportion of the network and will also include solutions such as pedestrian crossings at tramways," says de Kievit. "Through this approach it is anticipated that accidents will be reduced before specific locations become red routes or accident black spots."

Smart safety

"A prominent cause for conflicts between VRUs and vehicles is the lack of mutual recognition and awareness," says Cristoph Stiller, from the Karlsruhe Institute of Technology. "And the situation is likely to get worse as a result of our aging society – with more drivers and VRUs possessing reduced cognitive capabilities."

Physical separation of VRUs and vehicles is the safest option, but mixed traffic will be unavoidable in many cities for a long time," he continues. "Eventually vehicles will be equipped with sensors that perceive the environment and automatically generate safe driving behavior. Also, vehicles, VRUs and road infrastructure will share knowledge via wireless communication."

While there are already numerous initiatives to enable pedestrian detection via roadside cameras, these solutions can be costly and rely on additional transponder devices.

"I think smartphones with a broadband connection and advanced GPS could be used as mobile sensors in an active safety system for VRUs," describes Stiller. "Also, radio-frequency identification (RFID) tags could be integrated into school bags. The curse with these technologies is that it would be impossible to equip 100% of VRUs and as drivers would come to rely on the automated warnings, the risk could actually increase for unequipped VRUs.

Stiller is working with Ko-FAS on enhanced pedestrian recognition using cameras on experimental vehicles. "Pedestrians are detected automatically from afar, providing greater opportunities to identify that they might want to cross the road," he explains. "The vehicle will then react by informing and warning the driver, or even by automated adaptation of the velocity."

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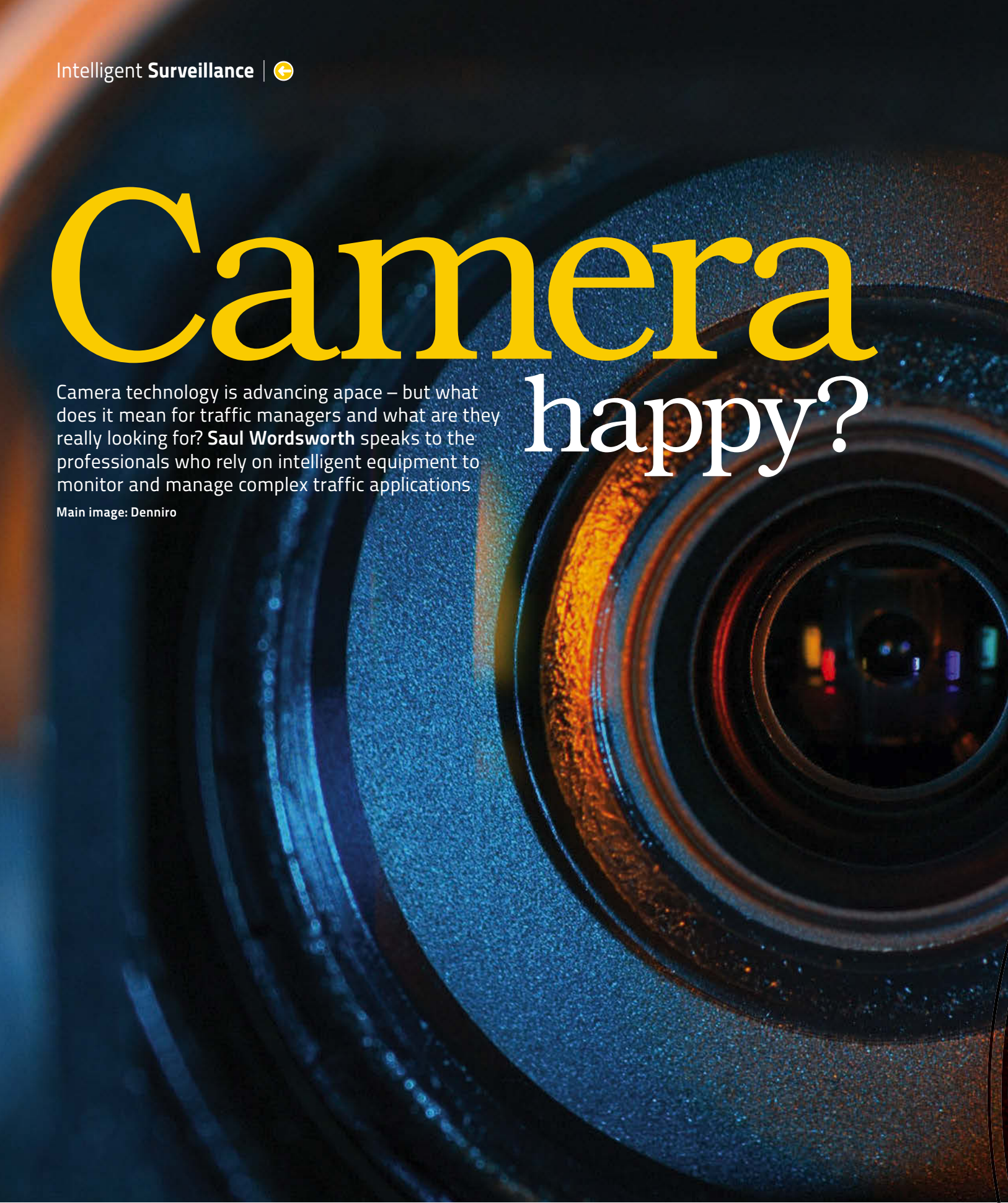
Camera happy?

Camera technology is advancing apace – but what does it mean for traffic managers and what are they really looking for? **Saul Wordsworth** speaks to the professionals who rely on intelligent equipment to monitor and manage complex traffic applications

Main image: Denniro



Situated in the heart of England, Nottingham is a densely populated urban area. And with two major universities, several sporting landmarks and a wealth of cultural attractions, it is also a major tourist destination. To monitor traffic flow within the city – and beyond – Nottingham's Traffic Control Centre (TCC) uses CCTV cameras. The city itself boasts 100 traffic monitoring cameras, 20 of which are currently being converted to accommodate bus lane enforcement.

"We use PTZ cameras, dome cameras with a 360° view, and redeployable cameras that we move around the network for monitoring major events," explains Richard Childs, TCC operations manager for Nottingham City Council. In collaboration with the Woodlands Community Protection team, the local police and the Bus Lane Enforcement team, CCTV is essential for monitoring and managing designated areas and the overall network.

"When it comes to new technology, we are always looking at ways to save council funds," says Childs. "We have numerous analog cameras on Nottingham's network and are considering IP HD cameras with lower bandwidth and improved communications. The cost of streaming is lower than analog technology, and you can see greater distances with more detail. However, if your communications link is cellular 3G the image quality can be sporadic, which is why most cameras have a digital-fiber connection that provides great image quality all the time, although it is very expensive. You can install a great camera, but it's only as good as its communications link."

DoTs continue to invest in cameras, but getting the best deal relies on numerous factors, from the supporting communications network to the margin of error when used with analytics tools

To stay at the cutting-edge of technology, Childs and his colleagues consistently attend seminars and service improvement groups. They meet with camera manufacturers, as well as other control centers and network management teams around the UK, to see what they are doing and to discuss improvement. They have even collaborated on maintenance contracts with other local authorities to reduce costs.

"The advances in technology are truly incredible nowadays," says Childs. "But if you miss something, it will cost you money. We are always looking for ideas, especially

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http://parknet.su/en/

PARKRIGHT

PARKRIGHT ANPR COMPUTER SYSTEM

ParkRightANPR computer system is based on the ParkRightsoftware to register violations of Traffic Code. The computer system is appropriate for using in the passenger compartment of a vehicle. ParkRightcan be set in any car and this does not require much time. An IR projector is supplied so that ParkRightoperates during night hours.

The computer system is used to register violations of parking and stopping; passing crosswalks, fixed-route transport lines, moving to the wrong side and other types of violations that require the vehicle photo with recognized number plate, a photo and video of the surveillance camera to be proved. The video can be divided into frames and printed if needed.

The computer system operates in auto mode, though when registering some types of violations the operator may use the manual control mode. Regardless of the current operation mode, the system inspects automatically all the vehicles, located in the camera control zone, by using the search data base. Once wanted vehicle is registered the operator gets a visual and sound notification of detection. The data received during patrolling are passed automatically from the computer system to the data processing centre using wireless communication lines.

http://parkright.ru/en/

Royalty and the Olympics

When Queen Elizabeth came to Nottingham city center in the summer of 2012 during her Jubilee Year, her final port of call was the Old Market Square. Nottingham had set up redeployable cameras to improve its coverage as there were thousands of people present.

"We opted for 3G communication as it didn't seem right to pay for a fiber link just for one day," recalls the TCC's Richard Childs. "But because there were so many people using social media – on Twitter and Facebook – it brought the network down. It all went dark and we only had a couple of cameras working in the distance."

Different kinds of problems threatened to upset the arrival of the Olympic torch in the city in the same year. On that occasion the traffic control center ensured the lights at the junctions would be green all the way.

"One of the police inspectors monitoring the situation on the ground was worried that traffic would queue across the junction and stop the 30-car entourage," says Childs. "He parked in the middle of the road, causing major traffic queues, and refused to move, only relenting after being handed a phone and spoken to forcefully by a superior officer. If he hadn't moved, there would have been chaos. People don't realize just how experienced we are at managing Nottingham's roads and flushing traffic through signaled junctions," concludes Childs.

in data collection on the roads. We collect a lot of raw data through Bluetooth units on the network and use ALPR cameras for real journey-time monitoring figures. We try to understand where traffic is on the network, send the data to the TCC data room, and regurgitate information so that we can alter the phases of traffic lights and the way the network moves through each junction. Coupled with introducing new HD dome cameras, we're looking at how analytics help the service – functionally that means we can automatically pick up information. You don't need an operator, but instead can automatically monitor certain points on the screens for violations, or traffic-count surveys of how many cars go down key roads."

The team is also looking to upgrade some of the older analog cameras for police use. According to Childs, the inferior quality of some of these cameras is noticeable on the mosaic screens.

"Old cameras cost more to maintain," says Childs. "We can now replace them for less and maintenance is reduced as they are less likely to break down. It's all about moving the business forward – invest now, save in the long term."

Like many in the industry, Childs would like more cameras on the network, as coverage is still low, but he is aware that there is government pressure to reduce the number of cameras because of the belief that local authorities are simply playing Big Brother.

"With HD camera costs being so favorable, an authority can buy 40 cameras for the cost of 20 five years ago," Childs explains. "We are in a better situation than most, but we still miss camera coverage at vital locations. We've got many areas that don't have a camera, but are seeking financial approval to resolve this issue."

> The advances in technology are truly incredible nowadays
>
> **Richard Childs, TCC operations manager, Nottingham City Council**

(Above) **Nottingham's Richard Childs**

(Below) **The PennDOT District 6 Traffic Control Center**

Penn'll tell us

Douglas Tomlinson has been chief of traffic operations for the Pennsylvania Department of Transportation (PennDOT) since 2008. When it comes to finding a video analytics solution to help PennDOT get the most out of its cameras, Tomlinson believes the challenge is in seeking solutions that are highly reliable for a price that makes sense from a cost-benefit perspective.

"I don't think too much technology is ever a bad thing," he says. "It's figuring out how to use it effectively that's the key." PennDOT currently uses 350 cameras in the Philadelphia region and 700 across the entire state to support traffic operations.

"If the margin of error for analytics tools such as traffic counting, incident detection and other features is too high, the user is likely to stop using or relying on the product," Tomlinson details. "For a video analytics product to be valuable to a DOT, operators need to be able to rely on it as a key tool in their traffic management toolbox."

As DOTs continue to install more cameras and reduce manpower, especially during off-hours, PennDOT, like many agencies, is looking for tools to help operators get the most out of available equipment. However, with pricing structures that typically charge on a per-camera basis, it can be difficult to justify the added benefits of a large-scale video analytics program when working with many hundreds of cameras.

"Operating more than 700 cameras isn't cheap and it requires a serious cost analysis to determine things like the benefit of identifying an incident 10 minutes faster than we would have otherwise," he says.

For Tomlinson, the greatest opportunities for video analytics come into play when a regional TCC is supporting other areas of the state. With nearly 350 cameras in the District 6 (southeast Pennsylvania) region alone, and feeds from supported districts bringing the total to over 400, the TCC's video wall can only display so many images at a time. Video analytics can help operators

by identifying potential incidents from cameras that are not currently being viewed.

"Real-time speed data provides another mechanism for incident detection, with information that is updated every minute on all major routes during key hours of the day," Tomlinson explains. "We are building our software tools to take advantage of the benefits of this type of technology as well. Where we are today is nothing compared with where we anticipate being in 10 years' time, when TCCs will have access to feeds from connected and autonomous vehicles. Improving traffic operations has a lot to do with available technology and harnessing the power of available tools."

Wising up in Wisconsin

Wisconsin Department of Transportation (WisDOT) has 370 cameras that are monitored from its State Traffic Operations Center (STOC) in Milwaukee, along with a number of others on arterial roads and at traffic signals. New cameras are being added all the time.

"Increased intelligence in cameras means potentially improved incident detection and verification," says Elizabeth Schneider, a state freeway operations engineer. "The ability to run archived video through video analytics is already offering huge benefits in analysis of intersections and traffic counting. This does require that cameras be high definition with good compression techniques, but they don't necessarily need to be intelligent."

Schneider believes that there remain features or functions that are desired but are not yet available, such as improved fault detection and override schemes, as well as better tolerance for variations in weather. For instance, she claims that there are "units with a camera and microwave combined that seem to be a step in the right direction". The state's tough winter has brought out some particular design and software flaws in some of the cameras in Wisconsin, with lenses icing over in extremely cold temperatures.

> I don't think too much technology is ever a bad thing – it's figuring out how to use it effectively that's the key
>
> **Douglas Tomlinson, chief of traffic operations, PennDOT**

(Above) **PennDOT has 350 cameras across Pennsylvania**

(Below) **Berlin's Traffic Management Centre**

"One vendor is implementing a retrofit kit for the icing problem, and both our vendors are adjusting their software," Schneider reveals. "We've also seen some issues with high winds when cameras were mounted on monotube arms in rural areas. But sometimes it is a question of too much intelligence. There was a case a few years ago where we needed a vehicle detection system, and there were enough features and upgrades in one unit to enable it to function as a standalone controller. The cost was unrealistic for us, but since then the vendor has focused simply on detection and the cost is back in alignment with our needs."

Berlin prefers the loop

VMZ is the private operator of the Berlin Traffic Management Centre. The company has been under contract since 2001, with its current contract running until 2020. Unlike the majority of traffic operators, Berlin depends for the most part on detectors – inductor loops, radar detectors and infrared solutions.

"We have 300 cameras on Berlin's freeways, integrated into our lane and speed control systems," says Ralf Kohlen, project manager at VMZ. "Their purpose is to find the reason for traffic jams or other problems, and the detectors provide us with all the other information. With more than 1,000 detectors on motorways and major roads, so we have a comprehensive picture of the traffic

Decisions Down Under

Network cameras – also known as IP cameras – connect a video camera direct to a computer network delivering HD quality video over an IP network. The video stream uses very efficient compression that is ideal for minimizing storage requirements while maintaining high image quality. In the security industry, this has created a revolution from analog to digital based on open IP standards. ITS now enjoys the very

same benefits of HD-quality video using very efficient compression and intelligent image analysis inside the cameras.

Main Roads Western Australia currently has 240 CCTV cameras installed to monitor traffic on freeways, highways and strategic intersections. They are used to monitor traffic flow and congestion, as well as assist with detection, verification and management of incidents impacting the road network. Most cameras are PTZ and all were recently upgraded to IP-based digital technology. The authority is now considering analytics.

"With the number of CCTV cameras installed increasing, it becomes nearly impossible to be able to display all the images," says Albert Symcox, Main Roads' manager of traffic management services. "Having a system that enables a particular camera image to be displayed when an incident is detected will assist greatly. We envisage that implementation of video analytics in the future will assist operators to investigate events and traffic incidents, and to identify vehicles. However, you have to be careful; these days everyone has a camera in their pocket. It has become a way of life to expect instant vision of every occurrence. There is sometimes pressure to capture and release images that may be irrelevant to the original purpose of the camera's provision."

situation. For us, radar detectors are more effective than cameras. Cameras are limited by staff numbers, interpretation and even fog."

Of course, sometimes radars and loops are not enough. During the 2006 FIFA World Cup, Berlin experienced problems on the road to the Olympic Stadium and had no way of knowing the cause.

"The traffic load was normal and, as far as we could see, there was no accident. But there were jams," recalls Kohlen. "When in 2009 the state of Berlin installed 40 cameras on streets near the Olympic Stadium, we understood – the jams had been caused by demonstrations or people partying on the streets. There is no question that cameras are still useful to us. My perfect camera would be HD to identify the problem, with tilt, shift and zoom, but also having ALPR, a good stream so that you can see moving cars, and fully protected to prevent the connection from camera to center being hacked."

> Without cameras, I'd have six engineers on the street searching for problems, then reporting back to the control room
>
> **Jayesh Parmar, team leader for traffic engineering and area traffic control, Leicester City Council, UK**

Remembering the old times

Nowadays, traffic camera images are displayed in color, but 18 years ago they were black and white. "This means you can still see vehicle number plates, people's faces and the road layout after 9:00pm," says Jayesh Parmar, team leader for traffic engineering and area traffic control at Leicester City Council in the UK. "The digital side of it has improved vastly, with CCTV now interfaced with an urban traffic control system. In the control room we've got 24 monitors. If you have 100 cameras, you can't put them all on the monitors. Instead, monitors move to the congestion automatically when it picks it up. It's a case of intelligent systems working together."

Over the next five years, Leicester is looking to invest heavily in redeployable cameras. They will initially be installed on a temporary basis, with a view to going permanent if the need is there. As for the overall impact of modern camera systems, Parmar feels there is no comparison.

"Twice a month, football traffic enters and leaves the city," he says. "Without cameras, I'd have six engineers on the street searching for problems, then reporting back to the control room. In 1990 our engineers would leave the office at 4:00pm, head out looking for issues, and report back with, 'Can you give more green time to the main road?', 'Take it off now', 'There's an incident', and so on. Today we can tap into CCTV and react quickly. In the past you had to get there by car – and probably couldn't because of the congestion you were trying to fix!"

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Fast forward

While it remains uncertain when NHTSA will follow through with its recently announced plans to bring V2V communication to light vehicles, **Siegfried Mortkowitz** asks the experts how this accident-preventing technology is likely to become a reality

Photo: UMTRI

The announcement in early February by the US government's NHTSA that it would begin initiating a process to bring V2V communication to light vehicles has kicked up almost as much debate as enthusiasm. The agency said it was completing analysis of data from its year-long Connected Vehicle Safety Pilot Program, which was conducted with the University of Michigan Transportation Research Institute (UMTRI) in Ann Arbor and involved 2,800 vehicles. NHTSA says that by alerting drivers about imminent risks and hazards – especially those outside the driver's line of sight – the technology can prevent many common crashes, such as rear end, lane change and intersection collisions.

In comments made at January's International Consumer Electronics Show (CES) in Las Vegas, outgoing NHTSA administrator David Strickland said that if the technology is "linked with active in-vehicle technologies, V2V has the potential to help drivers avoid or mitigate crashes in 80% of the vehicle crash scenarios involving unimpaired drivers".

One example of that, according to Zachary Doerzaph, director of the Center for Advanced Automotive Research at the Virginia Tech Transportation Institute, is in the use of EEBL (emergency electronic brake lights), a V2V application that transmits a specific signal to following vehicles if the driver is forced to brake suddenly and hard.

