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February/March 2012

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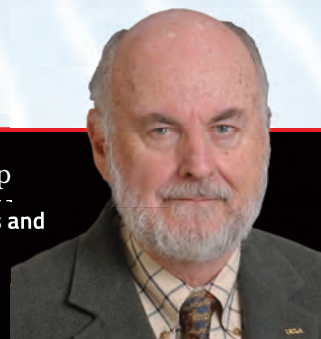
UCLA's Donald Shoup
"We've got free parking for cars and expensive housing for people – our priorities are all wrong!"



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Cover story

66 Motion picture

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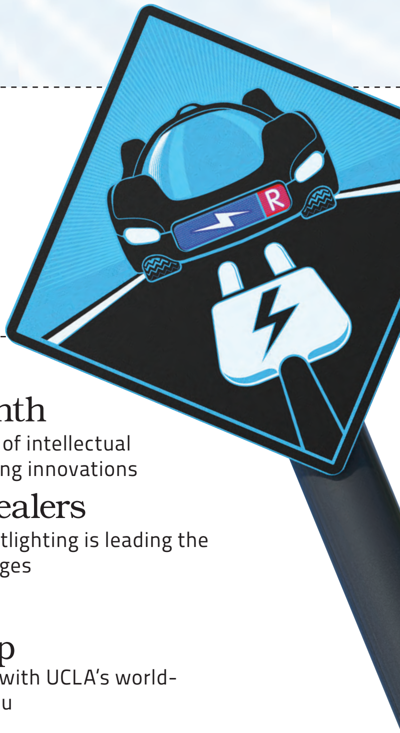
Investigating the electrification of road networks and the potential impact on (and contribution of) ITS



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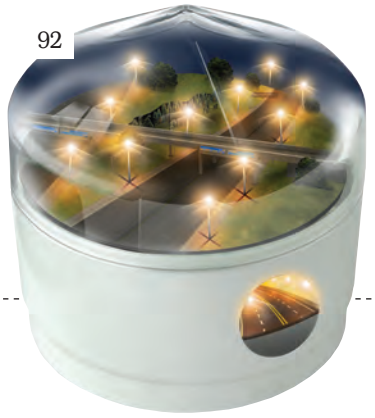
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Foreword

There are only a few TV shows I watch habitually – mainly because my wife watches them habitually so I have little choice. In no particular order they include: *Masterchef*; *Desperate Housewives*; anything that might result in the nervous breakdown of a celebrity; anything with Alex Polizzi (*The Hotel Inspector*); and lately anything with Mary Portas (*Mary Queen of Shops*).

Portas, a retail and brand communications expert, hit the news last December after unveiling her report commissioned by Prime Minister David Cameron into how to revive the flagging fortunes of the British High Street, which she insists will "disappear forever" unless swift action is taken.

Interviewed by BBC Radio 5 Live on the morning of the document's release, among her recommendations was a range of planning policy incentives that included free parking in town centers. As she convincingly put forward her ideas, there was one person I wish had been alongside me to phone in. Sadly, Donald Shoup, UCLA's Professor of Urban Planning, lives in California and was most likely tucked up in bed at the time. No hope of connecting the two, I did the next-best thing and scheduled an interview with him to see what he made of it all (*p*55).

In his seminal book, *The High Cost of Free Parking*, Shoup's theory is that parking is sorely misunderstood and mismanaged, so he's proposed new ways for cities to regulate it so people stop paying for free parking's "hidden costs". In response to Portas's suggestion that the lack of free parking is crippling local business, Shoup cites the ongoing SF*park* trial in San Francisco, for which he can take great credit.

"The City will charge the lowest price it possibly can and still leave one or two open spaces on every block," he says. "I'd say that's definitely better for stores than to have free parking but no availability, and leave consumers thinking there's such a dire parking shortage that they don't even come." Shoup also wonders if that 'free' space would simply be consumed by shop employees and shop owners in any case. "Parking is free – but not available when and where you want it!"

I have huge respect for both Portas and Shoup for completely different reasons, although I doubt you'll find the UCLA man advising Harvey Nichols about their window displays any time soon. What's clear is that the parking conundrum continues to provide food for thought. Which reminds me: *Masterchef* is about to start…

Nick Bradley,
Editor, Traffic Technology International

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

Traffic Technology International USPS 012-893 is published bi-monthly – in February, April, March, June, August, and October by UKIP Media & Events Ltd, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK. Annual subscription price is US$131.00. 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, 2010 was 17,423

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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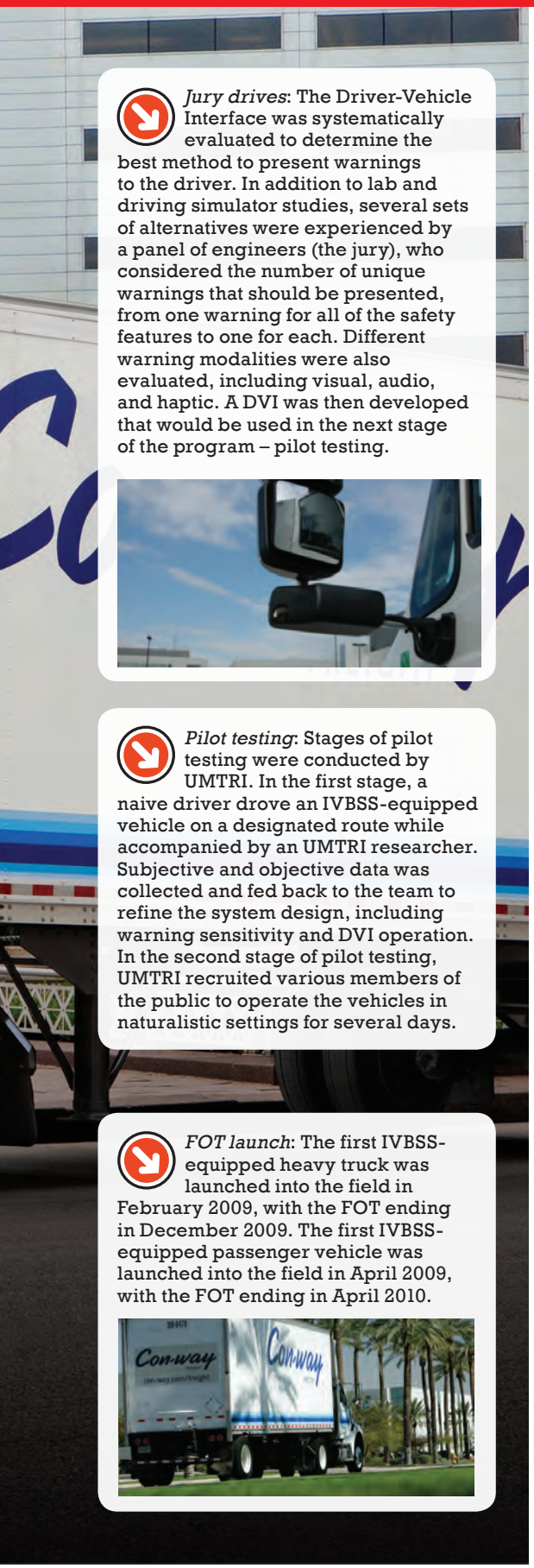
Objective testing: UMTRI, Visteon Corporation, the USDOT, National Institute for Standards and Technology and Volpe National Transportation System Center (NIST) worked collaboratively to develop and execute the objective test procedures. These were derived from evaluating crash statistics. Specifically the scenarios that most commonly cause the crashes that are targeted by the integrated safety systems were mimicked at the Transportation Research Center test track in Ohio. The test vehicles were equipped with a sophisticated data collection system designed by NIST, which included video, GPS, and a ranging system. For each test, the data collected was analyzed to determine whether or not the integrated system warned the driver as designed.

Driving tests

Shan Bao and **Jim Sayer** from the University of Michigan's Transport Research Institute offers some final thoughts on the Integrated Vehicle-Based Safety System research project, a huge team effort that has produced some intriguing results about how drivers react and perceive certain safety systems

Photographs courtesy of Con-way & UMTRI



Jury drives: The Driver-Vehicle Interface was systematically evaluated to determine the best method to present warnings to the driver. In addition to lab and driving simulator studies, several sets of alternatives were experienced by a panel of engineers (the jury), who considered the number of unique warnings that should be presented, from one warning for all of the safety features to one for each. Different warning modalities were also evaluated, including visual, audio, and haptic. A DVI was then developed that would be used in the next stage of the program – pilot testing.

Pilot testing: Stages of pilot testing were conducted by UMTRI. In the first stage, a naive driver drove an IVBSS-equipped vehicle on a designated route while accompanied by an UMTRI researcher. Subjective and objective data was collected and fed back to the team to refine the system design, including warning sensitivity and DVI operation. In the second stage of pilot testing, UMTRI recruited various members of the public to operate the vehicles in naturalistic settings for several days.

FOT launch: The first IVBSS-equipped heavy truck was launched into the field in February 2009, with the FOT ending in December 2009. The first IVBSS-equipped passenger vehicle was launched into the field in April 2009, with the FOT ending in April 2010.

Following five years of intense effort and more than a million kilometers of data, the final report on the Integrated Vehicle-Based Safety Systems (IVBSS) program was released by the USDOT in December 2011.

The IVBSS field operational test (FOT) program was a cooperative agreement between the USDOT and a team led by the University of Michigan Transportation Research Institute (UMTRI) – the goal being to develop a prototype integrated, vehicle-based, crash-warning system for both light vehicles (passenger cars) and heavy trucks (Class 8 commercial trucks).

A vital aim was to assess the safety benefits and driver acceptance of these systems through field operational testing (i.e. naturalistic). The scope of system integration included sharing sensor data across multiple subsystems, and arbitration of warnings based upon threat severity to provide drivers with only the information most critical to avoid crashes. The integrated crash-warning system used data gathered by inertial, video, and radar sensors, plus a GPS module and digital map. Crash-reduction benefits specific to an integrated system were achieved through a coordinated exchange of sensor data to determine the existence of crash threats. A major objective was to make improvements in threat assessment and warning accuracy through systems integration, when compared with non-integrated systems.

IVBSS subsystems

The integrated systems were designed to address the most common types of police-reported crashes. The integrated safety system for light vehicles incorporated four functions, including forward-crash warning (FCW), lateral-drift warning (LDW), lane-change/merge warning (LCM), and curve-speed warning (CSW). FCW warns drivers of the potential for a rear-end crash with another vehicle, while LDW warns drivers that they may be drifting inadvertently from their lane or departing the roadway. LCM warns drivers of possible unsafe lateral maneuvers based on the presence of adjacent vehicles, or vehicles approaching in adjacent lanes, and included a full-time side-object-presence indicator. Finally, CSW warns drivers when they are traveling at a rate of speed too high to safely negotiate an upcoming curve. The integrated heavy truck safety system included FCW, LDW and LCM.

