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June/July 2014

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News

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PLUS

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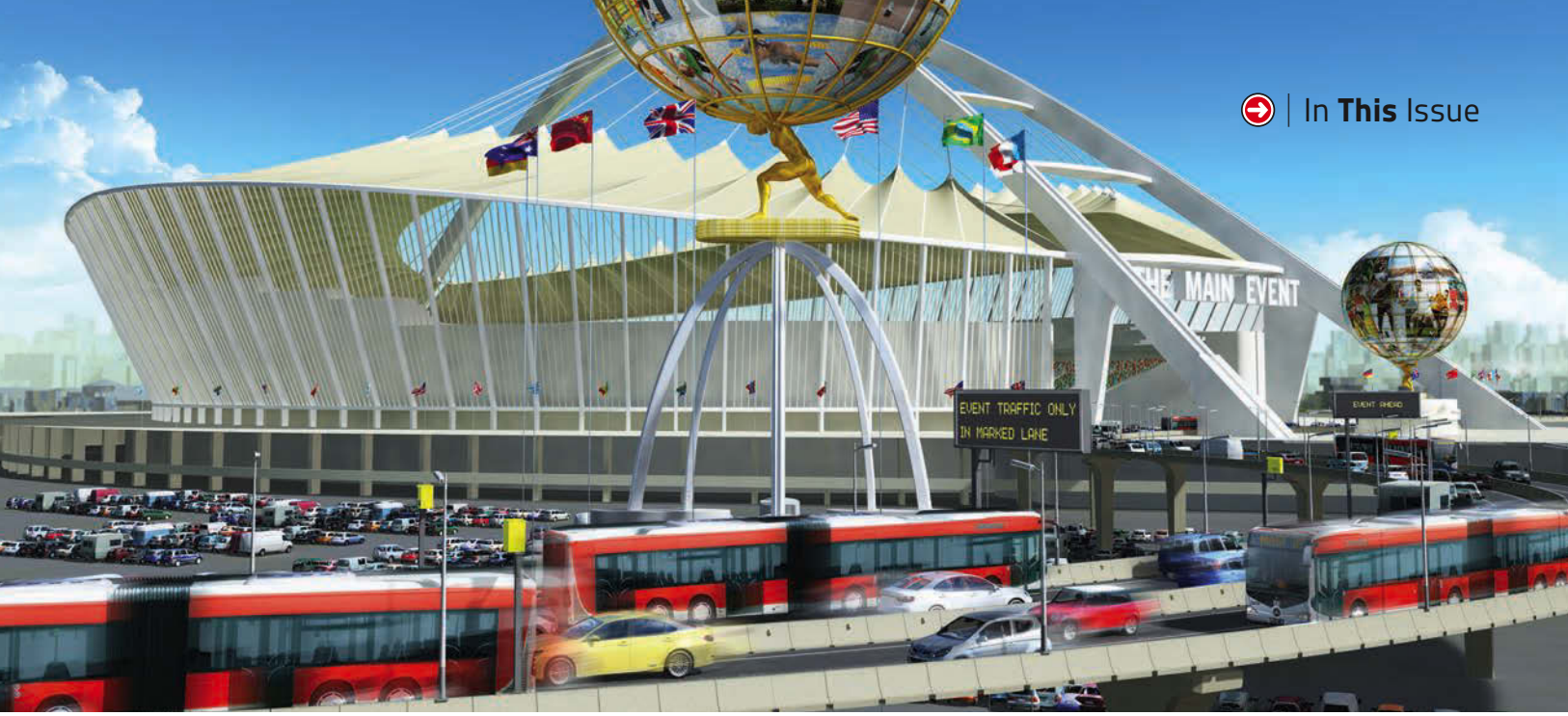

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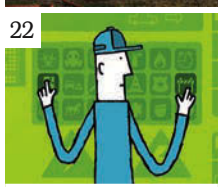

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Foreword

In 2012, I lived and worked in central London. From the very start of the year, hardly a day went by without media scare stories predicting "Olympic gridlock". Information leaflets were delivered to homes detailing the Olympic Route Network and Olympic Lanes system, and anyone planning to drive in the capital during the 60 days of the Games was generally considered to be crazy. As the opening ceremony approached, sports minister Hugh Robertson moved to calm fears, suggesting that Olympic Lanes could be suspended, if gridlock really did set in. He told the BBC, "If the whole of London grinds to an absolute halt, nobody can move anywhere, I don't think that is going to happen by the way, but if it were to, of course we would look at the plans. You'd have to be foolish not to."

Of course, Robertson's confidence in the system was not misplaced. What he knew, and what was perhaps too technical for the media to get their heads around, was that the full, breathtaking force of 21st century ITS had been focused on the streets of London for months and years before a single Olympic ring was painted on a road anywhere. He knew that Transport for London (TfL) had one of the greatest, state-of-the-art, control centers in the world. He also knew that, not only had the operatives involved used all the technology at their disposal to plan for every eventuality, they had also developed new systems. The Games Playbook was one such innovation. A staggeringly complex piece of software that streamlined information across the city, hour by hour, meaning if any unforeseen problems did occur, they could be dealt with quickly and effectively. As part of my first feature for *Traffic Technology International*, I was lucky enough to talk to Carl Eddleston, the man who headed up Playbook development at TfL. He talks about the system and reveals how it is shaping the future of traffic management, as part of a wider look at international mega events on p40.

Eddleston was just one of the many extremely knowledgeable and friendly people I have spoken to in the process of putting together my first issue. Another innovator was Scott Brusaw (p54), who has attracted federal funding and recently inspired a record number of private donations (nearly 50,000) to his Solar Roadways, through the crowdfunding website Indiegogo. As I write, Brusaw is returning from exhibiting his invention at the first ever Maker Faire at The White House. If his vision of paving every road in the USA with solar panels were to become a reality, it could not only propel ITS into a whole new realm, but also generate more than enough power for the entire country. No wonder President Obama is interested.

I'm thrilled with my first issue as editor and I look forward to meeting more of you in the coming months, and providing you all with a way to make your voices heard across the industry.

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Traffic Technology International USPS 012-893 is published bi-monthly – in February, March, April, June, August, and October by UKIP Media & Events Ltd, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK. Annual subscription price is US$131. Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434. Periodicals postage paid at Jamaica, New York 11431.

US Postmaster: send address changes to *Traffic Technology International*, c/o Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434. Subscription records are maintained at UKIP Media & Events Ltd, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK.

Air Business is acting as our mailing agent.

published by UKIP

Member of the Audit Bureau of Circulations

Average net circulation per issue for the period January 1-December 31, 2013 was 17,389
Annual subscription US$131/£73
USPS Periodicals Registered Number **012-893**

ISSN 1356-9252
Traffic Technology International

Printed by William Gibbons, Willenhall, West Midlands, WV13 3XT, UK

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SEEING IS BELIEVING

Slow motion?

Lauren Ansell discovers that although the variable speed limits on England's Smart Motorways are proving unpopular with the media and the public, the new ITS is reducing congestion and improving safety

According to a May 2014 report from the UK government's Department for Transport (DfT), 78.1% of journeys that took place on England's strategic road network in the past year were 'on time'. It's positive news for the Highways Agency, the authority responsible for these roads, which has been transforming highways through its technology-based Smart Motorways scheme since 2010. The scheme is designed to tackle congestion on the busiest parts of the road network, and is currently estimated to cost £2bn (US$3.4bn) each year.

However, a May 13 article in UK newspaper *The Telegraph* entitled 'Motorway speeds: Get used to driving at 40mph, says top highways official' put the agency and its plans under scrutiny. The article was based on an interview published in *Civil Service World* magazine, where Graham Dalton, the HA's chief executive, said, "If you're driving down the M6 to come to work in Birmingham every morning, we've got to the point where 50mph or 40mph is acceptable, and the target is to make it 40mph every weekday morning."

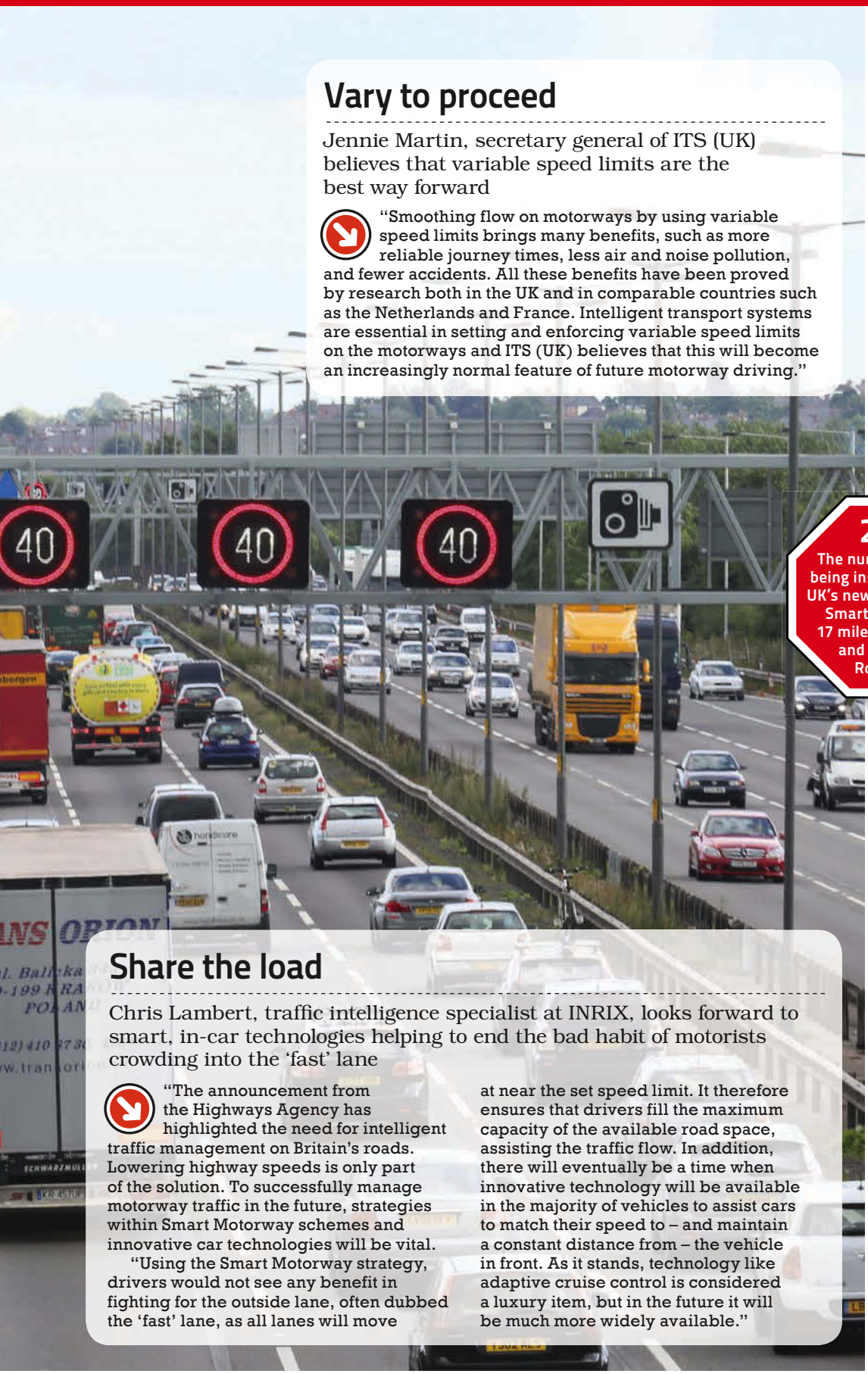
The Highways Agency's £105m (US$177m) Smart Motorway project on the section of the M6 near Birmingham began in April 2012 and was completed in April 2014. The program included the installation of 21 new gantries, refurbishment of three existing gantries, resurfacing 100,000m² (1,076,391ft²) of carriageway, laying more than 78 miles of cabling and construction of six new emergency refuge areas.

The Highways Agency says a combination of hard-shoulder running and variable speed limits at peak times is already reducing congestion and smoothing the flow of traffic, making journeys more predictable. However, Dalton told *Civil Service World* that getting more predictable, but slower and slower, is "not acceptable".

In response to the article in *The Telegraph*, the Highways Agency released an official statement confirming that there is no target to manage motorway average traffic flows at speeds below 70mph.

"In the face of growing volumes of traffic, the Highways Agency has supported governments to make journeys more predictable," Dalton said. "Since 2010 we have also added more than 200 miles of extra running lanes to England's motorways and trunk roads. Last year the government announced plans to improve traffic speeds, supporting this with a promise of long-term funding certainty so that we can deliver more than 750 miles of extra running lanes in the next five years."

In addition to the M6, parts of the M25 London orbital have also been converted according to the new scheme, and plans to transform the M4 into one of the longest stretches of Smart Motorway in England by 2021 are currently under review. The estimated cost for the M4 scheme is between £614m and £862m (US$1.02-1.43bn).



Vary to proceed

Jennie Martin, secretary general of ITS (UK) believes that variable speed limits are the best way forward

"Smoothing flow on motorways by using variable speed limits brings many benefits, such as more reliable journey times, less air and noise pollution, and fewer accidents. All these benefits have been proved by research both in the UK and in comparable countries such as the Netherlands and France. Intelligent transport systems are essential in setting and enforcing variable speed limits on the motorways and ITS (UK) believes that this will become an increasingly normal feature of future motorway driving."

Share the load

Chris Lambert, traffic intelligence specialist at INRIX, looks forward to smart, in-car technologies helping to end the bad habit of motorists crowding into the 'fast' lane

"The announcement from the Highways Agency has highlighted the need for intelligent traffic management on Britain's roads. Lowering highway speeds is only part of the solution. To successfully manage motorway traffic in the future, strategies within Smart Motorway schemes and innovative car technologies will be vital.

"Using the Smart Motorway strategy, drivers would not see any benefit in fighting for the outside lane, often dubbed the 'fast' lane, as all lanes will move at near the set speed limit. It therefore ensures that drivers fill the maximum capacity of the available road space, assisting the traffic flow. In addition, there will eventually be a time when innovative technology will be available in the majority of vehicles to assist cars to match their speed to – and maintain a constant distance from – the vehicle in front. As it stands, technology like adaptive cruise control is considered a luxury item, but in the future it will be much more widely available."

Publicity battle

Survey shows Smart Motorways are yet to be understood by the public

While the results of a recent survey by the UK's Institute of Advanced Motorists (IAM) show that 42% of participants believe that Smart Motorways have reduced congestion and 43% say that they have improved their journey times, the road safety charity believes that more information and advice about Smart Motorways needs to be made available to the public. Of those questioned, 67% said that they had not seen any publicity about Smart Motorways and 40% were skeptical that the monitoring systems would keep them safe.

200
The number of VMS being installed on the UK's newest stretch of Smart Motorway: 17 miles of the M60 and M62 near Rochdale

"In the face of growing traffic volumes, we support governments to make journeys more predictable

Graham Dalton, chief executive, Highways Agency

Generation now

Real-time traffic information has come a long way over the past 20 years. **Lauren Ansell** looks through the archives to chart its progress – from radio frequency-based alerts, to crowd-sourced maps reliant on GPS and 3G connectivity

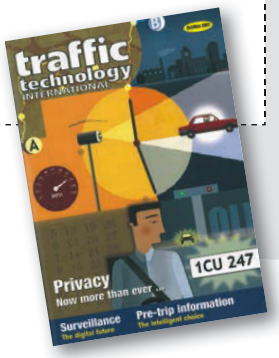
Autumn 1995

'Radio data system (RDS) services broadcast a constant stream of encoded information over a dedicated channel parallel to normal FM broadcasts. RDS-TMC is the dedicated Traffic Message Channel version whereby motorists will be updated with the latest traffic reports. Decoder-equipped car radios translate the digital broadcasts (up to 20 messages per minute) into traffic bulletins.'

In *RDS-TMC – Will Europe get it together?* then-editor Ian Nuttall wrote about the need for Europe to deploy RDS-TMC – a radio-based traffic information service, which, he wrote, 'promises the most up-to-the-minute information without the expense of other mobile communications media'. While the technology developers and vehicle manufacturers were willing to invest in the solution, Nuttall reported that a lack of cooperation between interested parties was stifling the progress of the technology in Europe. Nevertheless, today's modern satnav systems are reliant on this technology.

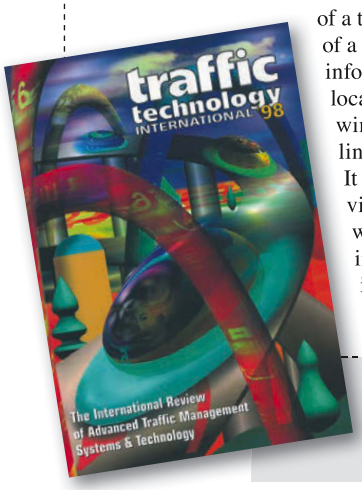
October/November 2001

'The computer system monitors and controls traffic flow on freeways and secondary streets with technology that senses traffic speed and volume, weather and pavement surface parameters. Those measurements are incorporated and communicated through VMS, highway advisory radio, news media and, of course, the internet. An impressive graphical web-interface guides users to desired content, and delimits automatic email messaging.'



1998 Showcase

'The AIDA project uses the 5.8GHz DSRC technology, mainly used for ETC systems. Within the framework of the AIDA project, CS Route's intention is to demonstrate the feasibility of a transport and traffic information system using this architecture. This road/vehicle link is based on its MELODHY ETC range and consists of a transponder, as part of a complete onboard information system, located behind the windscreen and linked to a terminal. It communicates, via microwaves, with beacons installed at regular intervals along the motorway.'



The French AIDA project was launched in 1996. Its mission was to use 5.8GHz DSRC (dedicated short-range communications) technology to provide drivers with relevant real-time traffic information. *AIDA – Towards information highways*, written by project partner CS Route, described DRSC ground equipment connected to the highway fiber-optic communication network. It said information could be processed and analyzed at a control center and then conveyed over the network to the ground equipment before being automatically transmitted to vehicles as they drive past beacons. The early developments in DRSC paved the way for today's V2X technologies.

December 2005/January 2006

'Cellular technology and services will undoubtedly continue to evolve… ITS will continue to take advantage of the cellular innovations, ad hoc network access and increased data rates available. Many opportunities and win-win business models appear feasible for ITS applications. First is the inherent opportunity to connect with the traveling public on the mobile terminals that they are purchasing, largely for other reasons. Thus, appropriately designed websites or multimedia messages can be developed to provide the information needed to make better travel decisions.'

The prospects of congestion pricing

Kenneth Orski was a regular contributor to *TTI* back in the 1990s, serving for many years as our Washington correspondent. Here, he reflects on an article he wrote for our June/July 1997 issue entitled *Congestion Pricing: What Does The Future Hold?*

Your 1997 article highlighted interest in the concept of congestion pricing in the USA, with investment being made in feasibility studies, but cast doubt on whether it would become a reality in the future. Is the USA any closer today to a congestion pricing scheme?
If by 'congestion pricing' you mean the kind of cordon pricing that London has been successfully operating since 2007, the answer is 'no'. A proposal to introduce such a scheme in New York City's midtown Manhattan in 2007 failed to obtain political support and was never revived. No other city has shown interest in cordon pricing. However, various applications of road pricing, notably in the context of 'managed lanes', are being pursued in many local jurisdictions in the USA.

Has the success of the London Congestion Charge influenced the situation in the USA at all?
The New York City proposal was directly influenced by reports about the London Congestion Charge. Many US planners and economists saw London as a fortuitous chance to adopt a successful 'lesson from abroad'. However, London's well publicized scheme failed to sway the political leadership in US cities.

HOT lanes were the big growth area for congestion pricing, or 'value pricing', in 1997. Has this growth continued, and is it still a good alternative to 'pure' congestion pricing?
The concept of 'HOT lanes' – now more commonly known as 'managed lanes' – has gained public acceptance and is being pursued in many metropolitan areas. Some urban areas (such as San Francisco) are developing area-wide networks of managed lanes, where drivers are charged a variable fee depending on the degree of congestion in the managed lanes. In the US context, where the most severe traffic congestion is experienced by commuters on approaches to the city (rather than in the city center itself), pricing of commuter highways is the appropriate response to this universally experienced metropolitan condition.

Looking to the future, how widespread do you think congestion pricing will be in the USA in another 20 years?
The use of pricing to manage traffic on suburban commuter highway lanes is likely to increase in response to the growing problem of commuter traffic. However, I am doubtful that cordon pricing à la London is going to gain popularity with the public or the support of local elected officials. Charging motorists an entry fee into the city is seen as punitive (paying for the use of managed lanes, on the other hand, is accepted because it is perceived as offering value for money in terms of a faster and more reliable commute).

What technologies do you think have made the biggest impact on tolling in the last 20 years?
The use of electronic highway tolling and widespread availability of real-time traffic reports (what used to be called ATIS) have had the greatest impact in my opinion. Both innovations have been widely embraced by the general public and have become part of the daily life for millions of commuters across the country.

> "Some urban areas (such as San Francisco) are developing area-wide networks of managed lanes, where drivers are charged a variable fee depending on the degree of congestion in the managed lanes

In an article entitled *No news is bad news*, Lee J Nelson reviewed the various real-time traffic information services available in the USA. Radio still played a prominent role in conveying information to motorists, but internet-based services were really starting to take off. Using 'digital delivery methods', the new technologies transmitted information to handheld devices and enabled individuals to personalize traffic alerts.

By early 2006, the ITS industry was beginning to take notice of the opportunities presented by the rapidly growing 3G cellular industry. In *The hard cell*, Bruce Abernethy and Jim Gunn explained how the multimedia services provided by 3G could be exploited to connect with ITS infrastructure – enabling the delivery of seamless real-time traffic information to travelers via the personal mobile devices that we continue to rely on today.

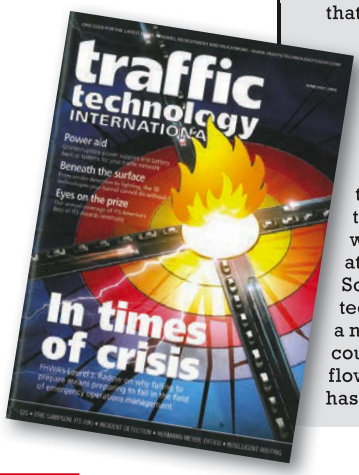
June/July 2007

'Despite a slow start, the real-time traffic data business is now accelerating at a remarkable pace and industry pundits will identify 2006 as the year the industry truly started its advancement from hopes and dreams to a sustainable, functioning market… In early 2006, Inrix and Clear Channel established a strategic partnership aligning the developer of the nation's most sophisticated real-time and predictive traffic flow inference engine with Clear Channel's Total Traffic Network – the largest traffic incident data provider. Just a few months later, in May 2006, Tele Atlas and Inrix merged their traffic data businesses under the Inrix umbrella to provide paying customers with the most advanced traffic information available.'

Rapid developments throughout 2006 were recounted in an article from Inrix's Bryan Mistele, *Here and now*. Several company mergers, combined with rapid developments by car manufacturers, resulted in a huge growth in the portable navigation device (PND) market. PNDs could offer real-time traffic information via FM sideband, satellite radio or GPRS. Meanwhile, major wireless carriers were also beginning to offer GPS-enabled devices along with a host of location-based services featuring navigation and real-time traffic.

June/July 2009

'Third-generation routing systems have gone further, now providing look-ahead estimates of traffic likely to affect a user's trip, and traffic-influenced alternate routes when incidents occur. Based upon the success of GPS probe network and data-fusion technologies, the coverage and quality of real-time and predictive traffic flow data is now rapidly expanding in Europe and in some countries in Asia.'



By 2009, improvements in probe technology and smart modeling techniques meant that GPS-based real-time traffic information was a tangible reality. In *Smart routing*, Christopher Schofield charted the progress of the technology, from the first Dijkstra's algorithm-based systems, to the GPS probe technology providing real-time traffic speeds through wireless services. However, at the time of writing, Schofield detailed that the technology was about to enter a new generation of systems that could provide predictive traffic flow data – an advancement that has now been realized.