If the scenario warrants it, following vehicles equipped with V2V technology would then generate an alert to the driver. "It is specifically designed to mitigate multicar pileups," says Doerzaph.

(Above) **Infrastructure-mounted communications system in UMTRI's Safety Pilot Model**

These alerts could take the form of flashing LED lights in the dashboard or rearview mirrors, audible warnings, or haptic feedback in the driver's seat – or any combination.

Trials and tribulations

During a demonstration of the technology on a V2V-enabled Ford Taurus at this year's CES, Farid Ahmed-Zaid, a technical expert for global driver assistance at Ford's Active Safety Department, said that the dedicated short-range communications (DSRC) technology picks up signals from other V2V-equipped vehicles within 250-450m.

The transmitted information includes vehicle speed, some vehicle-driver inputs, brake-light switch and turn signals.

"That data is added to the GPS information and packaged into one message," Ahmed-Zaid said. "You're going to know there's something here, and it's moving that fast and in this direction, and you're going to have

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Photo: UMTRI

that information 10 times a second," he explained.

There are also trials underway using a rapid brake pulse of 500ms. "This would provide a warning to the driver through the braking system of the car," explains Doerzaph. "It wouldn't stop the car, or even slow it very much, but it would prime the brakes and elicit a braking response from the driver."

However, all these lights, sounds and vibrations come with potential risks to the driver, warns Dave McNamara, president of McNamara Technology Solutions. "We want to improve the control of the vehicle," he says, "not add to the distraction."

An elusive timeframe

The early February NHTSA announcement also said that once the results of the testing were made public, the agency would "begin working on a regulatory proposal that would require V2V devices in new vehicles in a future year".

That strongly suggests that the USDOT has already decided to seek some sort of mandate, similar to the January 1, 1968 law that required all vehicles except buses to be fitted with seatbelts. However, it may not be weeks, but rather months, before NHTSA makes its findings public.

Doerzaph suggests that the agency was being prudent. "There are fairly strong indications that they will pursue regulatory actions," he says. "But they're trying not to go too fast, so as to avoid backlash and resistance.

"The regulatory proposal, when it comes, will provide more details about what parts of the V2V system they will approve," Doerzaph continues. "The timeline will be an important part of the announcement. It will be years before the mandate becomes real."

> V2V has the potential to help drivers avoid or mitigate crashes in 80% of the vehicle crash scenarios involving unimpaired drivers
>
> **David Strickland, NHTSA administrator, USA**

(Left) **UMTRI is testing V2I sensors mounted on gantries**

According to news reports, DOT officials said they plan to implement the policy by 2017 and McNamara estimates that it will take 12 years after the announcement of the mandate for the technology to reach 100% penetration among light vehicles. (To put that into perspective: Nissan's CEO, Carlos Ghosn, has said that the Japanese car maker will put an autonomous car on the market by 2020, which could render the mandate superfluous.)

"OEMs will need to have designs in their plans now," says McNamara. "So this was a strong nudge to move something into their product pipelines – most likely as an addition to existing ADAS on their luxury models. By then, commercial apps and vehicle-to-infrastructure [V2I] communication using DSRC will be on the road."

DSRC, 4G LTE or lidar?

For the time being, the DOT is banking on DSRC as the basis for both V2V and V2I communications. One aim of the Ann Arbor testbed was to determine if DSRC was reliable and if its use in V2V led to a decline in traffic accidents in real-world situations.

However, already being considered or tested are alternatives to DSRC such as the 4G LTE high-speed wireless networks and Google's roof-mounted Velodyne Lidar vision-sensor system.

But 4G LTE is not an alternative, according to McNamara. "It's not certifiable and not robust enough."

In addition, Doerzaph says DSRC has a powerful advantage over LTE. "Privacy and security are inherent in the DSRC design, but not necessarily in 4G LTE," he explains. "It's more possible that a government could track your position with 4G LTE. It is not put

Progress in Michigan

In April 2014, UMTRI, along with the federal and state transportation departments, announced plans to equip 9,000 cars in Ann Arbor, Michigan, with wireless communications technology.

These cars (approximately 10% of the city's driving population) will wirelessly communicate with each other and roadside infrastructure, including traffic lights and intersections. Some of the vehicles will also have the ability to use the wireless systems to alert the driver to danger or traffic.

UMTRI began the research project with 2,800 cars in August 2012 after receiving an 18-month grant from the USDOT. The agency has extended the contract by six months and has promised to renew the safety pilot project for a further three years when the existing agreement expires in September.

USDOT funded US$28m of the initial US$31m start-up cost of the study, and UMTRI expects the federal government to commit a further US$10-18m for the project's next stage. The University of Michigan is currently looking for industry funding partners in order to triple the size of the study by 2016.

After that, UMTRI and the Michigan DOT are planning to increase the number of connected cars to 20,000, grow the testing area to all of southeast Michigan and install wireless technology in infrastructure along the region's major corridors.

In addition, the university has recently begun work on a Mobility Transportation Center that will include a US$6.5m connected-vehicle test track. The facility will include building façades, street and traffic lights, replica parking meters and detailed signage that will all be equipped with V2X technology.

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together like DSRC, which can't be tracked because nothing identifying is transmitted.

"Furthermore, any time we allow any access over wireless, it opens the possibility that it could be hacked," Doerzaph continues. "Cyber security needs to be designed at the beginning. This is a critical factor when it is tied to control of the car. Hacking is less important when the system only allows warnings, like the current DSRC-based V2V systems."

However, the Velodyne Lidar sensor, used by Google on its driverless cars, may be a more formidable alternative to DSRC, if for no other reason than it eliminates security and privacy concerns. "There are no privacy issues with the Google autonomous sensors," McNamara confirms.

"Traditional sensor-based systems are great, but they are expensive, though they will certainly get less so over time," adds McNamara. "And they all have limitations; for example, they all require line of sight."

That would make them almost useless in any scenario where the drivers do not see each other.

Ford's Ahmed-Zaid underlined the crucial importance of this feature at CES. "OEMs have been working on this for 10 years – it's ideal for those scenarios where you can't see the threat," he said. "DSRC, being wi-fi based, can go through buildings sufficiently to give a warning to the driver."

"V2V is really just another sensor," Doerzaph says. "But it is inexpensive, requires little computational power, enables many applications with different goals and can be used to share information about intent, rather than traditional sensors, which can only respond to actions that have already been taken.

"In an automated world, I'd expect both autonomous sensors and connected vehicle capabilities to be present," he adds. "Assuming automated control of a vehicle is a very complex and very risky endeavor. A robust approach using sensor fusion to ensure reliability is required to create a safe automated environment."

(Above) **Connected vehicle technology will reduce crashes involving light vehicles and heavy vehicles** (Below) **V2V technology will help to reduce crashes at intersections**

Penetration is key

Once V2V becomes a reality – and no one doubts that it will – it will be vital to have it accepted as quickly and broadly as possible, since any vehicle on the road not V2V-enabled will increase the risk of accidents and decrease the effectiveness of the technology.

"We must reach a critical mass of deployment," says McNamara. "That means getting enough sensors on the road and gaining customer acceptance. The question is: will they pay for technology?"

Doerzaph is more pessimistic about the timeframe for full V2V deployment, putting it at 20 years after a mandate is announced. "People are going to keep driving old cars," he observes. "They have sentimental value and it's fun."

What's more, passenger cars are not the only vehicles involved in road accidents, and NHTSA has already been taken to task for not including trucks in its regulatory process. In a recent blog, Roger Lanctot, associate director of automotive multimedia and communications for Strategic Analytics, criticized this omission. "What specifically did not happen [in the NHTSA announcement] was a mandate for DSRC technology to be required for FMCSA class 6, 7 and 8 commercial vehicles and emergency vehicles," he wrote.

In his view, this could have a very negative impact on the technology. "By the time DSRC makes it to market, it is highly likely that competing technologies will already have been adopted via market mechanisms, rendering DSRC irrelevant," he wrote. "The one thing NHTSA could do to change this depressing prospect is to require the implementation of the technology in the commercial vehicle segments where it has the relevant authority."

McNamara agrees that not including commercial vehicles was a mistake. "They should have spoken about commercial vehicles first," he says. "Commercial fleets can afford it, and the federal government can make rules across fleets because it involves interstate commerce." He believes commercial vehicles were omitted because NHTSA partnered with the Crash Avoidance Metrics Partnership – Vehicle Safety Communications (CAMP VSC3) in the V2V testing. The CAMP VSC3 consortium consists of R&D segments from eight passenger OEMs, including Ford, GM, Mercedes and Nissan. But he does not see the omission of

> Assuming automated control of a vehicle is a very complex and very risky endeavor
>
> **Zachary Doerzaph, director, Virginia Tech Transportation Institute, USA**

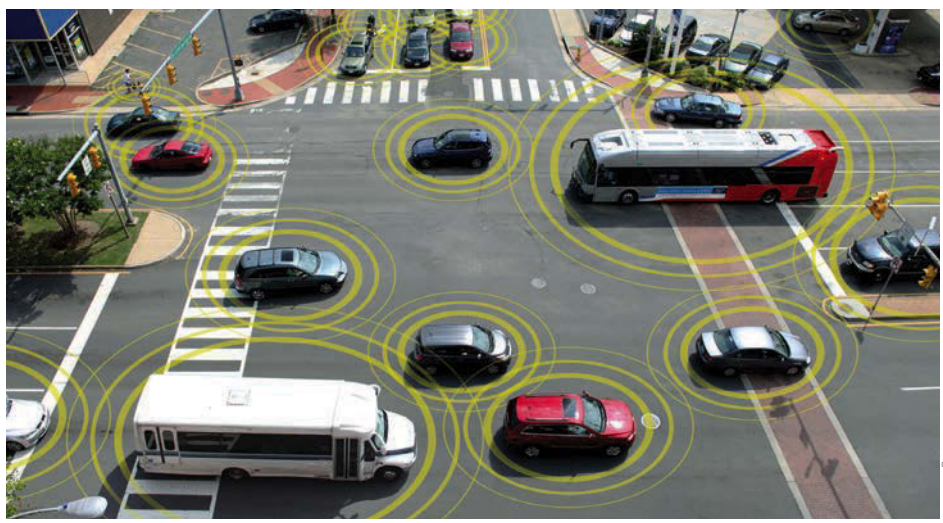

Image: USDOT

trucks as a major problem. "You can do commercial vehicles immediately," he says. "They would just add the equipment."

Doerzaph identifies that motorcycles would also benefit from the technology. "Here, you have a looked-but-didn't-see situation," he says. "The alert would catch drivers' attention when they don't see a bike. It makes sense for motorcyclists to send their positions."

Public opinion

Consumer acceptance of the new technology is a vital element of its deployment, and deploying a critical mass of V2V-enabled vehicles is vital to its functioning as intended. But as many OEMs have already discovered, consumers are not eager to spend money on safety features; they assume that safety technology should be standard equipment. In addition, the issue of privacy, as it has been perceived by the public and a number of libertarian commentators, is a factor in consumer acceptance that cannot be taken lightly.

Still, at the CES, Ford's Ahmed-Zaid described V2V as far from threatening. "If you're within 450m you're going to detect that vehicle," he said. "But you're not going to know if it's a Taurus or its license plate number. Everything's anonymous."

"However, the question is, who's using the data?" McNamara says. "The answer? Another car." It certainly raises the possibility of a driver or the police combining a visual sighting of an automobile with its V2V communication and tracking the vehicle that way.

More pressing is the need to convince consumers that the technology actually works and is worth the cost. "We're trying to find the best way to include security and still have a system that's deployable," Ahmed-Zaid said at the demonstration. "We need to find a reliable security system and make sure the vehicles can download the credentials. This could be complex and costly."

Security is essential to how well V2V works in preventing crashes, especially as it concerns the accuracy of the information communicated from one vehicle to the next. This is of great concern to OEMs and will require some time to work out. "There's a whole certification process that needs to happen so you can warn the driver properly," he explained.

(Above) **Connected-vehicle technology enables cars to communicate with traffic signals**

The future is now

These questions will no doubt be raised, and answered, as interested parties wait for NHTSA to move the regulatory process forward. In the meantime, OEMs will continue to develop the technology. Because each brand of car must be able to speak to every other brand of car, the technology requires a large degree of interoperability.

"Each car manufacturer will be focused on differentiating on HMI – how each OEM deals with the impact of the alerts on the driver," says Chris Ruff, CEO of UIEvolution, a provider of cross-platform connected device solutions. "This will become an important differentiator as the car becomes more autonomous."

> We're trying to find the best way to include security and still have a system that's deployable
>
> **Farid Ahmed-Zaid, Ford Active Safety Department, USA**

At the same time, some US states are already working on implementing DSRC technology in basic V2I functions to improve traffic flow, and reduce gas consumption and vehicle emissions.

According to McNamara, Florida, Texas and New York will start to deploy wireless communications at intersections, to coordinate traffic light signaling and harmonize traffic speed – the so-called green wave. "This will provide a lot of immediate benefits," he says.

It seems inevitable that, with or without a government mandate, cars will soon be speaking to other cars or, at least the surrounding traffic infrastructure.

This article is based on a white paper published by Telematics Update. The company's Advanced Automotive Safety event will take place July, 8-9, 2014 in Michigan, USA, where Zachary Doerzaph will be speaking about consumer attitudes towards advanced automotive safety

Fear factors

While the results from an April 2014 poll conducted by UMTRI indicate that the majority of people in the USA, the UK and Australia believe that connected vehicles will make driving safer, it also told of concerns about privacy and security.

Some 30% of those questioned said they are 'very concerned' about security breaches from hackers, and about data privacy in tracking speed and location. Another 37% are 'moderately concerned'. In addition, most expressed concern about system failure and performance, and about drivers relying too much on the technology or being distracted by it.

Despite concerns, about 75% of respondents believe that connected vehicles will reduce the number and severity of crashes, improve emergency response times and result in better fuel economy. In addition, more than 60% expect less traffic congestion, shorter travel times and lower emissions.

Americans were shown to have a lower overall opinion of V2X compared with Britons and Australians. They are also more concerned about security and data privacy.

More than 80% of respondents specified safety as the most important aspect of connected-vehicle technology, compared with mobility and environment, and 80% also said that integrating personal communications devices with vehicle technology is important to some extent.

"We were surprised to find such similar opinions across all three countries," says Brandon Schoettle, project manager for sustainable worldwide transportation at UMTRI. "Most people were optimistic about V2X technology and expressed a desire to have it when it becomes available. The main concerns were around system performance and data security/hacking.

"We also found a strong relationship between prior knowledge and a positive impression of the technology," Schoettle continues. "This suggests that the more informed the public are about connected vehicles beforehand, the more accepting they will be when it is implemented on a large scale."

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Inside information

Jim Gunn explores the benefits and applications of small cell technologies in ongoing connected and autonomous vehicle initiatives

Photo: USDOT

(Above main) **In-car warning devices will help drivers to avoid crashes** (Above inset) **High-speed and reliable network connectivity will enhance navigation**

Within our modern world of rapid technology evolution, communications and transportation technologies present an exciting opportunity to enhance our quality of life and economic output. Specifically, ongoing potentially synergistic activities in commercial 4G cellular, connected vehicles and autonomous (driverless) vehicles appear on track over the next 10 years to offer society a more productive work and personal environment. 4G cellular refers to the accelerating deployment of Long-Term Evolution (LTE) for enhanced mobile data speed and capacity (broadband).

A key LTE initiative is small cell technologies. Connected vehicles and autonomous vehicle activities promise to more effectively extend communication to individuals as they drive and, in a longer time frame, to enable driverless vehicles.

There are many advantages to using commercial LTE services and technologies (where applicable) in public sector communications services, systems, equipment and devices. A major benefit is the economies of scale that the international cellular operators and supporting ecosystems command. The lowest cost and most advanced technologies will generally be in this ecosystem. Industry reports indicate that worldwide there were approximately 6.9 billion cellular subscriptions at year-end 2013 (world population approximately 7.14 billion). Cellular handset sales are estimated to have been approximately 1.7 billion units in 2013.

The cellular ecosystem includes suppliers of systems; equipment; handsets, tablets and other user devices; semiconductor devices, etc. Cellular is an attractive, high-volume opportunity for successful players at all levels. LTE is in the early years of international deployments (three to four years) and is estimated by GSA.com to have had 191 million subscriptions at year-end 2013 and to grow to 1.3 billion by year-end 2018. Almost all industry pundits forecast that LTE will become the international cellular technology of choice and that other cellular technologies will eventually be phased out.

The term 'connected vehicles' refers to technologies and services to provide drivers in their car with internet access. Many drivers are already connected to the internet in their vehicles via their cellular smartphones or tablets, often with Bluetooth access to vehicle voice-

> Almost all industry pundits forecast that LTE will become the international cellular technology of choice and that other cellular technologies will eventually be phased out

recognition dialing and hands-free talking features. Connected vehicles extend this by integrating car wi-fi access and by adding more extensive integration with the user interface and other vehicle functions to enable infotainment, convenience features and safety. Cellular operators can provide services via cellular bands and, if desired, integrated with in-vehicle cellular terminal devices.

'Autonomous vehicles' refers to ongoing initiatives to develop and deploy driverless vehicles that provide traditional automotive transport capabilities. The goal is autonomous vehicles equipped with sensing, navigating and communications subsystems that drive vehicles from origin to destination without human intervention.

New policy

While tests and demonstrations are ongoing, many international government authorities have expressed interest in accelerating mass deployments. In a May 30, 2013 policy release, the US Department of Transportation's National Highway Traffic Safety Administration (NHTSA) announced a new policy concerning vehicle automation, including its plans for research on related safety issues and recommendations for states related to the testing, licensing and regulation of autonomous vehicles. In this release, NHTSA defined vehicle automation as having five levels:

No automation (Level 0): The driver is in complete and sole control of the primary vehicle controls – brake, steering, throttle and motive power – at all times.

Function-specific automation (Level 1): Automation at this level involves one or more specific control functions. Examples include electronic stability control or pre-charged brakes, where the vehicle automatically assists with braking to enable the driver to regain control of the vehicle or stop faster than possible by acting alone.

Combined function automation (Level 2): This level involves automation of at least

Below, from left to right) **The 2015 Audi A3 will offer a 4G LTE wireless data connection; Ford's integrated SYNC system enables drivers to perform actions using voice commands; the 2015 Volvo XC90 will have fully autonomous parking**

Photo: Audi

Photo: Ford

Photo: Volvo

Photo: Google

Google began testing its self-driving cars on public roads in 2010

two primary control functions designed to work in unison to relieve the driver of control of those functions. An example of combined functions enabling a Level 2 system is adaptive cruise control in combination with lane centering.

Limited self-driving automation (Level 3): Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions, and in those conditions to rely heavily on the vehicle to monitor for changes, requiring transition back to driver control. The driver is expected to be available for occasional control, but with sufficiently comfortable transition time. The Google car is an example of limited self-driving automation.

Full self-driving automation (Level 4): The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. Such a design anticipates that the driver will provide destination or navigation input, but is not expected to be available for control at any time during the trip. This includes both occupied and unoccupied vehicles.

Some currently available vehicles have lower levels of automation, but commercial availability of Level 4 automation will be in the future as much standards development, testing, demonstrations, supporting regulations and policies, supporting infrastructure deployment, vehicle upgrades and production must still be accomplished.