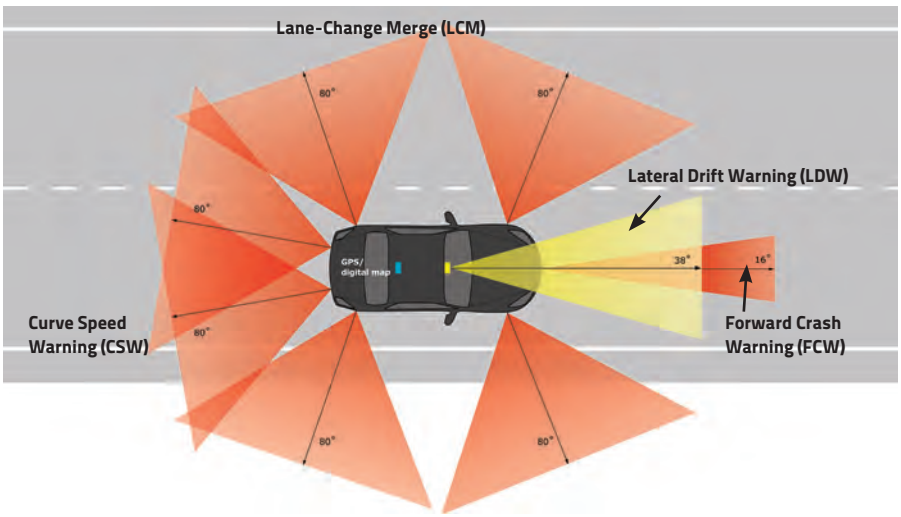
IVBSS team

UMTRI as the lead organization was responsible for managing the program, coordinating the development of the integrated crash-warning system on both light-vehicle and the heavy-truck platforms, developing data-acquisition systems, conducting the FOTs, and conducting analyses of the data. Visteon Corporation, with support from Takata Corporation, served as the lead

The IVBSS platform combines radar, image processing and GPS technology

> No evidence was found that the integrated system introduced more secondary tasks or that drivers became overly reliant on the system

In the Netherlands, the 'Smart In Car' project will improve traffic safety through technology that can read the CANbus signals of more than 90% of existing cars



(Above) **UMTRI analyzed all the data collected, including information on IVBSS system, driver and vehicle performance, as well as vehicle location and driving environment**
(Above left) **Sensor coverage on the light vehicle fleet**

> Results of the data analysis show that drivers generally accepted the integrated safety system and believed the integrated system increased their driving safety

Vehicle
crashes in the USA account for more than 32,000 deaths each year and are the leading cause of death of Americans between the ages of 4 and 35

system developer and system integrator of the light-vehicle platform, while Honda R&D Americas provided engineering assistance. Eaton Corporation – with support from Takata Corporation – served as the lead system developer and system integrator on the heavy-truck platform, with Navistar providing engineering assistance. Con-way Freight served as the heavy-truck fleet for conducting the field test. UMTRI, meanwhile, supported Visteon in the development of the driver-vehicle interface for the light-vehicle fleet, while Battelle supported Eaton in the development of the driver-vehicle interface and warning arbitration for the heavy-truck fleet.

Federal partners included NHTSA, the Federal Motor Carrier Safety Administration (FMCSA), the Research and Innovative Technology Administration (RITA), the National Institute for Standards and Technology, and the Volpe National Transportation System Center.

IVBSS key findings: light vehicle fleet

There were five video channels and approximately 600 channels of numerical driving data, collected at 10Hz, recorded during the light-vehicle FOT. A total of 108 drivers participated in the study, driving one of the 16 2006/2007 Honda Accords that were used as research vehicles. Each participant used the vehicle as their personal mode for six weeks. During the first two weeks of each driver's exposure, the DVI of the integrated system was suppressed (but the integrated warning system ran in the background) – a 'baseline' period. For the subsequent four weeks, the DVI was enabled and warnings were presented to the drivers – a 'treatment' period. The data set collected represented 213,309 miles, 22,657 trips and 6,164 hours of driving. In all, there was a total of 12,202 warnings issued during the treatment period, of which 77% were the result of lateral drifting toward an unoccupied lane, 5% were attributed to a forward hazard, 5% were due to driving too fast for a given curve, and 13% were due to lane changing/drifting toward an occupied lane.

Results showed that drivers generally accepted the integrated system and believed that it increased their driving safety. Almost 75% of the drivers said that they would like to have an integrated warning system in their personal vehicles, and reported that the blind-spot detection was the most useful and satisfying component. Drivers rated the FCW the lowest in terms of usefulness and satisfaction, though, largely as a result of the relatively high rate of nuisance warnings elicited by stopped objects. Furthermore, drivers didn't like the FCW brake pulse used to direct the drivers' attention to the forward scene. Older drivers rated the integrated system more favorably, and were more forgiving regarding the nuisance warnings than either middle-aged or younger drivers.

Significant, positive effects were observed in improving driver behavior, such as fewer lane departures and increased turn signal use. In addition, no evidence was found that the drivers engaged in more secondary tasks while driving with integrated system as compared to without

2006/2007 Honda Accords were used among the light-vehicle field operational tests

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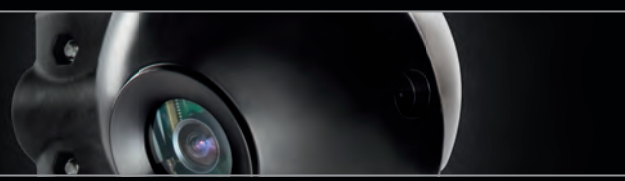

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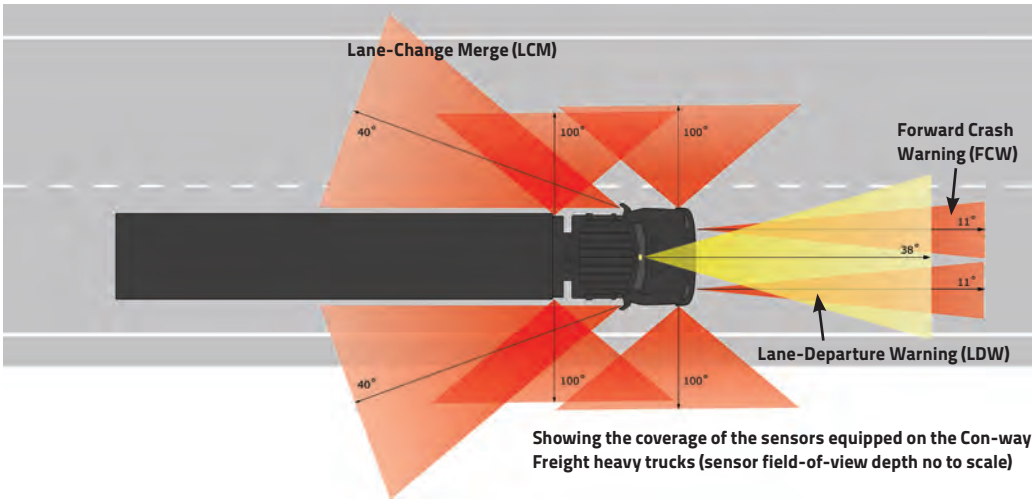
Next steps

Having successfully concluded the IVBSS project, UMTRI was the number one contender to secure the US$14.9 million contract from the USDOT to conduct a safety pilot model deployment of Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) safety applications in Ann Arbor, Michigan. "This is a tremendous opportunity, and we are very excited to be able to support the USDOT's demonstration of cutting-edge transportation technologies in our community," says program manager Jim Sayer, an associate research scientist at UMTRI.

The 30-month program will establish a real-world, multimodal test site in Ann Arbor for enabling wireless communications among vehicles and roadside equipment for use in generating data to enable safety applications. Passenger cars, commercial trucks, and transit buses will be included that are equipped with a mix of integrated, retrofit, and aftermarket V2V and V2I-based safety systems, a technology that could prevent thousands of crashes.

The data generated and archived as part of the Model Deployment will be used for estimating safety benefits in support of future policy decisions by the USDOT, as well as for use by the broader transportation industry in developing additional safety, mobility, and environmental applications utilizing wireless technologies. The testing phase will last 12 months, and include approximately 2,850 vehicles.



Showing the coverage of the sensors equipped on the Con-way Freight heavy trucks (sensor field-of-view depth no to scale)

the system. Drivers additionally reported that they did not become overly reliant on the system. Also, despite the development and implementation of a warning arbitration system, the results showed that multiple threat warning sequences were very rare cases, and in multiple warning scenarios the initial warning was generally enough to get their attention.

IVBSS key findings: heavy-truck fleet

There were five video channels and approximately 500 channels of numerical driving data, collected at 10Hz recorded during the heavy-truck FOT. A total of 18 drivers were recruited from Con-way Freight, and 10 instrumented trucks were used as research vehicles. Each vehicle was equipped with eight radars. The test period for each participant was roughly 10 months of conducting normal Con-way Freight business. During the first two months, the integrated system was suppressed (but running in the background), also known as the baseline period. For the remaining eight months, the integrated system was enabled (the treatment period). The data set collected represented 602,000 miles, 23,000 trips and 14,000 hours of driving. A total of 85,933 warnings were issued during the eight-month treatment period, of which 72% were due to lateral drifting toward unoccupied space, 18% were due to forward hazards, and about 10% were due to lane changing/drifting toward an occupied space.

Lane-departure warning technology was combined with Eaton's radar-based technology in a fusion of data management and decision-making algorithms

Similar to the light-vehicle results, drivers generally accepted the integrated safety system, also believing it to increase their driving safety. They, too, reported that the integrated system made them more aware of the traffic environment and their position in the lane. Of the systems used, LDW was reported as the most beneficial function to truck drivers. The invalid warning rates for LCMs and FCWs (1.6 per 100 miles and 1.8 per 100 miles, respectively) led some to describe the warnings as 'distracting' or 'annoying'. In spite of this, though, 15 of the 18 drivers preferred driving a truck equipped with the integrated warning system as compared with a conventional truck and would recommend the purchase of an integrated warning system to increase safety. As with the light vehicle tests, significant positive effects were observed in driver behavior and safety, such as driving closer to the lane center and keeping longer following distances under complicated driving conditions. Drivers specifically mentioned valid FCW warnings and a headway-time margin display to be useful. In addition, there was no evidence to show that the integrated system induced more secondary tasks on the part of drivers.

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Technology roadmap

On a visit to the Dutch satnav giant **TomTom**, **Louise Smyth** discovers that a multitude of new business plans are being rolled out that look set to totally re-define the firm's role within the international marketplace

For a company that's famous for selling satnavs, it was surprising to hear that only 50% of TomTom's business comes from, well, selling satnavs. But that was just the first of many remarkable facts about the company that were divulged during a recent press visit to its Amsterdam headquarters.

So, how has the firm gone from 95% of revenues coming from satnav sales to just 50% today? A great deal of forward-thinking is the short answer. But a big clue can also be found in something called 'TomTom's Traffic Manifesto' (see sidebar on the right). The manifesto shows the ethos behind TomTom's current move from satnav supplier to ITS solutions provider – and much of it depends on floating car data (FCD).

Carlo van de Weijer, senior manager intelligent transport systems, TomTom Licensing Business Unit, explains the inspiration behind the manifesto: "When we introduced our HD Traffic system into the first countries in Europe, our experience was that road users had become numb to traffic. In their perception (and that of some road authorities), nothing could be done to solve traffic jams apart from building new roads.

"As TomTom was the first to give the complete picture of the traffic situation and had the technology to find the smartest route, we were convinced we could make a difference but we had to create a paradigm shift in people's minds," van de Weijer explains. "That is where the manifesto came in. We wanted to show the world we were serious and determined to make a major change but that we could not do it alone, we needed everyone's help: consumers, universities, governments and everyone else associated with mobility."

Reliable sources

HD Traffic is an innovative system that fuses data from a number of freely available sources to create an accurate picture of what's happening on the road network and offer users real-time route guidance. Sources include government

The manifesto explained

TomTom says it is on a mission to reduce traffic congestion for all. The company already claims to reduce the journey times for individual TomTom drivers by up to 15%. In the future – when 10% of drivers use TomTom's HD Traffic navigation system – there will be a 'collective effect', and the Dutch giant aims to reduce journey times for everyone by up to 5% where there is traffic.