June/July 2012

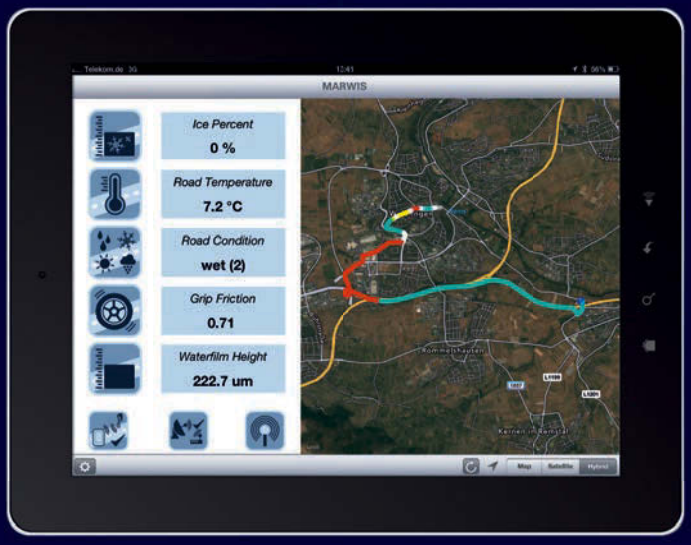
'Road managers and DOTs are also starting to adopt social media as part of their everyday operations, however. Nowhere is this tool more valuable than in the case of incidents. If something out of the ordinary occurs, once it has been verified, it can be communicated in real time to people using – or intending to use – that particular stretch of road.'

In an article entitled *Just in time,* David West discussed the accuracy and effectiveness of social media as a means to collect and share real-time traffic information. He also looked at some of the most advanced technologies available, including a Bluetooth-based traffic sensor, web-based information via satnavs, vehicle detection via magnetic sensors, and probe technologies that use crowdsourced traffic data and advanced analytics. To read more about how crowdsourced traffic information has progressed, turn to page 34.

January 2014

'The potential of geo-based services to evolve in ways that generate substantial value has clearly not gone unnoticed by industry giants, who have been busy in their acquisitions of navigation and location-based specialists in recent years. Whether they compete or cooperate, smaller players need to take maximum advantage of available technologies if they are to prosper.'

In *Free flow and prosper* Justin Graham explained how a new real-time traffic information service from Inrix is able to overcome the accuracy and coverage problems previously experienced by road authorities when gathering information. In addition to providing these agencies with better tools to plan and manage their road networks, the technology also promises to make life easier for motorists by giving them more advanced warning of impending congestion problems, more options for alternative routes and much higher confidence in their navigation technology.



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Handle with care

Lloyd Fuller looks at how advances in technology are making journeys safer for vulnerable road users in the USA and UK

Back on track

A new rule in the USA requires rear visibility technology in all new vehicles

The USDOT National Highway Traffic Safety Administration (NHTSA) has issued a final rule requiring rear visibility technology in all new vehicles under 10,000 lb (4,535kg) by May 2018.

The rule is intended to enhance the safety of vehicles by reducing the risk of fatalities and serious injuries caused by 'backover' accidents. The new rule requires all vehicles under the prescribed weight, including buses and trucks, manufactured on or after May 1, 2018, to come equipped with rear visibility technology that expands the field-of-view to enable the driver to detect areas behind the vehicle. The field-of-view must include a 3x6m (10x20ft) zone directly behind the vehicle. The system must also meet requirements concerning image size, linger time, response time, durability and deactivation. On average, there are 210 fatalities and 15,000 injuries per year in the USA caused by backover crashes. NHTSA has found that children under five years old account for 31% of these fatalities and adults aged 70+ account for 26%. Once the entire on-road vehicle fleet is equipped with rear visibility systems meeting the new requirements, 58 to 69 lives are expected to be saved each year.

Warning signs

Trials commence of technology to warn bus drivers about cyclists

In the UK city of Bristol, a device that warns bus drivers when cyclists are moving past their blind spot is being tested. The technology is being trialed on two vehicles that use a high-frequency bus corridor that is also used by more than 2,300 cyclists a day. The CycleEye technology has been developed to reduce the growing number of cyclist collisions and casualties involving large vehicles. It uses radar and camera sensors to identify when the risk for the cyclist is increased and gives an audible alert to the driver's cab. The unit, which can operate day or night, in all weather conditions, is fitted to the side of the vehicle. The system is programmed to ignore other objects, such as bollards, railings or cars, cutting out false alerts, which have been an issue with other technologies.

Drivers aware

A project testing blind-spot safety technology begins in London

A new project funded by Transport for London (TfL) will independently test blind-spot safety technology, which can be fitted to HGVs to help reduce the risk of collisions between HGVs, pedestrians and cyclists. The new safety initiative will be carried out by the UK's independent Transport Research Laboratory. The project will evaluate the effectiveness of the full range of blind-spot safety technology in spotting pedestrians and cyclists, which will include camera monitoring systems, optical and radar detection systems, and other sensors fitted to HGVs. The findings will then be used to create new and detailed performance criteria, such as: the distance objects can be detected; how easily the equipment detects vulnerable road users; and the reliability of the equipment. One of TfL's priorities is to reduce by 40% the number of people killed or seriously injured on London's roads by 2020.

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Nerve center

Even though Berlin has only 324 cars per 1,000 inhabitants, 43% lower than the German national average, its highly complex transportation network requires continuous investment

Infographics: Louise Adams

Berlin's traffic is monitored 24 hours a day by the Berlin Traffic Management Center, which is operated by VMZ. This includes the management of 2,000 sets of intersection traffic lights and nine motorway VMS, as well as 1,500km (932 miles) of roads

The number of annual traffic accidents in Berlin has fallen by 38,400 since 1992, but

130,000

still occur on the city's roads each year

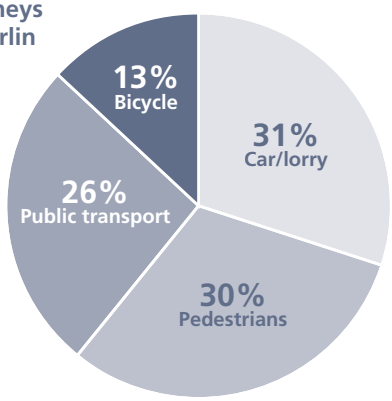
According to Visit Berlin, the city encompasses 892km² (322 square miles) and has a population of approximately 3.5 million people. Statistically, there are 3,809 Berliners to every 1km² (0.38 square miles) – the highest figure for any German city

Berlin is the 18th most congested city in Europe. Its roads are most congested on Monday mornings and Friday evenings. They are least congested on Friday mornings and Monday evenings (*2014 TomTom Travel Index*)

Every year Berlin spends more than €300m (US$411m) on construction, maintenance and energy for the city's road network

5,350 km (3,324 miles) of roads, including minor residential streets, wind through the German capital. Approx. 70km (43 miles) are autobahn *(Source: Visit Berlin)*

Journeys in Berlin



On average,

40%

of journeys in Berlin are by bicycle or on foot. The city has 662km (412 miles) of purpose-built bike paths

There are

94,354

managed parking spaces on the city's public roads

On average, each Berliner makes three journeys per day, and in the process spends about

70 minutes in traffic, traveling an average distance of 20.2km (12.6miles)

164km of Berlin's main roads have a night-time limit of 30km/h (19mph) and a further 372km have a 30km/h limit during the day. This means that

17%

of Berlin's major road network is, at least in part, subject to a 30km/h limit

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Fire fight

Far from being safe havens cut off from risk, the enclosed nature of tunnels makes them intensely dangerous environments. **Lauren Ansell** discovers why underground infernos are feared above all others and how advanced technologies can help

Even a casual glance at the current European and US legislation documents governing minimum safety requirements for road tunnels is enough to tell you that it is a serious business. The guidelines include construction, operation, maintenance and fire protection, and often incorporate some of the most advanced technologies on the road. But this has not always been the case.

"A few decades ago you would probably have found consensus that tunnels were, in general, safer than the open road, because they are a more 'controlled' environment – with no weather effects, uniform lighting and generally very few junctions," says Dr Ricky Carvel from the BRE Centre for Fire Safety Engineering at the University of Edinburgh. "People didn't usually take special notice of tunnel safety as distinct from road safety in general."

Indeed, until about 15 years ago, road tunnel fires were generally perceived as an occasional nuisance rather than a major safety issue. "The Mont Blanc tunnel fire in 1999 changed all that," says Carvel. "Thirty-nine people died, 34 vehicles were destroyed, and the tunnel itself was seriously damaged and shut for three years. The economic effect of that closure was massive. It wasn't just a tragedy – with it came the realization that if the same kind of event happened again, in any one of hundreds of road tunnels around the world, the established strategies would not be able to ensure life safety. The Mont Blanc disaster made a complacent industry realize it actually had to do something."

Road tunnels, by their very nature, make the risk of fire and the associated consequences more intense. As the heat cannot escape, it is retained in the tunnel structure. "This accelerates the burning rate of the fire, which means more heat is retained, and the cycle goes on," says Carvel, who also edited the *Handbook of Tunnel Fire Safety*. "This effect is only constrained by the availability of oxygen. When this starts to run out, the fire is limited, but with that comes increasingly toxic smoke."

"The fact that the smoke has nowhere to go means that conditions can become severe very quickly," adds Daniel Nilsson, an associate professor at the Department of Fire Safety Engineering at Lund University in Sweden. "Also, the confined nature of a tunnel means that fuel is dispersed and fires become violent. Evacuation conditions therefore deteriorate rapidly."

For this reason it is essential that tunnel users are warned about the danger in good time and are able to evacuate quickly and easily, before a fire has a chance to grow.

"Once a fire reaches a certain size, it becomes too late for people to escape on foot as the smoke will move faster than they do," says Carvel. "In the Mont Blanc incident, 27 of the 39 people who died were overcome by fumes before they even left their vehicles."

Battle ready

Ventilation systems have been used as a means to aid evacuation in road tunnels for a long time. The systems can blow the smoke in one direction, leaving a smoke-free path in the other for safe egress.

(Right) **After the tragedy in 1999, the Mont Blanc Tunnel was subject to major safety improvements** (Below) **Fires can grow extremely quickly in confined tunnel environments**

However, Carvel identifies that this strategy, which is used in most tunnels around the world, has a problem.

"By supplying oxygen to the tunnel, we remove the constraint on fire size, enabling them to grow much larger," he says. "Furthermore, the experience of Mont Blanc and other incidents over the past 15 years has shown that the capacity of many tunnel ventilation systems is not sufficient to extract or blow away the smoke from a fire."

Sprinkler systems have also been employed in tunnels since 1963, but until the Mont Blanc disaster they were only common in Japan and Australia.

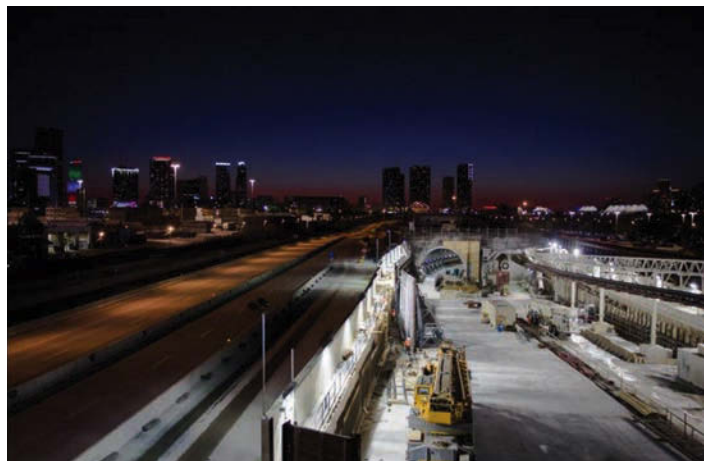
"In general the rest of the world – including organizations such as NFPA and the World Road Association – listened to a few doom-mongering 'experts' who came up with a list of myths about sprinklers, which led the standards to say that sprinklers could not be considered to be a life safety device," Carvel reveals.

Sprinkler systems are now, however, accepted internationally as an effective fire mitigation and safety solution.

> The Mont Blanc disaster made a complacent industry realize it actually had to do something
>
> **Dr Ricky Carvel, BRE Centre for Fire Safety Engineering, University of Edinburgh**

"Fire standpipes and fixed firefighting systems, such as deluge or water mist-type sprinkler systems are particularly effective in containing a fire to the incident vehicle and preventing it from spreading to other vehicles," says William Connell, technical director of mechanical engineering at Parsons Brinckerhoff. "Fire protection of the structure itself is also an effective means to mitigate the effects of a vehicle fire. Some vehicle fires have the potential to cause severe damage to the structure, which could result in loss of its use over an extended period. Passive structural protection systems such as fire boards and panels can be used to protect the structure from fire damage."

The best way to reduce the harm caused by a fire, however, is to rapidly identify its location within the tunnel and then ensure that people are evacuated as quickly as possible. "Devices such as automatic fire detectors, CCTV cameras, gas monitoring instrumentation and vehicle motion detectors are often used individually or collectively to recognize vehicle fires," says Connell. "Early detection will lead to the earliest possible



(Above) **To optimize safety, the Port of Miami Tunnel operates a 'No Tag, No Tunnel' policy – pedestrians and cyclists are prohibited from the tunnel**

intervention by emergency responders – and thus the best opportunity to mitigate the incident."

Safe harbor

For today's tunnel designers and owners, there is an increasingly sophisticated range of fire detection and mitigation solutions to chose from. However, Chad Duffy, senior fire protection specialist at the USA's National Fire Prevention Association (NFPA), stresses the importance of selecting the most appropriate type of technology based on the fire characteristics that are anticipated in the individual tunnel.

"Depending on the type of fire, some technologies will act more quickly than others," explains Duffy, whose organization's 502 standard for road tunnels, bridges and other limited-access highways, defines the minimum criteria that must be met by US road tunnels to provide protection from fire and related hazards.

"The standard covers a multitude of areas, including fire protection and fire life-safety factors, emergency response plans, communications, signage, incident detection, ventilation and firefighting systems," Duffy explains.

In Florida, the owners of the brand-new Port of Miami Tunnel (POMT) say that its safety features and systems not only meet the NFPA 502 standard, but exceed them.

"The tunnel has been designed to provide the highest possible level of safety for motorists in the event of a fire emergency," says Parson Brinckerhoff's Connell, whose firm has been contracted by the Florida Department of Transportation (FDOT) to provide design oversight compliance and construction inspection services for the project.

The POMT was conceived as a solution to the congestion in downtown Miami caused by the 16,000 vehicles that travel to and from the Port of Miami every weekday. By providing a direct link between the port and nearby highways, the tunnel will not only reduce congestion – and improve safety – on local streets, but will also enable the port to remain competitive.

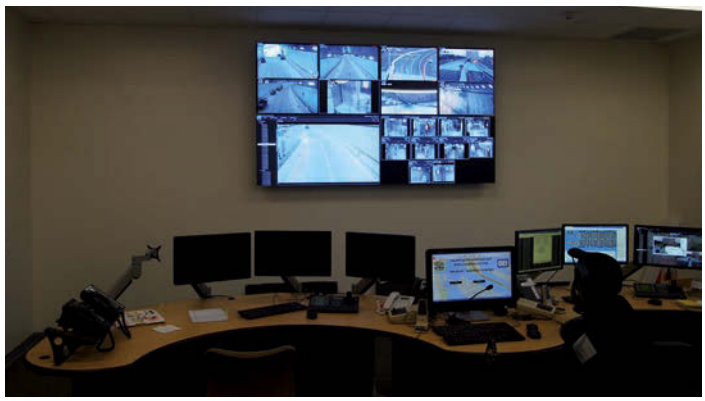
The major US$667m design and construction project, which began in May 2010, was completed in May this year. POMT comprises two 4,200ft-long tunnels,

> Depending on the type of fire, some technologies will act more quickly than others
>
> **Chad Duffy, senior fire protection specialist, NFPA**

each 39ft in diameter. Each tunnel has two traffic lanes, curbs and walkways.

"As a high percentage of the traffic that will use the new tunnel will be HGVs hauling containers to and from the port's cargo facility, as well as coaches and passenger shuttles serving the cruise terminals at the port, it has a dedicated traffic management system to closely monitor and control both normal and emergency traffic conditions in the tunnel and on its approach roads," explains Connell. The system will be manned by 30 experienced operations personnel from a dedicated on-site control center 24 hours a day, seven days a week.

"Safety has always been our priority," confirms Christopher Hodgkins, vice president of Miami Access Tunnel (MAT), the team in charge of designing, building, financing, operating and maintaining the tunnel. "The tunnel's 91 roadway CCTV



(Left) **CCTV cameras monitor the traffic in the Port of Miami Tunnel 24 hours a day** (Right) **The tunnel's emergency exits are clearly marked and provide a refuge area for people with restricted mobility**

cameras capture images that are displayed on a video wall in the operations control room. There are also live lane control and dynamic messaging systems that ensure the timely delivery of information for motorists, as well as innovative guardrail systems that are designed to reduce the severity of motorcycle accidents."

Should a vehicle catch fire in the tunnel, POMT is equipped with a jet fan-based longitudinal ventilation system that will control the flow of smoke. This is accompanied by state-of-the-art automatic incident detection technology and active sprinkler fire-suppression systems. Interestingly, the tunnel also has 110,000 lb hurricane flood gates. "Due to our location and rising sea levels, we had to ensure that the tunnel would be protected against storm surges," Hodgkins explains.

To accompany the tunnel's advanced safety technology and infrastructure, a multijurisdictional emergency response plan has been developed by the tunnel operator and all the emergency services and agencies, overseen by the state fire marshal. The plan identifies 19 emergency events and contains the specific roles and responsibilities for the 10 responding agencies in each type of event.

"Ideally the emergency services should be involved in the design of every tunnel," Connell suggests. "Each of these services have their own unique needs and requirements, which should be collectively considered and incorporated into the tunnel design in as practical a means as possible."

> The tunnel's 91 roadway CCTV cameras capture images that are then displayed on a video wall in the operations control room
>
> **Christopher Hodgkins, vice president, Miami Access Tunnel**

Also, as previously mentioned, an efficient means of evacuation is of vital importance and all tunnels are now required to enable egress to a safe place in the case of an emergency.

"In the Port of Miami Tunnel, cross-passageways are situated every 650ft to provide a means of escape," says Connell. "They provide a safe haven for motorists who may be mobility impaired and must wait for assistance. All the tunnel's systems, combined with the emergency response plan, afford the best possible opportunity to save lives in the event of an emergency in the tunnel."

Work in progress

The sophisticated safety features in the Port of Miami Tunnel are only possible as a result of the numerous research and experimental projects that have taken place all over the world since the disaster at Mont Blanc.

"Much of this research has focused on better defining our current assumptions about potential fire size and growth rates, and how ventilation and water suppression systems can affect them," says Connell. "It has enabled us to more accurately evaluate and determine the best combination and capacity of systems, as well as the necessary level of structural protection specific to any particular road tunnel based on its unique operational parameters and risks."

Human factors

Psychology plays an important role in emergency evacuations

In an emergency situation, the most important safety consideration is effective and prompt evacuation. However, tunnel disasters in the past have shown that people can be reluctant to leave their vehicles. To ensure that people evacuate as quickly as possible, there are psychological and behavioral issues that need to be addressed.

According to Lund University's Daniel Nilsson, there are several reasons why people may hesitate to evacuate a tunnel.

"People move towards the familiar in emergencies," he says. "The tunnel environment is unfamiliar, but the interior of your car is familiar. People are also often reluctant to leave their property – in this case, their car – in the tunnel."

Nilsson also observes that people tend to want a lot of information before they begin to evacuate and says that tunnel operators should provide both visual and acoustic signals.

"Just one cue is usually not enough," he explains. "The important thing is to get the attention of people and make them understand what is happening, not just give them instructions. In many tunnel disasters, the information has been limited and then conditions have changed rapidly."

According to the human-environment interaction (HEI) model, a person's emotional state will also play a large role in how they respond in an emergency. "The more 'stressed' you make people – with alarms, visual warnings and lights – the faster they will evacuate and respond," Nilsson explains. "It is, however, a balance because causing too much stress prevents people from thinking straight."

Reform for reliability

Safety in the Jack Lynch Tunnel in Cork, Ireland, is managed by a secure control and monitoring system

More than 60,000 vehicles a day use the Jack Lynch Tunnel to pass beneath the River Lee. The tunnel provides essential congestion relief for the city of Cork and to ensure continued operation, a full SCADA (supervisory control and data acquisition) upgrade was required. The aim was to increase the integrity of the system.

P Ducker Systems was asked to supply and install a new top-end for the existing PMECS (plant monitoring and environmental control system) and migrate system communications from a serial network to a 1Gbit high-integrity Ethernet network.

The Jack Lynch Tunnel is situated to the east of Cork city center

The new top-end was developed to control and monitor a variety of subsystems from local and remote control rooms. They included: tunnel and central passage ventilation, tunnel lighting, gas detection, radio rebroadcast, drainage, CCTV and fire detection. New high-integrity dual-redundant PLC systems were installed, which will provide automatic and manual control, switching and alarm functions for all subsystems and associated equipment, and are based on a high availability, hot-standby/dual-server configuration.

Installation work was all carried out without needing to close the tunnel, thereby minimizing disruption to the public and reducing the cost to the operator. The installation and migration of system communications required a carefully sequenced procedure to maintain operation of essential plant equipment at all times.

The University of Edinburgh's Carvel feels that in order to improve fire safety systems in the future, the industry needs to develop technologies that can identify and precisely locate fires while they are still small. And, whereas current deluge and water-mist systems generally activate over 190-230ft at once, Carvel envisages systems that are more precise. "They'll be able to deliver more water to the right location, which will result in a reduction in the amount of water sprayed overall," he explains. "Also, the form of the water – whether big drops, small drops, stream, with additives, without additives – needs to be refined and optimized. I also expect that there is an optimum combination of ventilation and water spray that will be more effective at firefighting. This needs to be investigated more fully."

Lund University's Nilsson, meanwhile, advocates the importance of notification and wayfinding systems that work in smoke. "Flashing green lights have proved to be effective in getting people's attention and directing them to emergency exits," he says. "Yellow flashing lights can also be used to attract attention to tunnel information systems. There also needs to be better provision for the elderly and disabled."

Traffic control

While the POMT is a great example of how the current codes, standards and guidelines for road tunnels effectively address fire protection and safety in an emergency, Connell feels that international safety regulations currently fall short in terms of establishing means of prevention.

"It is very common, particularly on busy roadways and in urban locations, for tunnels to effectively act as traffic choke points," he says. "We need to recognize that traffic congestion in tunnels is one of the biggest threats to safety. Limiting congestion inside a tunnel can substantially mitigate the risk of serious events occurring, as well as the consequences of a serious event should one occur.

"We have already acknowledged the dangers of hazardous and bulk fuel cargos in tunnels and have taken preventive actions to ban them," he continues. "However, little attention and guidance has been developed toward basic civil roadway alignment design and traffic control strategies, both upstream and downstream of tunnels, to ensure that traffic will move reasonably well into and out of a tunnel. I strongly believe that the time has come for tunnel safety regulators to start looking at ways to prevent or at least reduce the risk of serious in-tunnel events, by establishing specific requirements to control traffic on the approach and departure roadways serving tunnels."