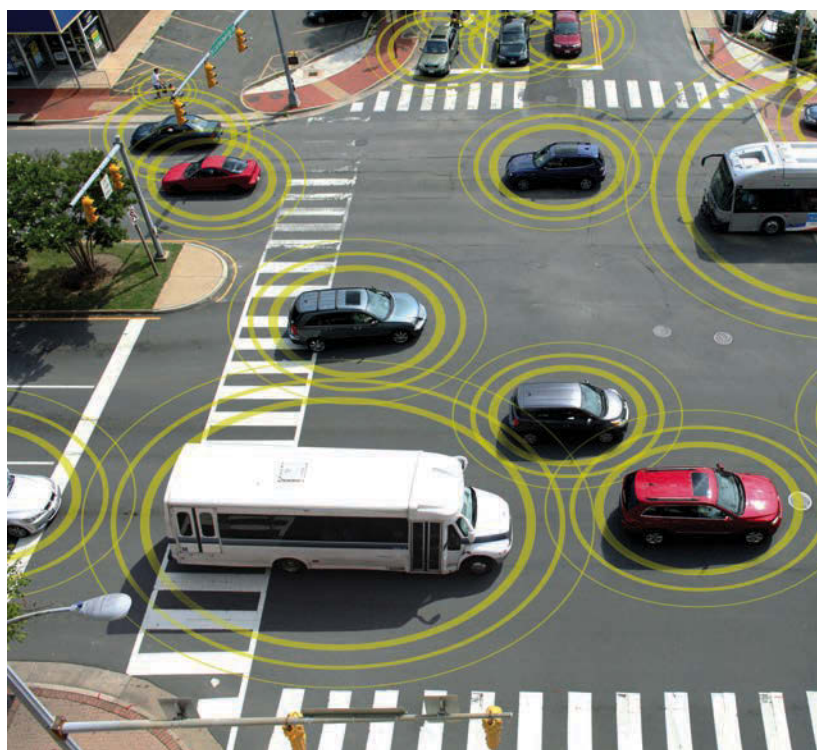
An integrated approach

Small cell technologies offer benefits that are applicable to connected and autonomous vehicle initiatives. Historically cellular operators have deployed macro cells (radius two miles or more) that provide coverage over large areas. As high-speed mobile data usage on smartphones and tablets has gained popularity, the capacity of cellular macro cell networks has become inadequate to handle the load. Small cells (radius of about 10ft to two miles) can be deployed underneath a macro network overlay to off-load data. Some estimate that small cells can offload up to 80% of required capacity from macro cell networks. [1]

Different types of small cells include femtocells, picocells and microcells, and can include in-building cells, stadium cells and related venues. The cellular community also has initiatives to use wi-fi offload that offers the advantage of not consuming capacity in the licensed cellular RF frequency bands. It should be noted that small cell technologies can also provide coverage in areas of poor macro cell coverage. With the cellular economies of scale, supporting ecosystems and overlapping user communities, it seems

Images: USDOT

Connected vehicle technology enables cars to 'platoon' at the same speed (right)**; vehicles to communicate with road infrastructure** (far right)**; and also enhances safety and awareness at intersections** (below)



4G LTE opportunities

There are numerous benefits associated with the adoption of 4G LTE:

- Use of high-volume LTE services, systems, subsystems, chips and software technologies;
- Distributed Antenna Systems (DAS) technologies that greatly improve capacity and coverage;
- Commercial LTE-enabled terminals (e.g. smartphones and tablets) can serve many public sector/ITS applications;
- Lower-cost, high-volume LTE terminal subsystems and chips can often be cost-effectively repackaged and enhanced to meet unique public sector requirements;
- Lower-cost, high-volume LTE base station subsystems, backhaul and chips can often be cost-effectively modified, repackaged and enhanced to meet public sector requirements;
- Software enhancements can often address unique PS/ITS requirements without expensive hardware changes;
- PS/ITS LTE applications can use commercial services or, where required, can be deployed in dedicated PS/ITS frequency bands (assuming they are available) and deployed and operated by PS/ITS entities.

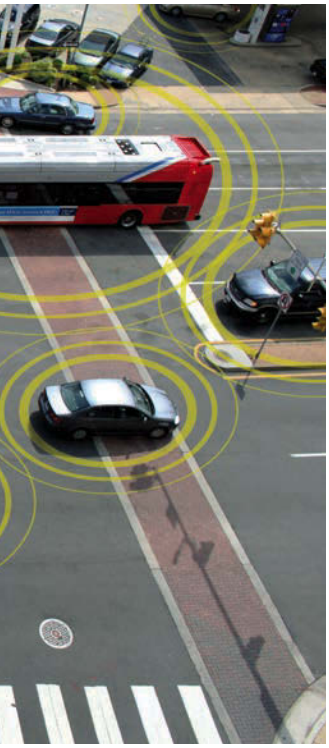
Image: Mercedes-Benz

(Above) **Car-to-X communication is a part of Mercedes-Benz's Intelligent Drive strategy** (Right) **USDOT Secretary Anthony Foxx is behind the authority's recent decision to pursue V2V technology**

irrefutable that the public sector/intelligent transportation system (PS/ITS) communities should have synergistic initiatives for tailored small cell applications.

Connected vehicle applications include services that are more suited to commercial operators and others that are better for public sector organizations. For example, it can be envisioned that many infotainment and convenience services might be most suitable for cellular operators, and safety and travel services might be best for the public sector.

> Small cell technologies offer benefits that are applicable to connected and autonomous vehicle initiatives



Light vehicle manufacturers have great interest in connected services that would provide substantially improved post-sale customer presence. One service that manufacturers could provide is over-the-air (OTA) updates for vehicle software. Each stakeholder has unique connected vehicle interests and essential resources that must be offered in a cost-effective integrated manner to attract and provide value to consumers. Future public-private partnerships should evolve to address these opportunities. Especially important is an integrated approach for scarce RF spectrum resources and safe vehicle user interfaces for these applications. LTE small cell technologies, with appropriate tailoring modifications and enhancements, offer compelling benefits to help enable successful connected vehicle deployments.

Autonomous vehicle initiatives will add new sensor and communications requirements in vehicles. To enable autonomous (driverless) operation

Effective cooperation

Emerging 4G LTE small cell technologies enable new opportunities. As DSRC deployment is a required enabler for autonomous vehicles, tailored small-cell co-deployments seem to be an essential complementary enabler. The primary purpose of DSRC is to enhance safety. It is being specified and designed to provide high-speed, low-latency, short-range, and highly reliable communications links for V2V and V2I. As such it will not necessarily be able or best suited for all other vehicle communication functions.

Also, commercial services by non-PS entities can be integrated to provide safe in-vehicle user interfaces.

Small cells can be co-deployed with DSRC and share backhaul and other required resources as well as address communications requirements not well suited for DSRC. This strategy should provide added incentives to motivate public-private partnerships to provide enhanced communication coverage and capacity. Tailored small cells could be deployed along urban, suburban and rural freeways, highways and streets. Lower-cost small cells leveraging commercial sector LTE R&D and developments, with appropriate PS/ITS enhancements, should be most cost-effective due to economies of scale.

Important LTE-supporting technologies include distributed antenna systems (DAS) that can be adapted to address unique requirements. Adoption of 4G LTE self-configuring technologies should also prove beneficial in PS/ITS applications.

Photo: Ford

(Left) **The Ford Fusion Hybrid research vehicle has four lidar sensors to generate a real-time 3D map of the surrounding environment**
(Below) **Ford's V2V communication system warns drivers about hazards that may not yet be visible**

a vehicle must include sensor technologies to sense its environment, as well as map and location technologies to facilitate self-navigation. Cameras, radar, lidar (light detection and ranging) and laser technologies are being used in tests by various parties to sense the environment. GPS with appropriate enhancements is a key element of self-navigation. However, GPS must be enhanced by data from local communications infrastructure to acquire sufficient local map, location, signage and related data to enable autonomous driving.

Standards, safety and success

Key initiatives to enable autonomous vehicles are vehicle-to-Vehicle (V2V) and the vehicle-to-infrastructure (V2I) communications links to enable vehicles to exchange real-time data with other vehicles and roadway infrastructure. These links must meet stringent requirements for low latency, capacity and speed (although latency is probably more critical), multivehicle multiple access, reliability, privacy, MTBF (mean time between failures) and related specifications needed to ensure the safety of the public in autonomous vehicles. The community has developed DSRC (dedicated short range communication) technologies for these applications.

Standards and regulations have been set forth by the US FCC and ISO. These technologies and standards are enhancements to the widely deployed wi-fi. The IEEE has approved an amendment, 802.11p, to the IEEE 802.11 standard to add support for wireless access in vehicular environments (WAVE). In 1999, the FCC allocated 75MHz of spectrum in the 5.9GHz band to be used for ITS purposes such as V2V and V2I. Vehicle safety is the stated top priority for this spectrum. In 2008 Europe's ETSI allocated 30MHz of spectrum in the 5.9GHz band for these purposes.

> Connected and autonomous vehicles, as well as commercial 4G cellular initiatives, will require substantial deployment of communication assets to enable applications in all desired geographies

Photo: Ford

Of recent importance is an announcement on February 3, 2014 by NHTSA stating: "…it will begin taking steps to enable V2V communications technology for light vehicles. This technology would improve safety by allowing vehicles to 'talk' to each other and ultimately avoid many crashes altogether by exchanging basic safety data, such as speed and position, ten times per second."

Connected and autonomous vehicles, as well as commercial 4G cellular initiatives, will require substantial deployment of communications assets to enable applications in all desired geographies. Substantial partnership opportunities will exist that will include a variety of stakeholders from the public and private communities. A conclusion, perhaps debatable, is that desired successes will not be achievable without appropriate partnerships.

1. http://en.wikipedia.org/wiki/Small_cell#cite_note-Small_cells_traffic_offload-8

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Joined-up thinking

As the need to reduce vehicle CO_2 emissions becomes more urgent, **Max Glaskin** looks at how authorities around the world are using cooperative systems to ensure that air quality targets are met

Illustration: Infomen

The days of the autonomous driver are numbered, if the effort being put into cooperative systems is any indication. The critical need to reduce road vehicle emissions means the human being at the wheel will be just one of the elements receiving and sharing information before taking action to cut tailpipe greenhouse gases (GHG). The other nodes will be digital, embedded in vehicles, roadside equipment, smartphones and traffic management centers.

According to the *Inventory of US Greenhouse Gas Emissions and Sinks 1990-2011* (the national inventory prepared by the USA under the United Nations Framework Convention on Climate Change (UNFCCC)), the transportation sector represented 27% of total GHG emissions in the country in 2011. Within the sector, light-duty vehicles (including passenger cars and light-duty trucks) were the biggest culprit, accounting for 61% of GHG emissions, while medium- and heavy-duty trucks were responsible for 22% of emissions.

Europe is also culpable. Road transportation contributes about 20% of the European Union's total emissions of CO_2, the main GHG, with cars and vans producing around 15% of the total. Despite the manufacturers of new trucks, vans and cars improving fuel efficiency, total road transport emissions on both sides of the Atlantic continue to rise. As a result, a systemic attack on the problem is well underway. Everything that can influence emissions is being asked to cooperate with everything else to maximize benefits – vehicles, smartphones, roadside equipment, traffic control networks and centers and, almost incidentally, the driver.

Simulation success

The development of cooperative systems is being tackled at every level and, appropriately, often cooperatively, from international framework agreements to individuals researching solutions, with near-market and commercial players taking part. A key piece of the jigsaw is ECOSTAND, which aims to help the EU, USA and Japan agree a common way to assess the impact of ITS on CO_2 emissions.

"[The fact that there are] different assessment methods and models in the three regions makes it difficult to compare the results and hampers decision making," says project coordinator Martin de Kievit of TNO, the Netherlands.

In parallel, the EU-funded ICT-Emissions project has been developing new methods to evaluate the impact of ICT on CO_2


STOP
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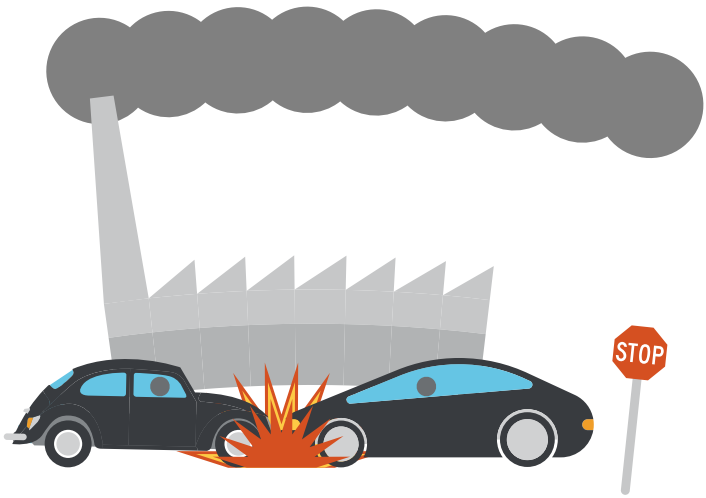


emissions in transport. One way the consortium, which includes Fiat and Iveco, is doing this is by developing a simulator that shows how emissions might change if light vehicles have elements of a cooperative system, including adaptive cruise control, advanced driver assistance, V2V and V2-traffic signal communications.

The Daimler Center for Automotive Information Technology Innovations (DCAITI), Berlin, has also produced simulation software to model the effects of cooperative systems in various scenarios. It has already been used to evaluate intelligent V2X-based navigation in which traffic was directed away from congestion. The simulation helped optimize the algorithms, thereby reducing travel time and vehicle emissions.

Simulators are useful because it can be easier to bring together ADAS, ACC, V2X and driver behavior models in a virtual world than to test cooperative systems in the real world. Ten years ago, DaimlerChrysler loaded an S-Class Mercedes with hard drives and sensors and drove it on a short route round Stuttgart. The car predicted when speed limits, gradients and traffic would require it to decelerate and could tell the driver so far in advance when he could step off the gas and freewheel, saving fuel.

(Below) **Traffic jams are a major source of pollution in urban areas**

The company spent about €1m (US$1.4m) on its predictive car, but even though it promised an emissions reduction of 11%, it would have been extremely difficult to advertise the fuel-saving benefits because they wouldn't show up during the rolling road tests that are used for official fuel-consumption figures. That's another reason why the methodology for assessing the impact of cooperative systems needs to be standardized.

"Currently there is no standardized method for estimating the impact of ITS measures on CO_2 emissions," says Gerdien Klunder, who is coordinating the EU-funded Amitran project, which is creating a methodology to estimate well-to-wheel CO_2 reductions achieved through ITS and will publish an online checklist and handbook this year. "Different projects and organizations are free to employ various methodologies, which leads to difficulties in comparison and benchmarking, perhaps even inaccuracies," she adds.

Collaboration for cooperation

Amitran has already ranked the likely impact of cooperative system technologies on CO_2 emissions, predicting that adaptive cruise control (ACC), cooperative ACC and predictive cruise control will produce the best results. Adaptive signal control, collective rerouting, dynamic parking guidance, junction control and automated speed enforcement, meanwhile, will give middling CO_2 reductions.

When cooperative systems are in place, the findings from the CarboTraf project can be implemented. It's creating a decision-support system so that ITS can adaptively influence traffic in real

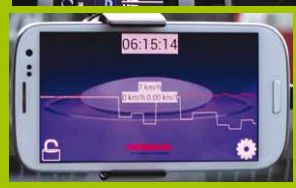
Going live

The police in Jakarta, Indonesia, have been guinea pigs for a smartphone app that Honda has developed for cooperative systems and emissions reduction.

According to Takamasa Koshizen and Hiroyuki Koike of Honda Motor R&D Center, Japan, the app monitors the patterns of a driver's acceleration and deceleration over time, and if a certain pattern, such as heavy braking, is likely to cause a traffic jam, it inhibits it.

The app can also interact with the cloud. Both systems have helped delay the formation of traffic jams by 3-6 minutes and have improved fuel efficiency by at least 20%.

Kapsch TrafficCom North America, with HNTB and the Michigan DOT, has delivered a Truck Parking Connected-Vehicle System at five sites along the I-94 corridor in Michigan. The Kapsch solution consists of a 5.9GHz DSRC in-vehicle unit and roadside equipment with customized application software that together provide drivers with real-time truck-parking availability information from MDOT facilities and private truck stops. It's the first truck-parking system to be deployed in North America using 5.9GHz. Knowing where to find available parking will prevent drivers from extending their service day illegally as they hunt for spaces, wasting fuel.



Denso, with Tongji University, Shanghai, has been testing its V2X technology on public roads in Taicang, Jiangsu province, China. The experiments are intended to help improve the traffic flow of public buses while improving fuel efficiency and helping to reduce CO_2 emissions. Buses have been able to pass through traffic sections without stopping at traffic lights by detecting the optimal driving speed, departing at the best time, or by the traffic light changing when the bus approaches.

Photo: Ford

(Above) **Ford's EcoMode software is standard in its new Focus models**

time, to reduce not only CO_2 but also black carbon (BC) emissions from road vehicles in urban and inter-urban areas. Tests in Glasgow, Scotland, and Graz, Austria, are underway using VMS routing and traffic signal control, with results due this year.

Whatever emerges from CarboTraf, there are impressive results from the ERTICO-coordinated eCoMove project, whose 32 collaborators completed their work last November. Dedicated to finding cooperative mobility systems and services for energy efficiency, they have achieved CO_2 emission reductions of from four to 25% by harnessing V2X, eco driving and rerouting. Overall results show that a reduction of more than 10% is feasible in urban networks. The largest impact on CO_2 reduction can be achieved in severe incidents, where concerned road users need to be informed as quickly as possible about the incident and alternative routes.

"eCoMove informs drivers about downstream events so that they can take action, for example by changing route or adapting their speed," says Jean-Charles Pandazis, eCoMove coordinator. "Traffic control systems have more possibilities for sensing approaching traffic and optimizing their strategies based on this information.

> Currently there is no standardized method for estimating the impact of ITS measures on CO_2 emissions
>
> **Gerdien Klunder, Amitran project**

Photo: BMW

(Left) **BMW's Traffic Light Assistant concept would communicate with roadside infrastructure** (Below) **Cooperative systems would reduce traffic jams**

Infrastructure-to-vehicle communications offer more flexibility for controlling traffic."

One of the project partners, Ford, tested a prototype accelerator pedal with haptic feedback that coaches a more fuel-efficient driving style. Similar in concept to the one that DaimlerChrysler demonstrated 10 years ago, the Ford system has the added extra of receiving advance information from traffic signals. The force feedback from the accelerator pedal and visual gear-shifting advice assists when the driver approaches a red traffic light, a stop sign or a sharp curve, and minimizes fuel waste. The performance of an ordinary driver being helped by the cooperative system was compared with the fuel economy of a certified eco-driving instructor in an ordinary car. The instructor achieved an 11% emissions reduction in the standard car. The ordinary driver in the car with the cooperative system achieved 13%.

Efficiency measures

Traffic controllers should also be looking forward to implementing other eCoMove findings. Rather than focusing on minimizing delays, studies considered how cooperative systems could optimize time and energy efficiency simultaneously. They found that the two generally affect each other positively. Using the newest I2V standards, researchers transmitted to the vehicles traffic signal phase data, intersection topology, speed and lane advice, route advice, route diversions, traffic flow predictions and parking information. The largest benefits were found for applications that smooth vehicle trajectories by transmitting speed and lane advice to them. The effect of route advice based on a calculation of the most energy-efficient traffic distribution came a close second.