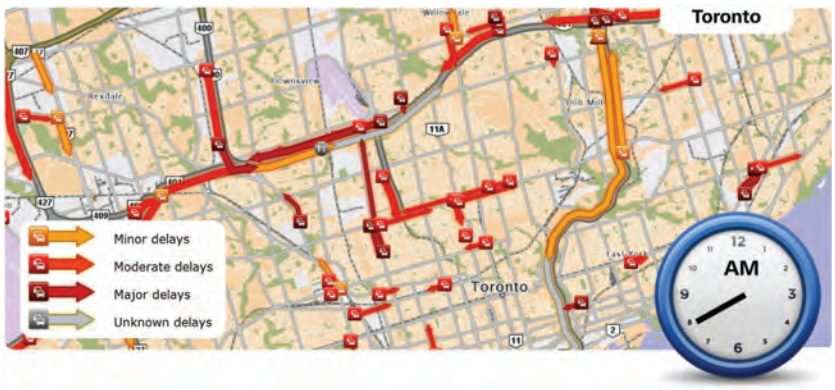
"We will reduce traffic congestion for all by making the best possible use of the existing road network," the company states. "Our Traffic Manifesto sets out the four key action areas. First, we will encourage and inspire people to play a role in reducing congestion. Second, we will increase the availability of TomTom HD Traffic. Third, we will lead the continuous improvement of traffic and route guidance technology. And finally, we will bring together key traffic stakeholders to share ideas and drive key actions forward."

TomTom's commitment to reducing traffic congestion appears genuine. "We are in this for the long term. We are also committed to tracking and communicating progress against our four manifesto action areas in an open, transparent and timely way."

Research by insurance company *Confused.com* reveals satnav systems caused £203 million (US$320 million) worth of vehicle damage in the UK last year

Expanded horizons

TomTom's expansion into a broader sector is certainly critical to moving beyond consumer products and into other areas, and there have been several recent cooperations with bodies outside of the consumer sector, designed to get other players on board with TomTom's concept. "Governments now see that Floating Car Data is not something that can benefit them in 20 years from now, but is here today," says Carlo van de Weijer. "Not only does it give them a much broader look at their road network but in times of economic stress it also gives them an accurate and cost-effective alternative for expensive roadside equipment. That awareness has led to several governments in Europe and the USA using our data for policy making, evaluation studies or traffic management."



FCD creates an accurate, real-time picture of traffic conditions, in this case in Toronto, Ontario

traffic data, some historic data, data from fleet management systems, some cellular data (accrued by monitoring the movement of cell phones) and of course data gathered from TomTom satnav units. The advantages of all these sources being combined to provide accurate, real-time information are obvious.

The manifesto was launched more than a year ago and van de Weijer reports a positive response to it: "The most important change so far is simply awareness," he confirms. "Road users better understand our products and the difference between them and conventional navigation and traffic information. Closely integrated real-time traffic information on every road within a reinvented routing algorithm advising you on the smartest route is different to simply showing where an incident is on the map for highways only. Universities and knowledge centers around the world are working closely with us to research how time-dependent routing can lead to more efficient mobility."

Popular appeal

HD Traffic is already used by a million people across Europe and is present in 23 countries around the world (new additions include Australia and Poland), but TomTom is aiming to get up to its desired 10% penetration figure sooner rather than later, hence coming up with other ways to get the system out there: "You will now find our information within in-dash navigation from OEMs such as Renault and Mazda," reveals van de Weijer. "It is integrated in mobile applications such as our iPhone app, it is integrated in our special truck-specific navigation to help the logistics industry, it is available on the web as a free service in our route planner and traffic viewer and it's shown on displays in petrol stations throughout Europe."

This certainly explains where the non-consumer revenues are coming from. As well as deals with OEMs, fleet operators and business customers, TomTom also sells some data from the 60 million GPS-connected TomTom devices around the world to other service providers

Toyota now provides the TPEG digital traffic information service in the UK, offering more detailed information and greater location accuracy than analog RDS-TMC

> "Governments now see that Floating Car Data is not something that can benefit them in 20 years from now, but is here today

Selling on this data has not been without some controversy, however. It's a familiar issue within the traffic sector: the ethics associated with using customers as probe vehicles without their explicit approval. Could the paranoia over being 'tracked' prove to be a hurdle in TomTom's traffic-busting strategy? Van de Weijer is adamant that it won't. "The (independent) Dutch Data Protection Authority investigated our use of location data in 2011. They published their report in early 2012. They found no issues with the way we use location data from our customers and the information we derive from that to include in our maps and other map and traffic-related products. They concluded we fully operate within the law.

"The major reason for arriving at this judgment has been that we apply strict technical and procedural measures with respect to the way we use location data. We have been doing this since 2006, when we started collecting location data. The location data, once obtained from the users' devices, is used in an anonymous way and this is confirmed in the report by the Dutch Data Protection Authority."

Greater transparency

"The Dutch DPA also found that we need to be clearer in informing our users when asking for permission to use their data," he adds. "To this end we have launched a new website, tomtom.com/yourdata (including an explanatory video), and we will have more information on the navigation devices themselves."

One clear advantage of this floating car data is that, by its nature, it covers all roads that people are driving on – so, not only those equipped with loops, CCTV or other traffic data collection systems. Therefore the potential impact on traffic management (in terms of reducing congestion) is huge. TomTom is poised to become a huge player in the ITS market – hence it being so keen to get everyone from governments to customers and fleet managers on-side. As with its manifesto, TomTom's aim sounds altruistic: 'Traffic management via a self regulated system of well informed individuals'. But this philanthropy could also turn out to be a commercial goldmine.

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Active measures

The relationship between road marking quality and the effectiveness of ADAS has gone largely unnoticed and under-researched. But **Timothy Compston** finds steps are now being taken to encourage best practice in such a safety-critical area

Images courtesy of BMW, Ford, RSMA & Volvo

There's a growing recognition of the need to consider the bigger picture when it comes to road safety, and specifically the interaction between the roads infrastructure – in particular road markings and signs – and the vehicles that use them. A major step forward came in June 2011 with the coming together of the two leading European road and car safety organizations, EuroRAP and Euro NCAP. This link-up was specifically to launch the landmark *Roads That Cars Can Read* consultation paper, with a call to the motor industry and highways sector to work together to ensure that technologies now available in new vehicles are able to achieve their potential to save thousands of lives.

The reality according to the report, though, is that the performance of cameras and sensors deployed in vehicles when reading the road ahead and assisting drivers in reacting to potential dangers is being curtailed by faded road markings and obscured signs. Reference is made to a survey of six European countries that underlines the significant variation in marking and signing practice. To move forward, the report recommends that the road and motor industries should collaborate more, assisting drivers with two key technologies – lane support and speed alert. In addition, it was proposed that when it comes to the quality and consistency of roadsigns and markings that the initial joint focus should be on the 10% of Europe's roads that account for the majority of journeys and deaths.

For John Dawson, chairman of the European Road Assessment Programme (EuroRAP), it became apparent with the UN Decade of Action for Road Safety 2011-2020 that something needed to be done to tackle the issue of the quality of roadsigns and markings, and the technology angle – with some manufacturers having problems – simply reinforced the need for attention. Dawson sees the next stage as actually quantifying the problem: "Until we can specify something and make measurements, it is impossible to gauge the extent of the performance gap. We are now working closely with Euro NCAP and the motor

Lane support systems currently work best on well marked highways. However, the serious crash rate on busy roads that are not highways is on average five times higher

Ford's focus

Ford's safety strategy is to expand the footprint of ADAS to lower-segment vehicles, in very large volumes, according to Pim van der Jagt. "An example of this is the Ford Focus, which in its class leads the way with the amount of active safety on offer, such as Active City Stop for fully autonomous emergency braking," says the managing director of Ford's Research Centre in Aachen, Germany. "You have to move up to the Mercedes E-Class or the BMW 7 Series to find vehicles with a similar content of active safety technologies.

"In terms of lane-keeping systems, if markings are of poor quality or completely missing, the reality is other systems may not work," van der Jagt warns. "Generally in Europe we are pretty happy with the standard of markings out there at the moment – other regions cause us much more concern and the same would go for roadside signs."

Considering Ford's lane-related technology in practice, when a vehicle is being driven the system status is directly communicated via the in-car display. Green side lines, for example, show it is active and has found the two required lane markings. Should one be missing, the appropriate line will disappear. In this case the system is designed to still work in concert with directional information. Should the camera be unable to capture both markings it no longer functions and this is immediately brought to the driver's attention.

Ford's Lane Keeping System debuted on the mid-sized Ford Fusion

industry to define what the tolerances should be for two sets of signs and markings. No-one has ever measured the quality of lines and markings to any kind of consistent, coherent, standard."

Dawson feels that the focus, as outlined in the joint consultation paper, should initially be on rural roads: "Two-thirds of deaths are outside the cities and over half are concentrated on 10% of the road network," he says. "We already know where these roads are as a result of our European Safety Atlas, which has mapped crash rates and accident analysis. The reality is that huge sums have been spent developing technology that is revolutionizing the safety of our vehicles but little attention has been given to the quality of basic signing and markings that drivers have to cope with."

Seeing the bigger picture

Euro NCAP's secretary general Michiel van Ratingen is enthusiastic about the benefits that will come from the joint initiative with EuroRAP: "This move certainly makes sense," he states. "Surprisingly, although both of our organizations have been in existence for more than 10 years, it was really only recently – two years ago – under the Decade of Action that we started to meet more regularly.

"EuroRAP was looking to measure the risk on certain roads and going beyond that to see whether there was a roadsign or marking," van Ratingen continues. "For our part, we were coming at things from a different perspective. We had started a process called Euro NCAP Advanced, for which we decided that we would look into these new advanced driver systems – not necessarily to start to rate them, because we were not sure how that would work in practice, but more to sit down with the manufacturer and to see how they developed the system in the first place."

Manufacturers had to supply a dossier and develop some statistical analysis as to how the systems would help in reducing severe and minor injuries. When Euro NCAP discussed with them the systems that use cameras to read speed signs, for example, it became clear that manufacturers were developing them more or less with the infrastructure as a given.

This assumption, van Ratingen says, was challenged by the fact that things are different wherever you go in Europe: "The road network has not been designed with these type of technologies in mind so their efficiency can vary," he explains. "Everything could be fine in Germany, where things are quite highly developed, but when the driver travels elsewhere they may find that the effectiveness of the system drops down to 10 or 20% as the right infrastructure simply isn't available."

Problems that van Ratingen cites for camera-based systems not identifying markings include the use of colors (especially if they are temporary), older markings still being visible under new markings, white on concrete, and night-time issues such as glaring, and when changing lanes where the markings are not well enough laid out for the camera to recognize.

> "Huge sums have been spent developing safety technologies … but little attention has been given to the quality of signing and markings"
>
> **John Dawson, chairman, EuroRAP, UK**

The reality, stresses van Ratingen, is that for these kind of systems it is imperative to look beyond the vehicle itself: "This is where the cooperation with EuroRAP will undoubtedly make the most impact if we can bring the two perspectives together, and with the technology in mind help to

Ground force

Martin Lamb from the Transport Research Laboratory in the UK explains how, over the next three years, he and his eight partners will take the road stud to a whole new level of intelligence

The INtelligent Renewable Optical ADvisory System, aka the more palatable INROADS, has been established as part of the European Commission's Seventh Framework Programme (FP7) to develop a raft of smart traffic management tools with LED-based road studs as the basis.

Road studs have undergone something of a radical evolution over the past decade. And based on the depth and variety of expertise within the eight-member INROADS consortium, the trend seems likely to continue. Among the partners are the Austrian Institute of Technology (AIT), Spain's Centro para la Investigacion y Desarrollo en Transporte y Energia (CIDAUT) and Desarrollo de Sistemas Tecnologicos Avanzados (DSTA), the Israel National Roads Company (INRC), the Institute Francais des Sciences et Technologies des Transports, de l'Amenagement des Reseaux (IFSTTAR), Siemens, and energy-harvesting specialist INNOWATTECH.