(Right) **The POMT has 42 emergency telephones, 45 manual fire alarm stations, 40 fire hose valve cabinets and 82 deluge zones**

> We need to recognize that traffic congestion in tunnels is one of the biggest threats to safety

William Connell, technical director of mechanical engineering, Parsons Brinckerhoff

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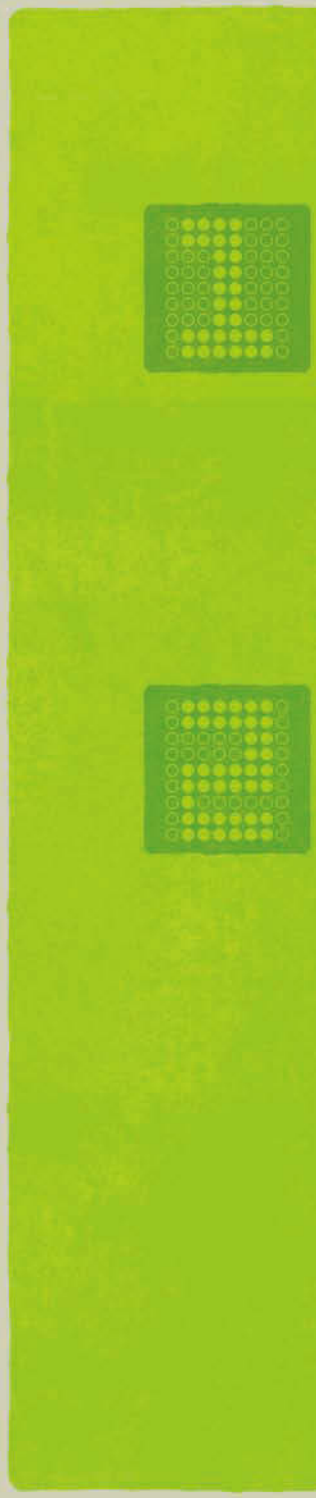
Street smart

The days when the only way to spot a mishap on a highway was to pore over grainy CCTV images are gone. **Max Glaskin** reports on a new multimillion-dollar EU project that will draw together detailed data from multiple sources, and looks at some other smart alternatives

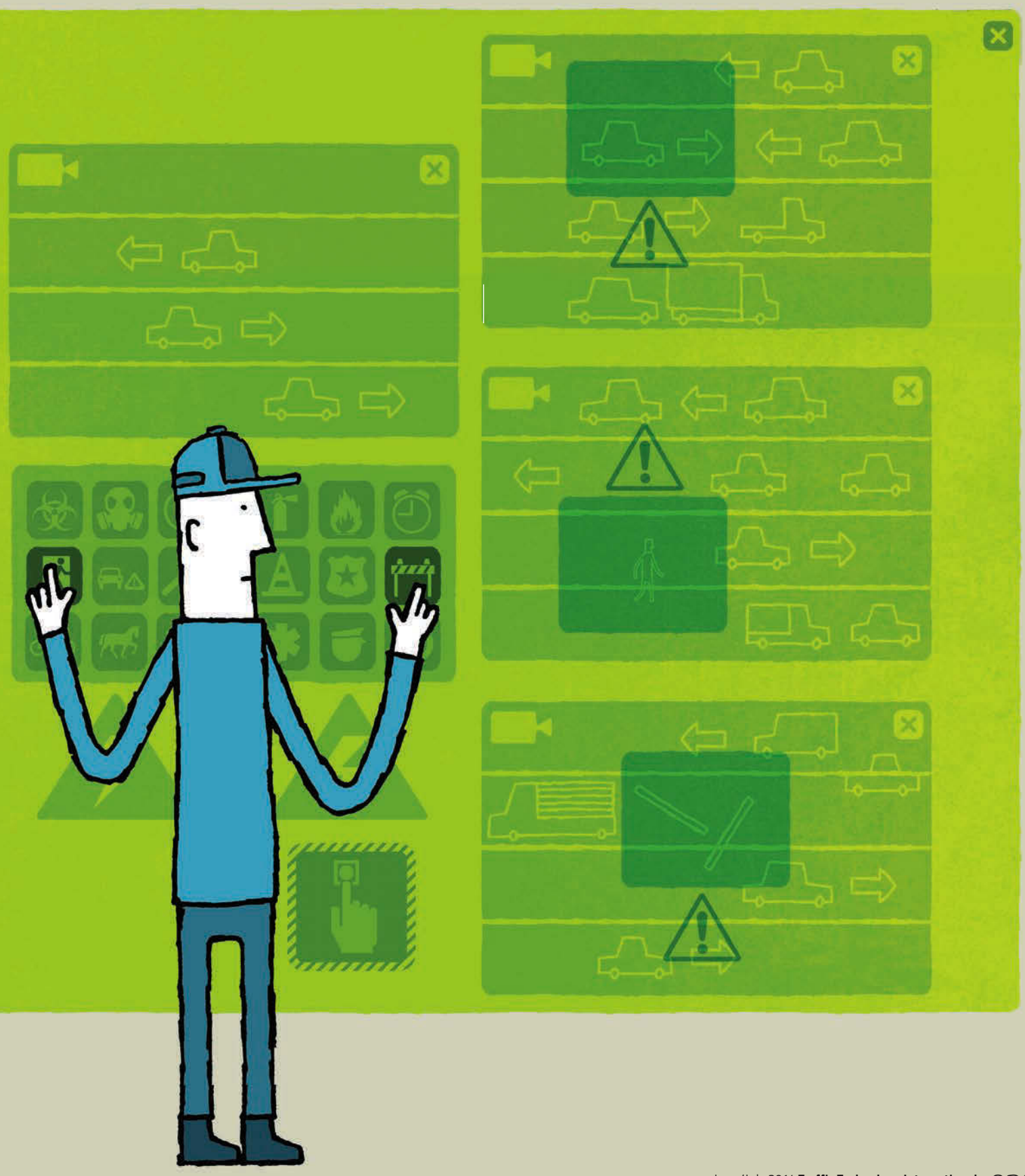
Illustration: Tim Ellis



New ways of collecting data promise to increase the quantity, quality, speed and extent of detecting traffic incidents and sharing information about them to road operators and users. The innovations also hold the alluring prospect that they could cost less than conventional methods.

One element of the EU-funded INSIGHT project is leading the way. The three-year project, known fully as Intelligent Synthesis and Real-time Response using Massive Streaming of Heterogeneous Data, is costing almost €4m (US$5.4m), of which the EU is contributing €2.8m (US$3.8m). Dublin is a testbed and its participation could benefit everyone who wants to travel through Ireland's capital city.

"We get a lot of data from different streams, including our SCATS traffic management software, which runs at more than 750 junctions, and from the city buses, which return location data every 20 seconds," says Dermot Kinane, executive ITS officer at Dublin City Council. The INSIGHT partners, including Technion-Israel, TU Dortmund, IBM, Fraunhofer and Germany's Federal Office of Civil Protection and Disaster Assistance, and led by the University of Athens, want to demonstrate how such disparate streams can be married and analyzed by software. It should generate alerts automatically so that traffic is managed more quickly when there is an incident.



"At the moment, we have a very manual approach," Kinane continues. "We monitor the pictures from 250 CCTV cameras around the city and we get calls telling us of problems. So we find out that things have happened – eventually. INSIGHT could spot anomalies in traffic patterns at junctions through the SCATS and bus data, and then alert the traffic manager to verify it by checking the CCTV images."

More with less

The architecture of INSIGHT is scalable to accommodate the introduction of more data streams and nodes. One such stream may come from an app for smartphones. It is being beta tested in Dublin by Kinane and others.

"We already have an FM radio station for traffic during peak periods, which has up to 70,000 listeners," Kinane details. "They have a vested interest in finding out where there may be traffic incidents. The app could extend the role of the active citizen so they feed back information to the traffic management system. Crowdsourcing through the app would help us to verify incidents and would fill gaps in places where we do not have any sensors or cameras installed."

Other possible streams of data into which INSIGHT might tap include weather data and Twitter. "The SCATS and bus streams have enabled IBM and Athens University to identify normal traffic patterns based on historical data, but to help us predict abnormalities before they happen, we need real-time feeds," says Kinane. For example, forecasting pluvial flooding, whether the data's from meteorological sources or messages on social networks, would help Dublin City Council to deploy personnel to the right places sooner and so reduce the impact on traffic.

It is hoped that real-time feeds will be trialed by a prototype system early next year and the entire project is scheduled to conclude in September 2015. "When INSIGHT detects incidents, we'll verify it on CCTV, where we have coverage," Kinane explains. "It will assist with what we do already, flagging incidents quicker than we can currently spot them. In the future, it might also trigger responses automatically. At the moment, like many road operators, we have limited resources, which are dwindling, and if INSIGHT can help us do more with less, then that will benefit everyone."

> INSIGHT could spot anomalies in traffic patterns at junctions through the SCATS and bus data, and then alert the traffic manager to verify it by checking the CCTV images
>
> **Dermot Kinane, executive ITS officer, Dublin City Council**

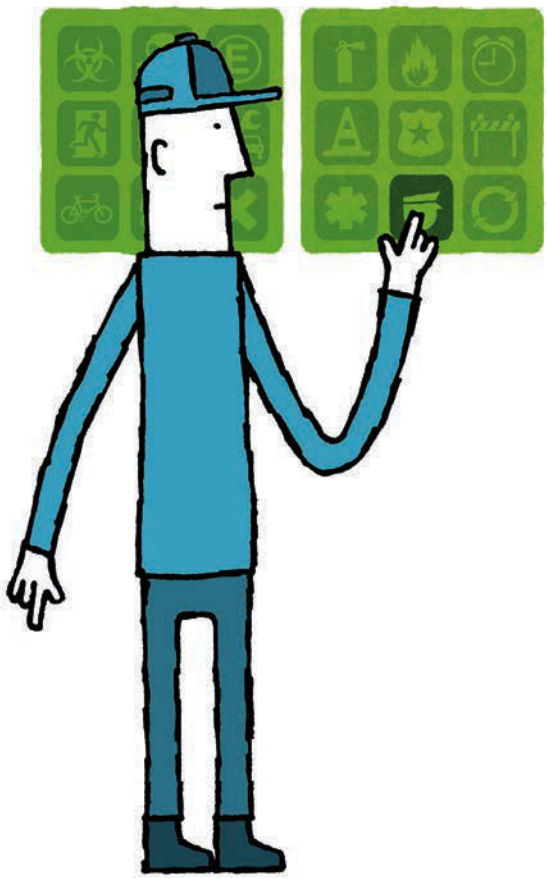
(Top) **Operators at Dublin City Council's Traffic Control Center keep a close eye on the city's roads**
(Right) **ARUP is looking at how social media-based data collection could aid with incident detection**

People power

The concept of using social technologies to detect traffic incidents is being explored by Rachelle Mulder, senior engineer at Arup's Dublin office. "The advantage is that the updates on Twitter and Facebook are instantaneous and they are free," she says.

"The limitations, as far as road operators are concerned, are that social technology can generate a large volume of non-transferable information. This would have to be validated and verified quickly because, to win trust, road operators have to be responsive in a timely manner. If I wanted to clear my path home I could send a Tweet about a hoax traffic incident, which means that road operators will be required to monitor messages to ensure that other road users don't react on inaccurate or misleading information. While text mining techniques continue to improve, there are still numerous challenges to transform text messages into useful and reliable information. Filtering through a large volume of traffic updates may become resource-intensive."

By adopting a humane and sympathetic approach to their social technology strategies, road operators have the potential to build better relationships with road users. "If you can establish that kind of dialog, you will become the preferred and trusted vendor of traffic information," believes Mulder. "Your users will reciprocate and supply accurate information; and road network operations will move toward true collaboration between road operators and citizens."



Extending the network

Future detection systems could be installed in streetlights

Well-resourced traffic management centers can never get enough information. More data, received and processed more quickly, should increase the volume and quality of helpful knowledge, to enable road operators to optimize vehicle flow. So it's worth keeping an eye on an imminent experiment to extend the network of devices that monitor conditions to places that are not usually covered.

The trial will be piggy-backing on another innovation – traffic-adaptive streetlight control. Since March this year, LED luminaires in three Austrian cities have been adjusting their luminance intensity according to traffic volumes. They are dimmed when there is no or low traffic, but when the traffic management system (TMS), to which they are connected – both by

wires and wirelessly – tells them vehicles are on their way, they get brighter.

"The next step is to deploy luminaires that have sensors to gather information about vehicle flow and send it to the TMS," says Thomas Novak, research project manager at Swarco Futurit. If it is applied strategically, this technology could plug holes in the data collection network, such as in residential streets or rural roads where conventional sensors aren't common.

"The sensors on adaptive, networked LED luminaires do not need to be sophisticated," Novak explains. "The aggregated data from them can enhance traffic management. And, when incidents are detected, the TMS can harness the aggregated data to increase illumination at that place so that the appropriate services can benefit."

Bird's-eye view

Until social technology is used as much by road operators as it is by teenagers, roadway hardware and associated communication methods will remain the most popular way to gather information and detect incidents. In the same year that Twitter was created (2006), South Korea embarked on a 10-year program to build the most intelligent highways in the world – and one of the earliest hardware innovations is the Smart-I .

One novelty of the Smart-I is its integration of three systems into a single unit, which monitors vehicles and traffic flow, detects anomalies, and provides information to enable road operators to verify the location and type of incident. It houses an array of seven cameras, plus an auto-tracking camera and radar. The array captures seven video images from above the expressway, which are processed and stitched together in real time to produce a bird's-eye panorama of the road. The prototype array was able to view at least 0.5 miles of highway. The auto-tracker is tuned to monitor and record any anomaly and the radar kicks in when clarity of vision is compromised by inclement weather.

To perfect the Smart-I, trials were held on a five-mile testbed section of the Jungbu Expressway. The study found it worked perfectly at spotting wrong-way driving, a pedestrian on the highway and a stopped vehicle. Obstacles, placed to replicate rock falls, were detected in up to 97% of instances and, through refinement, Smart-I didn't take longer than 11.2 seconds to detect any of the incidents. It was, however, found to be perhaps a little too sensitive because one in every five of the alarms it raised were false. Now it's being improved to play a full role in enhancing the country's traffic incident detection.

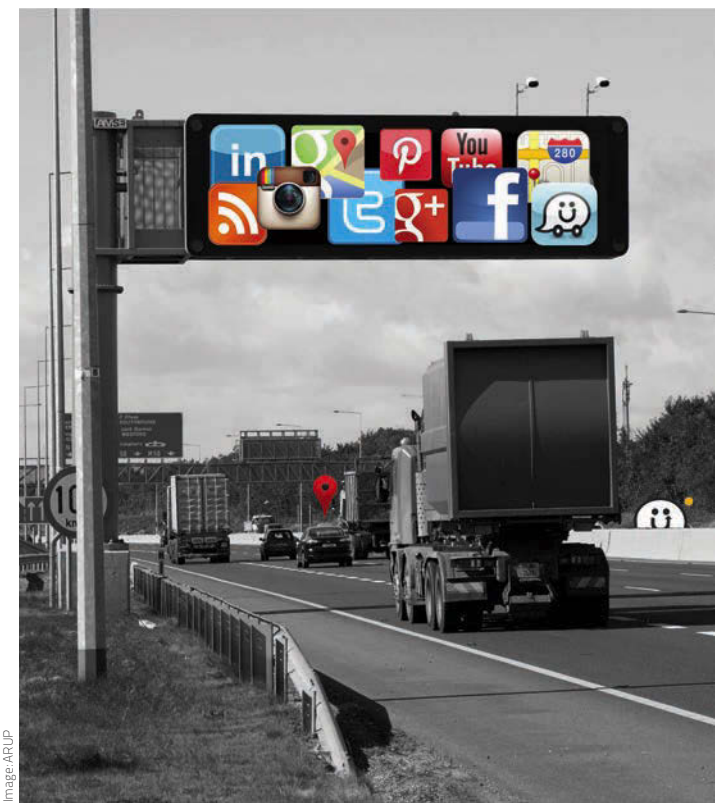


Image: ARUP

Caught in the act

Is current mobile enforcement technology effective in reducing accidents on our roads – or should we be moving toward in-car solutions? **Saul Wordsworth** investigates

Out on our roads, what are the best forms of law enforcement? Is it true people slow down at fixed cameras then speed up again? And if so, does that mean mobile enforcement methods are more effective? When it comes to speed-capturing technology, it often seems as if there are more questions than answers.

"Whether we are talking about mobile or fixed cameras, red light technology or lidar guns, they all are beneficial and all bring down speeds," says Bryan Lawton, road safety consultant at the UK's Transport Research Laboratory (TRL). "According to the 2005 Elliot and Broughton report, average road speeds are reduced by 3% as a result of increased enforcement. The effect is that, on average, they will reduce the likelihood of an accident happening and also the severity. The message that fixed-location enforcement technology is sending out is that excessive speed is dangerous. Mobile or covert enforcement is better at catching the more severe offenders. Whether mobile or fixed technologies are more effective depends almost entirely on who you are trying to catch and your overall objective."

In the UK, the principal means by which to catch and prosecute speeders are fixed cameras, average time distance cameras, and police-operated mobile laser speed measurement devices or older-generation radar devices. Other methods include signs that seek

to educate and encourage compliance, such as vehicle-activated speed signs and Community Speed Watch schemes. Meanwhile, some classes of vehicles are fitted with speed limits by law, and cars are increasingly deployed with speed limiters and cruise control systems that drivers can self-select to achieve compliance.

Fixed enforcement

In June of last year, the findings of a study by Professor Richard Allsop of University College London were published. Based on the analysis of 551 fixed speed cameras in nine areas of the UK, Allsop's research showed that on average the number of fatal and serious collisions fell by 27% after their installation. There was also an average reduction of 15% in personal injury collisions.

"The results of this report were fascinating, but you could not move the self-same technology to other countries and expect the same results," says Nick Croft, formerly assistant chief constable of the South Wales Police and now senior advisor for Road Safety Support (RSS). "It depends very much on the location in which you are operating, the weather, the roads, the problem you are addressing, and the culture in place. First and foremost you need strong legislation. If there are no penalties, you can put cameras where you like, but they will be ignored. Nations do different things with cameras and it's all down to the legal structure of each country. There are so many variables to factor in when introducing a casualty reduction enforcement system."

Allsop's report was clouded by the revelation that at 21 camera sites, collisions actually went up, enough to justify further investigation. The effectiveness of camera technology remains a contentious issue. Do people slow down when they observe fixed cameras? Lawton won't be drawn.

"It's difficult to say, based on the data we've seen," he says. "Often cameras will be located on a straight stretch, sometimes on small hills, and so on. But if they are placed at the point of highest risk – for instance outside a school – then that makes some sense. Different forces across the UK have different strategies based on their own experience coupled with the evidence available. They are aware that speed is one of the 'fatal four' alongside

> First and foremost you need strong legislation. If there are no penalties, you can put cameras where you like, but they will be ignored

Nick Croft, senior advisor for Road Safety Support

cell phones, drunk driving and not wearing seatbelts. The number of people caught is still the best metric for measuring effectiveness, as compared with the number of people complying."

This is something the European Transport Safety Council (ETSC) clearly understands. It is a non-profit organization dedicated to reducing the number of accidents and deaths on Europe's roads. The body constantly advocates that the European Union (EU) shows strong action on safety issues. ETSC has supported the adoption of new legislation within the EU. The recent Cross Border Enforcement Directive penalizes drivers who break driving laws in countries other than their own. Although non-residents account for only 5% of all drivers in the EU, they are responsible for 15% of speeding offences. If the transgressor ignores their fine, they will be sent their fine in their home country.

"As a result of this directive, instead of getting away with the offense, the driver is fined," says Ellen Townsend, policy director at the ETSC. "We believe this new legislation should

(Left) **Handheld radar devices are commonly used by UK police to detect vehicle speeds**

act as a deterrent and contribute an extra level of safety when driving in Europe."

To date, 25 of the 28 EU countries have agreed to take part.

Mobile enforcement

While fixed enforcement cameras are most effective as a general deterrent, the effects of mobile enforcement – in the form of moving cameras, speed guns or a police presence – can be further reaching on account of what is called the 'halo effect'. In other words, while driver behavior may improve at a fixed site, with mobile enforcement, speed and behavior are likely to improve over a larger area due to the uncertainty of where exactly the enforcement method is located. A 2013 report entitled *The Effect of Police Patrol on Car Accidents* by Sarit Weisburd suggests that a stationary police vehicle can result in an instant 9% reduction in accidents in a particular area, and a further 40% the week after.

Between 2006 and 2013, Victoria in Australia recorded the compliance rates of both fixed and mobile cameras. The results showed that 99% of vehicles passing fixed cameras, and 98% of those passing mobile cameras, were classed as compliant.

"These show that mobile and fixed cameras produce almost identical compliance rates," says Croft. "The slightly lower mobile figure is reflected in the fact that motorists will not know where mobile solutions are deployed unless they are familiar with the location and have taken the time to research where the sites will be deployed on any particular day."

The most successful example of camera technology, at least in the UK, is the deployment of average time distance cameras. These were originally introduced by the Highways Agency as a means of reducing danger for workers at road works.

> Intelligent Speed Assistance is very much a priority here at the ETSC. ISA will save lives
>
> **Ellen Townsend,** policy director, ETSC

"In 2001, the Nottingham Safety Camera Pilot achieved 'virtually complete compliance' on the major ring road into the city using average-speed cameras," says Croft. "Across all of Nottinghamshire, KSI (killed/seriously injured) figures have fallen by an average of 65% where average-speed cameras were installed."

In-car solutions

Another major priority for the ETSC is Intelligent Speed Assistance (ISA) within cars themselves. They view this as very much the way forward. "ISA is very much a priority here at the ETSC," says Townsend. "ISA will save lives. Estimates by the Carsten report, *How Much Benefit Does Intelligent Speed Adaption Deliver,* shows that ISA is predicted to stop up to 28.9% of collisions on all roads."

However, not everyone agrees that ISA is the ultimate solution. "ISA looks promising, but to my mind it's still too early to say how good it is," says TRL's Lawton. "When it is advisory, people give positive feedback, but there are still questions to answer as to whether it'll lead to improved driver behavior."

"When it comes to the emergence of auto-braking systems, seatbelt reminders and reverse collision warning, there is undoubtedly a place for all of these and they can only be a good thing," says Croft. "It is such a shame that you have to be well-off or own a company car to have such extras as standard. My one concern is that

Breathe to unlock

The innovative system to monitor convicted drunk drivers in the Netherlands

Last year in the UK, one in six road deaths were attributed to drunk driving. In 2012, more than 10,000 people died in alcohol-related incidents in the USA – 31% of all traffic deaths.

The Netherlands has a unique way of tackling those found to be over the limit. Since 2011, drivers with a previous conviction must breathe into a device called the Alcolock. If their bodies are alcohol-free, the engine unlocks and they are free to drive, although the process must be repeated at regular intervals during the journey.

The locks are installed for two years. If during that time the driver is completely clean, the lock is removed. Any recidivism leads to a possible six-year extension or a driving ban. In a country that sees 200 deaths per year due to alcohol, it has been estimated that the device saves five or six road fatalities annually.

When a text can kill

Canadian simulator reveals the true danger of texting and driving

Distracted driving is a major issue in Canada. All 10 provinces have some form of legislation in place as deterrent. Late last year, the province of British Columbia launched a campaign to highlight the problem through the use of a driving simulator. The simulator showed quite clearly how much smartphones can impede driving.

"The average text takes approximately six seconds to read when you take your eyes off the road," says chief constable Neil Dubord, chairman of the Traffic Safety Committee of the British Columbia Association of Chiefs of Police. "At 50mph, you are going to travel the length of a football field. In that length, all kinds of things can happen."

In 2012, 81 people were killed as a result of distracted driving in British Columbia, more than the number of fatalities ascribed to drunk driving. And 40% of residents admit to using their cell phones while driving, this despite an Ipsos survey from 2012, which concluded that the vast majority view using a device while moving to be as dangerous as drunk driving. Tests have shown that you are four times more likely to crash when talking on a handheld phone, and 23 times more likely to crash if you text while driving.

the more the car starts to think for you, the more you stop thinking for yourself."

The New York way

At the time of writing, New York is on the cusp of passing a bill that aims to eliminate all pedestrian, cyclist and driver deaths in the city that never sleeps. The NYC Vision Zero project encompasses a huge raft of changes including 20mph zones, the fixing of all broken traffic lights, tighter regulations on taxi drivers, and more punitive approaches for drivers who do not give way to pedestrians or cyclists. Last year, there were 286 road deaths in the city, a rise from 2012. According to an official release, the city regards traffic collisions as a "policy problem that can be addressed through enforcement, education and design".

Of particular interest are the technologies that are set to be introduced by the New York Taxi & Limousine Commission (TLC). These include speed radar equipment to enforce speed and safety regulations; black box data recorders; pilot technology alerting passengers and drivers to high speeds; and in-car technology that limits vehicle speed, warns drivers of possible collisions, or that reduces the fare when the driver exceeds the limit.

> We want to see the use of black box recorders to provide valuable information on vehicle movements and speed in the event of a crash
>
> **Meera Joshi, Taxi and Limousine Commission, New York**

(Below) **McGuinness Blvd is just one street in New York that has been made into a slow zone, as part of the Vision Zero program**

"TLC wants to explore the use of black box recorders, which are similar to data recorders on airplanes, and can provide valuable information on vehicle movements and speed in the event of a crash," TLC commissioner Meera Joshi told the New York City Council. "Second, TLC would like to explore technology that warns drivers and passengers that they are traveling over the speed limit in the hope of preventing crashes. These are ideas to think about as we embark on a path to make our streets safer for everybody."

Start them young

"If any country introduced black box technology tomorrow, everything would improve overnight," says Croft of RSS. "The big question is whether anyone wants the government to know where they are and what they are doing. I see a big role in relation to onboard technology, especially with young drivers. With graduated licenses, greater education and telemetry, you have the full package. Join them all together and you will get better youngsters entering the driving stream."