"eCoMove has shown that it is possible to reduce CO_2 emissions from road traffic while improving travel times in the road network," says Klaas Rozema, CTO at Imtech's Traffic & Infra Division. "Imtech believes that cooperative systems are creating new opportunities for sustainable mobility, involving all stakeholders with services for end users, as well as network managers, ranging from automated driving support to balancing regional networks."

Emissions reduction in the USA

On the other side of the Atlantic, RITA's AERIS program is working in partnership with V2V research on scenarios to cut emissions, including eco-signal operations, eco-lanes, low-emission zones and eco-integrated corridor management. Each encompasses applications that individually achieve environmental benefits but, by bundling them, AERIS expects to achieve

> eCoMove has shown that it is possible to reduce CO_2 emissions from road traffic while improving travel times in the road network
>
> **Klaas Rozema, CTO at Imtech's Traffic & Infra Division**

Bluetooth detectors vs ALPR

Truly cooperative systems encompass more than a single mode and the REDUCTION project, mostly funded by the EU, is looking at multimodal fleet management. It focuses on solutions that combine vehicle technologies with ICT to reduce environmental impact. This includes optimizing driving behavior and eco-routing. After three years work, this year the project consortium is due to produce a ready-to-market platform that will enable managers to use cooperative data to manage their vehicle fleets and minimize CO_2 emissions.

One area that REDUCTION has focused on is the detection of Bluetooth signals from vehicles to assess traffic flow. The tests have shown that Bluetooth detection performs reasonably well, compared with a baseline provided by ALPR cameras, especially when there is heavy congestion. The error in these traffic situations is between 1.5 and 4%. In free-flowing traffic, the error is 6-9%. The researchers acknowledge that this is high but claim the technology is still valid because it is most relevant when congestion is heavy.

The detection distance of the Bluetooth detectors is about 100m, which is five times greater than that of ALPR cameras. The researchers admit that this makes the accuracy of Bluetooth detectors less certain than that of ALPR cameras.

"On the other hand, the ALPR system is itself not error-free compared with real travel time," they say. "Studies have been done to compare GPS floating car data with Bluetooth data and the results have very little deviation."

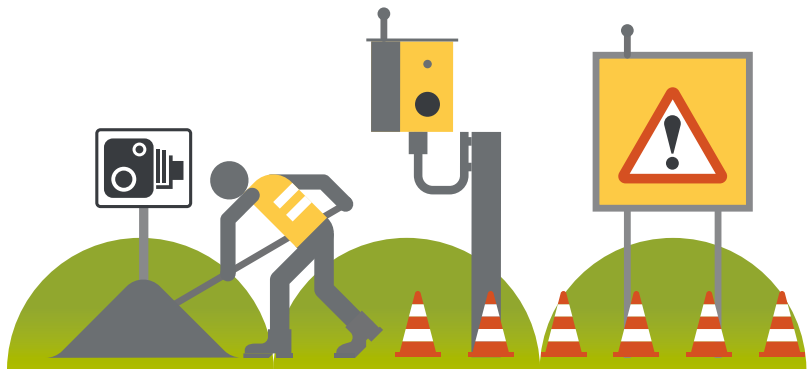
An improvement to the Bluetooth detection system would be to use a finer grid of detectors, each with a smaller detection radius.

additional environment benefits above those of the individual applications.

According to RITA, when cooperative ACC is linked to traffic signals whose role is to optimize vehicle approach and departure, fuel use – and hence emissions – can be cut by 21.84%. This figure from research is suspiciously accurate for an unrealized situation. However, the message is clear – car makers need to ramp up their cooperation with infrastructure and traffic control teams.

Truck drivers might initially rail against the idea of the Eco-Lanes being proposed through AERIS, though lower fuel bills, less congestion, more predictable journey times and improved safety should win them over. When a traffic controller determines that poor air quality demands an eco-lane, drivers of low-emission, high-occupancy, freight and transit vehicles would opt-in to take advantage of eco-cooperative ACC, with variable speed limits (VSL) transmitted from roadside equipment to the vehicle's engine management unit. The University of Texas at Austin has already shown that using VSL to cut speed from 65mph to 55mph resulted in a 17% reduction in NOx over 24 hours.

(Below) **The Audi Online traffic light system informs the driver of the speed required to reach the next green light**



> When a traffic controller determines that poor air quality demands an eco-lane, drivers of low-emission, high-occupancy, freight and transit vehicles would opt-in to take advantage of eco-cooperative ACC

Photo: Audi

The eco-integrated corridor-management scenario is a novel approach, for the USA at least. It relies on using V2I data from all vehicles on arterials, freeways and transit systems to feed a decision-support system. This will determine which operational decisions, across all operators in a major travel corridor, will give the greatest environmental benefit. For example, on a Code Red air quality day, the Eco-ICM Decision Support System may recommend eco-signal timing plans, eco-ramp metering strategies, eco-speed limits, and recommendations for increased transit services.

As the greatest benefits in emissions reduction are predicted to result from smoothing traffic flow around signaled intersections, it's no surprise that this is where there is the most obvious collaboration between nations. In fact, a working group from Europe's Compass4D and the US AERIS program is planning a joint demonstration of a prototype system at the ITS World Congress in 2015. Now that really is all about being cooperative.

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To Hull and back

David W Smith finds out how intelligent pricing and technology strategies are transforming East Yorkshire's Humber Bridge into a heavenly local asset

Images courtesy of the Humber Bridge Board

For years, little changed at the Humber Bridge, in East Yorkshire, UK. There was always criticism of the perceived high pricing levels, and the bridge's 'legacy' tolling system became more outdated with every year that passed. But over the past few years, the Humber Bridge has been undergoing a revolution. Last year, the cost of a car crossing halved. Now, an electronic tagging system is being installed to enable open-road tolling from September. As if that weren't enough, the bridge is undergoing a major structural upgrade, which is essential if it is to continue to support 20,000 vehicles a day.

These three major transformations are independent of each other. It just so happens that they are all taking place at the same time.

The price cuts in 2012 were the result of negotiations with the Chancellor of the Exchequer, George Osborne. The UK government was haunted by the perception that the Humber tolls were inflated and damaging business so it decided to offset the debt load, enabling tolls to be reduced.

"Along with the Severn Bridge, we had the highest tolls in the UK until the middle of 2012," reveals Peter Hill, the bridge's general manager and bridgemaster. "It was £3 (US$5) one way for a car and £20 (US$33) for an HGV. But we had no choice. Keeping prices high was the only way to pay off our debt to the UK government by the set date of 2033, as well as paying high levels of interest.

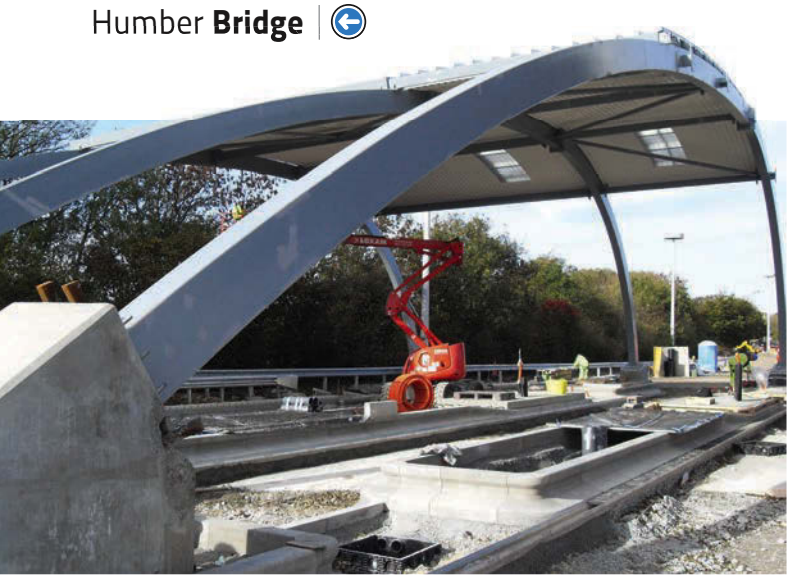
"We opened in 1981, with a debt of £151m (US$251), but by the mid-1990s it had reached £430m (US$715). High tolls were the only way to keep payments up. But rumbling in the background was the public perception that the Humber Bridge debt would never be paid off. People said costs were going up and up and it was cheaper to drive round the estuary," he says.

The innovative electronic tolling system is designed to improve traffic flow on and around the bridge, and reduce disruption for millions of users each year

The reality was that it was never cheaper to drive around the 75km estuarial diversion. Even under the old price structure, it was much cheaper to cross the bridge. "For a six-axle HGV, paying £20 (US$33) to avoid a 75km detour was still exceedingly good value, but nevertheless it was seen as damaging growth," says Hill.

Practical pricing

Following consultations to agree the Humber Bridge Board's governance structure and consideration of a series of traffic modeling scenarios developed by consultants AECOM, Hill says that the UK government finally agreed to relieve the outstanding construction debt by £150M (US$250M), allowing the Board to halve its £3 (US$3.30) car toll to just £1.50 (US$2.50).



The new canopy was installed in late 2013, and the project is due for completion by the end of 2014

The Chancellor gave no instructions about pricing other categories, but Hill simplified the task of setting tariffs by reducing the number of vehicle categories from six to three – cars, heavy goods and light goods. He opted to cut the price to £12 (US$20) for a truck and £4 (US$6.6) for a light goods vehicle.

Without the Chancellor's intervention, prices would have remained high. "The statutory board, which runs the bridge as a regional asset, has to operate it on a cost-neutral basis," says Hill. "That means if we lower prices and can't meet our repayments out of tolls, there is the risk of it becoming a precept on the Local Authorities, which is something that the Bridge Board and the Authorities are keen to avoid."

Following the reduction in costs in mid-2012, there has been a 14% increase in customers on the bridge. "Most of this is down to people making more social journeys, although the rise is now tailing off," Hill continues. "Now we're predicting a 5% ramp-up on expected annual growth. This may not seem a lot, but a large volume of our customers are commuters making repeat journeys. Video tracking showed 85% of passengers are regular users."

The high proportion of repeat traffic makes the transition to open-road tolling a more straightforward proposition. The risk of payment violations is relatively low. "Dartford is going entirely open-road about the same time as us, and I imagine they will have greater concerns about leakage because of the high number of non-regular users," says Hill.

Dartford is also implementing a full ORT system straightaway, whereas the Humber Bridge Board is playing it safe by introducing a hybrid system. "We'll initially have one open-road toll lane in each direction, with the potential for two, and three adjacent manual/ETC bypass lanes," Hill reveals. "A phased transfer into use of the open-road tolling will be applied; this will mirror the increase in account-based tag transactions and relieve the manual toll points accordingly."

Miles ahead

The Humber Bridge Board has also opted to introduce the new system gradually over the next year to avoid technical issues. "We were scared stiff that if we started to install the new equipment over the top of the existing system, the legacy equipment would go 'fizz, bang, pop', stop working and never start again," Hill admits. "Siemens told us that the technology to support our legacy system no longer existed, and neither did the knowledge.

"To deal with this, the bridge has a protracted implementation program," Hill continues. "The first part is to install new equipment to replicate the existing system, as far as possible, while the new infrastructure is being installed. Only when the new highway alignment, canopy and booths are in place will we start to install the new toll system and its associated equipment."

The antiquated 'legacy' system posed geometrical, as well as technological challenges. The bridge has six lanes, but is not wide enough for so many lanes under current regulations. "One of the few criticisms from the locals – and they have generally been positive about the changes – was to ask why we don't take out one booth at a time to avoid problems," Hill reveals. "But we could not do that as physically we didn't have enough width to put them back in to modern standards. So they are all coming out and all going back in at the same time – but this time with three lanes and barriers at the collection points, plus the two new lanes for ORT."

The final business rules have not yet been established. The Board is working with its contractor, SICE, to produce a reliable system. "We know it will be account-based and manageable online," says Hill. "At the moment, about half our customers pay in cash, and half buy books of pre-paid tickets at a 10% discount. We anticipate a high take-up rate for tags and will transfer the 10% savings."

> We were scared stiff that if we started to install the new equipment over the top of the existing system, the legacy equipment would go 'fizz, bang, pop', stop working and never start again
>
> **Peter Hill, general manager and bridgemaster, the Humber Bridge Board, UK**

Repairs: easing the pain

A £3.9m (US$6.5m) project is currently underway to replace four solid steel A-frames. The nearside lanes in both directions are closed to reduce the load on the structure while work is carried out.

Bridgemaster Peter Hill says disruption is being kept to a minimum. "At peak times we have three approach lanes and three toll booths open in each direction," he describes. "We only reduce this to two lanes, or possibly one, at the quietist times during nights and at weekends."

Hill says that although this work is unrelated to the Humber Bridge Toll project, it made both economic and operational sense to carry out the works in parallel. This avoids having to duplicate the lane restrictions for each project, which would extend disruptions for customers.

The work on the A-frames involves fitting 'wind shoes' to absorb lateral loading from the bridge deck, together with vertical 'pendals', which will restrain the bridge deck vertically. Temporary load-bearing 'arms' have been installed to enable the A-frames to be dismantled.

Bridge history

A possible bridge crossing was discussed as early as 1950, but lack of resources and economic difficulties prevented the project going forward until the 1959 Humber Bridge Act formed the Humber Bridge Board. But it was to be another 14 years before work started.

The Queen finally opened the bridge in 1981, at which time it was the largest single-span suspension bridge in the world, at 1,440m. It held that honor until the Akashi Kaiko Bridge opened in Japan in 1998. The Humber Bridge remains the longest single span that has access for pedestrians and pedal cycles.

The debt in 1981 was £151m (US$251), but this spiraled to £430m (US$715) in the mid-1990s. At that point, the government offered a re-financing solution through the Humber Bridge (Debts) Act 1996, which suspended some of the debt, allowing the Board to reduce the interest. In 2012, the government paid the Board £150m (US$250m) to ease the financial pressure, at which point car tolls were halved.

But even after the full debt is repaid in 2033, the Humber Bridge will have to pay for its own maintenance and operation costs out of tolls at an estimated cost of £8-10m (US$13m-16.6m) a year.

The system will use DSRC technology, which is compliant with the European Electronic Toll Service (EETS). This ensures interoperability across all European toll systems. "When we replaced this system, we took into account trends in tolling," says Hill. "We realized the tolling environment in Europe and the UK has moved away from manual to electronic and we expect it to move to open-road and interoperability. Although interoperability seems a long way away in Europe, it seems a good goal."

The new toll booths were installed under the new canopy in February 2014

Strategic engineering

As an early adopter of such technology, the Board faces additional challenges, however. "We are the first organization in the UK to operate in this way, so we have to carefully consider how far to take the interoperability concept when there are limited other players," says Hill. "We are wondering who will develop the contractual relationships across international boundaries."

It's been a particularly busy time for Hill, who has an active role in all of the projects. As general manager, he is responsible for the day-to-day operation of the Bridge Board in toll collection, administration and essential maintenance. And as bridgemaster, he has to make long-term plans to safeguard the Board's infrastructure assets.

But Hill is also a Chartered Civil Engineer and is involved in the ongoing work to replace the four A-frames. "It's very unusual for someone from an engineering background to be head of a non-engineering organization," Hill admits. "But it means my job is a nice mix of things. I wouldn't be able to do some of the engineering if I didn't have such a good team. Delegation is key."

Mike **Heiligenstein**

The executive director of the CTRMA and current president of the IBTTA, **Mike Heiligenstein**, discusses the importance of tolling in the future of the USA's roads

Interviewed by Saul Wordsworth

When Mike Heiligenstein joined the Central Texas Regional Mobility Authority (CTRMA) in 2003, he was the first and only employee. In the ensuing 11 years, he has been credited with jump-starting the agency into a nationally renowned center at the forefront of tolling technology.

"Today there are 20 of us," says Heiligenstein, looking relaxed and in full control from behind his desk at CTRMA's headquarters in Austin, Texas. "Our focus is providing congestion relief and traffic alternatives for the central Texas region. We have two million people in the region and this is growing rapidly. Like most of the South, we are an automobile-oriented area."

His work is a mix of critical disciplines: planning, engineering, environmental and legal work, institutional issues and financial arrangements for projects. The surprise for Heiligenstein is that the job is less about engineering and more about how the Authority finances its projects.

"Highway funding in the USA has fallen away," he says. "Thankfully, toll roads have filled the gap and given us opportunities. When we created our first toll road it was accepted almost immediately, with little resistance. As a result of the booming software industry in the Austin area, it is very tech-friendly. We currently have 600,000 toll accounts in Texas."

Heiligenstein realizes that a move from simple electronic tolling to express lanes and dynamic tolling will require more interaction with the community to ensure there is good understanding. This includes the development of new materials to ensure everyone knows how to use congestion-priced lanes. This ties in with the agency's approach to maintaining good community outreach and public relations.

> Toll roads are now an accepted and necessary means of building new capacity

"We must reach out to our constituency and provide excellent customer service," he says. "If one person gets upset about a toll bill, construction noise or planned works, they will tell 15 people. Our goal is to have numerous access points for the public to get to what we're doing – through smartphone apps, Twitter, email and print media."

Population boom

For Heiligenstein, the biggest issue facing the area today is the fact that the population is estimated to double to four million over the next 20 years. The infrastructure cannot handle that kind of growth without substantial additions to its capacity.

"This adds a whole new dimension and a level of concern," he says. "We are right on the corridor of Dallas and San Antonio. It's going to be all hands on deck to keep us from being swamped. The general public still believes there is a huge highway trust fund that sits up in DC that will take care of our congestion issues if we would only use it correctly. I don't believe the public is fully aware that the trust fund – of which the foundation is gas tax – will simply wither, and our road infrastructure will likewise deteriorate to the point where all money will be spent on maintenance as opposed to new capacity. Funding for new roads will be hard to come by over the next few decades. We would be nowhere without tolling. In the last 15 years we've spent US$3.5bn on new road capacity, US$3.1bn of which has been associated with toll roads."

In addition to his existing position at CTRMA, Heiligenstein has been elected as president of the International Bridge Tunnel and Turnpike Association (IBTTA) for 2014. Several prior presidents ("and this isn't a criticism", Heiligenstein points out) have managed toll bridges. Unlike him, they have not endured the hardship of trying to secure financing or establish new road projects.

"I believe our agency is where the toll industry is heading," he says. "A lot of new agencies in California, Illinois, Texas and Louisiana need to start defining how IBTTA operates. We are experiencing substantial growth from traditional toll roads and express-lanes. Once you get a bridge tolled, that's it; there is not a lot of mystery and public outreach is minimal. This situation is different; we're building and tolling roads that at one time the public thought would be non-toll. We have more toll roads than any of our adjourning states."

Heiligenstein also thinks it's important to fully embrace technology, not just in roadways but via smartphone applications. This is a paradigm shift from acting as a toll agency to more of a 'mobility authority'.

"All the alternatives are on the table," he says. "We can do everything. If it moves, we can do it. Interoperability throughout the country is another area that we are really focused on this year. We want to create a model where you are able to travel from one part of country to the other, with one tag. However, I don't want customer service to be lost. We use a lot of terminology in this industry that the public isn't exposed to on daily basis. I am pushing IBTTA to maintain a consistent approach in developing materials that make them comprehendible, otherwise they are never going to get to Vehicle Mile Technology [see *Trials and controversy*, above]. It will be shrouded in mystery."