> "We are also investigating how energy can be generated from the road through piezo-electric and other means

Having kicked off in October 2011, the project will run until September 2014 and is being coordinated from the UK by TRL's Martin Lamb, who believes there is scope to roll features such as active dyamic properties and wireless power transfer (and much more besides) into one product. "The potential to combine applications covering lighting, sensors and renewable energy generation is certainly there," he says. "But due to the limitations of solar photovoltaic technology in the road environment, such as the available panel size and performance degradation resulting from dirt and dust, we are also investigating how energy can be generated from the road through piezo-electric and other means. Another area we are considering is whether the stud can be used across the highway in certain situations, such as to warn of speed limits, potential hazards, and so on."

Lamb is definitely of the school of thought that the road stud is an under-utilized tool in traffic management. "With the ongoing switch-off of motorway lighting at non-peak times, there is potential for LED road studs to perform a function based purely on the far greater visibility that they offer," he explains. Beyond that, though, the TRL man suggests there are numerous ways in which LEDs could be used to provide information and driver guidance, although he is cognizant of the balance that needs to be struck between information provision

produce some working guidelines or tolerances for the road authorities with a focus on the high-priority roads."

A computing challenge

Toby Breckon, a senior lecturer in computer vision and image processing at the UK's Cranfield University, has been conducting research into the automated recognition of road markings for some time – work that is focused specifically on the automatic extraction of road text markings for secondary integration to vehicle navigation and driver control/display systems.

Results from his studies would indicate that concern on the part of van Ratingen and Dawson is justified – the standard of markings can indeed have a detrimental impact on the effectiveness of recognition technology: "Our findings are that road marking quality has a big difference to performance," he says. "In fact, just looking at our local area trunk roads – which were not dual motorways or dual carriageways – we found that the quality of markings varied significantly to the extent that if the test vehicle went one way out of our rural university campus and compared this to another direction we got quite different results."

He puts the disparity in the area adjacent to Cranfield University down to the fact that their test vehicle was moving between two different counties and, crucially, the markings were not being maintained to the same level. "The majority of our failure cases are sadly due to inferior markings," Breckon continues. "It is a real challenge to identify markings based on their shape characteristics if there is more variability, especially in the fine details. When you're conducting automatic text recognition of speed limits at the

Quality lane markings are key to BMW's research project, Traffic Jam and Queuing Assistant, which deactivates as a result of a lane change

and driver overload. "It's for this reason that one of the nine work packages to be undertaken by IFSTTAR and CIDAUT will focus on human factors," he confirms.

But could a road stud with all the bells and whistles envisaged by the INROADS team have any chance of deployment, given current funding constraints? "If the product isn't useful, the road owners won't want it; and if it isn't affordable they won't buy it," he states. "We want to hear what they would like to see developed, what issues they have, etc. The integration of the components should then lead to the development of a product that is cost-effective either because it is less costly than gantries or lighting columns, or as a result of a safety or operational benefit, for example."

FP7 funding doesn't, however, allow for full commercialization so Lamb hopes INROADS can reach the stage where there is a working intelligent road stud at the end of the project that could then be brought to market by one of the technology partners.

INROADS aims to develop new intelligent lighting applications, tools and methods, integrating LED lighting across the highway

side of the road, for example, certain elements can appear very similar due to poor maintenance, so we have to use a lot of contextual information to overcome this – an 'A' on a road marking, for instance, can look like a '4' in the font typically used in the UK."

To maximize accuracy, the Cranfield team applied several additional analytical layers: "Compared with other work that is out there, we are analyzing a much broader spectrum of symbols on the road, not only reading speed and directional arrows but also navigation information such as road names – the 'M6' for example."

The techniques adopted by Breckon apply a mixture of shape techniques borrowed from traditional work in optical character recognition coupled with a number of innovations: "We need to take things a stage further given the unusual perspective of the on-vehicle camera viewing the road," he adds. "Essentially it is not looking straight down on the text to be captured so we need to correct for that. We also implement a 'neural network' approach so the system can learn from experience.

Breckon reports that they are now able to achieve real-time road marking extraction and symbol sequence recognition with around a 92% success rate per symbol and 85% for symbol sequences such as words and labels.

Accident prevention

Duncan Vernon, the road safety manager at UK-based Royal Society for the Prevention Of Accidents (RoSPA), feels what is important about this debate is that the road clearly communicates to road users how people are expected to behave. "This communication

Brecken's research at Cranfield involved developing a method of automatically recognizing road markings in real-time using a feature-driven approach

with drivers can be achieved by road designers through signage, the layout and shape of the road and of course road markings. So in this context markings are an important tool for road safety," he confirms.

Vernon contends that inadequate markings may even potentially have a greater impact on the technology designed to help drivers than directly on the drivers themselves: "If road markings are wearing out or some old markings have been completely removed, a human driver might still be able to look at the context of that and

> We are analyzing a much broader spectrum of symbols on the road, not only reading speed and directional arrows but also navigational information
>
> **Toby Brecken, senior lecturer, Cranfield University, UK**

what is important, even though it may be more confusing and complicated than we might like. I would suggest that it would be much more problematic for today's ADAS technologies as at the moment they simply don't have the same capacity to analyze and interpret what we as humans do."

Considering the wider interaction between the driver and technology and the driver and the road, Vernon sees a potential risk: "As this technology is becoming better the role of the driver isn't necessarily being designed out but it is being changed in many respects," he feels. "Now the driver isn't just making their own observations about the road ahead but observing what the in-car technology is doing as well. The danger arises if the human element is too far removed or detached from the decision-making process and driver assistance is based on imperfect data."

In Vernon's view, if the road markings are not of a high standard from a road safety perspective, this introduces another way that an error can occur, with the vehicle misreading it and feeding the wrong information to the driver.

Having said this, the RoSPA safety expert sees practical issues with ensuring that road markings are up to the standards needed by the latest ADAS technologies: "We have to consider what the capacity is out there in order to do this," he suggests. "If you take a large county such as Devon with a lot of rural roads, just monitoring to see which road markings are worn out and need replacing is a task in itself. This is a very difficult demand to put on Local Authorities. For accident prevention, you might expect better-quality road markings to have some impact but to date, the benefits – in my opinion – have not been properly evaluated. This also has to be set against funding needed for other measures such as re-engineering a section of road, adding a sign or removing a dangerous intersection."

Active safety

So what consideration – if any – are car-makers giving to the issue of pavement marking quality as they pursue ADAS systems that might be reliant on a tip-top marking? "We have two functions that I helped to develop that are really using this information – Lane Departure Warning (LDW) and Driver Alert Control (DAC)," reveals automotive safety expert Daniel Levin from Volvo.

A key distinction between DAC and LDW – which both use a camera to monitor the lane markings – is the timescale over which they operate. "For the DAC, this works over several minutes as it is looking for slow, subtle changes in driver behavior whereas the LDW comes in immediately, for example if the driver is distracted by a cell phone ringing and drifts out of lane," Levin explains.

(Left) **Volvo's LDW uses a camera system to recognize lane markings, sounding an alert if the driver strays out of the lane** (Below) **For drivers, Lane Assist can feel like hitting a rumble strip even though no such strip exists**

"When we were developing these solutions, we went all around the world to collect data according to a predefined profile on as wide a range of markings as possible – white, yellow and box dots, weather and lighting conditions, etc. Wherever we sell our cars and whatever country it is, customers naturally expect this technology to work accurately for all types of lane markings. As a rule of thumb, because the camera and the human eye are operating in the same wavelengths, if you can see the lane markings with your own eyes then the camera can usually also see them. When no markings are detectable, such as in snow, we have a standard message for the driver so they're aware that this might be the case," Levin says.

Overall, though, Levin predicts that driver assistance systems will become ever more accurate in the future, as a result of better image quality from the cameras as well as enhanced algorithms for detecting lane markings in the captured images.

This will only lead to more exciting technologies, verging on the autonomous. "We have shown some concepts in previous years and will soon be coming to production with the first generation of driver assistance systems where they can actually help the vehicle stay in lane by steering back automatically," Levin says. "The system pushes quite gently and there is a sensor that detects if the driver is in control of the steering or not, at which point the intervention can be over-ridden."

A joined-up approach

So with the wider spread roll-out of driver assistance technologies gathering pace, it is encouraging to see that there is a realization that to maximize the benefits we need to take a long hard look at our roads infrastructure, ensuring that road markings are actually fit-for-purpose. The joint consultation paper from EuroRAP and EuroNCAP, *Roads That Cars Can Read* certainly pulls no punches and therefore has to be welcomed. Despite the task ahead, it has a clear direction of travel and realistic objectives and given the track record of these institutions a good chance of success.

Single cell solution

Road stud specialist Global Solar Vision is launching two new versions of its GSV – GSV 2 Snow Plow and the GSV 3. The former is developed to withstand snow plows on heavily trafficked roads thanks to its anodised aluminum housing that protects the surface of the road stud against plow blades. The GSV 4 has a smoother top cover and is tested with a pressure comparable with trucks weighing 60 tonnes to resist heavier traffic loads.

Both models feature Global Solar Vision's worldwide-patented solar cell technology. "Our edge is that the GSV cells are not serially switched, as with conventional solar cells," explains the company's Frank Bijl. "A big problem with the professional application of this technique is partial shading," he continues. "Leaves, sand, dirt or tire tracks can cover up one or more solar cell segments, which results in a total output that is too low to charge the battery. It's the same on a cloudy day if there is too little light. What will happen is that the battery will be completely discharged within a few days."

Global Solar Vision's technique centers around a single solar cell. "Partial shading is no longer a problem as the efficient converter ensures even small currents are transformed into energy for the battery," Bijl says. "So even with low-light conditions, the battery will be charged when the weather is overcast or the solar cell is partly covered. Our GSV road studs are designed to maintain light outputs throughout a full anual cycle."

The GSV 4 can be delivered with a wide range of color and intelligence options. In a market saturated with inferior products from Asia, GSV's products are manufactured in the Netherlands.

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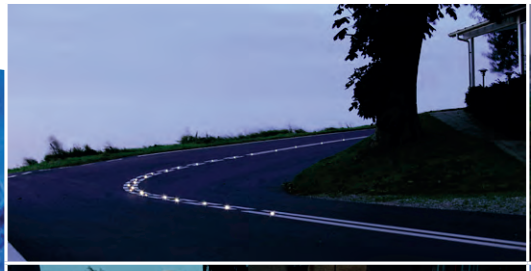
LED-Mark characteristics
- 2,000 hours of operation time
- Only 7 mm thick
- Charging at a sun angle of 15°
- Intelligent charging down to -15°C
- Theftproof
- Easy installation - no wiring



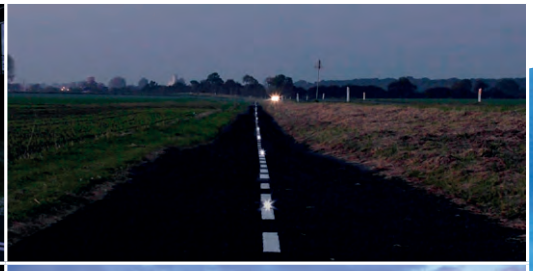


Photo: Pablo Celis

Installation costs of LED-Mark is $\frac{1}{10}$ of the wire-based technologies, and Geveko ITS is truly a professional partner.

Pablo Celis,
Project manager of
Aarhus Cycle City

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Where minds merge

Tori Read highlights some superbly smart tools that show what can be achieved when advanced computing power collides with human ingenuity

Illustration courtesy of Robert Nunn

Traffic modeling is used to great effect to answer all of the 'What if?' questions that arise when a new scheme is first proposed. Long gone are the days when this was solely the domain of software 'nerds' – traffic models are widely used today to bridge the gap between the engineer/designer and the layperson. If you need to sell your idea for a traffic management project to people holding the purse strings, what better way to do that than to show them an incredibly detailed simulation – based on real-world data – that demonstrates the benefits of your proposed idea?

And it's not only grand new ideas that benefit from these powerful programs, it's also the very nuts and bolts of traffic engineering. Is it better to build install a set of traffic signals at a location or construct a roundabout? Model both and see what works best.