The graduated license has been introduced in many countries, most noticeably Australia, which began the scheme in the 1960s and has seen impressive results. Others include South Africa, Hong Kong, Alabama, Ontario and British Columbia. Last year, the British Columbian government embarked upon a campaign to crack down on distracted drivers (see *When a text can kill*, above).

Summing up

"Technology unquestionably has a vital role to play, but for me education is key," concludes Croft. "Beyond that, the European Union is the best means by which to create a cross-national directive. It has already done some great work in setting standards around safety, both in terms of cars and roads."

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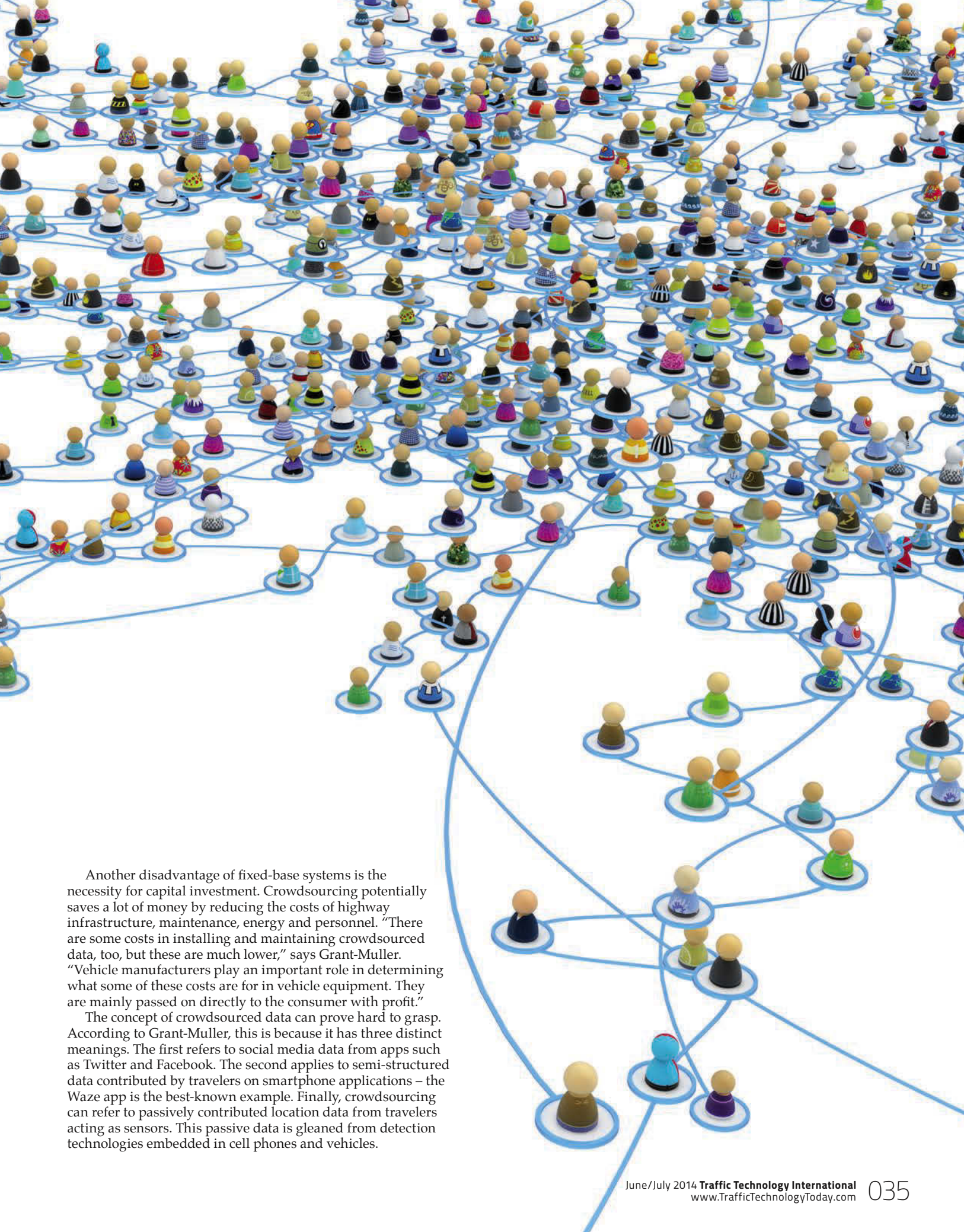
The social network

As the benefits of social media in ITS continue to increase, **David W Smith** finds out how crowdsourcing applications that exploit cell phone and in-vehicle technologies are changing the way that real-time traffic information is collected, analyzed and shared

Most experts in traffic control agree that crowdsourcing has a big future in helping DoTs and transport authorities around the world monitor their road networks. But it is much harder to predict exactly what that future will be. Road authorities need to find ways to integrate the new technologies into pre-existing systems with minimum disruption and cost. Meanwhile, the competing types of crowdsourcing applications are causing some confusion.

Dr Susan Grant-Muller from Leeds University's Institute for Transport Studies is a leading researcher in crowdsourcing traffic data. She believes the approach offers many advantages and will ultimately transform the world of real-time traffic. "Crowdsourced data gives far broader coverage than traditional methods," she says. "Some locations may have low levels of signal, so we cannot promise 100% coverage, but the data is dynamic and frequent, and it will become richer in quantity and quality over time."

Fixed-base methods of gathering traffic data have major disadvantages, Grant-Muller argues. One issue is that the geography of some environments makes it harder to collect information. As a result, spending decisions tend to prioritize areas close to major conurbations and strategically important highways. "Travelers in some areas have a wealth of frequent information and in others they have none," she explains.



Another disadvantage of fixed-base systems is the necessity for capital investment. Crowdsourcing potentially saves a lot of money by reducing the costs of highway infrastructure, maintenance, energy and personnel. "There are some costs in installing and maintaining crowdsourced data, too, but these are much lower," says Grant-Muller. "Vehicle manufacturers play an important role in determining what some of these costs are for in vehicle equipment. They are mainly passed on directly to the consumer with profit."

The concept of crowdsourced data can prove hard to grasp. According to Grant-Muller, this is because it has three distinct meanings. The first refers to social media data from apps such as Twitter and Facebook. The second applies to semi-structured data contributed by travelers on smartphone applications – the Waze app is the best-known example. Finally, crowdsourcing can refer to passively contributed location data from travelers acting as sensors. This passive data is gleaned from detection technologies embedded in cell phones and vehicles.

(Right) **With crowdsourced information enhancing the accuracy of real-time information, drivers can avoid becoming stuck in traffic**
(Below) **The Waze app is designed to be social and fun**

"A big advantage of passively collected data, in particular, is the ability to pick up details of the whole journey," says Grant-Muller. "This may turn into a game changer in terms of policy and planning. At present, the fixed-base data can only detect vehicle movements around the locality it is set to cover. This has led to high-density data for part of the trip – usually the middle – and very little for the start and end."

Grant-Muller says that many US DoTs are already using social media data effectively. "They have created a culture encouraging travelers on the highways to report system conditions, incidents using their local expertise," she reveals.

There is also evidence that some UK traffic control centers are monitoring social media for early notice of incidents. "In doing so, they may also refer to 'back-up data' from traditional sources, such as cameras and loop-generated delay statistics," adds Grant-Muller.

Joined-up thinking

The Waze app falls into the second category of data contributed by smartphone users. Though Waze has been acquired by Google, it still operates independently as a lean start-up with a staff of 130. The app is available to download free of charge in 200 countries and 45 languages, and the Californian company claims to have 50 million users worldwide.

Waze exploits two separate types of crowdsourcing. The most obvious is that drivers with the app open contribute information about the speed and location of their car. If they choose, they can use Waze to report accidents and a police presence.

"Our 'Wazers' leave comments on the map, so if the emergency services need to make a decision between two accidents – say a fatality and a fender bender – human input enables the right choice," explains Julie Mossler, Waze director of communications.

> A big advantage of passively collected data, in particular, is the ability to pick up details of the whole journey
>
> **Dr Susan Grant-Muller, Leeds University's Institute for Transport Studies, UK**

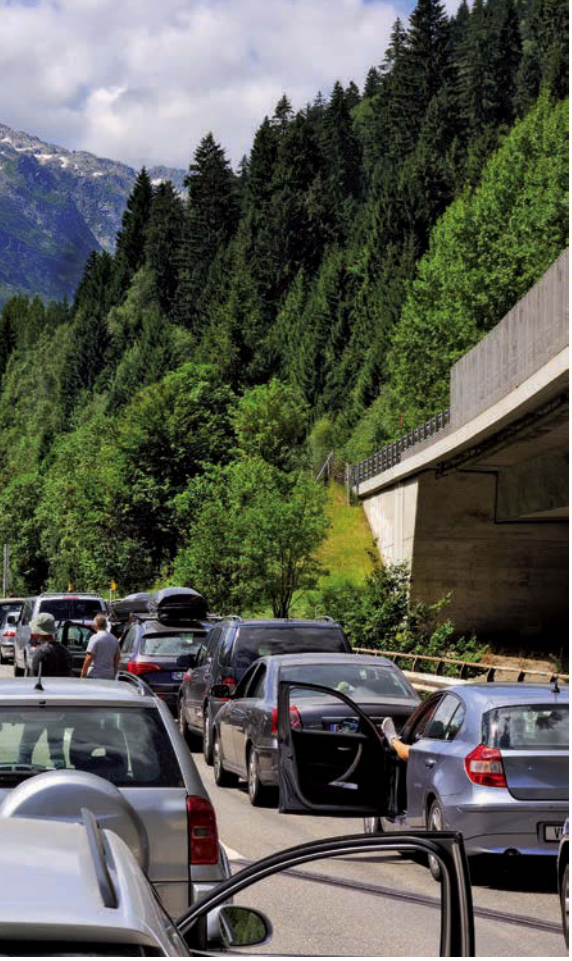
The second type of crowdsourcing data is less well-known and is unique to Waze. The company invites Wazers to edit their maps. The system works like Wikipedia, with 140,000 volunteers all over the world giving their time and knowledge to fill in details.

"Our editors earn higher ranks and more authority based on their number of edits," details Mossler. "The system also self-polices effectively. If someone changed the name of London Bridge, for example, a senior editor would quickly override it."

The experience, she says, is magical for Wazers. They organize conferences and wear Wazer T-shirts. "There's amazing passion there," says Mossler. "We have a community in Italy that got bored with mapping out Milan and turned to mapping small villages in Africa. They made contact with people there who downloaded the app and they worked together. It is grassroots and democratic as our editors map places normally off the beaten track. We've also used our data to help the Red Cross mark shelters when there were hurricanes in Arkansas and we worked with the US government during Hurricane Sandy."

Complex components

Washington-based Inrix Traffic has an entirely different approach. Inrix sources data from its network of 100 million vehicles and devices, including commercial fleets, cars, road sensors, accident reports and traffic feeds from government bodies such as the UK



The road ahead

The past few decades brought about a huge transformation of our roads. The next few will bring even more, according to experts

Inrix's Matt Simmons anticipates that in 20 years every person will be a sensor and the whole transport network will be 'smarter'. "There will be smarter roads, smarter cars, GPS that is accurate to a lane on a carriageway and wearable smart technology," he says. "But a lot of today's technology will still be around trying to fit in."

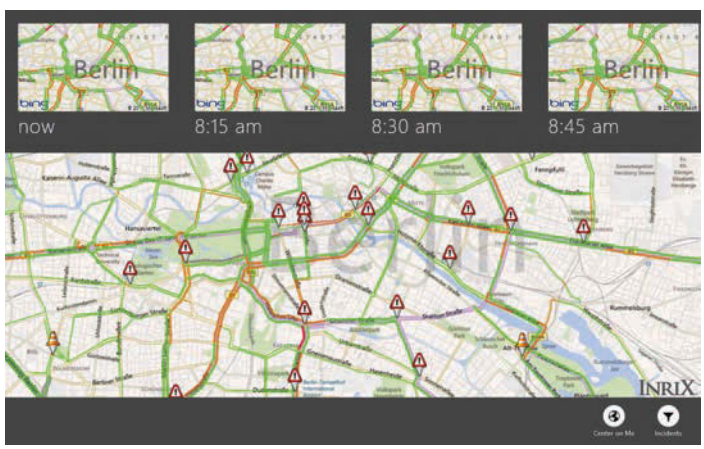
Simmons expects to see a two-speed environment. Smart cars able to talk to each other will have their own lanes with guaranteed achievable speeds and arrival times. "Taking a car journey may be more like sitting on a train," he predicts.

Meanwhile, traffic sensors will be common and the main challenge for authorities will be fusing huge volumes of data from disparate sources. "The challenge won't just be saying how busy an area is. It will be in communicating that message, and managing flows and decisions in real time," says Simmons.

Dr Susan Grant-Muller, from Leeds University's Institute for Transport Studies, feels there will be a generation of drivers who have grown up with user-generated content (UGC) and will take it for granted as part of two-way information flow and management.

She believes that ICT-based solutions will supply a variety of data from pervasive sensors, including various UGC. The system will be unobtrusive, accurate and energy efficient. "Transport sector staff will have a different set of skills and may work more across sectors," she suggests.

Meanwhile, Waze's Julie Mossler says that in 20 years' time historical and current crowdsourced data will be used to proactively open, or close, highways and route vehicles for more efficient traffic flow. "Our definition of traffic will be radically different," she predicts. "It may not even exist."



(Left) **Inrix Traffic Forecasts help drivers plan ahead illustrating how traffic conditions are expected to change up to eight hours ahead of their next trip**

Highways Agency. Those relying on the data include BMW, Audi, Ford and Toyota, as well as public sector organizations such as Transport for London (TfL) and the US I-95 Corridor Coalition.

Inrix recently introduced a Population Analytics tool that combines network operator data with GPS data to track large groups rather than individuals.

"Population Analytics understands not just where anonymous groups of people are, but where they've been, how they got there and where they're going," explains Inrix's Matt Simmons.

During the London 2012 Olympic Games, TfL used Population Analytics to analyze traffic flows across the capital. TfL could spot pinch points on the network in real-time to better advise on travel during the games.

Simmons believes that Smart City planners will benefit greatly from Population Analytics. "Knowing how many people are entering or exiting a city and where they are heading is critical for making informed decisions about everything from building new roads to implementing new bus routes or park-and-ride schemes," he says, adding that in the future there will be a focus on making crowdsourced traffic data smarter and more accurate. "We're doing innovative things around user-generated incidents (UGI), where we integrate incident data with flow data," he details. "This smart crowdsourcing approach enables us to transform UGI from pin-on-a-map icons to map-snapped, directional incident data."

TrafficSense, from Israel-based Cellint, uses yet another strategy, which fits into the category of passive data gathering. TrafficSense connects to the switching centers of the cell phone network and passively retrieves all available anonymous data. It pinpoints the location of each active cell phone in real time.

> **Population Analytics understands not just where anonymous groups of people are, but where they've been, how they got there and where they're going**
>
> **Matt Simmons, Inrix, USA**

"Any type of cell phone provides data – not just smartphones," says Ofer Avni, CEO of Cellint. "In Italy, for example, we work with Vodafone, which has 30% of subscribers, so we get a huge quantity of data. Customers pay for us to set up

Social dilemma

'Smarter' transport networks and services will inevitably have an impact on more traditional transport businesses

Thousands of taxi drivers brought large parts of central London to a standstill in June 2014, in protest at an alternative taxi service offered by the San Francisco-based tech start-up Uber. London's streets were gridlocked around Parliament Square, Whitehall and Trafalgar Square as an estimated 4,000 drivers protested.

The mobile Uber app – and its competitors Lyft and Sidecar – pairs up drivers with people looking for rides. But the London taxi drivers are not best pleased at being bypassed altogether. The Uber app also works out the cost of journeys. Cab drivers claim this is the same as using a taxi meter, which only black cabs are legally entitled to use, thus making the Uber system against the law.

The London protests followed similar demonstrations by taxi drivers in Paris, Madrid, Rome, Milan and Berlin. Uber, which launched in 2009, operates in more than 70 cities across 37 countries.

London taxi drivers also used the protests to make the claim that their trade is highly skilled. The Licensed Taxi Drivers Association (LTDA) says it takes between four and seven years to pass the oral and written exams. But supporters of the disruptive Uber technology say a shortage of cabbies in major cities has driven up taxi prices to unfair levels.

The Uber app is demoratizing the process, they argue.

Transport for London (TfL) is seeking a High Court ruling on whether the use of such apps is legal. But the protestors have inadvertently provided publicity for the Uber service. The company claims there has been an 850% increase in sign-ups since the London strike.

(Left) **TrafficSense uses a very large number of data points generated by the cellular network and combines this with information from Google Earth**

our system in their area and then pay an annual subscription."

Avni believes that crowdsourcing applications will eventually replace 95% of road sensors. "We will still need some sensors, such as ones to operate traffic lights in certain areas, but floating car data has reached a point where the data quality is as good as that from fixed sensors," he says. "Agencies can use the same budget and instead of covering 20% of their roadways, they can cover nearly 100%. It's only a matter of time before it becomes the gold standard around the world. In developing countries where GPS is not available, mobile data can always be used to manage traffic."

Fusion and future-proofing

Several US DoTs are currently looking at ways to adjust to the crowdsourcing world. Virginia DoT (VDoT), for example, is studying ways of fusing data from various sources.

"We have used Inrix vehicle probe data for a few years, but we're now looking at including Waze information, as well as aggregating data from Facebook, Twitter, and radio and news channels, says Ken King, VDoT's regional operations director. "Our research council is looking carefully at the data and we are doing a lot of spot checking in Northern Virginia to test the validity of crowdsourcing."

VDoT refuses to rush the process of fusing data. Extensive tests are needed to guard against invalid information, but trials on Waze data have so far been successfully verified by VDoT cameras.

"Our tests show that crowdsourcing should enhance effectiveness," King confirms. "We think we will be able to get the message out a few minutes earlier if there's a potential problem. That enables more cars to take a diversion, which means fewer cars stuck in queues waiting for lanes to clear."

> Our tests show that crowdsourcing should enhance effectiveness. We think we will be able to get the message out a few minutes earlier if there's a potential problem
>
> **Ken King, regional operations director, VDoT, USA**

Grant-Muller, meanwhile, believes that the smart approach for DoTs is to future-proof their business by using all three types of crowdsourced data. "The key message is not to immediately throw out fixed-base systems, but instead to see crowdsourced data as part of a toolkit," she says. "Rather than seeing it as a threat, smart organizations will bring it alongside current activity. Right now this is wise, but in 10 years' time we will be looking at a very different landscape for this sector."

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Game plans

The biggest challenge of hosting an international mega event on the scale of the FIFA World Cup or Summer Olympics is transport. But, as **Tom Stone** discovers, there's no one-size-fits-all policy: each city develops its own unique solutions to extensive logistical requirements, with varying degrees of success

Illustration: Barry Downard

As this issue of *TTI* goes to press, Brazil is well and truly in the grip of World Cup fever. Off the pitch, however, most of the drama in the build-up was centered on transport. Would fans be able to get to the stadiums on time? Could the unthinkable happen and matches be forced to kick off in front of half-capacity crowds? Before the opening game in São Paulo, a strike by metro workers almost succeeded in bringing the city to its knees, and made it abundantly clear that the small rail system was a vital part of transport around the city. This was ironic, as part of the reason Brazil's World Cup bid was successful was its promise that it would upgrade its Bus Rapid Transit (BRT) systems and implement new ones. The work on São Paulo's BRT, the Expresso Tiradentes, was postponed, with part of the route being replaced by a monorail, which was not completed in time for the tournament.

Nevertheless, many of the Brazilian World Cup cities do operate excellent BRT systems and, as the tournament draws to a close, attention will turn to Rio, where some of the country's newest BRT routes are already running, and others are under construction in preparation for the Olympic Games. If hosting an international football tournament has been challenging, logistically it's just a warm-up for the main event: Rio 2016.

US$6.5bn
The amount South Africa invested (R70bn) in its road network in preparation for the 2010 World Cup (FIFA)

Bus me in

The Brazilian city of Curitiba is the birthplace of BRT: it opened the world's first system in 1974, characterized by raised


THE MAIN EVENT
EVENT TRAFFIC ONLY
IN MARKED LANE
EVENT AHEAD

passenger stations, exclusive lanes and a frequent service. "BRT buses are more comfortable and have greater capacity than ordinary buses," says Vitor Aveiro, superintendent of operations at the Department of Highways, Brasilia. "Trips are non-stop and bypass intersections, so they behave like a subway. In Brasilia, a trip that originally took two hours has been cut to 35 minutes."

"In cities where you don't have sophisticated rail-based public transport, like London does, BRT systems are the best solution," says Dr Eva Kassens-Noor, assistant professor of urban and transport planning at Michigan State University, whose current work focuses on the transport challenges and solutions surrounding mega events – special events on an international scale.

4 hours
The time after a match that buses and trains must continue to operate to ensure the safe exit of fans from World Cup venues (FIFA)

Subways, of course, operate completely independently of surface traffic: not so BRT systems. Their smooth running is ensured by sophisticated ITS, which tracks their movements and ensures other vehicles do not stray into their exclusive lanes. Other road users and passengers need to be kept informed about the timetables and routes. The best systems have a network of variable message signs (VMS), alongside automated vehicle monitoring systems, usually via GPS, and operations management and monitoring software.

At the heart of everything, you need a modern traffic control center. "Whenever you have the Olympics coming to town, these traffic control centers either get newly built or substantially upgraded," says Kassens-Noor.

For Rio, that process began back in 2010 when a torrential storm caused landslides and more than 200 people lost their lives. Mayor Eduardo Paes demanded that the city create a centralized way of predicting and managing emergencies like this more effectively. With the help of IBM and hardware from Cisco and Samsung, they built the new Rio Operations Center (Centro de Operações Rio) in the Cidade Nova neighborhood. The vast control room is capable of drawing on the expertise of some 70 operatives at any one time, and has been credited with reducing incident response times by up to 30% against the backdrop of a 10% year-on-year increase in private car use. It is also able to keep citizens up-to-date with emergency situations using public address systems installed in high-risk areas, as well as through text messages and social media.

Since it opened, the function and scope of the Rio Operations Center has grown. It is now central to the management of the city's everyday traffic flow and is also helping to manage the new BRT systems. The first 52km section of BRT, the Transoeste, links Santa Cruz and Barra da Tijuca. It opened in June 2012 and has cut travel times between the two neighborhoods by 50%. It carries 150,000 passengers daily around the network's 55 stations. It is monitored by 185 cameras linked with the Operations Center and passes through 2,300 traffic lights, of which 52% are controlled via GPRS. There are 23 VMS that provide route and traffic information, and all buses in the system are monitored by GPS.

> Whenever you have the Olympics coming to town, traffic control centers either get newly built or substantially upgraded

Eva Kassens-Noor, assistant professor of urban transport, Michigan State University

2 million
The estimated number of visitors who came to Atlanta for the 1996 Olympic Games (*New Georgia Encyclopedia*)

Rio's second, even busier BRT, the Transcarioca, was opened on June 1, 2014. "It was launched for the 2014 FIFA World Cup," says Fernanda Salem, international communications advisor at Rio City Hall. "It is the first high-capacity corridor to cut right across the city, from Barra da Tijuca to the International Airport Antônio Carlos Jobim (Galeão), linking the north and west zones. It serves around 320,000 people every day. Two other BRTs – Transolímpica and Transbrasil – are under construction." The hope is that, once complete, Rio's BRT systems will create a transport system that, although very different from London's, will help emulate the logistical success of the last Olympics.

Masterplans

With one of the largest underground rail networks in the world, London was already well equipped to host the Olympic Games without having to undertake building projects on the scale of Rio's BRT. "The innovation potential in London was extremely high," says Kassens-Noor. "Which meant they were able to develop the Games Playbook."

The Games Playbook was awarded the ITS (UK) Scheme of the Year in 2013. It is a geographic information system (GIS), which provided live data to surface transport staff during the Games. Its huge database of maps and information was completely customizable to individual needs and gave Transport for London (TfL) staff access to interactive contingency routing. Had it not been for the Playbook, operatives would have had to roam over several systems to access all the information they needed at any one time.

Appropriately enough, for a system devised to manage traffic for the world's biggest sporting event, the idea came from the football field. "In American football, a playbook helps teams to plan exactly where they want everyone," says Carl Eddleston, an area performance manager for TfL, who ran the project team that developed the Games Playbook. "So, for every hour, we planned out the entire London road network, where everything would be, for 60 days. A visual story of a lot of painful hard work!"