(Left) **A TxTag enables a vehicle to travel on all toll roads throughout Texas**

Burning issues

Looking nationwide, Heiligenstein has two primary concerns. The first is whether the federal government will provide states with the flexibility to toll the interstates. These backbones of the country's system are often at least 50 years old, with many in need of repair and maintenance. Between Dallas and Austin alone it has cost billions of dollars, not to add capacity, but merely to keep the roads from deteriorating.

The second is how the county is going to handle the transit of freight, especially freight coming in from ports. "Ports are ramping up, particularly from the East Coast and the Panama Canal," he says. "There is more freight that requires good transportation. This needs to be addressed."

And what has been Heiligenstein's greatest achievement at CTRMA?

"It has to be getting projects on the ground in a short time," he says. "Since 2003, we have built almost US$1bn in projects. We have had a lot of public opposition, but now we have established both credibility and creditability such that over the past six to eight years we have been able to reposition the argument to such an extent that toll roads are now an accepted and necessary means of building new capacity. The achievement has been building consensus behind a very new agency. We have been fully accepted by the community and are in partnership with every transportation and political entity in the region."

Trials and controversy

To date, the notion of a London-style cordon pricing system has not been well received in any of America's cities. The only city to come close is New York. In 2008, and after much discussion, the City Council passed a bill to introduce such a scheme, only for the plan to be vetoed and the federal grant that had been awarded to New York moved over to a bus-only lane project in Chicago. There is, however, a growing view that over the next decade congestion charge-type pricing structures will start to appear. Concurrently, Vehicle Mile Technology (VMT) pricing may enter the mainstream as a replacement for the traditional gas tax. The concept of a VMT fee is extremely controversial and fraught with challenges, as the general public believes that a tax based on distance traveled – as monitored by satellites – is a 'big brother' impingement of civil liberties. A number of VMT projects are currently being piloted across the USA. Last year, Oregon passed a law to charge 5,000 volunteer drivers 1.5¢ per mile from July 2015.

A day in the life

While Heiligenstein usually arrives at the office at a reasonable time, he says he's never separated from his work. "One of the last things I do at night is check my texts and emails," he admits. "It could easily be midnight. And my evenings are often eaten up with meetings.

"These days I have a lot of IBTTA conference calls, but my work is very varied. One day I could be flying to the Federal Highways Agency to seek a loan for a project, the next I might be conducting a tour of one of our facilities with someone from the Florida Turnpike Authority. We'll share lessons learned and best practices on express lanes. Dealing with the press and media is also a large part of my job.

"We are very aggressive with our community outreach, much more so than most transportation agencies. It is beneficial for us to know what the opposition is, what the concerns are, and how to address them."

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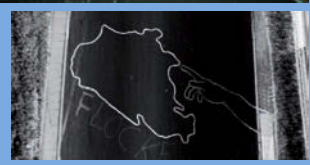

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From left to right: Scanner data, camera image, texture examples with graffiti.

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With a new, privately owned company committed to optimizing England's investments in its roads, **Graham Dalton** foresees a future rooted in collaboration, communication and advanced data intelligence

Interviewed by Max Glaskin

> There will be a lot less tolerance of traffic technology that doesn't work, can't demonstrate that it brings genuine benefit or, in simplest terms, is unreliable

Graham Dalton is chief executive of the Highways Agency (HA) and responsible for £108bn (US$180bn) of assets that make up England's 4,300 miles of strategic roads. As a civil servant he will spend £1.9bn (US$3.2bn) this year. Then everything will change.

The Agency will become a government-owned company. Instead of annual budgets, it will have long-term investment schedules. And that, of course, means change for the traffic technology market, too.

"You're going to find a business with a very big program that really has to perform," says Dalton. "There will be a lot less tolerance of traffic technology that doesn't work, can't demonstrate that it brings genuine benefit or, in simplest terms, is unreliable."

There's the rub. Although the UK government is increasing its spend on roads, the new company won't have money to waste. In fact, it will play a part in saving £1.6bn (US$2.6bn) in a decade. Efficiencies from reduced red tape and long-term planning will contribute their share, but Dalton is crystal clear that, should he head the new company, he won't be buying feeble technology.

"Far too much of it is unreliable," he says, "Go for a spin round a busy stretch of controlled motorway and you can play Bingo, giving yourself one point for each gantry on which all the lane indicators are working and lit up. You don't get many points. The equipment out there just isn't reliable enough and I think that cracking that one will come first."

Dalton would also adopt new purchasing methods. "The company will probably look at some different means of buying," he predicts. "Elements of remuneration may be set against availability or reliability so, for example, we'll pay 80% of the price of something, which would cover your costs of supplying it, and the rest you can have over five years – if it works. That's the sort of thing I'd be looking at because it gives some real incentives."

It's not surprising that the reliability of technology is important to Dalton. Having been sponsored by British Rail as an undergraduate to study engineering and then spending much of his career with the pre- and post-privatized UK railways, he is used to it being fail-safe, not fail-pause.

All in a day's work

Dalton enthuses, "This is a really good job. Last Monday I had a conference for suppliers, briefing them on our investment programme, building confidence so they can invest in the skills and be able to deliver. Then I was supporting at a [government] Home Office press conference on flooding. Next was the regular weekly round-up with my senior staff all over the country, good old line management stuff. Then I was on to York where my team looks after all the structures on the closed railway lines across the UK."

> The roads will be controlled in the cloud. It's part of our medium-term strategy to get to grips with what that means. I don't think anyone does yet

Setting the standard

Other changes for technology suppliers and developers will come from increased cooperation among roads operators across Europe. Dalton already represents all UK road agencies, not just England's, at the Conference of European Directors of Roads (CEDR), whose 27 members meet twice a year. "We're doing a little bit now but, as a company, we'll work more with administrations in other European nations, to try to make sure we are setting consistent specifications. That should help encourage standardization, and therefore volume. If volume is increased, then we will get benefits on price and reliability."

He sees the sector at the moment as small and fragmented. One implication of standardization and increased volume is that there will inevitably be rationalization of suppliers. "Some manufacturers will do well and others won't – but it becomes a more attractive market for the successful ones," he says. Such changes could happen swiftly. Already the Highways Agency is working with the Dutch roads administration on a traffic control system, is close to the Belgian agency and is sharing information with Germany.

The status quo will also be disrupted by the emerging ways of collecting and distributing information from and to road users. "Will this continue as it has done or will it be led by us, and others like us, aligning with the vehicle manufacturers?" Dalton asks, almost rhetorically. "I'll be very surprised if in 10 years time we're putting variable message signs on very expensive gantries, which have a 60- to 80-year design life. It will really be about communication between roadside and driver."

Under control

In his six years as Highways Agency chief executive, Dalton has overseen scores of projects. The one that gives him the most satisfaction is having put a proper crisis management system in place.

"In simple terms, it's having a manual so people all over the agency know exactly what to do and when," he says. "So when you're under stress, whatever it may be, you have a system that rolls into action, you have a common picture, you know what's going on and you know what your people are doing, you can prioritize and work with other agencies. It's transformed our service."

(Left) **Variable speed limits are in place on the M6 in an effort to ease congestion during busy periods**

Open road

With more than 4,000 miles of road to choose from, some with the most advanced traffic technology in the world, Dalton's favorite is one of the least sophisticated: the A303, ironically known as the highway to the sun.

"It's magic," he says of the 90 miles of tarmac. "Bits of it are wonderfully low tech. It's a road I tend to use frequently in my trusty Volvo. Yes, I've read the book and seen the film about it but I draw the line at picking up the road kill."

Work in progress

The era of expensive vehicle detection equipment is over with blind tracking of phone signals producing far better data. Half of the fleet that uses the Highways Agency's network is already equipped with smartphones to receive data. "The roads will be controlled in the cloud," says Dalton, "It's part of our medium-term strategy to get to grips with what that means. I don't think anyone does yet."

More prosaically, many of Britain's roads were controlled by the weather last winter, with the greatest rainfalls since records began causing flooding, often accompanied by extremely strong winds. The Secretary of State for Transport and the Highways Agency's chief executive were under scrutiny because taxpayers want their road network to stay open all year round.

"I believe we did remarkably well," says Dalton. "The wind affected us as badly as the floods, with several high-sided lorries being blown over. We had a weather forecaster embedded and the meteorological offices are now linked to the Environment Agency's flood models, so we were getting some good predictions of flood levels, which really helped us to get people to the right place at the right time."

With such prolonged and extensive extreme weather this winter, can Dalton predict how climate change might affect the operations of the Highways Agency? "You know what I think will impact operations more? Social expectations," he says, deftly changing the subject. "The acceptance of delay in the network is diminishing. We live in a world where people expect it all to work. People expect to do their journey as normal, whatever the weather."

So how does Dalton feel about trying to keep four million drivers a day happy? "It's deeply rewarding, taking ownership and accountability for something as fundamental to modern life as a big road network," he says. Whether he will find the predicted change – in organization status, business methods, weather and technology – as good as a rest has yet to be seen.

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At the ASF Vedène center near Avignon, France, traffic control operators monitor the country's largest and busiest motorway network on a Barco OVL-715 LED wall. This is supported by a TransForm ECU 110 controller and Barco's control management suite (CMS).

"What really won us over was the outstanding technology, especially the wall's controller and the functionality of the CMS software suite," says Bruno Roux, project manager specializing in traffic management and technology.

The operators at the ASF Vedène traffic center all agree that the new Barco solution helps them respond more effectively during incidents.

"The LEDs ensure brilliant color and high contrast, providing us with a clear overview of our road network," Roux continues. "In addition, we can now switch between different sources with the click of a mouse. This helps us to respond more effectively to – and even anticipate – incidents."

Need to know?

Traffic control centers in Europe are benefiting from innovative technologies

- Barco's OVL-715 LED wall features a unique liquid cooling system that lowers the temperature of the LEDs, ensuring a longer lifetime (>80,000 hours in eco mode)
- The OverView OVL displays are the first LED-lit rear-projection video walls to exceed 1,000 lm

(Above) **The OL-721 modules at Styria's new traffic control center emit sharp, saturated colors in full HD resolution** (Left) **The Barco video walls in the control and crisis rooms of the Mont Blanc Tunnel provide operators with a detailed overview of the area**

Heavy investment

A bit further west, the traffic controllers situated on both sides of the Mont Blanc Tunnel are equally as enthusiastic about their Barco equipment.

After a devastating fire in 1999, tunnel operator Groupement Européen d'Intérêt Economique (GEIE-TMB) invested heavily to raise safety levels. A key part of the infrastructure is the centralized technical management (CTM) system that keeps the tunnel under constant surveillance.

The system processes and automatically analyzes data from more than 35,000 control points, including 120 video cameras, to ensure that any incident in the tunnel is detected within seconds. It seamlessly works together with a Barco OLF video wall setup.

"An older Barco wall had served us well for 12 years while, initially, we had only assumed a six-year lifespan," explains Cédric Petitcolin, manager of the technical equipment division. "But newer solutions offer more possibilities. With the new wall, we have an immense view of the SCADA system and any other data sources, greatly improving collaboration and insight."

Winning combination

The secret behind the easy-to-use, ultra-bright visualization of sources and signals at the ASF Vedène and Mont Blanc Tunnel control centers is the integration of Barco's scalable network-centric Transform controllers, the flexible, user-friendly CMS suite and the high resolution, vivid video walls.

The Austrian government has been aware of the strengths of this end-to-end solution for some time now, as an increasing number of traffic control centers in the country feature Barco's traffic management solutions. The most recent installation, which includes eight LED-lit OL-721 modules, is found at the new control center near the Himmelreich tunnel, in the southern state of Styria.

Besides the image quality and ease of configuration, Wolfgang Göbl, technical advisor at Styria's traffic department, praises the installation's low TCO and sustainability.

"From experience we know that Barco offers advanced products and a superior aftersales service, which makes for a surprisingly low TCO," he says. "Moreover, future visualization needs can be met by extending the flexible TransForm N concept with additional TFN input and output nodes. So it will be easy to integrate extra safety information once we start monitoring a sixth tunnel in 2016. That makes our investment truly future-proof."

Contact

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When a medical emergency occurs, every minute – and even second – can mean the difference between life and death. A patient's fate is usually sealed in the first hour following a traumatic injury – emergency professionals call it the 'golden hour'. The patient's chance of survival improves the sooner definitive medical care is rendered. Yet, as cities grow larger and denser, and roads become more congested, emergency responders will progressively have more difficultly transporting patients to the care they need within that golden hour. Here's where ITS can come to the rescue!

And it's not just in cities that ITS can play a life-saving role. What happens if you're driving alone at night on a secluded road and get into an accident? And what if that accident leaves you unable to call for help from your cell phone? It could be hours before another motorist drives by and spots you, and by then it may be too late. With automatic collision detection and telematics, these concerns will become a thing of the past.

Pioneered by OnStar in the mid-1990s, telematics systems can detect when a collision occurs and instantly alert medical and emergency personnel. That immediate response could just be what saves your life. High installation costs and subscription fees have unfortunately resulted in a slow debut and a technology that isn't nearly as ubiquitous as it should be. However, with prices falling and more competition in the market, we could reasonably expect to see one installed in all vehicles in the future.

Perhaps one of the most proven methods for reducing response times is traffic signal pre-emption (TSP). TSP provides emergency vehicles that are approaching an intersection with a green light using vehicle-based emitters and signal-based detectors in the form of radio, light, or sound. However, each of these methods has its drawbacks, such as requiring clear sightlines, being affected by atmospheric conditions, and possible pre-emption of other approaches.

With recent advances in GPS technology, a new hybrid of TSP may offer emergency responders with a more reliable system. These systems combine traditional methods with the information provided by satellites to accurately determine where the activating vehicle is situated and where it is headed. As newer TSP technology becomes more widely adopted, we could see an appreciable drop in emergency response times.

Another advanced ITS technology that can benefit emergency responders is vehicle-to-infrastructure (V2I) communication. Using this, it may be possible to re-route traffic away from an emergency vehicle's route. While wide adaptation of V2I technology is still a long way away, researchers at the University of Zaragoza in Spain have investigated the impact of using an ITS system to clear a path for emergency vehicles. Their results are promising. Using their software, they found that, on average, emergency response times were reduced by almost 50%, with only a 14% hike in travel time for re-routed vehicles.

In the not-too-distant future, emergency vehicles may not have to contend with civilian traffic. Already, some companies are developing drone technology to render urgent medical care: Definetz's Defikopter can take to the skies and deliver a life-saving defibrillator when called by a smartphone app; and Urban Aeronautics is taking it a step further by developing an ambulance drone that can maneuver in tight spaces. While it may still be years before drone technology for emergency response really takes off, there are currently several ITS technologies that can have a measurable impact on response times. Even if it only means saving a few minutes of travel time, that may just be enough to save someone's life.

> A patient's fate is usually sealed in the first hour following a traumatic injury
>
> **Sam Schwartz, Sam Schwartz Engineering, USA**

Creating a better world with intelligent vision systems

The need to increase road safety, optimize traffic management and reduce the environmental impact of vehicles and their associated infrastructure is particularly pertinent in view of the increasing number of vehicles on the world's roads and their ongoing diversification.

Tattile is committed to the realization of intelligent vision solutions that will enable more efficient use of resources in industrial processes and traffic control. The company's traffic division, which specializes in ALPR-camera design and development within ITS installations, develops systems for license plate recognition in the field of speed control, with the aim of reducing fuel consumption and pollution.

Sensitive to environmental issues and to the desire, felt by many, to create smart cities, Tattile designs cameras for tolling, speed enforcement, red-light enforcement, traffic tracking, access control and tunnel security. An important part of this is customization; the company's engineers develop custom-made cameras for applications based on individual specifications.

(Above) **Italy's highways are monitored by an intelligent surveillance system** (Left) **Tattile's Vega 2HD camera for vehicle detection**

Safety and sustainability

Studies have shown that free-flow systems, when combined with speed-control solutions, are effective in reducing vehicle CO_2 emissions. To meet the demands of these systems, especially in developing areas where highly sustainable, low-cost systems are preferred, Tattile has developed 'light' solutions, which have much lower management and operational costs compared with traditional installations.

The need for sophisticated yet simplified solutions is met by Tattile's modern, integrated ALPR technology, which incorporates onboard plate processing (instead of using a separate PC). The camera sends out processed data, reducing the load on transmission systems, which results in a simplified installation that is less costly and burdensome. The new generation of solutions that can read license plates through automatic vehicle detection (such as Vega 2HD), can detect objects traveling at up to 155mph (250km/h).

Tattile has also developed solutions to detect both mean-speed and traffic light violations. Sophisticated tools, such as Vega HD and Vega 2HD, have proven to be extremely effective in improving safety, as they provide continuous monitoring of the vehicle and

Need to know?

A range of solutions designed to meet the needs of the modern traffic industry

- The Vega 2HD, which is designed for modern free-flow applications, has an onboard vehicle detection sensor and therefore does not require an external trigger
- The Traffic Light 2L solution features real-time processing of up to 75fps

(Above) **ANPR Mobile is a smart solution for crime prevention**

Tattile's Traffic Light 2L camera (above) **and the Vega III model** (right) **are designed to be non-invasive**

have reduced fatal accidents by up to 50% on monitored roads.

Subtle and effective

Among the range of intelligent products designed by Tattile, the most well known is the Tutor system, which was developed in collaboration with Autostrade per l'Italia. In a project engineered to reduce the number of deaths on Italy's roads, the two companies designed a system that uses precision cameras to detect the mean speed of vehicles traveling on the country's highways. The system has proven to be highly effective, with a large reduction in accidents recorded since its installation.

Tattile's automated, non-invasive solution to detect red light infringements, Traffic Light 2L, is designed to be compact and light. As it includes two sensors – one in black and white to read number plates, and one in color for photographic evidence of infringement – there is no need for an external sensor. The device is compatible with various types of traffic light systems and can also be powered via solar panels.

According to Tattile, environmental protection also translates into the realization of ALPR cameras especially developed for the identification of real-time access to restricted traffic zones. The company's Vega III plate-reading systems are designed for urban and suburban environments, and make it possible to control bollards or barriers in real time, preventing the entry of unauthorized vehicles into protected or historic areas.

The Tutor System, the Traffic Light 2L and the Vega III are all non-invasive solutions, since they do not require any external sensors and, therefore, road surface works are not necessary. This also helps to reduce the environmental impact.

Law enforcement

Tattile's traffic division is dedicated to developing solutions to enhance the safety and security of the world's citizens. As such, the company has developed an intelligent solution for crime prevention – ANPR Mobile – which can be used to assist police forces.

This advanced ALPR system, which can be installed on vehicles belonging to special operational departments or intelligence services, supports surveillance and protection activities by serving as a tireless watchful eye on the road. The solution incorporates megapixel sensors that can scan up to 100 plates per second.

ANPR Mobile is proven to be a useful tool, not only for patrolling, but also for carrying out criminal investigations, as it enables the police to trace and identify transits of wanted vehicles, facilitating the recovery of stolen vehicles and criminals. Surveys among police forces indicate a very favorable attitude toward this type of technology, which can be exploited on a larger scale to assist in the investigation of major crimes. In many cases, ANPR Mobile technology has played an important role in solving violent crimes including murder and kidnapping, and human and drug trafficking.

Contact

Flexible and reliable surveillance solution

The origins of the Vector ANPR camera go back to the first real-world use of machine vision in highways applications. Computer Recognition Systems – a forebear of Vysionics – began working with the technology in 1979, leading to several industry firsts. These developments included many high-end plate-reading applications involving measuring, monitoring and enforcement.