We've gathered a number of case studies on the following pages to show exactly how computer modeling is having an impact on real roads around the world, stories covering everything from roundabout design in Indiana to the integration of pedestrian and vehicular modeling in Hong Kong.

Admirable solution

Clement Ho, senior transport planner at OveArup and Partners explains how two simulation packages rolled into one helped transform a CBD

Bus-weaving is a problem in Hong Kong

> The tool combines the Legion pedestrian simulator and the Aimsun microscopic simulator in a single software application

Hong Kong's busy central business district, Admiralty, is in line for an extreme makeover. Now home to new government headquarters, the legislative council, it will have two new metro lines in addition to the two existing metro lines. These infrastructure developments will turn Admiralty into a major transport hub, prompting the need to manage the already heavy congestion and to improve pedestrian access.

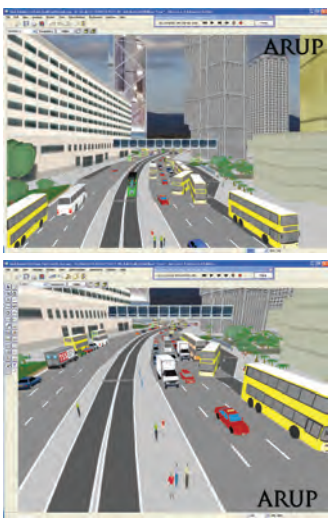
As part of the preparation for these new developments, the Transport Department of the Government of the Hong Kong Special Administrative Region commissioned Arup to conduct a large-scale assessment of the potential traffic problems. The proposed layout aims to reduce congestion by encouraging more people to use trains instead of cars, diverting road-based traffic to rail-based public transport.

Arup's design includes improved access for those with impaired mobility and has also helped to keep the harbor area next to the new government headquarters as a pedestrian zone, preserving its character and promoting green travel.

The traditional approach for traffic simulation models was to consider vehicles and pedestrians separately, if at all. Models were therefore built independently without taking into account the effects of interaction between the two modes, such as delays incurred by boarding and alighting activities at public transport interchanges.

In contrast, Arup took an integrated approach, using Legion for Aimsun, which combines the Legion pedestrian simulator and the Aimsun microscopic simulator in a single software application, enabling city planners to manage the different and often competing requirements of pedestrians and traffic. The pedestrian model includes richly detailed pedestrian areas containing obstacles, stairs, escalators, and queuing at ticket booths or bus stops.The traffic model represents multi-modal public transport in all its complexity: a mix of public transport services, scheduled and reserved lanes realistically represent Hong Kong's multi-level road structure along with 20 boarding/alighting points for 130 road-based public transport services during peak hour. Together with multiple metro entrances, an area for 'kiss-and-ride' operations, and multi-level mass transit rail (MTR) stations. Pedestrian interaction with buses adds realism to vehicle arrival and departure, providing load-dependent dwell times and platoons of passengers alighting and heading toward the MTR station entries on their intermodal transfer.

The project allowed Arup to collaborate closely with TSS-Transport Simulation Systems (the developer of Aimsun)



Legion for Aimsun was used to conduct pedestrian and vehicle modeling

and Legion, enhancing the modeling functionality from a user perspective with robust improvements. These include boarding and alighting interaction between pedestrians and vehicles, vehicles giving way to pedestrians at cautionary crossings, and modeling results in 3D and enhancing output graphics for advanced simulation animation.

Another key advance is that the study was the first to show the way pedestrians and on-street traffic interact at Admiralty in a three-dimensional simulation model. Using simulation outputs and a 3D model of the interchange makes it possible to create much clearer and more accessible presentations of the impact of the proposed mitigation schemes to key government officials.

In the final analysis, the Arup model successfully demonstrated that the proposed traffic improvement schemes could indeed mitigate existing traffic issues and cater for future traffic growth.

Calibrate to communicate

Richard Braidwood outlines how Paramics software greatly enhanced communications on a new housing development project

Paramics software was used to model the Stoneywood development

The far-reaching impacts of traffic modeling are aptly illustrated in this unique case study from Scotland.

In Aberdeen, the masterplanning process for the Dandara Stoneywood Estate housing development was led by multidisciplinary design company OPEN. Transportation Planning Ltd and Braidwood Associates were commissioned to provide transportation services; the latter's role being the development of a microsimulation traffic model.

The development site is on the north-west of Aberdeen in close proximity to a number of key transport hubs such as a railway station (1.85km), airport (1.90km), and major national roads infrastructure. The land usage around the development site is a mixture of residential and commercial, although the area is predominantly a business district. This provided some particular challenges in terms of traffic flow.

As part of the project submission, Aberdeen City Council requested the development of a traffic model. The Paramics microsmulation model represents the A947 corridor from the roundabout junction with the A947 Stoneywood Road and the A96 Inverurie Road in the south to the A947 Victoria Street/Farburn Terrace junction in the north.

A traffic data-collection program was commissioned to provide traffic volumes to build the demand matrices, queue length and operational data to assist in the calibration of the model and independent journey time data to provide a measure of the model validation.

Data was collected over the course of two days. This included classified turning count data at 11 junctions, queue length observations at 11 junctions, classified link count at one location, pedestrian crossing demand and stage call record at three locations, and journey time observations on two routes. This was collected between 07.00-10.00hrs and 15.30-18.30hrs on Wednesday January 19 and Thursday January 20, 2011.

> "Assigning the calibrated matrices to the model identified several issues that were not evident in the preliminary base model assignments

Both simulated time periods included a 30-minute shoulder period to ensure representative delay was evident on the network prior to the start of the simulated time period.

The network study area was developed within Paramics using AutoCAD DXF. The trip matrices were developed from survey video counts and include a car and light vehicles matrix and a heavy goods matrix so that the origin and destination of different vehicle types was representative. Finally, vehicle-release profiles were assigned to each origin zone to ensure ebbs and surges in traffic flow were modeled accurately.

Model calibration and validation involved the validation for 78 turns, count movements for each of the modeled six hours, as well as calibration of travel times in both directions of the A947 corridor.

Assigning the calibrated matrices to the model identified several operational issues that were not evident in the preliminary base model assignments.

Comparisons of the hourly turning volumes with the observed data also demonstrated that flows in the first hour of the model periods were higher on these sections than observed and lower during the next two hours, confirming that traffic was being released too quickly through the network.

A series of changes in calibration parameters was applied in four iterative steps until representative queue lengths and congestion levels were achieved.

The use of microsimulation software allowed a number of design alternatives to be analyzed before the optimum solution was identified. "The modeling aided our team to successfully communicate the proposed transportation impact of our development to council officials, identify current infrastructure shortcomings and ensure our proposals have a minimal impact on the local road network around our site," says Gavin Wyley, Dandara Scotland's MD.

The ability to communicate to the lay person is an invaluable tool in any project. In this instance, however, the model allowed Braidwood Associates not only to communicate externally with council officials but also internally, allowing everyone to have a strong understanding of all issues throughout the project.

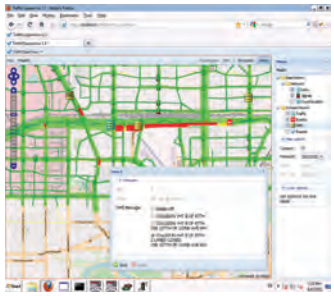
The holy grail of traffic management

Mygistics' Thomas Bauer on a Canadian case study

The city of Edmonton is testing software that creates predictive traffic modeling to offer real-time solutions to traffic congestion on its busiest road – the Yellowhead Trail.

Yellowhead Trail is the portion of Highway 16 (Yellowhead Highway) within Edmonton, an arterial facility that carries approximately 70,000 vehicles a day into, out of and through the city. As traffic congestion increases on the facility, demand increases, and funding for expansion of infrastructure decreases, so the city must look for innovative solutions. A project to develop an ITS that predicts traffic conditions based on sound modeling methodologies and transfers that information to drivers in real-time is one such example.

This road could represent any number of major arterial roads in other cities facing increased



PTV's Vision suite is used within the Yellowhead Trail ITS Laboratory

congestion. The busiest and most congested area is between 97 and 127 Streets near the city center. "Over the long term, we are planning to build more grade-separated interchanges on Yellowhead Trail," explains Wai Cheung, a City of Edmonton traffic engineer. "But such intentions are expensive and take time for implementation. ITS offers a medium-term solution to traffic problems, and with our pilot project we are showing the world what is possible."

Cheung together with PTV, its affiliates PTV America, Mygistics, SISTeMA and GEVAS as well as Fourth Dimension, created a virtual reality – the Yellowhead Trail ITS Laboratory. The lab consists of simulated traffic conditions using PTV Vision microsimulation software, VISSIM, and a model-based incident response system. It also allows for testing of various conditions and responses prior to deployment in the field.

At its core, the lab features the OPTIMA real-time simulation model, which takes in and processes the real-time traffic volume and speed data from local traffic signals and incorporates several dynamic message signs (DMS) strategically deployed throughout the project area.

The impacts of incidents (e.g. collisions) are predicted in real-time and mitigation detour advice provided for the DMS. Forecast volumes (with a 30-minute horizon) are then transferred to the integrated adaptive traffic signal control system, BALANCE, where new cycle, splits, and offset patterns are computed for the 32 adaptive system intersections. Each traffic signal controller is also continuously optimized through a local adaptive algorithm in one-second intervals.

As a result, drivers observing the prescribed detour routes are rewarded with signal timing plans designed to streamline their travel and minimize delay. "With personalized route mapping based on real-time congestion, we are moving step by step toward the 'holy grail' of traffic management," Cheung concludes.

Wide-area traffic simulation

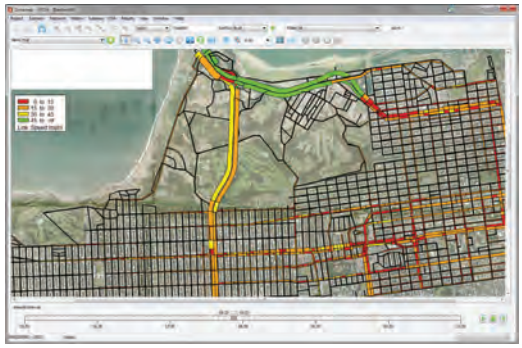
Shane Velan from Inro highlights a number of success stories for his firm's software

Wide-area traffic simulation is becoming a new reality in the transport planning and simulation field. Inro's Dynameq mesoscopic traffic simulation projects are paving the way for traffic simulation on a larger scale, providing evaluation bases for congestion relief strategies, corridor and lane management, construction mitigation, transit design, traffic impact studies, emissions modeling, and more.

The San Francisco County Transportation Authority (SFCTA) has successfully enhanced its original Dynameq corridor model, built for the reconstruction of the approach to the Golden Gate Bridge, adding a parallel bus rapid transit (BRT) corridor. Currently, SFCTA is doubling the study area to include the entire CBD.

Somewhat further afield is a recent project in Shanghai, China. The city's elevated highway system carries 35% of the total distance traveled in the region. The Shanghai City Comprehensive Transportation Planning Institute has built a Dynameq model of 1,047 lane-km and 322 ramps that carry 540,000 vehicles in a typical three-hour morning peak. The model was built over six months in 2011 and calibrated to speed data from over 170 traffic monitoring cameras and travel times from GPS probes. Initial applications include lane restriping to address weaving, which has cut queue density in bottlenecks by half.

Back in North America, the Seattle region has employed several Dynameq models. Across Lake Washington, the City of



San Francisco is reaping the benefits of Dynameq modeling

Bellevue uses the software to supplement regional travel-demand forecasts. The state capital, Olympia, built its first Dynameq model for a Smart Corridor project and has since demonstrated how to improve emissions estimates according to the new MOVES standard using vehicle trajectories from Dynameq. Now Washington State DOT has selected the software to model various scenarios for the reconstruction of the Alaska Way Viaduct. Toll modeling will be an important feature of this study.