During the Games, TfL had to manage major road closures on at least a third of the days. The main tool for doing this was 1,500 signal junctions, which could either store traffic further away from the center, or manage it around different areas. "In the central London zone, we had road event days where half the roads were closed," says Eddleston. "Altogether we had about 60 layers of information, which we needed 60 sets of maps for. We thought, 'There's no way on earth people are even going to be able to absorb it!', so we integrated it into one spatial application, based on time. You could go down to the hour and turn the layer off or on, and every map was there. If you were one of the traffic controllers, you could have six layers on at one time and look at, say, 1:00-2:00pm

Atlanta gridlock

How the traffic chaos of the 1996 Olympics sparked a revolution in logistical thinking

The 1996 Olympic Games was a transport disaster. An Olympic bus system was poorly organized, with multiple reports of drivers getting lost, and athletes and officials arriving late for events. Some drivers even quit. The situation was so bad it prompted British rower Steven Redgrave to comment at the time, "We've given up on transportation," after a bus he was on took two hours to make a 30-mile journey. "Nobody ever believes it will be as difficult as it is. Now they believe it," Dick Pound, then a vice president of the International Olympic Committee (IOC), told the *Los Angeles Times*.

"After Atlanta, the IOC pressed for cities to have rail access to Olympic sites. In London, there were nine rail lines going to the Olympic site," says Kassens-Noor. "In Sydney, there was completely new rail access. The baseline is to have access for 400,000 people per hour."

Part of the transport revolution that Atlanta began was the implementation, at Sydney 2000 and every Games since, of an Olympic Road Network and clearly signed and heavily monitored Olympic lanes (for the exclusive use of athletes, officials and VIPs).

A triumph of ITS, they have so far been successful in ensuring that members of the Olympic family can move relatively freely around congested international cities.

(Above) **Eighteen years later, the Olympic Rings still adorn the Centennial Olympic Park in Atlanta, recalling an event of mixed fortunes**

250
The number of regular buses withdrawn from Rio's streets as they were no longer needed following the introduction of the Transoeste BRT (Rio City Hall)

and all the information you needed would be there."

The Playbook didn't link with all live operational data, but it came close. "We linked it to live roadworks information, so if any permits were submitted, or anything was going on in the street, then it appeared," says Eddleston. "And we linked it to our live junction database, so if a junction had been added or removed, it would automatically feed directly in the background, so there was as little maintenance as possible. We had live CCTV linked into it as well, so you could hover over the cameras and every two minutes they would update."

So detailed was the Games Playbook that, although it was conceived primarily as a planning application, it was virtually used in real time. "There was so much going on that there wasn't much time for planning!" says Eddleston. "If it was 2:00pm on the first day of the Games, you were generally looking at 2:00pm on the map and figuring out what was closed." Much like the football playbook from which it took its inspiration, it was a system that relied on many hours of technical preparation: "All of the traffic signal plans had been prebuilt and were ready, so you were just applying them."

Olympic legacies

By the time the smoke from the final firework display was drifting over the Olympic Stadium in Stratford, it was clear that London 2012 had been a massive success, not only in terms of the quality of the competition, but also logistically. It therefore signaled the start of a new project for TfL: developing the Playbook into something for TfL's everyday world: a one-stop platform for all its planning.

"We are working with a company called Esri, which is going to launch the first version with us in August," says Eddleston, who is clearly excited about the possibilities. "We are building something that shows us if TfL have got a spade in the ground anywhere and at what stage those projects are. If any of the boroughs are building anything, or if there are developer works, it will be there. So you can put your plan into it and make sure you're not resurfacing something a year before it gets dug up again.

> Every map of every junction. Every road map. Every timing diagram for a junction. It will all be tied into one place. You'll be able to pull all your information off it
>
> **Carl Eddleston, area performance manager, Transport for London**

"It will have all our traffic modeling, all our schemes and where they are taking place, who is responsible for them and what the outcome is – all aligned to the sub-regional outcomes of the area. All the consultation will be tied into it. Then on top of that we'll have another layer that will give us all the information about the street. Every map of every junction. Every road map. Every timing diagram for a junction. It will all be tied into one place. So instead of going into multiple folders and multiple programs, you'll just go into this one thing, locate the spatial area that you're interested in, and there you'll be able to pull all your information off it. The whole

Freight can't wait

It's not just the movement of people that needs to be managed at special events

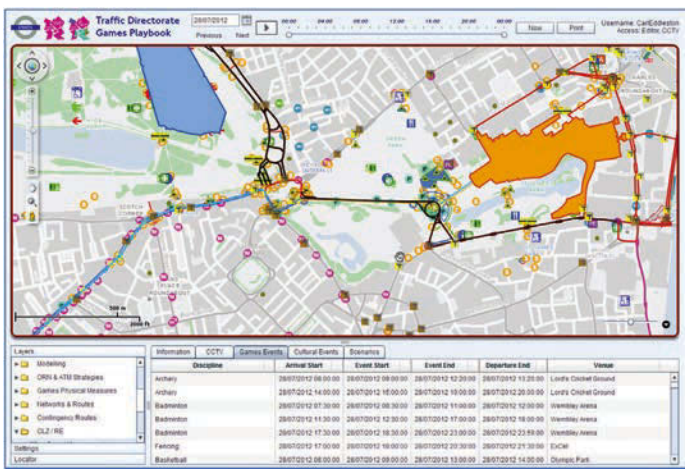
With any large event comes a massive freight operation. Temporary structures need to be delivered and removed. Food and drink supplies need to be well stocked, and trash needs to be taken away. If this type of operation isn't carefully managed, it can lead to delays in deliveries, which can affect the wider traffic situation and even lead to health-and-safety issues.

While careful pre-planning can go some way to alleviating pressures on venues, the latest ITS can provide more flexible solutions. A vehicle recognition system (VRS) in use at the Jaarbeurs Exhibition Center in Holland uses barcode technology to check deliveries in and out, and enables traffic operatives to control vehicle flow. It provides real-time information on 'hot spots' and enables corrective decisions to be taken. It also helps reduce fork-lift movements, reducing fuel costs and environmental impact.

"The implementation of the VRS dramatically improved the flow of traffic during the build-up and breakdown days at our venue," says Ron van der Heijden, vice president at Jaarbeurs Exhibition Center.

But the real beauty of the system is that it is completely portable and doesn't require any expensive dedicated hardware. "You can be sitting in your front room and over the internet you can see where your traffic problems are," says Paul Strachan, London branch manager for CEVA Showfreight, which developed the system. "I can look on my phone, for instance, and tell someone exactly where their delivery is. There is a live record of all parking."

CEVA, which is also partnered with the Farnborough International Airshow and the oil and gas exhibition Offshore Europe, in Aberdeen, hopes to roll this technology out to other venues and special events in the near future.



(Above left) **Rio's Transoeste BRT has 55 stations and two terminals: seven more stations and two more terminals are currently being built**
(Left) **Smart mapping using TfL's Games Playbook**

point of it is to save everyone a lot of time. It will be very useful for our engineers who build signal-timing programs. All the information they need to make a really informed decision will be in one place."

Games of the future

While Team GB's athletes came away from the 2012 Games with an impressive medal haul, the Playbook could end up having an even larger impact on the world stage. It was a piece of software that helped to ensure that not a single athlete or official was late for their event due to transport issues, and could have a very real impact on the efficiency of everyday transport around the world.

Nevertheless it will be some years before such sophisticated systems are in place in all major cities. "Nothing like the Playbook will be used in Rio," says Kassens-Noor. "London was exceptional in terms of Games hosts. In London there was already a pretty comprehensive transportation system in place. London knew what to expect when handling an Olympic Games. In Rio there's going to be more focus on the basic infrastructure, rather than implementing advanced management systems like the Playbook."

But Rio could deliver a different kind of lasting transport legacy to the world. If it can prove BRT is sufficient to keep a mega event on the scale of the Olympics moving, it could pave the way for a greater variety of cities to host the Games in the future. Cities that might not have a fully integrated ground-based transport system like London could build BRT systems on the Brazilian model. This means that the search for the next host city could become wider than it has ever been before.

10.1m
The number of visitors and staff expected to visit Tokyo during the 19 days of the 2020 Olympic Games, according to a bid document

The winner of the search for Rio's successor, however, has already been decided. The 2020 games will be hosted in Tokyo, and there we can expect a technological revolution. Putting the Games into a country famed for pushing for intelligent solutions to life is bound to create new and surprising innovations. In fact, some Japanese companies are already making predictions that far ahead. Nissan CEO Carlos Ghosn promised last year that the company's first autonomous vehicle would go into production in 2020. If he's right, forget banning private drivers from Olympic lanes: the network in Tokyo could be the first to operate without any drivers at all.

Weighty matters

Overloaded trucks compromise safety, damage road surfaces and spike emissions. **David W Smith** investigates how the latest weigh-in-motion technologies are winning the battle against offenders and generating income from fines, while also helping haulers run their businesses more efficiently

Photo: IRD

The use of weigh-in-motion (WIM) technology is increasing worldwide. But the Holy Grail of using WIM to detect illegal overloads remains elusive. Until that goal is achieved, there will be widespread and expensive damage to infrastructure from overweight trucks, according to Eugene O'Brien, professor of civil engineering at University College Dublin.

O'Brien, who is also an engineering consultant with Roughan O'Donovan Innovative Solutions, says, "The odds of being stopped by police for being overloaded are about the same as winning the lottery. Data from eight European countries, and the USA, shows there is a lot of moderately illegal overloading, and a small amount of amazingly bad overloading."

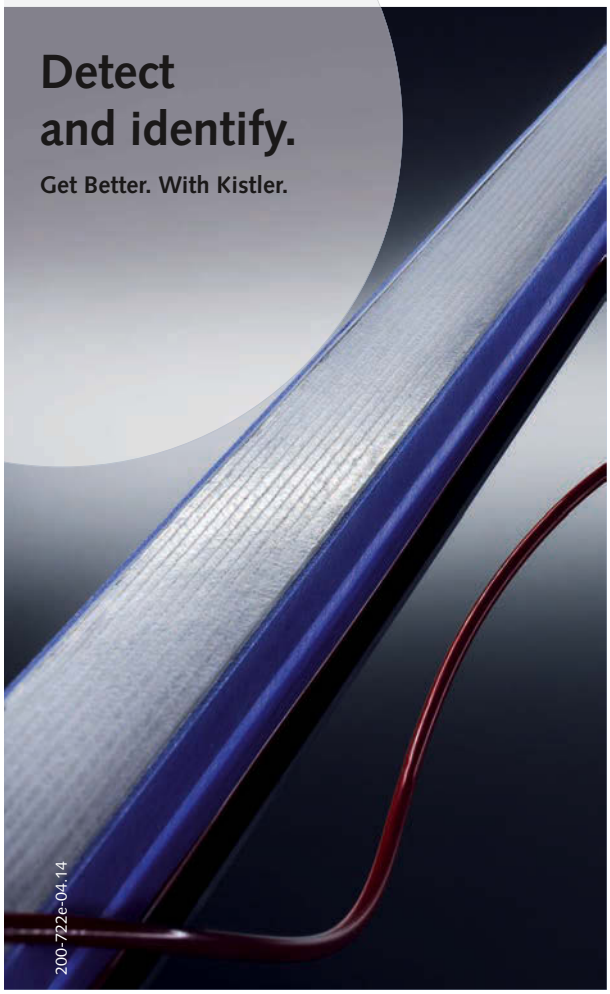
Martin Linauer, Kapsch's head of road safety enforcement, says overloading in the EU is massively damaging road surfaces. Official EU figures say one in three trucks controlled by European police is overloaded by 10-20%. Studies suggest that overloads of 10% cause 50% more damage. "This not only damages roads, but is also a safety issue as overloaded trucks require a longer braking distance. There's also an environmental impact as these trucks need more fuel," says Linauer.

IRD's Mainline Screening System identifies vehicles that are potentially in violation of regulations and directs the driver to the inspection station

Kapsch recently introduced its TrafficCom WIM system, which uses a number of sensors and loops to detect whether vehicles exceed permitted weights. The sensors identify the vehicle by its licence plates as it travels at high speed, without disturbing the traffic flow. This data is then stored and evaluated via either a mobile enforcement vehicle or a central system.

Linauer says there is a clear need for such technologies to prevent companies gaining an unfair competitive advantage. A French study estimated that a five-axle truck overloaded by 20% would generate €20,000 (US$27,500) a year in illegal financial benefits by requiring fewer journeys to transport goods.

"WIM is popping up more and more," Linauer believes. "On the one hand, you



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Advanced WIM systems not only accurately calculate the weight of a vehicle, but also size, speed and axle spacing – without it even having to slow down

save money by preventing damage to infrastructure, and you can also earn money from fines, ranging from hundreds to thousands of euros. The payback is so fast that the systems are a better financial investment than many believe."

Moving targets

The massive weights carried by gigaliners have fueled the controversy about illegal overloading in the EU. These 25m (82ft) long behemoths can carry 60 metric tons of goods and are inspiring the move to introduce more controls throughout Europe. But at the moment, these tests are usually executed at high-speed pre-selection stations.

"The accuracy is only ±10%, so if the pre-selection suggests overloading, the trucks are taken out of the traffic to a more static scale, where a low-speed system guarantees accuracy to within 1%. Then they are given a fine [if they are overloaded]," says Linauer.

The pre-selection method is time-consuming. It's much more efficient to use a system of direct WIM enforcement, but only the Czech Republic has made great strides forward in this respect. The world's first weigh-in-motion enforcement system (WIM-E) was approved by the Czech Meteorological Institute (CMI) in Brno in 2008. The system continuously monitors traffic 24 hours a day, 365 days a year, and an average of 500 overload infringements has been recorded each month.

"Soon other countries will go beyond the unwieldy pre-selection method with far-reaching consequences," says University College Dublin's O'Brien. "The industry will grow massively. Once you can automatically control overloads road authorities will save a lot of money and manufacturers will sell more devices. The illegal cowboys will have to comply, which will level the playing field."

For the time being, O'Brien says, weigh-in-motion technology is mostly used to collect statistics and is not particularly effective at immediately controlling or preventing damage to roads. "Data is important. If you're designing 500km of pavement, every centimeter of depth matters, and knowing the number of heavy trucks using the road means you can work out how thick to make it. The same calculations apply to bridges," he says.

> "The odds of being stopped by police for being overloaded are about the same as winning the lottery. There is a lot of moderately illegal overloading going on, and a small amount of amazingly bad overloading"
>
> **Eugene O'Brien, professor of civil engineering, University College Dublin**

Focused solutions

One of the reasons WIM has not been used much for direct enforcement is that

Deflation defeated

Automatic pressure checks will reduce tire wear and save fuel

British manufacturer WheelRight recently became the first company to incorporate tire pressure monitoring in a single WIM unit. The new product is a good example of the potential for multifunctionality of WIM systems.

The technology enables transport operators to check axle weights and tire pressures without the need for on-vehicle devices or manual intervention. Typically vehicle tires are 10% underinflated, which results in an extra 2% in fuel costs and an increase in tire wear of 8%.

The WheelRight system's RightStrip sensor plates are mounted flush with the road surface and record vehicles' tire pressures. Multiple axles and inner wheels, vehicle weight and load distribution are also recorded. The arrival of a vehicle is sensed magnetically and identified by an ALPR camera.

The system has also just gained ATEX accreditation, which means it can now be placed in gas stations around the world, making manual checking of tire pressure a thing of the past.

(Left) **Modern WIM systems enable road operators to systematically check vehicle weight and enforce weight limits**

there have been only small advances in performance and accuracy over the past 20 years. Randy Hanson, executive VP and COO of the Canadian firm International Road Dynamics (IRD), says one of the biggest issues was the amount of kit required for WIM measurements.

"Right now, when you do WIM, you include loops in the roadway to measure vehicle lengths and you need axle sensors to count the axles and measure the spaces between them. All these things require different technology. But we are working on collapsing those various technologies into one technical platform that is able to do WIM, as well as axle measurement and spacing," he says. "We will also be able to identify underinflated tires at highway speed, and prevent safety problems. Our tests show all this is possible and we hope to make an announcement about new products in the next few months. Collapsing the technologies will provide more accurate readings and will be much cheaper."

Onboard WIM is another important development, according to both O'Brien and Hanson. An onboard solution consists of the sensors, the 'box' and an interconnecting internal harness. The specific technology is guided by the type of vehicle and the accuracy requirements. Current systems can do far more than provide individual axle group data and gross vehicle load. They also offer wireless handheld displays, onboard printers, dataloggers and weight data transmission.

"There are many advantages of onboard weighing," says Kari Clark, technical sales marketing at Kanawha Scales & Systems in the USA. "The LoadMan system we distribute helps to avoid fines for being overweight, increases safety levels, and makes it easier to manage landfill diversions and to load trucks as full as possible. It's also possible to connect the systems to software that allows you to do route audits. Onboard systems have a big future because there is so much interest in diverting waste from landfills. The only way to do that successfully is to measure it."

Hanson appreciates the advantages of onboard WIM, but says it will never entirely replace WIM embedded in roadways. "Just because you have it on board a truck, it doesn't mean you will do anything about it. You can still overload the vehicle. So, it will take outside oversight to make sure people are compliant," he says.

Calibrated crossings

An alternative approach catching on worldwide is bridge WIM. Sensors are attached to the underside of a bridge to calculate the weight of trucks crossing over.

> "You get a signal when a wheel drives over the sensors, so you know exactly the distance between the two sensors. You can then calculate the spot speed accurately"
>
> **Martin Linauer, head of road safety enforcement, Kapsch**

Slovenian company Cestel dominates the market. Matija Mavrič, Cestel sales chief, says, "The advantage of bridge WIM is mobility. We can install all the equipment under the bridge within a couple of hours. It's easily uninstalled and can be moved on immediately to another location, enabling us to travel around the road system measuring in as many locations as possible using just one system."

In Cestel's homeland of Slovenia, bridge measurements are taken at approximately 150 locations a year.

"The most important part for the Slovenian road authorities is to get information about the traffic itself," says Mavrič. "The behavior of traffic is changing constantly and we can follow it around the networks. Other important elements are the road surface and the bridge itself. The government gets a clear picture of what to do."

O'Brien argues that one limitation of the Cestel system is the necessity for bridges to have easy access to the underside. But Mavrič claims that it is rare not to be able to find a suitable bridge.

Mavrič says Cestel's bridge systems are growing in popularity around the world – a trend seen throughout the WIM industry. Hanson, for example, says IRD's products are now sold in 50 countries and the company is seeing considerable expansion in the developing world.

"Since the mid-1990s, the opportunities outside North America have grown," he says. "Around 35% of our business is outside the USA and Canada now and we have offices in Santiago, Chile, to cover South America, and Delhi, India, for the Asian market. We also have a joint venture partner in China. As countries develop, they need to maintain more and more assets, whereas the North American market is quite mature."

Hanson also sees a continued growth in safety applications of WIM. The systems are being used, for example, to weigh trucks in advance of curbs, or extreme downhill gradients. Drivers are advised of safe speeds in such situations to prevent rollovers. Another recent safety application combines in-road ice detection sensors with vehicle weighing.

There is also a lot of interest, according to Hanson, in bridge protection. "We have installed WIM at a number of sites in advance of a bridge. The systems can notify trucks they are overweight and should not be going on that bridge, or send information to the bridge owners," he says.

Kapsch's Linauer sees another trend toward spot speed enforcement. "WIM sensors make it easy to calculate speed. You get a signal when the wheel drives over the sensors, so you know exactly the distance between the two sensors. You can then calculate the spot speed accurately. You could use WIM instead of a speed camera, saving money with multiple purposes."

Data revolution

All the various applications of WIM will be aided in the future by the development of enormous databases, supplying more accurate data, says UCM's O'Brien. Paradoxically, the result could be allowing bigger trucks on the roads.

"When calculations get a lot more accurate, we get a much better understanding of the true safety of bridges and better control of overloads," he says. "That will allow us to go a little bit over the limit without compromising safety. As a result, trucks might get heavier. This could be less damaging to the environment as bigger engines enable two trucks to carry a load instead of three. Less fuel is needed and it reduces the carbon footprint of freight."

Off the scale

WIM technology can provide a complete traffic picture

The California Department of Transportation (Caltrans) has installed an extensive network of 106 data WIM collection sites that provide 24-hour traffic information at key locations on the state's highways.

The information collected includes axle weights, gross weight, axle spacing and vehicle speeds. The data is used for pavement studies, highway monitoring and capacity studies, accident rate calculations and also the analysis of truck transport practices.

Caltrans' WIM system components are provided by International Road Dynamics (IRD). The sensors are either bending plates on frames embedded in concrete, or piezo sensors epoxied into the pavement.

Inductive loops are placed before and after the WIM sensor array. The loops measure vehicle speed and overall length. Smooth pavement and proper calibration ensures quality and consistency in weight data. Caltrans specifies 200ft of approach and 75ft of departure concrete ground to a ±3mm tolerance in 12ft. Before final acceptance, a new WIM system must be calibrated to ±5% accuracy with a test vehicle of known static weight driven at various highway speeds over the WIM instrumentation.

(Right) **Bridge WIM systems are lightweight and easy to move between different locations**

> We can install all the equipment under the bridge within a couple of hours. It's easily uninstalled and can be moved on immediately to another site, enabling us to measure in as many locations as possible using just one system
>
> **Matija Mavrič, sales chief, Cestel**

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For electrical engineer **Scott Brusaw**, many problems – from ITS and road safety to global warming and the energy crisis – have just one answer: solar roadways

Interviewed by Tom Stone

> You can swap a panel out in five minutes… that's what the Federal Highway Administration really likes about our system – the modularity

Scott Brusaw has been playing with the idea of an electric road since childhood, when his favorite toys were slot cars. Back in the 1960s, real-life roads that glowed with their own light and generated power for the cars that drove on them were strictly the stuff of sci-fi comic books. Fast-forward five decades, and advanced photovoltaic panels coupled with LED technology and compact heating panels have enabled Brusaw to build a section of road that not only generates power, but also lights and (when snow and ice threaten) heats itself, with energy to spare: Brusaw estimates that if all the roads in the USA were made of his solar panels, they would generate three times the country's energy needs. Of course, roads made of solar panels would never have been possible without really strong glass…

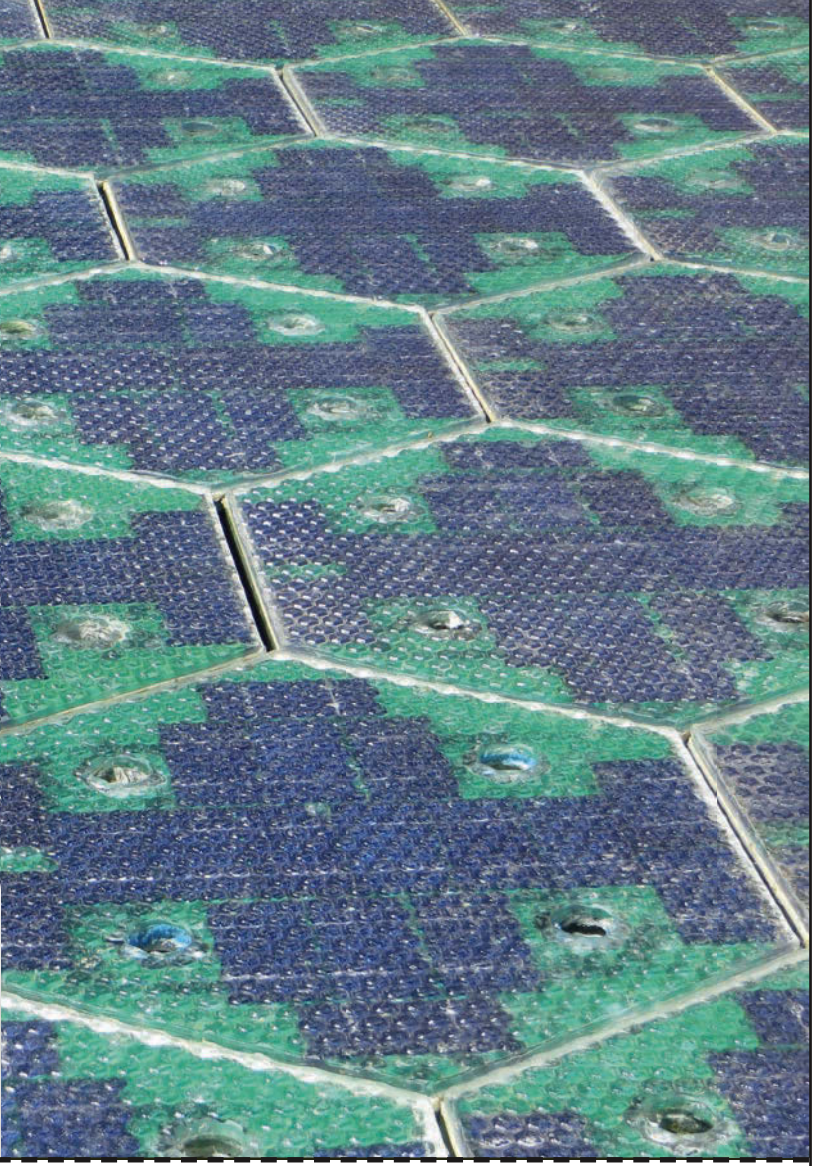
Pressure points

"In the USA, the maximum legal weight limit for a truck is 80,000 lb, so I told our glass developers to design our road to take 100,000 lb, just to be safe," Brusaw tells us from his Idaho home. "But I live in logging country and I knew a guy who used to drive a truck who said, 'That's great, Scott, but when we're up in the woods, we don't have scales. I've had to drive 20 miles to get to a set where I've weighed in at 124,000 lb.' So I changed the spec to 150,000 lb. Then we learned oil companies get permission to move refinery equipment up to 230,000 lb. So, I said let's go for 250,000 lb and that should cover everything! We had our glass load tested and it came in at 250,000 lb plus – even on a 3D finite element analysis."