All this ANPR experience was directed into Vysionics' fully integrated Vector camera, which represents the most flexible and powerful solution that developers could squeeze in to a single, elegant enclosure. Following the launch of Vector in April 2013, volume production is now underway, with cameras being shipped across the globe for use in a number of highly challenging and interesting applications.

It is highly capable HD ANPR that forms the platform for a range of enforcement and monitoring applications. Vector has already been selected for applications as diverse as average speed enforcement, police surveillance, rail crossing monitoring, journey-time systems and weigh-in-motion.

Active solutions

The SPECS3 Vector is recommended for UK Home Office Type Approval (HOTA). As a fully self-contained device it optimizes average speed control, covering two lanes of traffic per camera and requiring no additional street furniture. Vector has vastly simplified the production, installation and continuing support for this application, facilitating opportunities that were otherwise cost-prohibitive or not previously considered.

Need to know?

An advanced camera breaks the mold in traffic monitoring and enforcement

- Vector can operate in two trigger modes: by auto-detecting vehicles as they pass, or by linking to an external trigger for applications where only specific vehicles are required to be identified
- Following each plate read, an evidential record is created comprising data and images. Data includes the vehicle registration number (VRN), read confidence, time, date and camera location

(Above) **A Vector camera in-situ on the A69 in the north of England**
(Right) **Vector is a highly capable and compact ANPR camera**

Vector LX, meanwhile, is a new enforcement solution for railway crossings that is in the advanced stages of UK HOTA. The device combines Vector ANPR with scanning radar and video capture. The solution uses a number of specialist submodules, ensuring that the device is easy to maintain. At the heart of the system is the Vector ANPR camera, which is used to identify and capture images for violations, triggered by the radar unit as it tracks the passage of vehicles and by video detection of police wig-wag lights.

Vector Police is operational with law enforcement agencies worldwide, providing an immediate police alert to vehicles of interest contained on national and local databases. As a fully self-contained camera module, Vector has been welcomed by police because it can be simply and unobtrusively positioned, enabling fast and effective detection.

Vector Journey Time captures origin and destination data to enable cities to better manage traffic congestion. Dual-lane capability enhances the cost effectiveness, providing plate reads for two lanes – for both dual carriageways and bidirectional traffic.

Vector WIM is a national network of ANPR sites used to enforce an HGV road-charging levy. The two-lane capability of Vector was a key requirement of this application, minimizing the need for multiple camera units and enabling data to be processed and communicated from one camera device.

Vector was designed to be a cost-effective but capable platform for high-end ITS projects, with a particular focus on enforcement applications. Every day, more cameras are being used to monitor vehicles as they enter parking lots, cross train lines, drive through 20mph limits, travel in bus lanes and journey through roadworks.

Contact

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Innovative sensor design ensures precise measurements

Intertraffic Amsterdam 2014 saw the unveiling of a new road sensor from Lufft. The MARWIS mobile contactless sensor, which can be mounted on any vehicle, collects weather information – including surface temperature, dew point, water film height, road conditions and friction – and transmits the data via Bluetooth for real-time evaluation on a smartphone or tablet.

The sensor has been designed to be highly resistant to salty water, with a metal casing that is made from the same aluminum alloy that is used to make ship propellers. Housed within a tube, the built-in optics are also well protected from road dirt. Engineered to be light and flexible, the sensor weighs 1.5kg and measures 120 x 220 x 100mm without the mount and protection tube.

It was clear from speaking to visitors to the Lufft booth at Intertraffic that simple installation and maintenance for highly technical products is as important as ever. To cater to this need, the company offers webinars about each new product shortly after any product launch or upgrade.

Meanwhile, there is also strong demand for an integrated software solution for MARWIS. Lufft is currently testing a software solution from US-based Applied Information that locates and visualizes the measured road conditions on Google Maps. Lufft partner Brian Mulligan, demonstrated live recordings of street measurements to visitors at Intertraffic Amsterdam.

It is anticipated that Lufft will offer an optional standard software solution for MARWIS. Users will also be able to connect with their own software through the open UMB protocol.

Need to know?

Intelligently designed road sensors reach new levels in data accuracy

- The MARWIS sensor extracts and measures meteorological and road-condition data directly from vehicles 100 times each second
- The IRS31Pro-UMB is mounted flush against the road surface and uses radar technology to measure the thickness of water-film up to 4mm (with an accuracy of ±0.1mm)

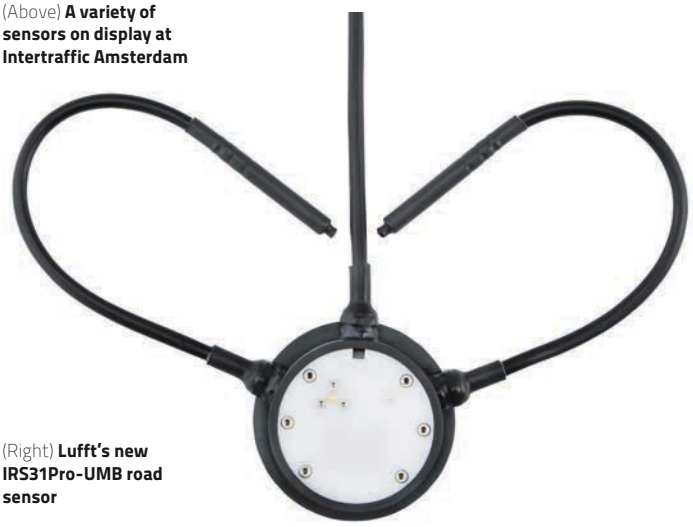
New and improved

Lufft also used Intertraffic Amsterdam as an opportunity to present its passive-invasive road sensor IRS31Pro-UMB, as a replacement for the IRS31-UMB. The company claims that it is the first invasive road sensor that is able to measure friction and ice percentage and, with the help of radar, determine up to 4mm of water-film thickness. In addition, this sensor is able to measure temperature more precisely than the previous model, with an accuracy of ±0.1°C within the range of -20°C to +20°C. The IRS31Pro-UMB also has optimized and calibrated freezing temperature measurement and an improved road condition model.

From May 2014, the sensor will also feature the SDI-12 communications protocol. It can be housed with up to two external temperature sensors, which are usually mounted at 5cm and 30cm depths, and its two-piece design makes it very easy to maintain. All sensors can be linked in a network and evaluated using Lufft SmartView software.

Despite the new features, the IRS31Pro-UMB uses so little energy it can be powered by a solar panel. To communicate, the sensor is equipped with a resistant RS485 interface, and is warmed and cooled via a Peltier element, which enables it to identify the freezing point in any type of de-icing material. This is particularly important at airports, where materials other than salt are used for de-icing the runways. ○

(Above) **A variety of sensors on display at Intertraffic Amsterdam**



(Right) **Lufft's new IRS31Pro-UMB road sensor**

Contact

Traffic monitoring and detection in high definition

The high definition (HD) standard for high-resolution video was born in the broadcast and entertainment sector, and is already further maturing in the security and monitoring industry. Now, HD camera technology has started its conquest of the traffic world.

Worldwide market studies show that network cameras are quickly replacing analog solutions, especially in professional applications. Although in the networked world, standard resolution cameras still represent a significant chunk of the market, the use of HD-compliant cameras is on the rise. In the surveillance and industrial markets, 85% of cameras are already HD compliant. History has shown that innovations in the surveillance market usually seep into the traffic surveillance market with a delay of one to two years.

HD benefits

While a lower 'HD-ready' resolution (1280 x 720 pixels) exists, the 'full HD' or 1920 x 1080 pixel video resolution is definitely the preferred choice to fully enjoy the benefits of a higher resolution picture. And these benefits are numerous for traffic applications.

First of all, more pixels enable traffic management operators to see more details and allow automatic incident detection (AID) systems to pick up more events. This considerably improves the decision speed and accuracy when it comes to guaranteeing a smooth and safe traffic flow.

An HD video has a wider (16:9) aspect ratio than standard resolution (4:3) video. The 16:9 ratio is more natural to a human operator, because it is consistent with the way we see the world.

Need to know?

A new HD box-camera combines integrated video analytics and streaming capabilities

- TrafiBot HD's advanced processing unit generates traffic data and incident detection information, and supports traffic operators with alerts on stopped vehicles, wrong-way drivers, pedestrians, lost cargo, smoke, and traffic flow
- Highly detailed images are captured with 1920x1080 pixel resolution at 30 frames per second

(Left) **FLIR's Trafibot HD camera brings HD imaging to today's AID systems**

As a result, it is less tiresome for the operator. And 16:9 also provides a wider coverage of the road, especially at short range, which improves the chances of detecting possible anomalies.

Light challenges

There are a few challenges in working with higher resolution. Most importantly, more pixels in a camera has often meant lower light sensitivity, since more or less the same amount of light has to feed many more light-sensitive circuits inside the sensor. Light sensitivity is one of the most important requirements for traffic applications as traffic cameras need to operate in relatively dark tunnels and on scarcely lit or even unlit roads.

In the past, this was often solved by presenting less frames per second, thus integrating light over a longer time. Unfortunately, this technique sometimes results in shaky images and insufficient information for detection systems to work effectively.

The new generations of CMOS sensors that are designed

for low-light conditions overcome this challenge.

Higher resolution also requires more resources: encoding, decoding, transporting, storing, processing and analyzing about six times more pixels than a PAL video. It also requires more powerful hardware processing power, network bandwidth and storage size. A smart solution to this problem is performing the video processing inside or near the camera. This solution, which is commonly referred to as 'edge processing', removes the need to transfer a huge amount of information over the network and to invest in heavy hardware to perform the video processing.

A sensitive solution

FLIR's TrafiBot HD is a full-HD camera that has been specifically designed to bring the benefits of high definition to AID systems. The camera sensor has been selected for its low light sensitivity and for its exceptional resistance to blooming and smearing caused by vehicle headlights. Part of the high internal processing capacity is fully dedicated to image analysis. This means that there's a full set of AID capabilities already integrated into the camera. When events occur, a locally recorded video sequence is sent to a central server for review and evidence purposes. This decentralized concept contributes to an affordable overall system infrastructure and at the same time delivers a superior HD visual experience.

Contact

lyermack@gmail.com

I've been reading the other columns that appear alongside mine each month and can't help but note that I've known the other writers for a long time. I have known Jim, JJ and Sam for respectively 10, 20 and 30 years. They have had, and are continuing to have, distinguished careers in this field. Sam and JJ in particular have had a lot of experience with transportation payment systems, and while Jim has been more on the vehicle side, I suspect he has worked there as well.

I thought that I would pose a question to them in this issue, a) to see if they are reading what I write, and b) to get their opinion. I would also solicit feedback from any readers out there among the thousands that read this magazine. My interest is a general one about the historic and potentially pivotal role of payment systems as an organizing principle in cities. I promise to offer my response and opinion in a future issue of this magazine.

Historically, the transportation field has, as it developed technology, had its focus on the front end: detection needed to be in the street or lane; payments were accounted for at the fare box or tollbooth; and managing that data had to be local. When we started to use cameras, they were of limited value since bandwidth was costly and sporadic; and transmission of images was slow and expensive. Data networks were not yet ready for the dream of full-motion video at the control center and for the end users. Phones were just phones then.

As a result, we kept as much intelligence as possible at the data collection point of the system and had to let decisions be made at that level. Now, all in-lane data can easily and cheaply be sent upstream to the traffic management center so that operators can make quick, informed decisions. All data is centralized and easily accessible. That's just one part of the equation; the other part is paid transportation services.

We have had toll roads, bridges and tunnels, buses and subways, and parking, for quite a long time. They are provided by disparate organizations that do not coordinate their programs. There are multiple taxi companies and now also shared services like Zip Car and Uber. In San Francisco, admittedly a leading-edge location, there are 14 different shared-use transportation services. People are voting with their wallets and there is no reason to believe that this trend won't continue.

Savvy managers are beginning to realize that price strategy is a sure way to affect behavior. Look no further than Professor Donald Shoup in LA, who has developed a new priced approach to on-street parking that maximizes use and enhances the revenue stream as well.

If we put these two trends together, we can begin to see the outlines of a new approach. If the focus shifted from data in the field to information in the back office, and if customers responded to price signals from operators, there could be a new tool in the pockets of transportation managers. I am suggesting that a coordinated pricing strategy, combined with effective customer communication, can offer a new dynamic to our cities.

> Savvy managers are beginning to realize that price strategy is a sure way to affect behavior
>
> **Larry Yermack, Wendover Consult, USA**

Modular camera solutions enable optimum functionality for ITS

With the numerous possibilities offered by ITS, there are equally a range of challenges. Each ITS component requires a vision solution that can accommodate its needs, but operators also want to avoid paying for features that are not needed. Flexibility is essential and the best way to achieve this is through tailored, modular camera solutions.

Modern vision technology solutions offer a variety of modular components that can meet a multitude of requirements. Thus, operators are not restricted to a fixed, standard set of equipment designed to match the specific requirements of particular application in one region, nor do they have to commit to solutions that are a good match for the requirements, but come loaded with unwanted additional features that boost the price.

Speed enforcement

Depending on regional and local conditions, the image requirements for a camera or a set of cameras can vary. In speed enforcement applications, for example, two cameras with different sensors and resolutions can be combined within the same housing.

In Europe, highways are usually constructed with no more than two or three lanes in each direction. Here, cameras with resolutions of lower than 1.4MP per lane are adequate. American or Asian mega-highways, however, can be four to six lanes wide and in some cases even wider. Such a setup requires the camera resolution to be between 8MP and 20MP to cover as many lanes with one camera as possible.

Color requirements can also differ. In some places, black and white, and infrared images are sufficient, but other applications require a combination of black and white, and color images.

Companies that provide intelligent traffic systems to multiple countries therefore benefit considerably from modular solutions. For example, numerous requirements can be met with a single camera model in its multitude of variants.

Basler's camera portfolio offers GigE cameras in more than 80 (40 color/40 mono) variants, with resolutions from VGA to 14MP, monochrome or color modes, and with frame rates between 14 and 120 images per second. This multitude of variants offers extensive flexibility and reduces installation efforts, while keeping costs to a minimum.

The original system setup can remain unchanged, and the integrated cameras can be exchanged and combined as required.

Red light enforcement

Red light violations usually require documentation with more than one still image. To provide seamless evidence of the infringement, authorities need consistent evidence in the form of still images combined with a video stream.

Using the same housing as described above, the high-resolution camera is replaced by a network camera. Hence, one camera focuses on the front of the vehicle, capturing both the driver and the license plate, while the network camera records a video stream of the vehicle in its movement across the red light stop.

In some traffic applications, features such as real-time

Need to know?

Different applications in different countries can vary greatly in their vision requirements

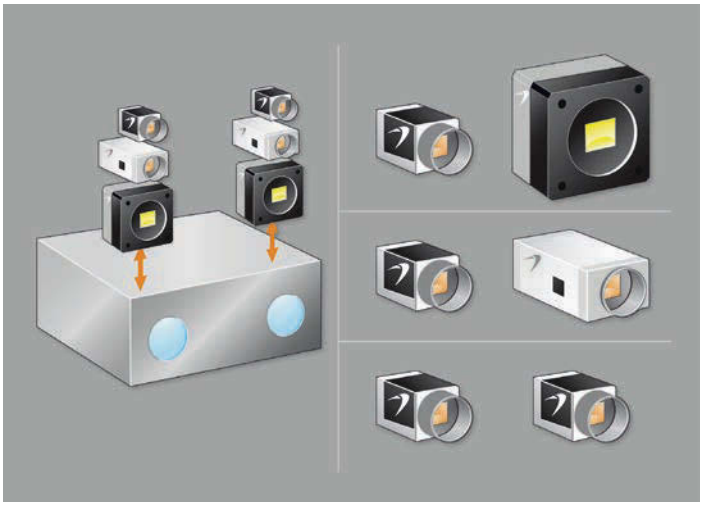
- Basler's network cameras, which are used for traffic monitoring, are designed to provide exceptional image quality and frame rates of up to 100fps
- The ace models – with resolutions of 1.3-4MP – provide high sensitivity and frame rates of up to 50fps, making them an ideal fit for free-flow tolling and other ALPR applications

trigger, auto-iris and day/night functionality are essential for reliable 24-hour operation in all weather conditions, while high sensitivity and short exposure avoid motion blur in moving vehicles.

The recorded video proves that the driver has deliberately run through a red light instead of perhaps just coming to a delayed stop as a result of braking late. To support and complement the required evidence, the license plate in the still image is checked against an ALPR algorithm to identify the driver. With this combined evidence, authorities can initiate their enforcement activities.

Multi-lane scalability

Camera setups in tolling systems must provide for two different applications. Electronic toll collection (ETC) simplifies the process of collection tolls; and cameras read the license plate of a vehicle as it passes a toll gate. Each license plate is associated with an individual account, from which the toll fee is automatically deducted. With ETC, vehicles are captured while in motion – a huge advantage when it comes to maintaining a constant and uninterrupted flow of traffic.



(Above) **ace GigE Vision cameras are a compact, high-performance solution** (Left) **Basler's ITS camera modules**

Toll enforcement, however, is a more common application that depends on the method of toll collection. Here, the camera identifies the size of a vehicle so that the corresponding toll fee can be applied. By simultaneously capturing the license plate, the system helps to prevent fraud by non-paying vehicles.

Both types of tolling application start with the same housing described above, and have a medium-resolution still-image camera, and – in lieu of the network or high-res camera – add another still image camera with the resolution you need for the given number of road lanes. What you get is a sophisticated, yet cost-efficient, camera system for almost any tolling application.

As architectural setups of tolling installations and electronic methods can differ from region to region, cameras of any resolutions, sensitivity and color capability can be combined to fulfill the specific set of requirements. When flexibility is needed, modular setups beat monolithic solutions. Easy-to-replace components win over complete system redesigns, guaranteeing that the customer gets precisely what is needed.

Contact

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Truck control: taking a closer look at transit traffic

There is an ongoing conflict between heavy goods vehicles and road authorities. With companies looking to transport the maximum amount of goods in the shortest time, trucks are being overloaded and exceeding regulations. A new generation of weigh-in-motion (WIM) stations is designed to detect these trucks.

Another way for companies to minimize transit time is to take shortcuts and pass through zones where heavy vehicles are not permitted, such as village centers. This not only results in congestion, incidents and degradation of the road surface, but it is also a burden to local residents as it generates a great deal of noise and inconvenience.

Smart solution

Tein Technology has developed a solution that automatically identifies and reports freight traffic traveling into forbidden areas. Using two gantries, the Truck Lock detects traffic violations and provides video evidence, with customized, user-friendly software.

While it is nothing new for local authorities to attempt to banish truck traffic from villages by narrowing roadways and installing physical obstacles, Tein Technology's system takes this safety concept a step further.

The two gantries are placed at the entries and exits of the zone at risk, and monitor traffic in both directions. The system is able to distinguish freight transit traffic from local destination traffic, based on its transit time. Whenever necessary, fines are issued to offending vehicle drivers entering the forbidden area.

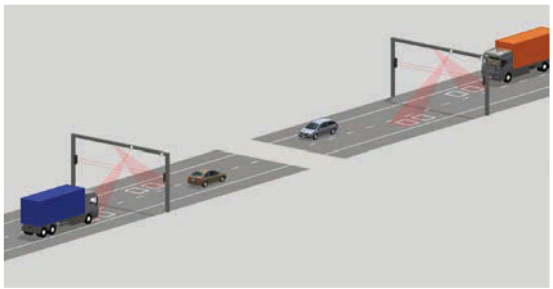
How does it work?