Finally, Portland, Oregon is embarking on an implementation plan to use Dynameq as a planning tool to account for queuing effects, dynamic path choice, congestion duration, detailed emissions, and transit operations on a regional scale.

Magic roundabouts

Mike Hutt from TRL reveals how simulation software is giving the roundabout a lease of life in the USA

Although the traffic industry's more vocal discussions continue to surround signals and adaptive control strategies, the UK's TRL has been quietly but rapidly experiencing international growth in the world of unsignalized intersection modeling.

ARCADY, in particular, has seen substantial growth, especially in North America where roundabouts are growing in popularity. Leading the way in the USA is Indiana DOT (INDOT), which plans to construct a number of roundabouts over the next five years in strategic locations. TRL has supplied the state with multiple ARCADY licenses for engineers in each individual district as they need to quickly but reliably analyze whether or not a roundabout would work as soon as certain projects hit their desks.

"In our design process we investigate all intersections for their feasibility," explains John Wright, director of highway design at INDOT. "Last year, we trained 56 engineers on the use of the ARCADY 7.1 software. Indiana currently has more than 150 roundabouts and has 30 more in the design process. ARCADY software has allowed us to become more knowledgeable and accepting of roundabouts and has pushed us forward into this area."

Indiana DOT relies on TRL's ARCADY software

As the software analyzes roundabouts using six key geometries for each leg and is very outcome-orientated, it allows users to analyze the efficiency of a design based on the actual layout of the roundabout, and with the simple calibration factors available can very quickly provide a localized prediction. Those charged with the responsibility of submitting a design need to know how well their proposed layout is going to work. The model utilizes the actual layout and is highly sensitive to any alterations that are made. Whether it's the addition of another lane, a change to approach alignment, or simply altering a tangent to lower entry speed, these can all have a significant effect on capacity.

TRL and roundabouts are intrinsically linked. The company developed the offside priority (or yield-at-entry) rule and has conducted many large research studies into roundabouts, covering capacity, safety and pedestrian facilities. "Although we have a fantastic pedigree in this area, we're not resting on our laurels," suggests Gavin Jackman, head of software. "That's why we've developed an additional Entry Lane Simulation model to derive optimum lane configurations and allow the user to instantly swap the roundabout for a four-way intersection for comparisons. Many of our US customers are required to provide results using alternative analysis methods, so the HCM 2010 Gap Acceptance Roundabout Model is now an option in ARCADY."

Dividing opinions

Timothy Compston seeks out the views of operators, industry leaders and systems innovators for an inside track on the latest approaches being deployed to meet the very real safety and security challenges faced by today's road bridges

Illustration courtesy of Magictorch

Prolonged disruption to bridge operations can potentially have serious economic and social repercussions, necessitating detours of tens of miles and splitting communities apart. With their overall role in the smooth running of our transportation infrastructure pivotal, it's essential bridges are as resilient as possible: to natural events such as earthquakes and extreme weather; to the threat of terrorist attack; and resilient in design and construction. The I-35W bridge collapse in Minnesota clearly underscores the need for vigilence when it comes to ensuring the integrity of these valuable assets.

While traffic levels continue on an upward trend, we are also challenged by a much tighter fiscal environment in which central government funding for replacement projects such as I-35W remains severely curtailed. And when combined with rising construction costs, the reality is that it's not always practical to replace aging bridges that are nearing the end of their design life. Instead, in the near term, we are likely to see more emphasis being placed on carefully considered remedial measures to manage their health. With a rigorous inspection regime and ingenious repairs to prevent their deterioration, the hope has to be that they can, at the very least, remain viable for a few decades more.

Addressing the funding gap

John Horsley, executive director at the American Association of State Highway and Transportation Officials (AASHTO) is well placed to offer a bigger picture view on the need to keep bridges in a safe and secure condition as well as offer some insight into the practical issues caused by an aging infrastructure in a tougher fiscal climate.

"We are having to contend with a generation of aging bridges coming through simultaneously," the AASHTO man begins. "When they reach 50, 60 or 70 years old, something needs to be done, but it's increasingly difficult to replace structures

A smart view

John Dalinsky heads-up the ITS division at Perceptics and believes that although there is still a case for traditional video cameras to be deployed around bridges, the emphasis is moving to smarter more flexible technologies such as ALPR. "The bottom line is that there isn't the same amount of funding around, so successful providers in this marketplace need to be in a position to demonstrate a strong solutions-based case, highlighting the security, business management and toll collection benefits for bridge operators.

"Bridge operators can, for example, get rid of their tolling booths and move to free-flow tolling with LPR picking up any plates not captured from a transponder. This same technology can also add value by securing the bridge, as the information on vehicles can be fed into a database, and be deployed for wider traffic management decisions such as lane closures and to provide detailed statistics."

Dalinsky highlights questions that need to be considered before a system is selected: "How accurate is it going to be? How are these accuracy levels defined? Is there an open architecture? What can the ALPR system be interfaced with? Are bridge operators going to be limited to using the supplier's back-end product?"

that have reached the end of their useful lives. We are going to have to do triage in terms of which bridges can be saved – and how we can preserve the capacity through aggressive preventative maintenance – because legislatures and the federal government have not found a way to give us the resources necessary in the longer term to add capacity or even replace key facilities."

Against this backdrop, Horsley sees effective asset management as being critical for the health of the USA's bridges and is hopeful of action from Congress: "The Senate has been listening to this message and hopefully the House will take it up so it can be included in the legislation for the next Highway Authorization."

An asset management approach is preferable to a 'worst first' stance, according to Horsley. "If resources are focused only on the worst bridges – and others are left to deteriorate to the point where they have to be totally replaced – invariably states are going to find it difficult to keep up with the financial burden. There has to be more attention paid to intermediate repair and maintenance so bridges last longer."

Given that bridges tend to span spaces such as valleys or rivers that make it difficult to move around in other ways, Horlsey points out that where money is available to build new structures, it is often better to implement a complete road closure to allow rapid reconstruction to take place: "Doing the work intensively rather than through an incremental shutdown is something we are seeing across the country," he says. "Given that traffic volumes are at unprecedented levels, there simply isn't the luxury of shutting down facilities for long periods."

Photo courtesy of Morry Gash/AP/Press Association Images

The scene after the I-35W bridge collapsed over the Mississippi River in 2007

Protection and preservation

Horsley's colleague Kelley Rehm is program manager, Bridges, Structures and Hydraulics at AASHTO, and says that extensive efforts are now being made on the ground: "Better paint coating and joint systems are being adopted and there are several initiatives looking at this," he says. "For our part at AASHTO, we have created a specific technical service program. The mentality is that we have to be smarter about how we are spending money on our bridges. We are certainly getting better at looking at the network of bridges and taking into consideration what maintenance we have done, what we are going to add on, and looking at the total life-cycle cost and we have created new software that helps."

In addition, there has been a big push to use more non-destructive testing and evaluation techniques to add to the more usual visual inspections, especially given the need to extend the life of older structures: "Examples include aerial photography and LIDAR (Light Detection And Ranging) scans. We are really adding to our inspection and testing tool box to keep workers out of traffic and to minimize any disruption."

> Legislatures and the federal government have not found a way to give us the resources necessary in the longer term to add capacity or even replace key facilities
>
> **John Horsley, executive director, AASHTO, USA**

Designs on security

Turning to the issue of bridge security, Rehm stresses that much of the advice is focused on monitoring: "Essentially this is the cheapest and easiest way to stop people getting close to your bridge, whether it be done with cameras or other sensors."

In terms of the physical design of bridges to resist any kind of blast, Rehm cites AASHTO's release last year of a key

Help is at hand

Bridge safety and security is being assured by some noteworthy advances in technology, finds **Lloyd Fuller**, both to monitor the structural integrity of the infrastructure as well as to guard against acts of terrorism

A member of the NYPD Counter Terrorism division surveys vehicles at a bridge check point on the 10th anniversary of 9/11

With its tens of thousands of miles of roads, tunnels and bridges, the road network is a particularly easy target for terrorists – and they are aware of this vulnerability. Al Qaeda cells in Afghanistan, for instance, are known to have trained operatives in methods to bring down suspension bridges using improvised explosive devices (IEDs), while evidence unearthed following the arrest of one suspect in 2003 revealed that New York's Brooklyn Bridge was on a list of targets.

The iconic crossing across the East River is now one of the most secure in the world, although the relatively simple plan to blowtorch through suspension cables – and officials' admittance that the plot could have succeeded prior to security upgrades – highlight the need for ongoing vigilance.

This is not lost on Associate Professor Eric Williamson from the Cockrell School of Engineering at the University of Texas in Austin, who last year developed the first-ever national guidelines for building and retrofitting bridges so that they're better able to withstand acts of terrorism. "There's a lot of information available as to how blasts can affect structures, but as far as specific guidance that practicing engineers can use to improve a bridge's resistance to an explosion or blast, this is the only thing out there," Williamson says.

> "The general public is probably not aware of the risks associated with bridges, but the good news is that many people are taking a close look at how to improve their safety

Computer simulations and blast-tests on half-scale bridge columns allowed Williamson and his colleagues to analyze how various critical bridge components responded to numerous explosive scenarios. Circular columns, for example, were proved to be significantly more resistant to blasts than square or rectangular versions. "The general public is probably not aware of the risks associated with bridges and other transportation infrastructure, but the good news is that many people are taking a close look at how to improve their safety."

This also includes innovations to prevent attacks from occurring in the first place. The screening of bridge traffic for vehicle-borne IEDs (VBIED) with gamma-ray and high-energy X-ray technologies is a noticeable trend on high-profile installations, particularly post 9/11. And although ALPR systems have found the ITS market a hugely valuable sector generally, they remain an indispensable tool in crime-fighting by flagging-up watchlist vehicles automatically. Facial recognition software is even being utilized to compare images of vehicle drivers with databases of known suspects. And CCTV technologies continue to advance, with artifical intelligence such as motion detection and behavioral analysis being amalgamated to enhance security operations. Imaging systems, too, are becoming smarter, and thermal-based cameras such as those pioneered by FLIR can be networked to create what it refers to as a 'Thermal Fence'.

Such attacks on bridges are thankfully rare, though, with the majority of disasters attributable to engineering faults and/or wear and tear resulting from increasing traffic levels on aging, ailing structures – the perfect storm for a tragedy, demonstrated as recently as the I-35W bridge collapse.

Natural disasters must also be factored into the equation. Here, too, there are

numerous developments to increase seismic strength, including advances in the field of construction materials, such as shape-memory alloys, the thermodynamic and mechanical properties of which are being investigated by researchers at the Georgia Tech State University. These composites essentially 'bounce' back into shape after experiencing heavy loads, such as during an earthquake. Engineers at Maine DOT, meanwhile, recently completed the construction of the world's largest composite bridge – the Knickerbocker Bridge in Boothbay – featuring lightweight beams made of fiber-reinforced polymer in conjunction with concrete and steel. The weight, cost, and durability benefits have generated a huge amount of interest, particularly from cash-strapped DOTs.

There have also been huge steps forward in sensors, which provide early warnings of faults in structural integrity. The new I-35W bridge, completed in September 2008, features 323 such sensors that spit out a constant stream of data regularly analyzed by engineers at the nearby University of Minnesota. They don't eliminate the need for visual inspections but provide an extra layer of security by monitoring corrosion, stress and the movement from bridge traffic.