That's not to say Brusaw's panels are indestructible. A serious accident could still smash a hole in one or more of the hexagonal panels that interlock to make the road surface. As ever, though, Brusaw is calmly confident and enthusiastic about the robustness of his invention. "That's the nice thing about having a modular system," he says. "If they get damaged – let's say a truck flips over and destroys a bunch of them – there are just four bolts holding them in. And they talk to each other. It's an accident detection system. If a truck wipes out 15 panels, all the neighbors suddenly realize 'they're not talking to us' and call it in. A maintenance team would load up a truck with as many panels as needed and go out there. You can swap a panel out in five minutes. So you pull all the bad ones out, throw them in the truck, put the new ones in, reprogram them and drive off. This is what the Federal Highway Administration really likes about our system – the modularity."

Emergency help

The road of the future could also help emergency services deal with accidents. The fact that the road markings on a solar



roadway will be 'painted' with LEDs means they can also be changed instantly. "I'm making a handheld device that will enable me to walk around and change the light structure," says Brusaw. "So we're thinking of giving this to first responders at accident scenes. With this, they could reroute the lane markings around the accident and could start flashing red LEDs in the road a mile before, to warn people. You could even draw a helicopter landing pad on the highway to bring an emergency vehicle in at night."

This kind of system could even be programmed to work automatically. "One of the options for the panels is what we call 'load fills', which turn it into a weighing machine. So if I step on one of the panels it can detect about 200 lb. It doesn't know what it is – a deer, a pedestrian, a fallen tree branch. It just knows that the 3,000 lb object coming round the curb at 40mph doesn't want to hit it. It can warn the driver by putting words on the road ahead of them. It could say, 'slow down', 'danger ahead' or whatever you want." The same technology could be used for weighing much heavier items, such as trucks: "We had the Idaho Transportation Department talk to us about

(Above) **Brusaw's prototype. Solar roadways are built using interlocking hexagonal panels. Beneath the surface, power and high-speed data lines are planned for a truly connected road, which not only supports its own ITS, but also puts energy back into the grid**

creating a lane meant for nothing but weighing trucks, so they won't have to stop."

Trucks aren't the only vehicles that could be kept rolling with Brusaw's system. "We're talking to three companies that make mutual induction technology for electric vehicles. It works, but the problem is that right now they have to go out and dig a big hole in the asphalt and try to get power to it and it's just not very feasible. They said, 'We have the technology, you have the delivery system, this could be perfect.' It extends the range of an EV and makes them practical."

Speed detection

Whatever kind of vehicle you're driving, a solar roadway could make it safer. "The panels know exactly where you are and how fast you are going. You could mount a camera under the glass and it would be a foot away from your license plate, taking pictures," says Brusaw. "A police officer told me that crossing the middle line three times in a mile is a sign of an intoxicated driver. Our road can detect that. So if you're driving erratically, it can paint a ring of LEDs around your car that will follow you wherever you go. It would take a police officer to turn that off. So it warns other drivers to stay away and it gives the police a reason to pull the driver over and see what's wrong. The policeman I spoke to thought that was great and said, 'Can you turn off their engine until I get there?' But we can't do that yet…"

In fact, for now, while the technology itself is very real and the prototype is built and working, the application is all just theory. Now comes the real test: will it all work in the real world? "You can tweak things to get the results you want in your lab," admits Brusaw, "but if you really want to know how something is going to work, send it out into the field. The city of Sandpoint wants to do some of its sidewalks and parking lots. So we're going to go there first, because that's right in our backyard. And we expect there are going to be lessons to learn. We'll put the panels down and maybe in six months we'll see something isn't working quite right. We don't want to go out on the road until we know it works great. Then we would start off with residential roads, because it's slow-moving lightweight vehicles. Our ultimate goal, the last thing we'll do, is the high-speed highways. That's just the logical way to do this thing."

Logical and methodical seem to sum up Brusaw, but he's also inspirational. His vision has captured the imaginations of federal funders, city planners and tens of thousands of private individuals who have put their own money into the project through its record-breaking crowdfunding campaign online. Word of his invention even reached the highest office in the land and President Obama invited Solar Roadways to exhibit at the first ever White House Maker Faire, held on June 18, 2014.

Now the ball is firmly in Brusaw's court and the pressure is on for his company to install its first fully working system in a public area. For anyone wanting to predict the future of our roads, it might be worth keeping an eye on Sandpoint, Idaho.

The road to success?

The funding landmarks in the Solar Roadways story

US$100,000 Small Business Innovation Research (SBIR) Phase One contract from the FHWA

US$50,000 Ecomagination Challenge GE winner (voted the best of 3,795 submitted ideas)

US$750,000 SBIR Phase Two contract

US$2,100,000+ The project has smashed previous records for number of backers on crowd-funding website IndieGoGO, attracting over 47,000 and raising more than double its original target

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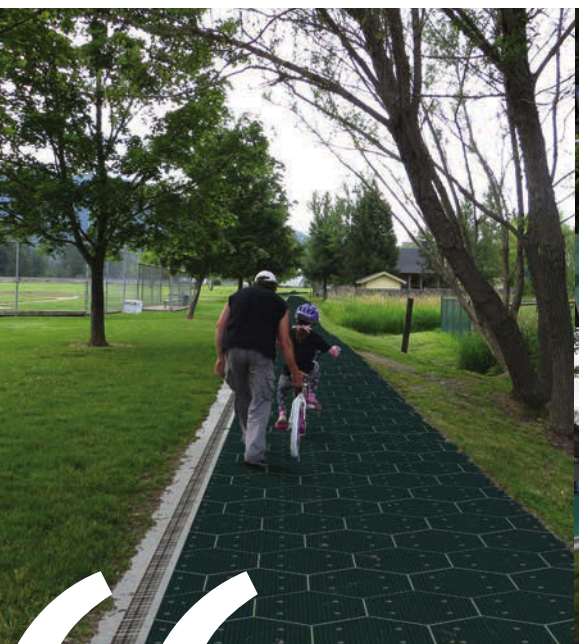

(Below left) **Artists' impressions of how solar roadways might look, including road markings 'painted' in LEDs. The first planned installations are sidewalks and parking lots in Sandpoint, Idaho**

> The panels know exactly where you are and how fast you are going. You could mount a camera under the glass a foot away from license plates

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traffic TECHNOLOGY INTERNATIONAL

NYSDOT commissioner **Joan McDonald** is overseeing one of the biggest traffic policy changes in decades. The New York State Complete Street Act means cars won't always be top priority

Interviewed by Saul Wordsworth

> The Kosciuszko Bridge will soon have bicycle lanes, pedestrian paths and other use-friendly adjustments – with fantastic park space, too

Joan McDonald has been commissioner of the New York State Department of Transportation (NYSDOT) since February 2011. In that time, she has had to contend with tight budgets, hiring freezes and plenty of weather.

"We certainly felt the full effects of Superstorm Sandy and Hurricane Irene," she says. "Whatever the reasons for it, we are having to deal with some unprecedented weather. Thankfully we are always looking at ways to make our infrastructure more resilient and invest wisely for both the short and long term."

McDonald is based in Albany, the state capital. The department employs 8,500 people and has an annual budget of US$4bn, half of which is invested every year in a transportation system that to the north stretches all the way to the Canadian border.

Revolution on the streets

In August 2011, soon after Governor Cuomo came to office, the New York State Complete Street Act was signed. It required state and local agencies to consider convenience and mobility for all users when developing transportation projects. A 'complete street' (CS) is a roadway that is planned and designed to provide safe and convenient access and mobility for all roadway users including cyclists, pedestrians, public transportation and motorists. Similar acts are being passed across the country, though each is state-specific.

"Our country is changing and making different transportation choices from those it once did," says McDonald. "We have to factor these in. We want complete street considerations in everything we do. Our design manuals are now being modified to ensure sidewalks, bike lanes, signage, crosswalks and pedestrian control signals are considered in the design phase, along with bus pullouts, curb cuts, raised sidewalks, mid-block crossings and places of refuge in some of our wider boulevards."

Bridges to the future

Route 347 in Long Island is a 10-mile stretch running north to south onto which DOT planners, architects and engineers have been incorporating additional bus lanes, bulb-outs

Career highs

As well as being commissioner of the NYSDOT, Joan McDonald is chair of the Metropolitan Transportation Authority Capital Program Review Board and a member of the Women's Transportation Seminar. She has been named Woman of the Year by the Women's Transportation Seminar-Greater New York and is known for her support of women right across the industry, with no fewer than five prestigious accolades from other associations and industry bodies.

Before 2011, McDonald was commissioner of the Connecticut Department of Economic and Community Development and held senior positions at the New York City Economic Development Corporation, MTA Metro-North Railroad and Jacobs Engineering.

A Day in the Life

There is no average day for me. I spend 60% of my time in Albany, the rest elsewhere. What I always do first thing is check in with our Incident Command Center to see whether there have been any major occurrences. We are hoping that this year hurricane season won't be too harsh. When I'm in Albany, I'll typically get briefed on the status of capital projects, plus any planning initiatives. Most of my days are spent in the field visiting projects or in our regional offices to see how they're doing, and leading the department.

Sometimes I speak to students in college. When I do I explain that I'm not an engineer; I majored in English and communications. The message I give is that transportation is not just about engineering, it's about moving people and goods by whatever mode. I tell students that if they make the right decisions, it can open the doors to some fantastic career opportunities in our sector.

The current, automobile-centric Kosciuszko Bridge (left) **is soon to be replaced by a multipurpose, 21st century successor** (above)

for pedestrians, landscaping and traffic control devices that are more favorable to those on foot. Changes to the Rexford Bridge in Albany will see new bicycle and pedestrian lanes, plus widening in places from two lanes to four and redesign of a roundabout. However, perhaps the most noteworthy CS project is the Kosciuszko Bridge in New York City.

"This is a two-phase project costing around US$800m," says McDonald. "The bridge currently carries 180,00 vehicles a day. Soon it will have bicycle lanes, pedestrian paths and other use-friendly adjustments. It was opened in 1938 and certainly didn't factor these things in. We are planning some fantastic park space beneath the bridge, too."

McDonald has been impressed by the manner in which all stakeholders are embracing the notion of CS. This includes not only the usual bicycle, pedestrian and advocacy groups but also the engineers who are now growing to understand what the act is trying to achieve.

"This embracing of the concept has to me been the greatest success of the project to date," says McDonald. "Because of that, we have held four workshops across the state to provide guidance and leadership to local government. Balancing the CS program with ongoing operations and maintenance is key. We are a heavy-snow state so you have to make sure you are not making life too difficult for snowplows to operate, for garbage to be picked up, or blocking the way for fire trucks."

One challenge for the DOT is a reflection of the Act's very success – the need to temper people's expectations. McDonald describes what she calls "an outgrowth of popularity" regarding CS, and as a result people demanding change "yesterday".

"From my point of view the best way to incorporate CS elements into a project is to do it very early in the planning and design phase," she says. "When the law was passed in 2011, a lot of our projects were already underway and including CS would have been too costly. Now any CS elements are integrated right at the start."

Pulling together

McDonald's proudest moment as commissioner has been the way the department has responded to the various catastrophic weather emergencies that have befallen the state, most notably Hurricane Sandy in October 2012.

"It demonstrated how the DOT and citizens of the state can come together and help out their neighbors and communities," she says. "When Hurricane Sandy hit, employees from the DOT traveled up to 250 miles and gave up their Thanksgiving holidays and vacations to help their fellow citizens. Out of a great crisis came a great willingness to help."

Also in 2012, Governor Cuomo initiated the New York Works program. This was the government recognizing that investment in infrastructure was linked very closely to economic prosperity. Cuomo advanced an additional US$1.5bn in capital for infrastructure investment and to help put people to work because, according to McDonald, a number of projects were "truly shovel-ready".

"I believe Governor Cuomo sent a message to the business community and its economic drivers that New York was ready and open for business," she says.

A safer future

One indelible mark McDonald has already made is her focus on road safety. New York State has the country's toughest penalties for drivers who are caught texting at the wheel, but now it has introduced over 100 'text stops' along many of its busiest routes, where it is possible to pull over to use a cell phone.

"We are one of the leaders in what I would describe as the governor's carrot-and-stick approach," she says. "There are big signs five miles from the text stops to alert drivers that they can pull over. After three texting violations, you lose your license. You cannot quantify the deaths or accidents this has prevented, but we hear plenty of anecdotal evidence from events with young people and students and we are always looking to ensure that fatality and accident numbers are going down."

There remains much work still to be done, not least in the realms of recruitment. McDonald regards her greatest challenge to be persuading young people that the DOT can be an exciting and rewarding career.

"There are a high number of people who are retiring right now, leaving us with human capital issues," she says. "With constrained budgets and a hiring freeze for the past five years, we need to get the message out to engineering and architecture students that working for the DOT is still a great opportunity."

McDonald continues to serve at the pleasure of Governor Cuomo. He will be running for re-election in November. "I very much hope to continue to serve the governor and to lead this department in a way that keeps the momentum going forward," she says.

A smart solution to tackle road crime

With the number of vehicles on our roads continuing to grow, identifying and catching individuals breaking the law can be a complicated and time-consuming task. However, new generations of intelligent ALPR technologies can assist police forces and enforcement agencies in their fight against crime. Corrado Franchi, Tattile's CEO, says his company's ANPR Mobile device has been specifically designed to support the surveillance and protection efforts of these authorities.

How can intelligent ALPR solutions help law enforcement authorities catch criminals?
Police officers need smart technologies that are as subtle and easy to use as possible. Our ANPR Mobile system provides a constant and unwavering eye on the road, and can instantly detect the license plates of vehicles passing by. The system will sound an alarm if it detects the license plate of a wanted vehicle.

How is the system able to cope with the challenges faced by police officers?
It is an embedded solution powered by strong processor. The system can detect and recognize every license plate in its field of view – even those that only appear for a fraction of a second.

What are the benefits of mobile ALPR as opposed to fixed roadside solutions?
Both types of camera are very important for enforcement purposes, but mobile solutions are particularly useful because they can be directed toward specific areas, as and when required, and do not require any supporting infrastructure.

How does your ALPR technology work?
The system has two 1.3MP sensors (one black and white,

(Above) **Tattile ANPR Mobile can be attached to the roof of a car** (Left) **It is an ideal tool for surveillance and security** (Below) **The device can capture clear images of fast-moving objects**

Need to know

An intelligent onboard system has been specifically designed to detect and read license plates in movement

- The Tattile ANPR Mobile system is able to scan more than 100 license plates per second, front and rear
- The license plate analysis is conducted directly from the cameras installed on the roof, hood or trunk of the car; the data transmission occurs via wi-fi

and one color), which run at 100fps. These are enclosed in a certified case that also houses a multicore processor, a GPS (for exact localization and time certification), a wi-fi access point (giving the system capability to transmit the plate result without any physical connection inside the car), and a micro SD card, which saves the data collected.

Who uses your technology?
Tattile ANPR Mobile is used by entire police and military departments: from traffic, highways and road authorities, to crime prevention police and local police.

How is the system helping authorities tackle crime?
The device ensures effective territory control as, whenever it is switched on, it detects every license plate that passes through its field of view, in any light condition.

What has been the camera's biggest success story?
While the new model of the camera is still being tested in several countries worldwide, 5,000 units of its grandfather, which we developed in 2002, are currently in use around the world.

How do you see your cameras developing in the future?
We will continue to improve our technologies in order to keep up with the evolving demands of the industry.

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I'm sure anyone who read the *New York Daily News* headline in April, *Woman in North Carolina killed while driving and texting about being happy*, felt awful but also wasn't surprised. Apparently, she was also "snapping selfies as she drove".

These days, automobile dashboards look more like a 747's cockpit, much to the dismay of safety advocates. I'm not only talking about GPS navigation, which is more or less standard fare nowadays. I mean using a smartphone to update your Facebook status or take a selfie while traveling at highway speeds. As our world becomes more connected, the industry contends they're simply giving consumers what they want. But are we sacrificing road safety for convenience?

Distracted driving has always been a problem. Whether you're texting, talking to a passenger, or eating breakfast on-the-go, part of your attention is diverted from the road. What makes using a smartphone while driving so alarming is that it requires all three forms of a driver's attention: manual, visual and cognitive.

A Virginia Tech Transportation Institute study found that, on average, a texting driver takes their eyes off the road for five seconds. At 55mph, that's the equivalent of driving the length of a football field with your eyes closed. The consequences of being distracted behind the wheel are unmistakable. In the USA alone, some 3,300 people are killed in distraction-affected crashes every year.

Those in the car industry claim that their newest gadgets are safer than using a smartphone while driving. Modern in-vehicle infotainment systems, such as Apple's CarPlay, are voice controlled. Some even have the ability to read your text messages to you.

Google Glass, a wearable computer, is another innovative approach. Not only is it voice controlled, but Glass users barely have to move their eyes to see the display, enabling drivers to maintain a line of sight on the road. While both of these technologies make great strides in reducing distractions, neither eliminates them entirely, and some may reasonably argue that they introduce new ones.

In terms of legislation, the predictable response to distracted driving is to ban any product deemed a potential risk to public safety. The past decade has seen a flurry of distracted driving-related legislation in the USA, as lawmakers try to get ahead of the growing problem. Twelve states currently ban all handheld cell phone use while driving. Texting is far more scrutinized, with 43 states banning this behavior. More recently, a handful of US state legislatures have turned their attention to Google Glass, with eight states considering banning it. Some, however, question whether this is an appropriate response, especially since the safety aspects of Glass haven't been carefully researched yet.

Others believe that technological and legislative solutions are not enough. Before we can address distracted driving, we need to understand the social context that encourages it. Nowadays, there's an expectation to be accessible 24/7, even if it means putting yourself and others at risk. Shifting this social norm and changing the way people think about driving will have a lasting impact.

The solution, I believe, will be a combination of all of the above. We need tech firms to continue finding new ways to make driving safer. Laws should be passed to help protect us from ourselves but, at the same time, should not stifle innovation. Most importantly, however, rather than forcing people to behave in a certain manner, we need to educate drivers so that they can make the right decisions on their own. "Friends don't let friends text and drive" needs to be an aggressive campaign. We were able to make seatbelt usage mainstream in the 1980s. I'm hopeful we can achieve the same results with safer driving habits.

> Laws should be passed to help protect us from ourselves but, at the same time, should not stifle innovation
>
> **Sam Schwartz, Sam Schwartz Engineering, USA**

High-performance traffic imaging for the next generation

Imaging solutions are used in a variety of ITS applications, such as automated tolling, safety monitoring, speed and red light enforcement, and ALPR. With each of these applications comes a demand for systems integrators to create simple solutions that can speed up deployments and lower costs.

A new solution might involve real-time video capture and post analysis via software rather than relying on expensive in-ground sensors that connect to systems that trigger cameras. Those systems are much easier to install and maintain as the road infrastructure does not need to be modified and most of the equipment can sit on the side of the road rather than on gantries.

One challenge with software implementations is that the high frame rate and high resolution required result in a data rate beyond the capabilities of traditional technologies. For example, if an application requires an image with a resolution of 5MP, a bit depth of 14bits and a frame rate of 30fps, one cannot use a camera with a GigE interface since it requires a payload throughput of 2.1Gbps. A camera with a USB 3.0 interface is the right choice as it can handle this higher throughput (5Gpbs total throughput with 3.2Gbps effective for payload once the overhead is taken into account), is reliable and cost-effective.

GigE is one of the more popular interfaces for cameras used in traffic applications since it is relatively fast and stable, and requires no expensive frame grabber cards. The introduction of USB 3.0 in 2008 and the release of products in 2010 created a buzz in the camera community about the potential benefits for cameras using this new interface.

GigE was fairly ubiquitous for cameras as it was mature, is found on most computer platforms, and at 1Gbps could meet the needs of most of the older image sensor technologies. When USB 3.0 was introduced with a throughput of 5Gbps combined with the emergence of affordable high-speed image sensors, this changed the landscape of camera interfaces.

(Left) **It is becoming more common for traffic lights to be accompanied by enforcement cameras**
(Right) **Lumenera's new industrial camera is built with USB 3.0 technology**

Benefits and possibilities

Before USB 3.0, if you required a camera that could output higher resolution and higher frame rates than GigE could support, you needed an interface such as CameraLink (medium or full modes), which were more costly and complex, had limited cable length and required a frame grabber card. The requirement for a frame grabber can become a major obstacle for compact embedded platforms, such as those found in transportation.

In 2011, Lumenera recognized that USB 3.0 would change the landscape of camera interfaces by enabling higher resolutions and frame rates without requiring frame grabbers. USB 3.0, like USB 2.0, is a plug-and-play interface, which has grown in popularity and now has strong support on the host side with many hardware platforms and mature drivers. This makes USB 3.0 an ideal solution for applications requiring more than can be offered by GigE and dual GigE interfaces.

A fairly common misconception with USB, is that it is restricted by cable length. Most people might think that 5m is the maximum distance that can be achieved between a USB 3.0 device and host computer. This is simply not true. Many vendors now sell active cabling solutions that permit customers to extend the range between the device and computer by as much as 20m.

An active cable is a simple solution and is nothing more than a regular cable including built-in electronics that are powered directly from a second USB port for a plug-and-play experience. For deployments requiring up to 100m between camera and host computer, there are transcoder solutions over optical cabling that can achieve that distance with the added benefit of providing

Need to know

USB 3.0 technology enables systems integrators to create better imaging solutions for ITS

- In spring 2014, Lumenera launched a new high-performance USB 3.0 industrial camera based on Sony's EXview HAD II ICX694 CCD sensor
- The Lt665R camera runs at 27fps at full resolution, faster than any other USB 3.0 camera on this sensor
- The camera has been engineered for excellent sensitivity, a high dynamic range with low noise, and reliable delivery of images through advanced frame buffering technology

electrical isolation in between equipment. In open road deployments that are prone to lightning strikes, the decoupling of the camera and computer via a fiber optic cable and USB extender increases the reliability of the solution.

Beyond higher throughput, there are other advantages to USB 3.0 over USB 2.0 and other interfaces such as the now dwindling FireWire interface. USB 3.0 also provides increased power delivery (900mA versus 400mA for USB 2.0), which can enable many cameras to operate without requiring a power supply, thus reducing the number of cables connected between the camera and host computer. USB 3.0 offers extremely fast signaling for accurate synchronization of cameras, even in multicamera systems.

USB 3.0 supports Direct Memory Access (DMA), which minimizes CPU usage while transferring large amounts of data to the hard drive. Minimal signal latency with USB 3.0 is another benefit when dealing with the synchronization of cameras and other devices.

Future proof

There are several questions systems integrators must ask when building a quality USB 3.0 host computer solution. Will the computer be able to handle the higher throughput for streaming video or high resolution, and fast frame-rate snapshot modes of high-speed traffic applications such as ALPR? Will there be some sort of post-processing of images after capture? How stable and efficient are the drivers being provided by the camera vendor? How much CPU, RAM, HD space is required? How many solid state drives will be required for the application? Will I require a RAID configuration for my drives?