Data collected by the Tein Technology system is transmitted in real-time to the local traffic control center, where it is processed by specialized software. The software compares the data with predefined travel times per road segment and automatically reports any infringements of road usage. As system operators are presented with information that is accurate, transparent and simple to analyze, the risk of data misinterpretation is eliminated.

The software application automatically provides video sequences of the detected offence, and photographs will also be generated to provide the legally required evidence that must be attached to the fine. Records of all offences are kept in the central database.

In addition to detecting freight traffic in transit, the gantry also has ALPR cameras that can detect 'wanted' vehicles. The police can enter a blacklist of number plates to search and the system does the rest. If the ALPR cameras recognize a plate on the list, the operator in the control room is immediately notified. A single gantry is sufficient for this particular function.

Similarly, a 'white list' can also be entered into the system to allow approved vehicles to drive through the system without being fined. This includes public buses, fire trucks and other emergency vehicles. The software compares the captured plates to those registered in the system. If a match is found, the vehicle will not be fined.



(Left) **A truck lock in the Ghent Harbour area of Belgium** (Above) **Vehicles are monitored as they enter and exit the specified zone**

Need to know?

An effective system for identifying and preventing violations by heavy goods vehicles

- Tein Technology provides solutions that enable complete integration of command and control centers for mission-critical environments, including: financial trading rooms; traffic control for road, rail and waterways; port monitoring; city surveillance; and public transport
- The company celebrated 100 years of successful operation in 2013

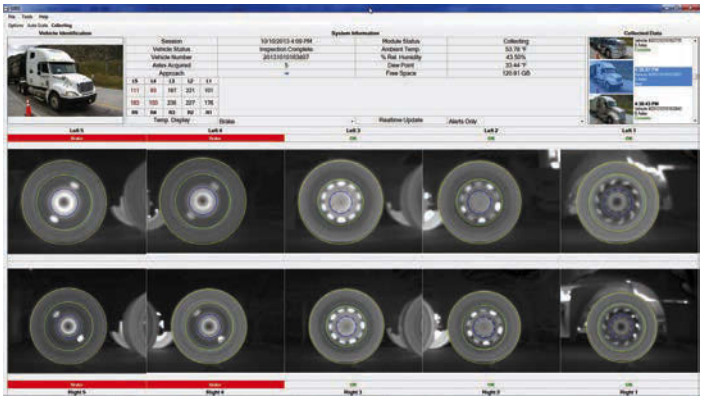
Contact

Automatic thermal inspection improves large truck safety

Commercial motor vehicles, comprising tractor-trailer combinations in a variety of configurations, constitute one of the most prevalent traffic elements on highways.

According to FHWA 2011 statistics, more than 10 million registered large trucks travel more than 250 billion miles per year on public roadways in the USA. Monitoring the safety of these vehicles, as required by a variety of state and federal laws and regulations, falls to trained law enforcement officers. Each year, US inspectors conduct more than two million vehicle inspections, with 20% of the inspected vehicles being placed out of service for one or more serious safety violations.

However, as a result of the limited resources available for conducting vehicle inspections, only a small fraction of the total number of large trucks on the highways will ever be subjected to a detailed vehicle inspection. Pre-screening trucks for inspection can greatly improve the out-of-service rate, while ensuring that trained inspectors spend more time inspecting 'bad' vehicles and less time inspecting 'good' ones.



(Left) **The SIRIS user interface showing a vehicle that has been flagged for brake temperature** (Below) **A truck passes through the SIRIS system on an access ramp to a weigh station**

A number of studies, including the Federal Motor Carrier Safety Administration's (FMCSA) 2006 Large Truck Crash Causation Study, have shown that brake faults are quite often associated with other safety violations and are often cited as a factor in fatal accidents that involve large trucks.

Between 1990 and 2006, other studies conclusively demonstrated that handheld infrared thermometers and thermal cameras could identify vehicles with faulty brakes by evaluating differences in brake temperature. The use of thermal inspection increases the 'hit rate' of finding unsafe trucks.

But the problem with thermal pre-screening was that it came with a high labor cost. Most approaches required at least one dedicated inspector to perform the thermal inspections and some required a team of as many as three. Clearly, if the objective of pre-screening was to maximize man power for vehicle inspections, this approach would not work.

Embedded intelligence

From 2006 to 2009, International Electronic Machines Corporation (IEM), working with funding from the FMCSA and the New York State Energy Research and Development Authority, developed the SIRIS thermal inspection system, the first automatic thermal screening system for large truck safety inspections. Unlike earlier approaches that required someone to watch a screen or take direct temperature readings, SIRIS employs smart vision technology to automatically collect thermal data from each truck as it passes, to process that data into meaningful information, and to evaluate the truck's safety risk.

Smart vision systems, such as SIRIS, employ empirically derived rules to determine whether a specific vehicle warrants a full inspection. If so, it generates a visual and audible alert. An inspector can then review the thermal data and make a reasoned decision on whether or not to inspect the truck.

In its first controlled test, nearly 70% of the vehicles flagged by SIRIS were subsequently placed out of service based on a full vehicle inspection. After further refinements to the processing and evaluation algorithms, a subsequent field operational test conducted on behalf of the FMCSA found that nearly 85% of the flagged vehicles had one or more serious safety violations and more than 90% had at least one notable safety concern.

The SIRIS thermal inspection system currently operates at multiple truck inspection sites throughout the USA. To avoid an information overload for site operators, SIRIS can be integrated with existing pre-screening systems. The success of this automated pre-screening technology further suggests alternative uses, such as pre-screening commercial vehicles at tunnel entrances to reduce risk of tunnel fires and for enhancing fleet maintenance activities.

Need to know?

Smart technology makes essential vehicle inspections more accurate and efficient

- During 2013 IEM deployed its latest version of SIRIS at four truck-inspection sites in two US states and markets this technology internationally
- SIRIS thermal inspection can also be used for tunnel safety procedures, passenger bus and transit system inspection, fleet maintenance, and a range of freight and passenger rail applications

Contact

International Electronic Machines Corporation (IEM)
enquiry no. **508**
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Panama's Madden-Colón highway benefits from intelligent solutions

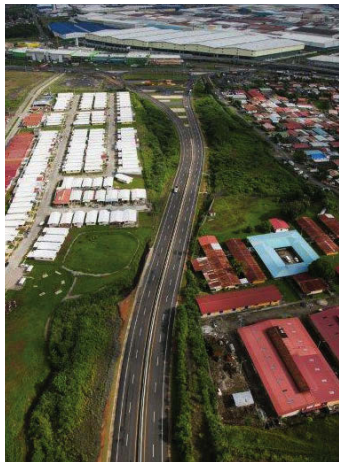
The Madden-Colón Highway is considered a key element in the enhancement of Panama's logistic infrastructure. As part of the Panama-Colón Highway, the four-lane road expedites the movement of goods between the Colón Free Trade Zone (the largest free port in Latin America), the container ports situated on Panama's Caribbean coast, and the ports at the Pacific entrance of the Panama Canal. The highway has also reduced travel time between the Pacific and the Atlantic coasts, thus facilitating the transisthmian flow of goods and people.

The 26-mile section of toll road was funded by a loan secured by the Republic of Panama and Concesionaria Madden-Colón, S.A. (part of the Brazil-based Odebrecht group).

Modern ambition

Odebrecht took over construction of the Madden-Colón Highway project from a Brazilian company in 2006. With safety and efficiency as priorities, the company sought advanced license plate recognition (LPR) and traffic incident detection solutions that would aid in addressing traffic flow problems, accidents, vehicle breakdowns, and crime, as well as toll booth collection.

To do so, they turned to two companies renowned for their expertise in this arena: Intelligent Security Systems (ISS) and Traficon. SecurOS Traffic solutions from ISS have a long history of success in numerous highway projects around the world. The solution focuses on both video management services (VMS) and video analytic software, which covers a range of areas, including LPR and traffic monitoring solutions. Traficon, meanwhile, is recognized as a market leader in video image processing for traffic analysis.



Need to know?

Advanced surveillance and analytic technologies ensure optimum security

- The Madden-Colón highway project was constructed in 13 million man-hours by 3,000 people and using 500 pieces of equipment. The project was completed in 2009 without a single serious accident
- The official name of the Panama-Colón Highway is the Don Alberto Motta Cardoze Highway, in honor of a prominent local businessman. Locals often refer to it as Panama's 'Dry Canal'

(Above) **The toll road has provided a boost to the local economy**
(Left) **Monitoring equipment covers large expanses of highway**

Safe solution

The security installation involved 150 Pelco Espirit analog cameras and 16 SecurOS LPR channels from ISS, as well as 14 Traffic Server solutions (IP Converter) from Traficon for traffic incident detection. In addition to monitoring the road, there is also video surveillance for official buildings on the highway.

(Left) **The highway is very important to the region, both socially and economically**

(Left and below) **Parts of the Madden-Colón Highway were built through tropical rainforest**

Brazil's Mirabit Consultation and Training was involved in the installation process.

The solution includes script capabilities, which enable the operators to move the cameras on the poles, altering the range of what can be seen on the screen at any given time.

"These security solutions are absolutely necessary for the smooth operation of this crucial highway," says Remy Rosas, systems analyst at Odebrecht. "The cameras, LPR and traffic incident solutions all work together, which means that operators are always one step ahead with regard to safety issues. SecurOS LPR was recommended in particular because of its high accuracy rate, and it has proven to be very effective to that end."

Rosas confirms that there are plans to expand the security solutions in the future. ○

Contact

Intelligent Security Systems (ISS) enquiry no. **509**

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J J Eden

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When we talk about industries that, like tolling, are struggling through unpopularity and uncertain growth, we usually focus on the cell phone sector, but there are plenty of other industries facing the same challenges: paid television for example. I remember when TV was free. Every Sunday my family watched *The Ed Sullivan Show*. In fact, every night my family had a series of shows we watched,

Back then (and seriously, it wasn't that long ago), we had only three channels. For most of the USA today, television is a paid subscription, offering us hundreds of choices in programming, with the ability to record and replay our favorite shows around our busy schedules. We now have a choice of providers including cable, satellite, fiber (provided by a telephone company) and even internet. Although free TV is still available, this industry has successfully made the transition from 'free' to a paid service, while continually increasing service options and steadily expanding its geographic reach. Although they are still experiencing steady growth, the big players are challenged by new technologies and mergers that threaten their future.

Tolling is a similar industry, bucking the free alternative by offering more choice and better service. While we are still challenged in many markets, look at how we have expanded our footprint; look at the services that are now offered. We, like the television market, have been challenged by technology, going from cash to electronic, and moving toward fully electronic toll collection. We, like television, have interoperability issues. HDTV did not get approved as a standard without major negotiations between competing technologies. Free TV did not need a customer service department and neither did cash toll lanes. Free TV did not need to manage accounts and the installation of a box in your home, just as the tolling industry is shifting from coin payments to transponder installation issues and credit card processing.

Like television, we will need to deal with emerging technologies, updating standards, game-changing mergers and direct competition. As an industry, we will need to resolve how we deal with vehicle-to-vehicle, vehicle-to-infrastructure, mileage-based user fees and auto industry-installed transponders. We will need to decide whether to enable, or even endorse, the commercialization of mobile in-vehicle transactions. Do we become a customer of a conglomerate? Maybe one, or several, customer service centers will offer fully mobile commerce, not only processing toll transactions, but also fast food and parking. Ten years ago, would you have thought that cable and satellite television services would offer telephone, home security and automation? Or that a toll agency would offer parking services?

Our futures may not be intertwined, but we both face a challenging yet promising future. I just read that within six years, toll roads will be a US$12-13bn business. As we blaze a trail into the future, we should look at other parallel industries and learn from their successes and mistakes.

> Like television, we will need to deal with rapidly emerging technologies, updating standards, game-changing mergers and direct competition
>
> **James Eden, director of tolling, Aecom, USA**

The benefits of a motorized zoom lens in ALPR cameras

In the January issue of *Traffic Technology International*, Tamron discussed the role of the lens in an image-recognition process and its specific role in ITS. And while it is clear that it is important to select a good quality lens for certain applications, it is also important to look at how installation processes and services could be simplified.

In some ways, the ITS market could be defined as a merger between security and machine vision (MV) – with regard to the components that make up an ALPR image-capturing system. There are many machine vision camera manufacturers that use their knowledge and technology to provide cameras specially designed for ITS. The typical MV lenses attached to these cameras generally have a metal body, a fixed focal length, a manual iris, a compact size, a short MOD, and extremely high quality and resolution.

However, manufacturers sometimes choose security lenses in order to take advantage of the adjustable focal length. MV cameras with CCTV lenses usually have a slightly larger lens size than those with MV lenses. Security lenses are usually made of plastic, and offer vari-focal, manual zoom, focus and iris features. Of course, there are exceptions and sometimes DC iris or P-iris lenses are used in cameras that enable iris-control.

(Below) **Tamron's single camera lens has the flexibility to benefit a wide range of ITS applications**
(Opposite) **Tolling infrastructure varies from country to country**

Pros and cons

With fixed focal lenses, every time an operator of a portable speed enforcement camera wants to change its position, he has to consider the angle of view and the focal length of the lens when deciding on convenient place. Or, if the ALPR camera is in a fixed position, different lenses have to be prepared and tested until the desired angle of view and focal length are found. To some extent, vari-focal lenses provide more flexibility and the focal length can be adjusted accordingly. The focus and iris also have to be manually adjusted when the focal length is changed.

Tamron recommends the use of an integrated zoom lens that can be operated remotely. This solution enables precise remote control by using stepping motors. This not only reduces installation time, it also facilitates an auto-focus camera. There is no need to prepare multiple lenses and operators can take advantage of the superior functions associated with camera integration.

Toll bridges and tunnels

One of the arguments in favor of using a fixed focal-length lens on highway tolling bridges is that the required object distance and focal length are known in advance, and the focus can therefore be set up during production. However, many companies that export their products worldwide are faced with the reality that different countries have different standards and the height of tall bridges can vary.

Furthermore, vibrations on the top of toll bridges can cause a camera's focus to shift and therefore frequent maintenance is mandatory. Tamron's new 1/1.8in, 15-50mm,

F/1.4 lens with remote zoom and focus has been designed for optimum versatility in order to resolve the above-mentioned installation and maintenance challenges.

In addition to specialized ITS companies and MV camera producers, security camera manufacturers also get involved in the ITS market and provide corresponding solutions. The advantages of remote control are obvious in areas like tunnels, where light condition is critical, and highly sensitive sensors and good optics are required to capture and reproduce all the needed details. For this reason, it is common for integrated camera systems with PTZ functionality to be used inside tunnels. The challenge for the lens manufacturer here is to provide both high-quality optical performance and a compact size, so that the lens can fit into the chassis.

Fluctuations in temperature can mean that camera focus has to be adjusted manually. Tamron's new integrated zoom lens is equipped with a thermistor to measure the temperature of the lens and, if necessary, to adjust the focus. This is particularly important in extreme environments, where heat or freezing temperatures could cause damage to the lens.

Simple solution

The numerous conventional and complicated lens line-ups result in difficulties in selecting the appropriate lens for the application.

Instead of a wide range of products, Tamron supplies a simple solution: a single lens that provides camera manufacturers with advanced features and flexibility. Furthermore, there is no need to keep inventory with various models, and the number of product items could be reduced, simplifying logistic procedures and reducing cost.

A motorized zoom lens is a competitive alternative to the commonly used fixed-focal and vari-focal lenses. Tamron's new zoom lens features an extensive range of focal lengths, including the most widely used viewing angles for traffic surveillance. ○

Need to know?

The installation and maintenance of cameras can be simplified by choosing the right lens

- Tamron's new remote-zoom lens is designed to be compatible with the 1/1.8in sensors found in many traffic surveillance system cameras
- The 15-50mm focal length is suitable for license plate recognition, and identification of vehicles and individuals

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Traffic control and violation enforcement – the Russian way

The number of vehicles on Russian roads is growing at an impressive rate of some one million cars each year. There are currently more than 50 million vehicles in Russia, 39 million of which are privately owned. It is becoming increasingly difficult for authorities to control this complicated sphere, as well as to curb the growing number of accidents, traffic hold-ups and collapses. However, experience with automatic traffic control video systems has proven that efficient control is possible.

Recognition Technologies is an expert in license plate recognition. Through the continuous improvement of its custom recognition systems, the company has developed hardware-software solutions for vehicle detection. Its AvtoUragan, ParkRight and ParkNet solutions are making a huge difference to those looking after Russia's roads.

AvtoUragan is a versatile hardware-software solution for automatic violation control. In addition to speeding violations, it also detects violations on crossroads, including the crossing of stop lines, passing of red lights, and stopping and parking at pedestrian crossings.

(Right) **The AvtoUragan system can now recognize license plates from Thailand – one of the most complex designs in the world** (Below) **The ParkRight Monoblock 2G unit is mounted to the windshield of the vehicle**

The system can detect violations from all vehicles within its field of view. It incorporates one general-view camera that detects the violation and the color of traffic lights at the time of vehicle passage, as well as several recognition cameras that recognize license plates in relevant lanes. The cameras achieve an accuracy of 97% in daylight, and are also effective at night-time and can recognize the dirty license plates that are common throughout Russia.

AvtoUragan can now recognize 380 types of license plate from 58 countries. The system is extensively used for vehicle detection by numerous state law enforcement agencies all over the world. AvtoUragan was also used during the 2012 APEC summit in Vladivostok, as well as for traffic control at the Summer Universiade in Kazan, and for security purposes during the 2014 Sochi Winter Olympic Games.

Parking control

The downtown areas of most Russian cities are usually built around historical city centers that were established long before the automotive boom. The old streets are physically not able to cope with modern traffic and they usually cannot be widened as historical buildings are protected by law. For this reason, city authorities pay a lot of attention to paid parking areas.

In response, Recognition Technologies has developed a mobile hardware-software solution called ParkRight. The unique device for paid-parking control is installed inside a patrol vehicle. The hardware includes two cameras, a GPS/GLONASS module and a PC.

Need to know?

Clever monitoring and recognition systems optimize roadway and parking operations

> The AvtoUragan measures speed using radar, but the result is only accepted as valid if the radar speed is similar to the estimated values captured by the video camera, i.e., the complex system performs selective radar readings and filters out unreliable measurements

(Clockwise from top left)
AvtoUragan can be used to monitor roadworks; the complete ParkNet system; ParkNet integration with a tablet device; AvtoUragan on a Russian gantry

One camera is intended for a general overview of the traffic situation and the other is for license plate recognition.

ParkRight's recognition algorithm is particularly notable for its high accuracy. Violators' license plates are recognized while the patrol vehicle is on the move. Meanwhile, the associated PC is connected to vehicle databases, enabling authorities to find the owner and obtain other vehicle data at short notice. ParkRight is among a select few mobile detection solutions that enable vehicle searches while on the road and transfer data in real time.

Before operation, a patrol vehicle equipped with ParkRight moves through the designated area and records the coordinates of paid parking zones. The system can then transfer coordinates to other patrol vehicles.

The subsequent operation is highly automatic. When approaching the control area, the general-view camera starts to record the road situation while the recognition cameras detect and read vehicle license plates. The video captured by the general view camera is transferred to the data processing center and can be used as evidence in controversial cases.

The system can also be used to detect vacant places in parking lots, as well as to retrieve information about vehicles with unpaid or expired parking places. The owners of such vehicles will receive penalty notices.

ParkRight is widely used in Russia, the Republic of Belarus, Moldova and Ukraine. Road police units in these countries benefit from being able to recognize license plates from neighboring states, which are frequently detected in transit traffic.