The Resensys solution is a cost-effective and scalable solution for the real time monitoring of important structural state quantities such as stress, strain, fatigue cracks, vibration, etc

University of Strathclyde researchers, meanwhile, have even developed an intelligent nanotechnology-based paint that detects microscopic movement that – when combined with cheap electrodes – can detect damage at a fraction of the cost of more advanced structural sensors. "Research tends to focus on high-tech options that look to eliminate human control," suggests Dr Mohamed Saafi at the University's Department of Civil Engineering. "Our research shows that by maintaining the human element through something like a smart paint, the costs can be vastly reduced without an impact on effectiveness."

The new I-35W bridge features 10 lanes of traffic, five in each direction, and has a 100-year life expectancy

document entitled *Bridge Security Guidelines*: "We have been working with the FHWA and are developing a workshop that we can take out to teach bridge designers how to incorporate specific measures into the bridges that are at risk," he reveals. "This is focused on new bridges and really deals with the hardening of the concrete, and adding more reinforcement, so in a strong blast the columns remain standing."

Looking at older bridges, where elements may need to be retrofitted, Rehm says that special types of wraps can be put around the columns to strengthen them: "In many ways this is very similar to steps that might be taken to provide additional protection against earthquakes."

> "The mentality is that we have to be smarter about how we are spending money on our bridges"
>
> **Kelly Rehm, manager, bridges, structures and hydraulics, AASHTO, USA**

Seismic shift

How well bridges are able to withstand major seismic events is especially an issue for earthquake-prone California. A case in point is the new eight-mile-long San Francisco-Oakland Bay Bridge, which is scheduled for completion in 2013. Its design reflects many of the lessons learned from earlier incidents in the state, such as the 1989 Loma Prieta earthquake that damaged part of the East Span. Ultimately, the program of work will see the West Span retrofitted, through seismic reinforcement, and the East Span replaced entirely.

Bart Nay from Caltrans underlines the necessity of ensuring that the Bay Bridge continues to function as a major arterial route: "It handles about 280,000 vehicles every day, ranking it in the top three busiest bridges in the USA and not just an economic engine for the region but the whole state. It

was important as work progressed that we were in a position to limit the amount of time it was taken out of service."

The desire to keep the original structure in place at the same time was a major logistical challenge in upgrading the Bay Bridge seismically: "We had to completely replace whole sections by putting elements of the new bridge in the exact same footprint as existing traffic," Nay reveals.

With the level of work going on, it was obviously vital to have the public on side so Nay and his Caltrans colleagues came up with a number of creative approaches beyond the usual publicity campaigns to capture the attention of drivers: "We actually produced a mobile app with a safety dimension that was essentially a video game that allowed people to actually drive and familiarize themselves with any changes to the bridge layout," Nay says. "To put this into perspective, for our last closure we had 10,000 downloads even before the new alignment was finished."

In terms of seismic technology, the Caltrans man believes that the Bay Bridge exemplifies an almost geometric progression compared with what went before: "A new standard has now been created for bridges in California called 'Lifeline', which was really the first step in determining the design. Not only is there a no-fail or no-collapse criteria after a major earthquake, but the structure needs to be accessible, immediately, to the emergency services and for the post-event rebuilding effort. It's also stipulated they be returned to public service without being replaced."

To satisfy more stringent seismic requirements, the new Bay Bridge features a number of critical enhancements. "We pulled together a seismic panel of engineering experts to peer review all of the key design elements," Nay recalls. "Another step forward is the placing of motion sensors – accelerometers – throughout the bridge. These are being integrated so it will be possible to provide detail not only on the strength of any future earthquake event but crucially how specific parts of the bridge have actually reacted to this."

An International perspective

After 50 years, the 1.8-mile International Bridge serving the twin cities of Sault Ste. Marie is still going strong, thanks in no small part to a rigorous maintenence regime.

The only vehicle crossing between Ontario, Canada and Michigan in the USA for some 300 miles, the bridge's traffic management and security surveillance system was last upgraded in any significant way back in 2005. "We currently have a network of cameras operating above and below the main deck so that a fast response can be taken to any incidents, whether that be stranded motorists or suspicious activity," reveals Phil Becker, International

Bridge Administration (IBA) general manager. "We work very closely with the US and Canadian authorities from a traffic, physical asset and border management perspective. Looking after a bridge that also serves as a border crossing means that although our revenue source is traffic, we don't have complete control over this."

What Becker means is that the US Customs and Border Protection and their equivalents in the Canadian Border Services Agency have it in their power to make the crossing experience a positive or a negative one for bridge customers.

The IBA man thus sees a strong partnership with these agencies as a very high priority: "We depend so much on local traffic – about 80% – who, when faced with delays, may simply cut down on their discretionary journeys, whether that be crossing to shop, see a relative or to purchase fuel." For Becker the aim has to be to make sure that when people travel across the International Bridge, the process is as expedient and hassle-free as border security will allow.

> The Bay Bridge handles about 280,000 vehicles every day, ranking it in the top three busiest bridges in the USA and not just an economic engine for the region but the whole state
>
> **Bart Nay, California Department of Transportation, USA**

Picture perfect

Beyond structural changes, when it comes to the deployment of technology to manage and secure bridges, we are seeing the widespread take-up of ALPR. Kevin Giles is the vice president of engineering at Perceptics, which has systems installed to allow agencies to monitor vehicles crossing bridges on the US-Canadian border. "The greater use of digital cameras now offers much better resolution with a wider view," he says. "The key point is that this leads to fewer vehicles being excluded due to out-of-field reads. The ability to undertake multiple plate reads is also becoming essential, so front and rear plates can be readily correlated and details of commercial vehicles – which may have two or three plates registered in different states – can be captured." Moving forward, Giles sees another key discriminator as being a solution that can read retroreflective and non-retroreflective plates.

Bridging the gap

Although continued belt tightening will be a feature for some time to come, the good news is our understanding of how bridges should be designed, constructed, maintained and protected has moved on, as has the technology at our disposal. When placed alongside the development of best practice guidance from bodies such as AAHSTO, the hope has to be that there are practical solutions that can be employed on bridges whatever their age, size or budget.

(Upper left) **The US$6.3 billion eastern span replacement of the San Francisco-Oakland Bay Bridge it scheduled to open to traffic in 2013**

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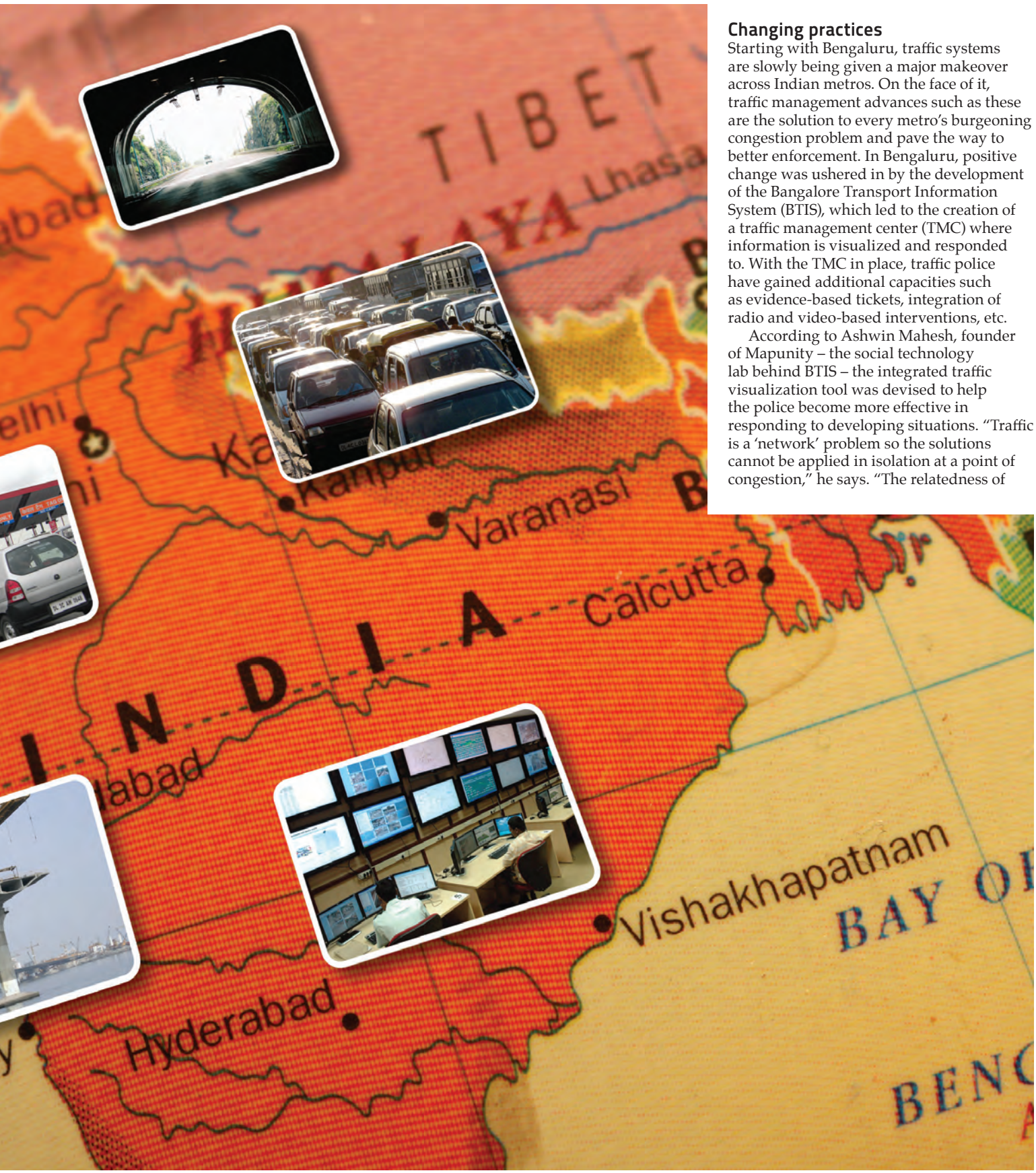
Made for India?

Traffic police across India are clamoring for advanced traffic management systems to be installed. But, asks **Charu Bahri**, are they and city planning authorities ignoring the basics of traffic engineering?

Illustration courtesy of Bob Smith

Deepak Gupta, a US-returned Bengaluru-based architect, had a déjà vu moment when he received a traffic ticket in the mail and learned that the fine was payable online. The ticket was the upshot of one of his employees jumping a red signal – a lapse Gupta had not been informed about. The ticket was issued in any case as the infringement hadn't gone unnoticed. Gupta was reminded of his life back in the USA where traffic violations detected by cameras are actioned by default, with the help of expansive databases of vehicle registrations.

"It is great that the Bangalore Traffic Police is introducing similar advanced traffic systems," admits Gupta, who is extremely appreciative of the new methods. "Now motorists caught violating traffic regulations can put their foot down and ask for the ticket to be mailed, if they find themselves up against police personnel not equipped with a Blackberry and portable printer. Fines not duly acknowledged by a receipt often used to end up in police personnel's pockets. Technology is doing away with such corrupt practices as well as making navigating Bengaluru easier."



Changing practices

Starting with Bengaluru, traffic systems are slowly being given a major makeover across Indian metros. On the face of it, traffic management advances such as these are the solution to every metro's burgeoning congestion problem and pave the way to better enforcement. In Bengaluru, positive change was ushered in by the development of the Bangalore Transport Information System (BTIS), which led to the creation of a traffic management center (TMC) where information is visualized and responded to. With the TMC in place, traffic police have gained additional capacities such as evidence-based tickets, integration of radio and video-based interventions, etc.

According to Ashwin Mahesh, founder of Mapunity – the social technology lab behind BTIS – the integrated traffic visualization tool was devised to help the police become more effective in responding to developing situations. "Traffic is a 'network' problem so the solutions cannot be applied in isolation at a point of congestion," he says. "The relatedness of

Indian highways vs cities

So far, highways are faring better than cities in installing advanced traffic technologies – possibly because they are managed by a single agency, the National Highways Authority of India (NHAI). "Now that all the BOT highways have some semblance of ITS, the country must work on enhancing the efficiency of these traffic systems. Integration of systems at the regional, state, and national level is the need of the hour," suggests Sachin Bhatia, CEO, Metro Infrasys P Ltd.