These are all valid questions that need to be worked out between the system integrator and the camera vendor. There are so many unique applications that ITS systems are used for, so it is important for road authorities to partner with camera vendors that understand the requirements of their solution, and who can quickly provide expert advice and solve problems as they arise.

A successful ITS deployment involves more than cobbling pieces of equipment and software together; it involves strategic partnerships with companies that will provide the quality and ongoing service level required to produce a high quality and reliable imaging solution.

As ITS requirements evolve, one needs to consider the benefits of USB 3.0 for these applications. Understanding all the benefits of using a quality USB 3.0 solution is the first step to ensuring the right decision is being made for the application in mind.

Lumenera has spent many years developing reliable, high-quality, customized camera solutions with GigE and USB interfaces, and the company believes that the time is right for integrators to adopt USB 3.0 as the new technology that will enable new and more powerful ALPR and other traffic-related applications. ○

An intelligent solution: real-time forecasting meets e-mobility

Originally designed for petrol and diesel-powered vehicles, the current transport network in many cities is not optimized for electromobility. And while investing in a network of high-speed charging points would be very costly for road authorities, infrastructure and technical systems can be used to create a more feasible solution.

In connection with the research project Smart Mobility in Thuringia, the federal state capital of Erfurt in Germany is creating an integrated traffic management system for the metropolitan region. To achieve this, the state is using PTV Optima: a model-based solution that combines offline transport modeling with real-time data and algorithms.

"For drivers of electric vehicles, up-to-date traffic information is essential," says Frank Helbing from the Civil Engineering and Transport Agency of the state capital of Erfurt. To cater for these road users, Erfurt is developing a system that collects information from different data sources, compiles it, and then delivers it to the driver of the electric vehicle via the sMobiliTy-Cloud.

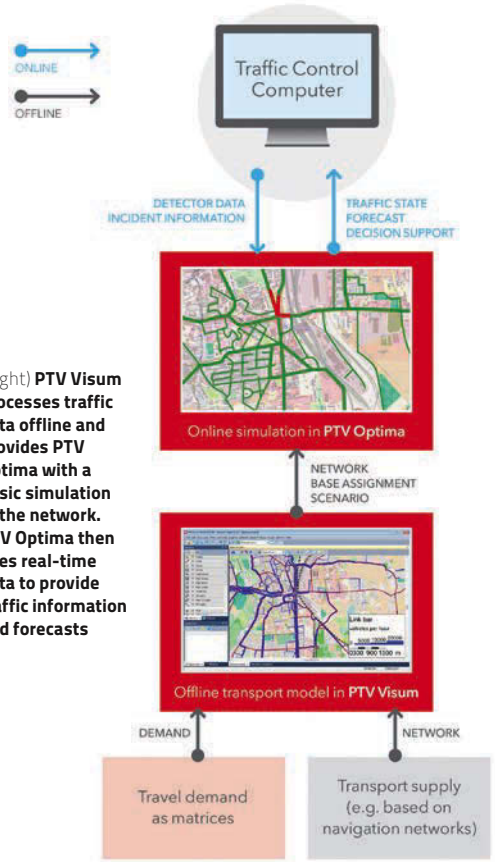
"Erfurt has an advanced traffic model, which has been created and refined by the Urban Planning and Development Agency using PTV Visum over several years," says Helbing. "This traffic model uses PTV Optima to form the basis of the traffic forecasts."

Demand-based modeling

The transportation model created in PTV Visum shows a 'typical day', such as a working day or a weekend, for the selected transport area. It models transport services and travel demand using matrices.

Photo: Stadtverwaltung Erfurt

(Top) **Traffic management in the city of Erfurt**
(Above) **PTV Optima showing congestion evolution following an accident**



(Right) **PTV Visum processes traffic data offline and provides PTV Optima with a basic simulation of the network. PTV Optima then uses real-time data to provide traffic information and forecasts**

Need to know?

An advanced transportation model exploits dynamic traffic information

- As PTV Optima explicitly includes the network structure, traffic flow dynamics and the route-choice behavior of road users, it also covers the traffic situation for routes without detectors (spatial distribution) and predicts the impact of unforeseen incidents (temporal distribution)
- It is also possible to assess and compare different strategic actions

A Dynamic Traffic Assignment (DTA) model is used to calculate the time-related traffic volume and turning movements in networks based on travel demand. Then, all of the information is transferred from PTV Visum to PTV Optima. In PTV Optima, the data is used in real time to adjust capacity, speed and volume from PTV Visum's base model to the current local flow and road conditions.

"Prior to the online project, our traffic model contained detailed demand matrices for every hour of every working day," says Helbing. "Now, we also have demand matrices for Saturdays and Sundays, and have extended the network of measuring points." To do so, detailed modeling was carried out, and around 1,800 detectors were mapped, particularly in the areas surrounding intersections. In fact, a quarter of these have already been activated. Floating car data (FCD) will also be integrated in the next few months.

Statistics and simulation

There are two main approaches to forecasting traffic situations: statistical and model based. The statistical approach uses interpolation, interference, data mining, artificial intelligence and mathematical models to match the observed time series with historical patterns. Flow and speed variables are analyzed and forecasted without trying to explain and reproduce the underlying phenomena, namely vehicular interaction and driver behavior.

Statistical modeling techniques can be used to predict traffic flow in low volatility or homogeneous traffic patterns with random variable discovery methods. However, this technique fails if there is not enough historical data, which is often the case for accidents or road works.

Conversely, the model-based approach is founded on an explicit and physical interpretation of the network, demand and traffic conditions. The model enables a simulation to calculate information that is difficult or impossible to measure.

PTV Optima provides an effective and consistent representation and prediction of impacts, such as drops in speed, spillbacks or queue patterns generated by unexpected events. Moreover, the solution enables motorists caught behind an incident to be rerouted in a more realistic way as well as to estimate the effect and predict the impact of signal control changes on traffic conditions.

"At the moment we are focused on providing traffic information to the smartphones and tablets of e-vehicle drivers, which will then also be integrated into navigation," Helbing describes. "But we are also toying with the idea of how to use the system for other purposes. In a city that has grown over the years, we need to use the existing transport network as efficiently as possible. Powerful and dynamic traffic management is key."

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Those of us who are 'in the business' of transportation have varying ideas of what surface transportation should look like in the future. Are we the ones with all the answers? Do we understand what capabilities new technologies will bring? Do we understand what subsequent generations will want or require?

Because we eat-sleep-breathe transportation and toll-road technology, it's easy to get bogged down in details and specifics. But as the old adage goes: if a tree falls in the forest and no one is there, does it make a sound? If we launch new technology that no one understands or sees a need for, will it make a difference? It's time we stepped back and asked the next generation of highway users what they want.

Sometimes it's difficult to understand younger generations. What's important to them seems foreign and so drastically different from what we remember at that age. I remember my dad, who was born in 1897, not understanding my music or the new math I was learning in grade school.

I have had the privilege of speaking at several colleges, and that generation gap is widening. I now hear some 30-year-olds saying they "don't get those teenagers". While I was at the DMV the day I turned 16, the new generation is not as interested in driving, with some not getting their driver's license until they leave college, if at all. We are seeing a generation that is not concerned with privacy, which in part helped in the success of transportation systems relying on RFID, such as TxTag.

This new generation is the most technically advanced group ever to graduate. Some readers will remember trudging through touch-typing class. By the time most students attend high school, they are already typing 60 words a minute and using iPads in the classroom. Time – and, in particular, leisure time – is very important to this demographic, so sitting in traffic is a particular annoyance. Will these trends continue? What new technological demands will the generation after this one bring? Today's toddlers learn how to use touchpads before they hit kindergarten. Add rapid technology advances to the continuing generational changes, and planning for the future becomes very complex.

As we develop standards for technology and business rules, we need to keep an open line of communication with younger generations – keep our finger on the pulse of the future. I know that if it were not for countless conversations with my daughter and college students, or recent grads at conferences, many of the innovations that we are now implementing through the Alliance for Toll Interoperability would not have been developed. As we look toward launching a North American HUB, and the release of other innovations in settlement, payments, registration lookup, interstate enforcement and in-vehicle transponders, we must continue to innovate for future generations.

In the words of Steve Jobs: "If you do something and it turns out pretty good, then you should go do something else wonderful, not dwell on it for too long. Just figure out what's next."

> It's time we stepped back and asked the next generation of highway users what they want
>
> **James Eden, director of tolling, Aecom, USA**

Dynamic duo: IP cameras with a real-time trigger and YUV images

When choosing a camera for a traffic management system, a fundamental decision must be made between two possible options: IP cameras and industrial cameras. Recently Basler has added a new benefit to its IP camera, with the integration of critical functions for traffic applications that were previously only found in industrial (machine vision) cameras. These features include a real-time trigger option, which enables specific events to be recorded with still images as well as a video stream. Furthermore, recent developments have made it possible to output the recorded data in an uncompressed YUV format.

With the real-time trigger, a system can capture individual JPEG images of specific traffic events, such as violations, in parallel to video footage. Rather than being captured in a continuous stream, the images are acquired precisely when triggered.

One of the most impressive aspects of this function is the short trigger response time, especially for the high-speed application of image data and flash synchronization. IP cameras in surveillance systems usually operate in a free-run mode, recording continuously at a set frame rate. To ensure sufficient light, image acquisition and flash are synchronized accordingly. However, capturing single images means that the flash must also be triggered individually, often via a radar device or induction loop in the ground. The function has been engineered to minimize the time between the trigger signal and the start of image data acquisition.

(Right) **Basler IP cameras can now deliver uncompressed YUV images**

Need to know

The real-time trigger can be enabled by using the IO-Selector to select a port, and directing the function accordingly

- An image capture will be triggered every time the electrical signal applied to the port causes the port to transition from the inactive to the active state
- The active state can also be reset by enabling the inverse function of the port: an image will only be triggered when the electrical signal causes the port to transition from the active to the inactive state

Color and compression

YUV is one of several color systems within the color space. In every color system at least three values are needed to characterize a specific color; for example, in the RGB system the values are R (red), B (blue) and G (green). In the YUV system, color is characterized by the luminance (Y) and the chrominance (U and V).

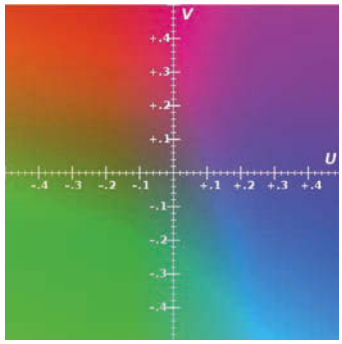
A color camera uses several pixels with different color filters to reproduce the color impression for every location in the image, using three color values. Without correction, these color values depend on numerous factors, including the technical detail of the camera and the illumination, so cameras are usually calibrated to record colors realistically.

While many video recordings use data compression to reduce the storage volume, some applications require uncompressed images because they contain the most detail. ALPR applications, in particular, record minute image details to help identify numbers correctly.

Basler IP cameras are able to record both compressed and uncompressed images and are therefore suitable for a wide range of traffic applications.

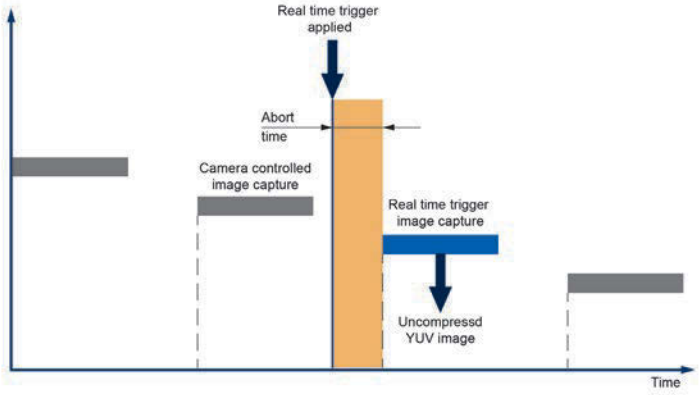
In the uncompressed YUV format, the image data passes from the sensor through the camera's FPGA (field programmable gate array) and on through to the DSP (digital signal processor), to reach the PC without any revaluation and compression. Naturally this creates a large data volume. However, no image information is lost by compression or revaluation.

(Below) **Chrominance component of the YUV color system**



ALPR systems have generally been matched with industrial cameras, but Basler's IP cameras are now a viable alternative. For detail-critical applications, such as parking access, city tolling and dragnet investigation systems, even the smallest details are important, which makes uncompressed images much more useful than compressed ones.

Parking access, in particular, often involves additional security requirements, which the cameras can deliver in the form of a simultaneous video stream. To acquire YUV images, the real-time trigger in the IP camera settings must be activated, and the camera must be set to uncompressed YUV streaming. This enables users to set the encoder format for real-time triggered images to the uncompressed YUV format.



(Above) **As the uncompressed YUV image format is available only if the real-time trigger feature is activated, these uncompressed YUV streaming images are obtained at a particular point in time**

Motion pictures

When capturing moving objects with IP cameras, motion blur can occur as a result of long exposure times. Recording individual details, such as license plates, requires a clear and crisp image, which can often only be achieved with additional synchronized IR strobe.

In this case, short exposure times and low gain are recommended to avoid motion blur and overexposure from the additional light source.

Basler is currently working on a flexible solution that will enable users to set individual exposure times and gain values independent of the settings the camera automatically uses in its normal free-run mode. Operators will therefore have the flexibility to use individual parameters when working with uncompressed YUV images.

Decisive criteria: the real cost of WIM systems

Unlike the decision to buy a new car, the decision to purchase a WIM system will never be made because the system looks pretty in the road. The choice should be based on profound analysis, rational criteria and technical specifications. Yet, with a variety of technologies available on the market, these criteria often fall short when comparing options.

Too often, price is the deciding factor – even though quality is directly related to the purchasing price of a system. Cheap products usually have strong limitations regarding the quality of data and the durability – requiring frequent maintenance and replacements.

The key is to define a set of criteria for a decision besides price. One of the most common approaches is to focus on the application: where will the system be situated and what will it be used for? Based on the application, key specifications can be determined regarding installation, operation and quality of data.

(Right) **Data is stored in processing units at the roadside**

The WIM Data Logger (left) **works together with the Lineas WIM sensor** (below left and right) **to monitor traffic and gather accurate vehicle data**

Wise investment

WIM systems are used to measure the impact of heavy trucks on roads and bridges, as a pre-selection tool for the enforcement of overloading or as an instrument to determine a fair fee for toll roads, based on the weight of the vehicle. Whatever the application, buying a WIM system only makes sense if the benefits of the application are greater than the investments in equipment and operation. Fortunately, in case of WIM systems, the benefits usually outweigh the investment costs, so much so that the return on investment for a WIM system is usually calculated in months.

One should look at the costs of ownership and go for quality. Too often, decisions are based on the initial equipment price, while more focus should be on the costs of maintaining and operating such a system over the years. The total cost of ownership is a much better indicator of actual costs. Besides the initial equipment price, a cost analysis will also include installation, calibration and operation, as well as maintenance and replacement costs over a number of years.

When looking at the costs for installation, calibration and operation, as well as maintenance and replacement, Kistler's Lineas quartz WIM sensors have a very favorable price-performance ratio. For years, they have been used worldwide to collect accurate vehicle data in applications such as traffic loading analysis, weight enforcement and weight-based toll collection.

The sensors are extremely durable and stable, which means that the accuracy is not affected by aging or environmental conditions. They also have high frequency range, so they can be

Need to know?

An investment in high-quality and reliable equipment ensures a favorable ROI

- Kistler's Lineas quartz sensors are not influenced by temperature changes or ageing, and ensure precise measurements of wheel and axle loads
- The Kistler WIM Data Logger gathers accurate and realiable vehicle data from the Lineas WIM sensors, over a wide measuring range, from low- to high-speed

(Above left) **Applications for the WIM system include toll booths**

used for both slow- and high-speed applications.

Better together

Even the most advanced WIM sensor will not provide vehicle data, unless it is connected to a signal processing platform. To ensure optimum performance of the Lineas WIM sensors, Kistler has recently launched a WIM Data Logger.

This signal processing unit has been specifically developed to work with the Lineas WIM sensors and to provide accurate and reliable vehicle-weight data. It offers a high weighing accuracy over a wide measuring range, from low to high speed. The Kistler WIM Data Logger is capable of OIML-certified measurement. It has a compact design, with integrated charge amplifier and a modern web interface that enables a quick system setup. The Data Logger can be easily integrated into any solution via a system integrator. As a result of its modularity and flexibility, it can cover a wide range of applications.

The combination of Lineas WIM sensors with the Kistler WIM Data Logger guarantees optimum accuracy throughout the measurement chain.

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I was recently at a Connected Vehicle Summit at the University Of Michigan Transportation Research Institute. It is hosting the major federally funded DOT pilot of connected vehicles and, because of their proximity to Detroit, are very important in this space.

It was a far cry from my first experience with connected vehicles, in 1996. At that time, the National Automated Highway System Consortium was showing off driverless cars at a nationally advertised demonstration in San Diego. It was the culmination of years of work and millions of dollars in research. The entire ITS community was there and we had scheduled the ITS America Board to coincide with the demonstration. We saw cars zipping around the track singly, in pairs and in entire fleets, just inches from each other. It was thrilling but deeply flawed. For those cars to function without a driver required thousands of magnets to be installed in the track. To take the system outside the controlled environment would require millions of magnets and billions of dollars. It was dead on arrival.

Now let's fast-forward nearly 20 years to the success of DARPA with autonomous vehicles in rural and then urban settings. You know the DARPA folks; their work contributed towards the launch of the internet. Oh, and Google has a few driverless cars too. But I want to focus on the next step: cars that can communicate with one another – that is, vehicle-to-vehicle communication, or V2V. Regardless of popular stories, the car manufacturers don't expect fully automated vehicles in the fleet in less than a decade.

The next step for V2V is for vehicles to send safety messages and receive safety warnings, such as lane departure warnings. The technology for this has been tested over the past few years: GPS for location of the vehicle, and DSRC for communication. There's more to be done, but we know it can work. Let me instead discuss the obstacles still in our path.

Earlier on, the big issues were intellectual property and liability. The IP issues have largely been settled, but we do have the liability issues. V2V might save 10,000 lives a year, but what happens when someone dies as a result of a wrong message? I can see the news stories already.

The keys to success of V2V will be: a high percentage of the fleet participating, a security system to check vehicles in to the network, and a clear disposition of liability by the federal government. Work is proceeding to deploy V2V via rule making and work on a security system is also proceeding. Liability will need to be explicitly addressed.

However, my frustration is that after 20 years and with workable technology available, we are still, at best, six years away from the start of deployment: two years for rule development, two years to adopt the rule, and two years for the OEMs to start selling V2V-equipped cars. I would love to see a regional roll-out of this technology in less than six years. There has to be a quicker way.

> My frustration is that after 20 years and with workable technology available, we are still, at best, six years away from the start of deployment
>
> **Larry Yermack, Wendover Consult, USA**

Working toward holistic traffic management

Make any machine run for too long at greater than its rated capacity and the penalty will be a reduced lifespan. Roads and other transport infrastructure, such as bridges and tunnels, are no different, and if they are used to carry greater numbers or heavier vehicles than they were designed for, they will wear out more quickly. In extreme cases they may even fail, with safety and political consequences.

The principles of preventive maintenance are well understood, as is the fact that road wear increases exponentially with axle weight. As a result, technologies such as weigh in motion (WIM) are now well established as means to monitor and help to enforce against gross violations of vehicle loading. WIM has itself undergone an evolution in recent years, being fused with ALPR to give enforcement authorities a real-time ability to detect and counter overweight violations or to track hazardous cargos.

At the same time, other means of vehicle profiling can help detect over-height or otherwise out-of-parameter road users, but the emphasis need not be solely on catching offenders or on enforcement – in many instances congestion growth and the sheer weight of traffic can take a road outside of its designed limits.

Detecting symptoms

The toolbox from which we can draw to monitor vehicle types and their movements is bigger than ever and good-quality data can be obtained at a cost far lower than has previously been the case. Technology developers, keen to add value or differentiate their products, have looked to non-traditional means of data collection; loops and cameras are no longer the only way to gather information. Technology developments and customer take-up in consumer electronics have made their presence felt and, for instance, Bluetooth-based tracking of vehicles (via smartphones and other nomadic devices) can be used to obtain journey time information and origin-destination data at a fraction of the cost that would have once been the case.

This cost advantage enables network planners to spend less and still enjoy quality data or else, for a given investment, geographic scope can be increased, leading to an ability to increase the health of an overall network. It is a trend we can expect to continue as other areas of technology, such as connected vehicles, become common. Once we have widespread vehicle connectivity, probe data will become even more relevant. For example, vehicle suspension systems will be able to detect developing cracks and bumps in the road surface, and then report their exact positions for preventive maintenance before expensive problems develop.

Healthy changes

The technology fusion of WIM and ALPR is but a small reflection of the far larger trend toward convergence within the ITS industry. The information-gathering methods mentioned above can be used to gather empirical data, but their meshing and fusing also gives them a real-time capability, of which on-road enforcement against weight infringements is but one example. This is not a new concept, but perhaps, in light of the convergence trend, it is time to consider again what we mean by the 'health' of a road infrastructure.

Broadly, this can be seen in three ways: the actual physical condition of the network, its ability to cope with traffic and its financial health.

Finding the money to build and maintain road infrastructure is challenging. In the face of constrained budgets, many jurisdictions have to cope with networks that have grown in terms of road miles, but that have also increased in sophistication. New safety standards, and the increased technology that is needed, mean that not only do we have more actual roads to consider but that, per mile, they are more expensive than ever before.

Increasingly, some form of private investment is seen as necessary, and tolling/road user

(Opposite) **Sophisticated technology offers a better level of service to paying road users**
(Left) **Increasing complexity of inter-urban ITS systems has led to the convergence of the traffic management and tolling sectors**

charging (RUC) has gained popularity. Although we are still some way from a situation where distance-based charging has the political support it needs to become a widespread reality, there are encouraging signs that deployments are on the way. There is at least a consensus among transport professionals that distance-based RUC is the most equitable means of infrastructure funding, especially if it is combined with a tariff that links volumes of emissions to distances traveled.

Tolled facilities have, by not being free to the road user, had to look for ways to justify the fees they charge. This has been done by offering customer service that is over and above that of untolled roads. This has pushed tolling companies to become de facto ITS experts, as they have worked to provide solutions that both ensure that tolls are collected to an adequate degree of accuracy and at the same time enable road managers to carry out their tasks.

Need to know?

Better planned, truly comprehensive ITS solutions are the key to transport and traffic management's future

- New generations of ITS will include vehicles and individual travelers in the information-gathering and sharing processes
- Road users will be able to use a single device to access all transportation-related information and payment services in a truly multimodal setting – improving individual journeys and reducing the environmental impacts of travel-related activities

Holistic therapy

The logical progression from there is what we are now seeing: tolling system suppliers are pushing into the ITS sector, and making acquisitions in the advanced traffic management system (ATMS) field. This increases their areas of expertise beyond traffic management on strategic, inter-urban routes, and into the urban environment.

This is not just a case of the tolling system suppliers going it alone, however. It is also reflected in an increasing number of requests for both an infrastructure management solution and a means of financing it. In the not-too-distant future, we will find it increasingly hard, if not impossible, to distinguish between the tolling and ITS sectors – the two will be symbiotic, and then synonymous.

This all reflects a maturing of the transport management market and a move away from the more piecemeal procurements of past decades. Infrastructure managers are looking to acquire ITS 'systems' in the fullest sense of the word, in that they are looking for total solutions that work, are self-sustaining financially, and are better able to give feedback on their health. Importantly, they are increasingly looking to do so from a single source.

In the past years and months, Q-Free has looked to reflect and lead this trend. It has major acquisitions including ALPR market leader Dacolian, parking management specialist TCS International, urban traffic control specialist Elcom, and data collection and info-mobility specialist TDC Systems. The aim has been to add to existing its expertise and to create a complementing portfolio that can be tailored to address the needs of any traffic management project.

The acquisitions reflect the heartfelt view that a silo mentality to procurement is no longer sustainable, either for budgetary or operational reasons. The building of better-considered, holistic solutions is the only way to balance safety and efficiency and to do so in a cost-efficient way. ○

Monitoring conditions in a harsh environment

Imagine a place where the temperature can vary between 14°F (-10°C) and 131°F (55°C) in the same month, and the temperature in the morning can rise nearly 1.5°F (1°C) every 10 minutes. Water, ice and snow can all occur here, and you pass through the freeze-thaw process more frequently than most places on Earth.