Smart technology

Recognition Technologies has also designed a solution for parking inspectors that patrol on foot. The ParkNet system is engineered to monitor paid parking lots and provide visual confirmation of parking violations. This portable device is based on a protected tablet device. It enables inspectors to monitor and control parking areas of densely parked vehicles where it is not possible to see the licence plates with cameras.

ParkNet also enables inspectors to detect violations that often go unpunished as they are committed in residential areas where there are no automatic systems for violation detection. The solution uses the same recognition algorithm for license plates identification as the AvtoUragan system.

Although ParkNet is new to the market, it has already established itself among the authorities of several Russian and Belarusian cities, as well as among paid-parking companies. It is already widely used by parking inspectors in Moscow and its suburbs.

Following the success of its range of detection solutions at Intertraffic Amsterdam 2014, Recognition Technologies anticipates that its systems will soon benefit traffic authorities throughout Eurasia.

Contact

Recognition Technologies
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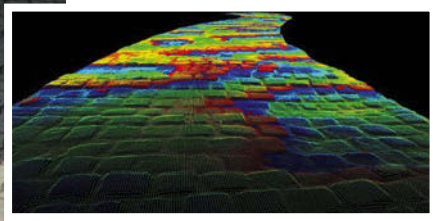
HD digitalization as a basis for mathematical vehicle simulation

Every driving-simulator application is based on models of existing roads. In order to digitalize these test tracks, race tracks and public roads with sufficient accuracy and resolution, the mobile surveying equipment must include high-definition (HD) scanners, precise vehicle movement compensation and multiple cameras.

3D Mapping began developing such technology in 1995 and now has two systems – Mobile Road Mapping Systems (MoSES) II and III – which have been qualified for automobile applications. They have been proven to be highly effective in a variety of simulation projects (Figure 1).

The MoSES systems have two advanced scanners that digitize the road corridor with a 360° field-of-view capturing more than one million points per second.



(Left) **Figure 1: MoSES III mounted to a vehicle**
(Below) **Figure 2: An example of a laser scanner point cloud**
(Bottom) **Figure 3: A Belgic block test track transformed into a 0.005m curved regular grid**

Need to know?

Innovative techniques to recreate test tracks, race tracks and public roads for digital applications

- MoSES is equipped with eight types of camera, including color, grayscale and infrared
- The system detects road geometry elements such as road axis, road edges, road width, cross slope, road network organization, chainage, intersections, number of lanes and number of tracks
- 3D Mapping began developing the technology in 1995, and is based in Germany

Each scanner measurement creates a 3D coordinate for the scanned point, including a grayscale value. The standard deviation per scan measurement is below 1mm.

A precondition for precise digitalization of the road is full compensation of any vehicle movement during the survey. This is achieved with the use of a laser gyro-based inertial platform (IMU), which delivers the attitude of the system with accuracy in the range of 0.001°. The scanner data is time-synchronized to the inertial system with an accuracy of 10^{-6} seconds to guarantee maximum precision for vehicle motion compensation. The result is a digitized point cloud, which is devoid of any disturbance from vehicles, as seen in Figure 2.

The sensor data is completed with high-resolution digital images, which are also taken during the survey. The photogrammetric cameras deliver calibrated visual documentation and are used to generate textures for simulator environments. The resulting data is the basis for true representations for test tracks, race tracks and public roads for simulator applications.

Accurate representation

HD digitalization transfers road and environmental information into the digital world. This provides simulator applications with a geometrically precise copy of the real road, which enables the automobile industry to transfer real-world testing to the simulator environment. As a result, testing in the simulator becomes more reliable and cost effective.

As a special application, the scanner results can be used to generate 3D road surface models. The regular grid models are the basis for mathematical vehicle development processes and simulations for tire-model testing, NVH, ride, comfort and durability. Figure 3 shows a section of a Belgic Block test track with a curved regular grid size of 0.005m as an example.

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Innovative engineering reduces the severity of high-impact crashes

Ensuring the safety of road users is becoming an increasingly complex and challenging task for authorities. Decision makers are having to balance the need for improved safety infrastructure with strict budgets and targets.

Snoline's family of Tau crash cushions has provided protection for drivers on the world's roads for 20 years, and the most recent version has been engineered specifically with government cutbacks and reduced budgets in mind. The Tau Tube meets both the technical and cost-saving needs of modern road authorities.

Tested according to EN1317-3, the Tau Tube is currently one of the most advanced crash cushions on the market. It is the result of sophisticated engineering using the best-available finite elements, techniques and subcomponent experimental testing.

The short length of the Tau Tube redirective crash cushion is one of its most impressive features. Although it measures only 5.8m long, it can absorb the energy of an impact up to 68mph. This highly efficient design makes the cushion ideal for very narrow, short areas such as tunnel exits.

Material matters

The crash cushion's superior performance is provided by its aluminum-alloy tubes. As well as providing excellent impact resistance, the environmentally friendly material is also highly resistant to corrosion and lighter than most other materials used to make crash barriers.

As an additional benefit, the system is up to 70% reusable after an impact and has also been engineered to offer some interchangeability with Tau spare parts – resulting in noticeable savings in inventory and maintenance costs.

While the tubes' strong telescopic structure provides an impressive energy-absorbing performance, the barrier's progressive-resistance design can safely stop a car traveling at 68mph within a short distance. The system can achieve a Class B severity index level for light vehicles in this situation.

The Tau Tube crash cushion has been designed using the most advanced engineering solutions and materials in order to achieve the highest achievable performance at the minimum possible cost.

(Top) **Tau crash cushions are redirective and bidirectional** (Above and left) **Excellent impact performance** (Below) **Aluminum alloy provides an environmentally friendly solution**

Need to know?

A light, sustainable barrier design provides maximum protection at minimum cost

> The EN1317 European standard was developed within the framework of the Construction Products Directive 89/106/EEC. The EN1317-5 standard serves as a basis for the CE-marking of road safety systems including barriers, guardrails, crash cushions, barrier extremities and transitions

Contact

Enabling effective integration of different traffic management systems

(Below) **Figure 1: A fully integrated TMC**

The main objectives of intelligent transportation systems (ITS) are to improve safety, increase traffic flow, decrease congestion, reduce fuel costs and enhance the response time of the emergency services. ITS technology is complex and incorporates numerous components, technologies and subsystems, which are all controlled and operated by the local traffic management center (TMC).

One of the most basic examples of a single subsystem managed by a TMC is a tunnel fault detection system. However, this application may include other subsystems, such as a ramp metering controller, traffic cameras, highway segment speed metrics, traffic signal controllers, and weather information.

Need to know?

Fast and cost-effective information management for traffic control centers

- Teleste's video wall units are a cost-effective alternative to traditional video wall processing units
- The Command & Capture system requires fewer monitors, fewer operators and less office space than many other solutions
- The system is flexible with regard to its bandwidth requirement

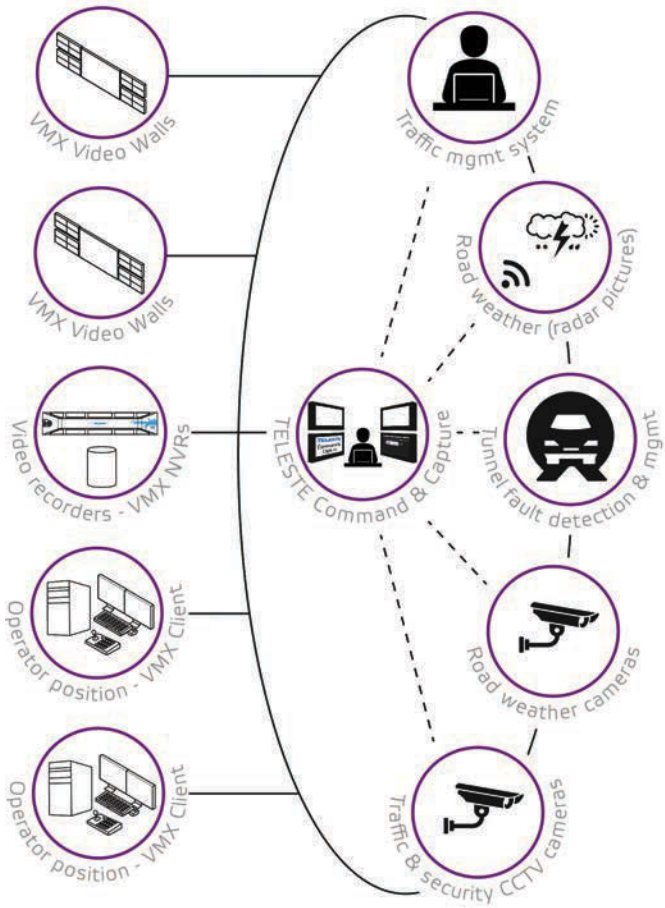
As ITS systems evolve all the time, TMCs need to be prepared to constantly upgrade and incorporate new components into the system. However, this can be a challenge as operations must continue as normal. Integration needs to take place as quickly as possible in order to minimize disruption.

Integrated solution

Teleste has developed a solution to speed up the integration time and optimize costs in the process. Command & Capture enables an operator to integrate any remote or local video, information management application/system, sensor, camera or several separate TMCs into a single unit, regardless of the operating system or the software that is used for the applications in different systems (Figure 1).

The solution enables seamless operation and control of all events and tasks, centralized through a single operating point. The size of the system can be expanded, or scaled-down dynamically.

Command & Capture has been designed to be secure, cost-efficient and future proof, with



(Above) **Figure 2: Using Command & Capture to visualize information**

the flexibility to adapt to the most complex systems. All that is needed is a PC and an internet connection.

The system has been engineered to offer full situational awareness by providing a visualization of multisystem information in the same graphical user interface (GUI) and video wall. This enables traffic operators to quickly react to situations with the full capability of any integrated system.

Command & Capture also offers a unique way to expand the use of video management systems beyond normal CCTV system functionality, as it integrates third-party applications into the video management system (VMS) without application-specific integration. Any application of a remote system can be viewed, or fully controlled, from Teleste S-VMX client stations; only one operating station is required.

Furthermore, alarms and information from CCTV and other systems can be visualized in the same GUI.

Applications

Command & Capture can be used to integrate any subsystems as part of the TMC. Figure 2 is an example of architecture from a recent project where Command & Capture was used to visualize information from traffic management programs, road weather radar pictures, CCTV, tunnel fault detection and management programs, on CCTV video walls and workstations.

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In early February, the USDOT announced its intent to go forth with what is referred to on this side of the pond as the Connected Vehicle Initiative (and as Cooperative ITS elsewhere) and very specifically, the light duty vehicle-to-vehicle (V2V) safety proposition. With V2V safety, cars would talk and listen to one another, and in a lightning-quick manner, alert drivers to potentially imminent crashes. With ubiquitous deployment, about 80% of crash types could be addressed, or so says the USDOT.

What's needed? More research and a Notice of Proposed Rulemaking, then in the waning days of the Obama administration (roughly corresponding to the end of 2016), we'd have a V2V mandate and phase-in timeline.

"Let's do it sooner," says the safety advocate in me. With 30,000 lives lost on US roads each year, why wait? I make my living doing research, but this case requires more than usual. Here's why.

System performance must be ascertained. This integrated V2V and safety system must perform to certain technical levels. Take this conversation as an example: Car 1 to Car 2: "Can you hear me?" No response, and then a crash. Car 2 wasn't performing to even a minimum level.

With market penetration, channel congestion must be addressed. Car 1 to Car 2: "I can't hear you. Cars 34-197 are yelling their trajectories over and over. It's all a cacophony!"

There are others who want the spectrum to do other things (for example, wide bandwidth machine-to-machine communication, enabling Johnny to stream Grand Theft Auto with impunity). Car 1 to Car 2 (yelling): "I'd love to talk, but the *Bohemian Rhapsody* from Car 3 is interfering with our conversation."

Security remains a concern. Car 1 is actually traveling to a very private, even romantic, rendezvous with Car 2. Their discussions must be secure, as Car 3 could ruin their assignation by causing Car 1 or Car 2 to think they are going to crash. Moreover, Car 3 may be an anthropomorphic snoopy and overzealous government official. Cars 1 and 2 simply do not want Car 3 to know their original and secret destination.

And there's more: how can we accelerate the number of cars in this V2V ecosystem? Should we use aftermarket or brought-in devices?

Alas, the research must be done, as these are important questions. One key question, addressed to some degree in Europe, is: once we get this V2V system that talks and listens, what do we do with it until an adjoining vehicle has one too? We may own the well-equipped Car 1, but if Car 2 is not going to be equipped until next year, and we can't communicate with the vintage Car 70 that will be equipped, what will our car's equipment actually do? Would it be a veritable brick?

The real key that transcends the (good) important research is to determine what reliable short-range communication applications would cause drivers to demand – and even buy in the aftermarket – devices that can participate in this V2V system.

> "Let's do it sooner," says the safety advocate in me. With 30,000 lives lost on US roads each year, why wait?
>
> **Jim Misener, transportation and technology consultant, USA**

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Paris parking lots are monitored by advanced video wall technology

The semi-public parking system operator for the City of Paris, SAEMES (Société Anonyme d'Economie Mixte d'Exploitation du Stationnement), has installed a new control room for the central surveillance and the management of the 90 parking lots that it manages in the French capital. With over four million visitors using the parking facilities each year, SAEMES' goal for the new control room was to increase the surveillance capabilities of the parking lots, in order to increase the safety of both the parked vehicles and their users.

The central control room operates around the clock, 365 days a year, with no human presence necessary in the parking lots. The control room staff answer all service requests

and emergency calls from clients in the parking lots, which amounts to more than 3,000 calls being answered each week.

Signals from the network of CCTV cameras deployed in the 90 facilities are centrally displayed in SAEMES' control room. The visualization system for the CCTV cameras has been installed by the German manufacturer and installer of large screen equipment, Eyevis.

For the Paris control room, the company has deployed a 7m² video wall, consisting of 12 of its EYE-LCD-4600-M-USN-LD 46in display screens. The incoming signals are controlled with a netPIX 4800 graphics controller and the eyeCON wall management software platform.

Because the reliability and accuracy of the displays is important for SAEMES, Eyevis has chosen to use units with full HD resolution (1920 x 1080 pixels) and direct LED backlight technology for best brightness and contrast. The company has been able to provide a homogeneous picture quality along the entire video wall, due to a minor resulting bezel of only 5.7mm between neighboring display screens.

A new tool for integrating real-time parking information

Streetline has released ParkerData Availability API, a real-time application programming interface (API) that enables application developers to incorporate real-time parking availability into applications, websites, in-car navigation systems and electronic signage.

Using the ParkerData Availability API, developers can build their own parking visualizations on smartphone and internet apps, in-car navigation, or drive variable message signs (VMS) that display an availability count, as well as the total capacity for the facility or collection of spaces.

The API can display availability for all combined spaces in a parking facility or can segment availability by row or by space type. The ability to segment is particularly useful when displaying availability of special use spaces, such as EV, accessible, or visitor spaces. Data is currently available for locations in the USA, Canada, Germany, the UK, Spain and France.

At the core of the ParkerData Availability API is an inference engine that has analyzed more than 225 million sensor-based parking events, and through Streetline's proprietary machine learning algorithms, delivers accurate and timely parking space availability across various space topologies, including parallel (on-street), perpendicular (lots and garages) and diagonal spaces.

The inference engine also provides an availability index value – low, medium or high – which can be used as a space-count alternative.

"Opening up our real-time data set is an exciting step forward in accelerating the

development ecosystem and the use of parking data as an ingredient in apps, websites and in-car navigation systems," says Zia Yusuf, CEO of Streetline. "By encouraging the integration of both our static off-street data and now our dynamic, real-time data through the ParkerData Availability API, we can optimize the benefits of parking guidance, including reduced congestion, reduced emissions, improved motorist experience and a thriving downtown community."

Do you foresee a shift away from roadside message technologies to smartphones in the years ahead – and are there ways to minimize distraction?

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Even discounting the pending V2X roll-out, the consumer-driven integration of transportation and commercial systems will reduce the need for roadside message technologies over the next 10-15 years. As an example, when the smartphone is fully integrated into the vehicle, we will be able to see and hear (in-vehicle) everything we now project onto a message board. Speed limits are already being displayed on our GPS and head-up displays, and Apple recently announced a vehicle integration standard that several manufactures will deploy next year. Impacts are already evident with the shift away from once-promising systems such as Highway Advisory Radio. And when the driverless vehicle becomes the norm, will we really need the displays we use today? Driver distraction is a menace. Last night a local young driver posted a photo seconds before the accident that took her life. We can minimize the physical distractions with voice and other technologies but the mental distractions are socially driven. What we will continue to see is a trend toward collision avoidance systems that take control of your vehicle when you don't. Eventually a vehicle may 'take control' of any phone detected in the vehicle and limit operation to functions that avoid distractions.

J J Eden
Director of tolling, AECOM, USA

It's an interesting question because it really highlights the distance between smartphones and the infrastructure, which includes the vehicle itself. There will not be a shift away from smartphones, rather they will continue to proliferate and their capabilities will only increase. There is no natural reason or regulatory authority that I can imagine would limit their scope. On the other hand, it is very much in the interest of the owners of the infrastructure and the vehicle manufacturers to channel messaging in safe ways through the cars themselves. That's the only way for the human-machine interface (HMI) to be properly tested. Cooperation between vehicle manufacturers and infrastructure owners will increase to an unprecedented level, as we are already beginning to see as V2V technology is tested and deployed.

Larry Yermack
President, Wendover Consult, USA

Considering that there are currently more phones than toothbrushes in this world, such a shift is inexorable. The very ubiquity and handiness of smartphones will engender innovation. Visual and manual distraction could be minimized (and indeed in the USA, guidelines to minimize distraction are in the offing by industry groups and the Federal government). Invention will transcend guidelines. Moreover, I am confident that standard interfaces to large-font and voice enunciation over the car system will be invented. Head-up displays will proliferate as well and wearables may even have a positive effect if very carefully designed; they can keep the drivers informed while their eyes are still on the road. Of course, in the more distant future, cars may be self-driving, obviating concerns about distraction. Granted, my optimistic view will be tempered by the Luddite few who eschew smartphones and the like, so the redundant static and dynamic road signs won't be completely so. Unlike buggy whips, therefore, expect road signs relics to be around for a long while.

Jim Misener
Transportation and technology consultant, USA

The growing ubiquity of location-aware smartphones and vehicles means that opportunities are emerging to provide drivers with specific information about upcoming traffic conditions and to instigate traffic management measures through in-vehicle information systems rather than roadside infrastructure. Lane-specific information can potentially be better tailored to the needs of individual vehicles and take into account journey-specific factors, greatly enhancing opportunities for traffic management. Of critical importance in the success of these systems is that the information is delivered in a manner that is compatible with the demands of the driving task. Visual information, whether presented on an in-vehicle display, a dashboard-mounted nomadic device (such as a smartphone) or on a head-up display, should not cause a driver undue distraction. Our driving simulator studies have demonstrated how distracting drivers' interaction with smartphones for text messaging and social media can be – we would want to be sure that traffic management information can be quickly and easily read and understood so that drivers can safely act on it.

Nick Reed
Principal human factors researcher, TRL, UK

Readers are invited to answer the Burning Question for the June/July 2014 issue:

If you had to choose just one, what single technology or innovation has had the greatest impact on the traffic sector over the past 20 years?

email answers to:
lauren.ansell@ukipme.com

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