Now imagine objects passing over you weighing upward of 80,000 lb (36,000kg) and vibrations similar to a minor earthquake occurring on a nearly continuous basis. Does this sound like somewhere you would like to live? Probably not – but this place could be closer than you think. The road surface outside your home or place of work may be subject to many, if not all, of the conditions described above.

The surface of the road is a harsh place. You would not leave your smartphone out there because you know what condition it would come back in. But we do put electronic devices on the road and expect them to work. Road sensors that measure traffic or road weather conditions have to live in this environment.

Trial and error

Over the past 40 years, Vaisala has designed, tested and manufactured numerous types of embedded road-weather sensors, and over that time the company has learned that the road surface is an unforgiving environment. It has a low tolerance for equipment with sophisticated designs and features. It is a place where simple design means a long life.

For example, a sensor with a removable lid might sound like a good idea because it would give you the ability to service the sensor. However, removable lids can let in water.

(Left) **The remote sensor measures surface temperature via emitted infrared radiation and lasers**

(Below) **The thermally passive sensor measures road surface and subsurface temperatures, as well as water layer thickness, black ice and chemical levels**

Need to know

With road sensors subject to the extremes, a simple design is key to longevity

- Vaisala's Remote Surface Condition Sensor DSC111 is pole-mounted at the roadside to provide accurate readings of surface conditions including water, ice and snow, as well as grip level
- The company's DRS511 and FP2000 passive, embedded sensor provides information about all road weather conditions, including chemical applications

Often the sensor will remain watertight until the first time it is serviced. Then, due to temperature changes and forces from vehicles, the lid no longer fits the housing. Vaisala's experience has shown that only a completely sealed sensor remains watertight.

Another design idea is a completely wireless sensor with batteries. This concept is cheaper to install with less hassle, but the batteries struggle to last as long as expected. Though batteries have improved greatly over the past 20 years, nearly all types still struggle to cope with extreme heat and cold, which lessen their life, and as described above, very few places on earth experience more extremes than our roads.

Embedded road sensors work most effectively if they are passive, i.e., they do not attempt to change their environment. Active heating and cooling to detect the freezing point of the surface liquid is not a simple process and makes the entire sensor more complicated. A passive sensor simply measures its environment and does not try to change it. Through Vaisala's experience with sensor technologies and road physics, it has learned that embedded sensors work best if they are completely sealed, have hard-wired power and are passive in their measurements.

Non-intrusive investment

Over the past 20 years, as road weather networks grew, road authorities began to come to terms with maintaining an increasing infrastructure of road-weather ITS. Costs to repair and replace road sensors became more important, and thus agencies wanted a solution to prevent frequent replacement of embedded sensors following road resurfacing. Solutions such as lids and batteries appeared on the market to lessen costs, but they also reduced reliability. The only real solution was to remove sensors from roads altogether.

Nowadays, sensors that use lasers and infrared technology can be mounted on the side of the roadway. They are referred to as remote or non-intrusive sensors. They typically cost more than their embedded counterparts, but non-intrusive technology has proven

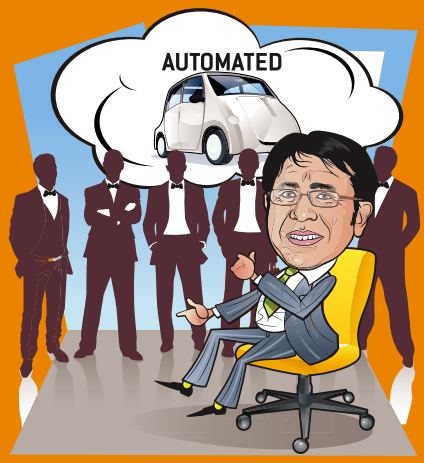
to be much more cost effective in the long run.

Non-intrusive sensors are easier to maintain and do not require any lane closures. They also offer an advantage to the decision maker. As they use lasers to detect water, snow and ice on the road surface, the grip, or road friction, of the road condition is measured. When the road authority knows the grip value, it can make better decisions.

Furthermore, a quantitative measurement of conditions means that agencies can use a performance index to monitor maintenance crews during an event, or as an evaluation of success after the event is over. Authorities using this method have seen a notable decrease in chemical use by using an index that measures performance.

The grip reading can be used for automated ITS applications, such as activating signs or controlling signal timing. This attribute takes road weather monitoring beyond maintenance and increases the return on investment by keeping drivers aware of changing road conditions.

The key to the future of road weather technology is that it must offer the most return for the least hassle and cost. Solutions with short-term gains or overly complicated designs will not survive in the long term. Vaisala has learned that reliability and accuracy are the cornerstones to a successful road weather management program. ○



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Excitement is in the air, or more accurately, on the ground. These days I often write about happenings and hype with what some call self-driving cars and what others call automated vehicles. On this occasion, I write about a group of researchers, usually level-headed but sometimes prone to break out in song. This July, venerable National Academies of Science Transportation Research Board will team with the Association for Unmanned Vehicles International to host the Automated Vehicles Symposium near San Francisco.

So what's the big deal, you ask? An underlying theme will be deployment, considered from virtually any perspective you could imagine except the unabashed PR perspective. Perhaps 500 to 600 informed, possibly bow-tied academics and a heavy dose of industry and government experts will gather in the hallowed halls of a business hotel to debate issues such as deployment in breakout sessions with working titles such as below (replete with my made-up but assuredly representative questions to consider):

Human factors: Will transition of control from relaxed driver to one that needs to intervene in an emergency be the bugaboo?

Freight and trucks: Given the economics of goods movement, will these applications be the earliest deployed?

Transit and shared mobility: Will 'transportation as a service' with nearly ubiquitous, demand-responsive automated and shared trips be enabled by automated transportation?

Active traffic management: Will automated cars deterministically behave such that centralized systems can manage traffic flows? Are traffic jams to be a vestige of the 20th and early 21st centuries?

Long-range regional planning: What about sprawl? Automated vehicles could ease the pain and inconvenience of long commutes, resulting in wide metropolitan areas and in the worst case, even reverse or suburbanize that trend to urbanization.

Traffic control devices: Will these be quaint reminders of the past, or will they become ultra-modern roadside modems that communicate by wireless link to your car's throttle and braking systems?

The prospect of like-minded folks clustered by skill and interest, and with an overall mix of disciplines, applications and technology topics is a necessary microcosm of the larger societal debate that needs to occur. And this debate won't be just about your garaged car: commercial heavy vehicles and city buses will be considered, as will be shared-use vehicles, new forms of transit and maybe even robot bicycles.

In short, the transportation future, with its messy mix and full breadth of problems and possibilities will be considered and debated. The perspectives will likely include strong doses of utopian, dystopian and "heck, I don't know" points of view, engendering lively, informed debate and even-handed consideration. It will be compactly delivered in a span of less than three days. And it will portend automated vehicles for our future. I'm so excited.

"The prospect of like-minded folks clustered by skill and interest, and with an overall mix of disciplines, applications and technology topics is a necessary microcosm of the larger societal debate that needs to occur"

Jim Misener, transportation and technology consultant, USA

Thermal technology: a revolution in ITS

Thermal imaging cameras are becoming more attractive to numerous industries, as a result of improving camera technology and higher volume production. And now the thermal revolution has reached the ITS market. Traffic authorities are quickly discovering the benefits that thermal imaging has to offer for video analysis.

City roads, highways and tunnels have long been equipped with conventional video cameras. However, in order to perform traffic video analysis in a wide range of environments, these cameras need additional algorithms to overcome their vulnerability to low-light conditions, sun glare and shadows that can hide vehicles or pedestrians.

Traffic authorities are discovering that thermal sensors do not have any of these issues. As they create an image based on subtle temperature differences, thermal cameras do not need light to work, are not blinded by direct sunlight, and can provide authorities with uninterrupted 24-hour detection of vehicles, pedestrians and cyclists, regardless of the amount of light available.

Road safety and incident detection

Although the number of cycling traffic casualties remains unreasonably high worldwide, cyclists are often neglected in the design of road traffic systems. A lot of this has to do with the inability of conventional video cameras to detect bicycles or to separate them from other traffic. For example, it is very difficult to detect cyclists close to vehicles. The same is true for cyclists in shadows. Night-time conditions are often challenging for bicycle detection due to poor road illumination.

Thermal imaging cameras are able to solve all these detection problems. The TrafiSense sensor from FLIR Systems, for example, is dedicated to the detection of bicycles at signalized intersections. Relying on the detection of the thermal energy emitted from a cyclist, the TrafiSense sensor can perfectly separate bikes from other vehicles. The sensor then transmits this information to a traffic controller so that signal timing can be adjusted dynamically for vehicles and cyclists – resulting in reduced waiting time and improved traffic flow.

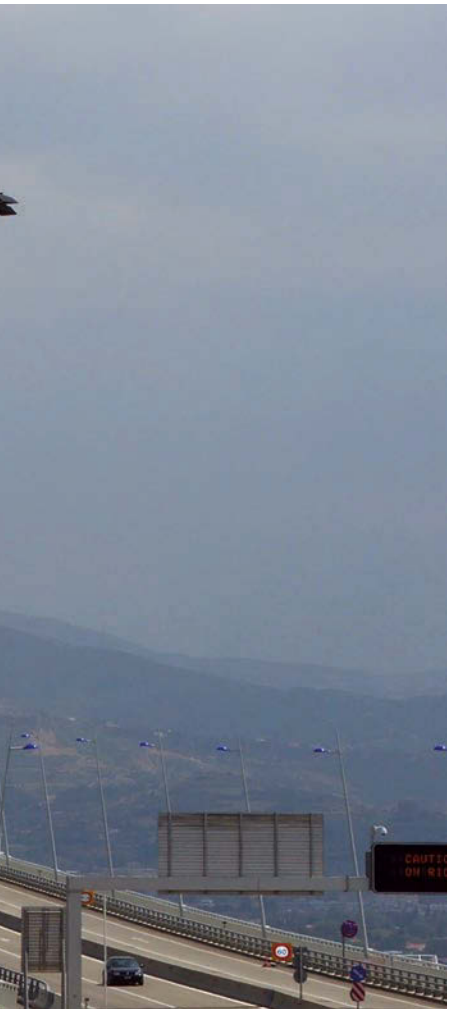
Another area where thermal cameras are gradually taking over the role of conventional video cameras is automatic incident detection (AID) on highways, in tunnels and on bridges.

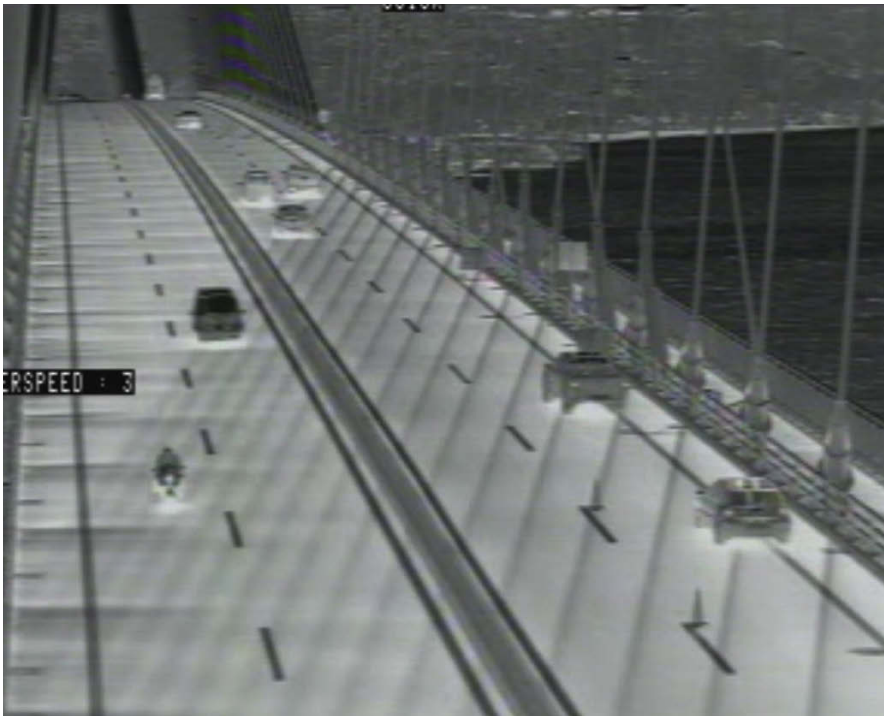
A good example is the Greek Rion-Antirion Bridge, the world's longest cable-stayed

Need to know?

Thermal imaging can improve the quality and reliability of traffic monitoring and detection applications

- As thermal cameras do not need light to produce an image, they can be used for a wide variety of traffic applications and are particularly useful in tunnels and at night
- Bicycle detection and AID are just two examples of traffic applications where thermal imaging is a perfect fit





(Far left) **FLIR's intelligent thermal traffic sensor** (Main and below right) **The Rion-Antirion Bridge uses thermal imaging for AID** (Below left and center) **TrafiSense technology combines thermal detection and analytics to detect moving and stationary vehicles, including bicycles**

bridge, over the Gulf of Corinth in the Ionian Sea. To ensure safety on the bridge and make quick interventions possible if an accident happens, the bridge was equipped with conventional video cameras with AID analytics in 2006.

However, due to bad weather conditions during the winter and the structure of the suspension bridge, a lot of false detections were being generated. During sunset and sunrise, the poles cast shadows on the road deck, creating a specific situation that was very hard to handle with visible light cameras.

While attempts to improve and fine-tune the video detection algorithms yielded good results, another approach turned out to be more effective. In late 2012, the Rion-Antirion Bridge authorities decided to experiment with thermal imaging cameras. The new AID system, including thermal imaging cameras, substantially improved the detection performance. Shadows cast by the bridge structure were no longer a problem and the system has already proved to be reliable in various tough weather conditions.

The thermal advantage

Thermal imaging cameras are gradually taking over the functions of conventional CCTV cameras, giving better performance and adding functionality that is impossible for video cameras. Bicycle detection and AID are only two examples of traffic applications where thermal imaging cameras are a perfect fit. As prices drop and thermal cameras become more attractive for traffic authorities, there are numerous possibilities ahead.

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AVI solutions for access control and truck tolling

Truck tolling is of growing interest for recycling sites, bridge owners and toll-road operators, who can all derive revenue from levies on commercial vehicles. Systems to collect entry fees need to be efficient so as not to impede commercial activity and also auditable to ensure that system integrity is maintained. Electronic tolling systems using active or passive transponders provide high-efficiency access control, while complementary ITS technologies enable special requirements to be met.

International Road Dynamics (IRD) has supplied systems for weighstation preclearance and toll collection for many years, and recent projects have enabled the company to leverage this expertise to provide systems for fee collection.

Intelligent solutions

Haya Water's waste water treatment facility in Oman charges tanker trucks a fee for entry. This is a high-volume facility and manual collection of fees was creating long lines of vehicles at the gate. With a large number of returning vehicles, it needed a fast, automated system that would optimize operations at the plant entrance.

The site integrator selected IRD iToll software and lane hardware as the solution: passive RFID is used for electronic fee collection for vehicles entering the facility.

All waste water vehicles are equipped with RFID tags, which allow entry only to registered vehicles that have a valid account and sufficient funds. The RFID tags are tamper-proof and attached to the windshield.

Meanwhile, at the Deh Cho Bridge, near Fort Providence in Northwest Territories, Canada, tolls are charged only to commercial vehicles weighing more than 4,500kg that are traveling northbound.

The local government recently signed an agreement with the Province of Alberta to be part of its Partners in Compliance (PIC) program – an electronic screening program using AVI technologies in 25 weighstations at 16 locations across the province.

At the site, transponders are read by automatic vehicle identification (AVI) readers on an overhead gantry. Cameras and weigh-in-motion (WIM) sensors are also in place.

Those without a transponder can purchase single-use permits and an additional service charge is levied. Cameras record license plates for payment verification.

IRD has also supplied toll collection and access control systems along the Tavan Tolgoi-Gashuun Sukhait toll road in Mongolia. The road is a crucial route being used to enhance mining development and expansion in the Gobi region.

The system uses passive RFID tags to collect tolls from the 1,000 heavy trucks that use the road every day to transport coal from Tavan Tolgoi to the Gashuun Sukhait border point.

AVI in toll systems includes auditing against authorized user lists. License plate readings may not provide enough accuracy on their own, but camera systems can be a valuable addition to a truck tolling system.

Photo: NWT DOT

(Above main) **Deh Cho Bridge gantry** (Above) **RFID reader and camera; AVI reader, lane signals and VMS** (Left) **Mongolia toll plaza** (Bottom) **Queuing at the waste water site**

Need to know

Combined expertise can provide a highly effective tolling solution for large vehicles

- The Deh Cho bridge toll system makes use of 915MHz active transponder technology that is commonly used in North American CVO preclearance systems for interoperability, while the systems in Oman and Mongolia use passive 18000-6C RFID tags
- Vehicle operators in the PIC Program can enroll to use their existing AVI transponders for identification to remit tolls at the Deh Cho Bridge

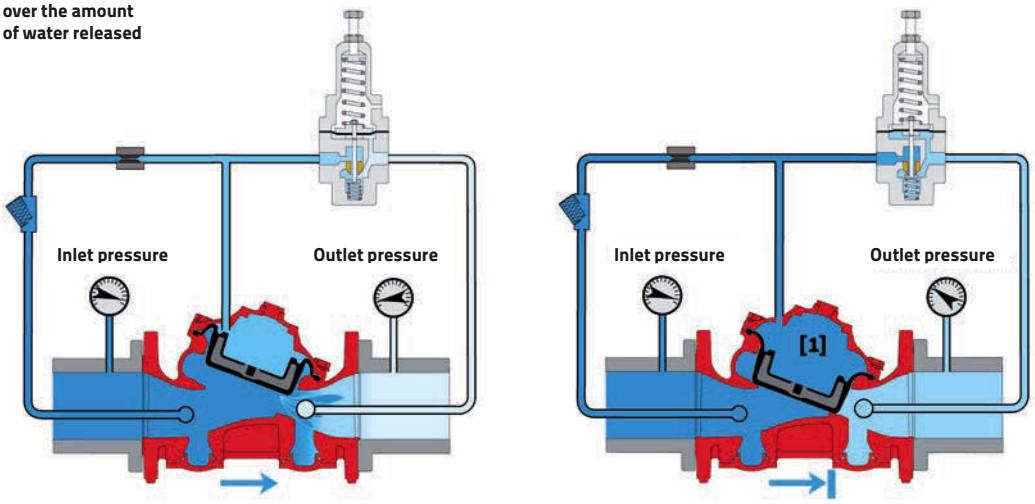
Advanced protection for high-risk tunnels

Tunnel disasters in recent years have made road authorities realize that an effective fire protection system is essential in this high-risk environment. To ensure the safety of tunnel users, modern, sophisticated fire equipment must be incorporated.

Many modern tunnels need to be designed to have high water pressure in order to accommodate fire extinguishing systems. Furthermore, a tunnel that contains chemicals, oil or gas is considered a high-risk zone, and must have automated fire systems in place.

Bermad has engineered a valve that is designed to meet the safety requirements of modern tunnels. The solution has several advanced features, including: a diaphragm with three types of elastomers, an indication with no mechanical moving parts, extremely high flow rates, and a drainage system that makes it possible to operate the deluge valve in freezing conditions.

A pressure control valve offers optimum control over the amount of water released



Valve open (flowing condition)

Valve closed (static condition)

The Bermad deluge valve, which has been designed to meet all European and US standards, is engineered to be corrosion-free. It also provides excellent pressure control, and remote control without risk of power failure. The valve operates in a pressure range of 0.5 bar to 25 bar and has a pressure loss of less than 0.5 bar in operating flow.

Safety features

The new Liefkenshoek Tunnel in Belgium is typical of a high-risk tunnel. As a result, it was decided that high-expansion foam generators that use foam concentrates should be included in its design.

Bermad was chosen to supply a complete foam system for the tunnel, including elastomeric deluge and concentrate valves, the foam proportioner, and the control panel for each system. The company designed a system that incorporates equipment every 165ft, totaling 290 units along the twin three-mile tunnels.

The deluge and concentrate valve package includes: an epoxy-coated elastomeric deluge valve body, a 'Y' pattern opposite flow concentrate valve, a position indicator with open and close limit switches, and a pulse solenoid valve with last-position operation. The system is in a fire-resistant cabinet that is engineered to last 120 minutes in a fire.

(Above) **A water and foam system situated inside a fire-resistant cabinet**

Need to know

An innovative foam system provides effective fire safety in a Belgisch tunnel

- A modern fire protection system must provide an accurate, reliable valve positioning indication
- It must be possible to control the pressure/ amount of water released
- The pressure range should be 0.5-25 bar
- The system should be able to work with various water sources (seawater, brackish and unclean water, or foam concentrate)
- The valve should enable a high capacity flow

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

A Twenty years represents four or five generations of technological development. There have been many innovations during this period of time. Rather than a single factor, I'd offer a two-part response: developments specific to traffic and transportation; and external developments (enabling technologies) that have influenced the traffic sector. The development that has had the greatest influence within the traffic sector has been the explosive growth of in-vehicle telematics. The introduction of navigation systems, adaptive cruise control and back-up cameras have influenced both the safety and performance of the system. The enabling technologies that have had the greatest influence on the traffic sector have been the rapid advances of the IT field (computers and telecommunications), which have enabled the development of the telematics, as well as many improvements in traffic management, including more reliable equipment and functionality that has not previously been possible.

Philip Tarnoff
Director of the Maryland Center for Advanced Transportation Technology

A Even though they are still in their nascent stage, I have to go with self-driving vehicles. If successfully deployed, they will radically change many other elements of ITS – from traffic management to smart parking. Will real-time traffic information be as important if vehicles automatically divert from congested routes? How does traffic management change when autonomous vehicles predominate? There will even be a major impact on public transport as self-driving vehicles are deployed in large numbers. It has the potential to make Vision Zero initiatives achievable and could radically redefine cities and suburbs.

Bernie Wagenblast,
Editor, Transportation Communications Newsletter, USA

A The biggest single factor that has had the greatest impact has been the ability to collect and analyze vast amounts of data. Faced with the constant pressure of traffic growth and the inability to keep pace with the provision road space, managing traffic has become increasingly difficult. Detection, communication and storage technologies have all improved exponentially, while costs have plummeted. Advances in data analysis, combining adaptations from computer science, mathematics and statistics means managing traffic using real-time data has yielded considerable benefits. And further advances can be expected.

Phil Charles
University of Queensland, Australia

A The innovation that has had the greatest impact is the inexpensive RFID transponder. It has brought about a revolution in tolling, enabling the progression from: increasing throughput at existing toll plaza lanes; to enabling introduction of high-speed 'open road tolling' bypasses of toll plazas; and now to the transition to 21st century all-electronic tolling, in which toll booths and toll plazas are being removed altogether. These changes make tolling more customer-friendly, and eliminate the safety and pollution impacts of toll plazas. Moreover, the RFID transponder has made possible the introduction and acceptance of HOT lanes and Express Toll Lanes, which have successfully employed congestion pricing on the expressway systems of a large number of US metro areas. A growing number of those metro areas have adopted plans for creating entire networks of Express Toll Lanes, which in my view will eventually pave the way for using peak/off-peak pricing on the remaining general-purpose lanes.

Robert Poole
Director of transportation policy, Reason Foundation, USA

A For me, the most influential factor was the introduction of EuroNCAP crash testing program in 1997. This vehicle rating system owes much to the determination of the UK Department for Transport (DfT) as well as the Federation Internationale de l'Automobile (FIA), Transport Research London (TRL) and bodies such as the AA, who helped to promote it. These groups stuck together – despite heavy lobbying against NCAP from the motor industry – to ensure it went ahead. Eventually the EC and other countries came in to add their support. Now the concept of NCAP has spread around the world and thousands of lives have been saved as a result.

Edmund King
President of the AA, UK

A As the need to make quick, effective decisions based on the exact situation on our roads becomes even more important, the value of video-wall technology cannot be understated. It greatly impacts how incidents are dealt with. The technology provides real-time information on incidents, enabling quicker corrective actions. Multiple display angles, task sharing and intelligent display solutions with control features all lead to short response times and fast troubleshooting in emergencies. Large-screen systems are used to collect, visualize and distribute information to guarantee a comprehensive survey of the complete situation.

Steve Murphy
Managing director of Eyevis UK

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