The recent decision to adopt a nationwide RFID standard to improve the integration of individual highway ITS exemplifies the way forward. India must also establish a national central clearing house, which would mandate a central registry of registered vehicles (tags). The country must also focus on toll plaza-based enabling.

B-TRAC in Bengaluru is a pioneering citywide ITS. Overall, the absence of a single agency responsible for the base grid and ITS design is slowing down the process of ITS deployment in Indian cities. Pramod Radhakrishnan, country head, IRD India feels this would partially be overcome if standardized police forces were framed by multiple stakeholders, regulatory bodies, enforcement agencies and traffic management authorities working in conjunction with one another. Such policies must be capable of adapting to changing and highly complex market conditions.

this point to the originating traffic and its impact on directions into which traffic flows must also be seen and understood."

BTIS also overcomes the risk of an exclusive government-only system as different agencies that were previously working in silos now understand that sharing data creates a new and compelling value – both for the public and for officials. "Traffic is an area where the 'management' of the problem by the police alone cannot suffice," Mahesh observes. "Information originating in other departments, such as the public transport company, the Metro, the municipality, and the transport department, can empower the police to make informed decisions." For instance, the bus company shares bus locations and speed (through onboard GPS) with the police, which is a useful measure of congestion. The transport department's database enables the collection of fines for traffic violations, as Gupta experienced. BTIS has also enabled the public to respond in real-time to police directives to prevent congestion.

Value trail

BTIS is being replicated for other cities on popular demand. Mahesh, who is also a researcher in urban governance at the Indian Institute of Management Bangalore and a senior fellow at the Indian Institute of Sciences' Centre for Infrastructure, Sustainable Transport and Urban Planning (IISc CISTUP), believes that the transport information system is delivering value because it is unusual. It's the outcome of marrying thought leadership and academic research to public administration, rather than solving the traffic problems by contracting it out to a solution provider. "'Contracting' assumes that the police have a well-defined understanding of what technology they need now as well as going forward, but in our context that is not the case," Mahesh explains. "A lot of learning happens as you go, and this kind of situation can't be handled by contracts. What works better is a partnership between researchers and public officials, simply focusing on the problem without looking at the economics. This is a well-established model for research elsewhere, but needs to catch up in India."

Research and understanding are the keys to customization and developing technologies for mass deployment in Indian conditions. "Intelligent Traffic Systems (ITS), a potential bundle of technologies, must be adapted to Indian conditions to improve traffic management in Indian cities and enforce traffic laws," suggests Dr Ashish Verma, founding president, Transportation Research Group of India, assistant professor in the Department of Civil Engineering and associate faculty, IISc CISTUP.

ITS versus scaling up the basics

Verma accedes that traffic conditions in India today are beyond control by simple traffic management measures. "Scaling up basic traffic systems would not do because the Indian traffic system and driver behavior is more complex than western countries." For instance, the heterogeneous mix of two- and four-wheelers makes the process of accurately and continuously capturing the state of traffic using sensors or other mechanisms more challenging in the Indian context. Additional factors adding to the complexity include the absence of lane discipline, exponential growth of vehicles, bad roads, poor geometrics, conflicting movements of pedestrians and vehicles on the road, problems with the driver licensing system, poor traffic law enforcement, etc.

> Scaling up basic traffic systems would not do because the Indian traffic system and driver behavior is more complex than western countries
>
> **Dr Ashish Verma, Transportation Research Group of India**

India has eyed record road network expansion and was expected to have awarded 7,300km of road-building contracts in 2011, worth US$12 billion

"Scaling up basic traffic systems would not solve the traffic congestion challenges facing Indian cities, let alone provide motorists world-class mobility," concurs Dr S. Velmurugan, principal scientist, Traffic Engineering and Safety Division, Central Road Research Institute (CRRI). Nothing short of ITS would give the country the infrastructure it needs to handle burgeoning traffic and sanitize traffic management

The B-TRAC 2010 project is the first of its kind in India to address the issues of traffic safety, etc, utilizing the latest traffic management technology

practices, Velmurugan feels. Still, he is of the opinion that a developing country such as India would do well to deploy ITS in a phased manner.

ITS in phases

Traffic authorities across the country are displaying a willingness and strong leaning to adopt technologies proven successful in developed nations. Such deployment, however, is associated with years of catch-up in terms of driver behavior, driver skills, and education.

The Gurgaon-Delhi Expressway was thrown open for public use in January 2008. Four years on, Sachin Bhatia, CEO, Metro Infrasys P Ltd, points out that ETC speed at the highway toll booth is 700 vehicles an hour vis-à-vis the expected 1,200 vehicles an hour. According to him, the low ETC throughput is traced to the presence of non-ETC users in ETC lanes. Lane indiscipline, tailgating and run-through instances are the bane of ITS installed to manage traffic on Indian highways, leading Bhatia to opine: "Indian traffic authorities must run parallel awareness programs focusing on educating road users and agencies about new methods as well as adopt steps toward better enforcement, as advanced systems are made a part of city and highway traffic management practices."

The phased implementation of ITS would give authorities the opportunity to test for readiness for each of the four 'Es' of traffic engineering, education, enforcement, and environment. In addition, ITS mandates better coordination between road agencies and infrastructure agencies at various levels. The desired level of contact is established over time.

In Hyderabad, the traffic police plan to launch education and awareness campaigns supported by the public and press to prepare individual motorists for the change. According to Ake Ravi Krishna, IPS, DCP, Traffic II, Hyderabad, "Exponential increase in vehicular traffic in Hyderabad [and other Indian cities] mandates the ITS, a new technological initiative." Still, the traffic police is moving slowly toward ITS. "Preliminary steps such as e-challan (traffic ticket), signal improvement, etc, and executing pilot projects are also helping prepare citizens for new systems and are bringing social acceptance for new initiatives. The results of pilot projects will also be analyzed for any new course corrections and for improving the systems."

Citywide ITS also necessitates an effective and reliable communication network whereas Verma says the uninterrupted availability of communication networks for traffic systems is an ongoing challenge. In Bengaluru, he estimates that close to half of the pan-tilt-zoom (PTZ) cameras installed at junctions for traffic management remain unconnected at any given time.

Back to basics

Some quarters in India are concerned about the adoption of ITS in the absence of suitable road infrastructure and communication systems, arguing that the latter would in themselves improve driving conditions. Rohit Baluja, the president of the Institute of Road Traffic Education and director of the College of Traffic Management, believes India's current road designs and traffic engineering standards are not based on well-researched systems to meet prevailing needs. "Instead," he feels, "the standards put out by the Indian Roads Congress are formulated by a group of members from different organizations that are neither accountable for their work nor oriented to the well-established traffic engineering practice."

> Indian traffic authorities must run parallel awareness programs focusing on educating road users and agencies about new methods as well as adopt steps toward better enforcement
>
> **Sachin Bhatia, CEO, Metro Infrasys, India**

India vs the developing world

In an interview with *Intertraffic World India* published in July 2011, IRD India country head Pramod Radhakrishnan contrasted the state of development of ITS in India and in developed countries.

ITS is defined as a system that helps road users move from point A to point B with the least conflict, in the least possible time, and in the safest manner. In developed countries, take Germany as an example, ITS is precisely overlaid on a well-defined grid or network. Modifications in the grid are incorporated into the tightly integrated system. ITS manages and controls traffic with minimal human intervention.

In contrast, ITS in the Indian context so far comprises the deployment of technology solutions to help authorities manage rapidly increasing city traffic. Technology serves as a source of information for appropriate human intervention.

Indian ITS initiatives may seem simplistic vis-à-vis ITS in developed countries, but that should not hold back the country from continuing to take small steps in the right direction. After all, ITS is an evolutionary concept by virtue of having a fairly large number of dynamic components – the environment ITS serves, the users' beneficiaries, and the vehicles monitored. So, ITS by design must be capable of accommodating some level of evolution. It can start small and grow, with changes being accommodated and the shortfalls being plugged along the way.

India could shorten its learning curve by adopting best practices and cherry-picking technologies from developed nations. India-specific research would help localize these technologies.

(Above) **Bangalore traffic police have been equipped with BlackBerry smartphones, giving them access to a large central database of vehicles, drivers, and offenders** (Left) **The toll plaza at the Delhi-Gurgeon border**

"The application of these standards is not statutory. Some aren't suited to Indian mixed-traffic conditions comprising of many modes and kinds of motorized and non-motorized traffic. For instance, two-wheelers account for more than 63% share of the motorized traffic but the country lacks practical guidelines for mixed-traffic applications for such traffic composition.

"Needs of pedestrians are largely ignored in the design process," Baluja continues. "Roadsigns, markings, and signals are not systematically and uniformly used across the country and many times these are not well integrated with the national legislation, which is one of the important reasons that Indian roads are unsafe." In spite of India being a signatory to the UN Conventions of Road Traffic and Signs and Signals of 1949 and 1968, standards are not being adhered to in principle.

Ninad Patil, director of the Save Pune Traffic Movement, a not-for-profit company driving a citizen's movement to improve the city's traffic conditions, concurs with the back-to-basics approach. "Pune needs several fundamentals to be implemented before thinking about ITS," he says. "These alone could resolve many of the city's traffic problems." Among these basics, he counts observing traffic discipline and ensuring that the base infrastructure is in working condition, such as traffic signals working continuously, signage installed at expected locations and maintained in good condition, and so on. Nevertheless, he agrees that ITS would help the traffic and transport authorities manage better and more efficiently by virtue of having at hand records of road users and information about traffic build-up.

Baluja also feels that Traffic Engineering Centers should compulsorily compose integrated systems to be followed by all Indian road development and maintenance agencies. "ITS can only be successfully implemented when it is overlaid on a sound foundation, and based on location-specific traffic engineering," he concludes. "You can't ignore the first few steps and jump to the 20th step. It isn't about buying and installing traffic management products, however advanced the tools may be."

Deepak Gupta would agree. Readiness in every sense of the word would make ITS a bigger success and driving on Indian roads a more pleasurable experience. ○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Chauffeur driven

As **Michael Feld** from the DFKI reveals, the smart car is so much more than a safer car. Featuring artificial intelligence, it will learn from your daily routine, access your schedules, and play a crucial and smart part in getting you from A to B

Should you happen to take a trip to Las Vegas, Nevada this year, you stand a pretty good chance of being overtaken on I-5 by a driverless car. As of 2012 onward and in full compliance with the law, autonomous vehicles are now allowed in road traffic in the Silver State, thanks in part to recent Google initiatives.[1] What this ultimately proves is that methods from robotics and artificial intelligence have finally produced assistance systems that are not only sufficiently highly sophisticated enough to simplify driving but can also even take over completely.

Those drivers who aren't quite ready to relinquish control of their steering wheels can nevertheless expect numerous new services to make their cars more 'intelligent', which is where 'smart cars' also come into the equation. One example is the compound project sim^{TD}, within which a suite of safety systems is being created to alert drivers to dangerous situations such as a traffic jam or obstacles on the road.[1] In the future, such events will be detected by the onboard sensors of the vehicles involved and alerts will be forwarded on to downstream traffic.

All in the presentation

The Automotive Group at the German Research Center for Artificial Intelligence (DFKI) has been addressing the question of how to present this multitude of additional information in the cockpit without diverting attention from the traffic. This might also involve 'information sparseness' – in other words, the omission of certain messages that need not concern the driver.

However, even seemingly simple tasks can consume dangerously high levels of concentration in dense traffic – setting the air-con or changing a radio station, for instance, particularly in cars where drivers might be unfamiliar with the layout. With the help of eye-tracking, though, the car could establish when the driver is looking in

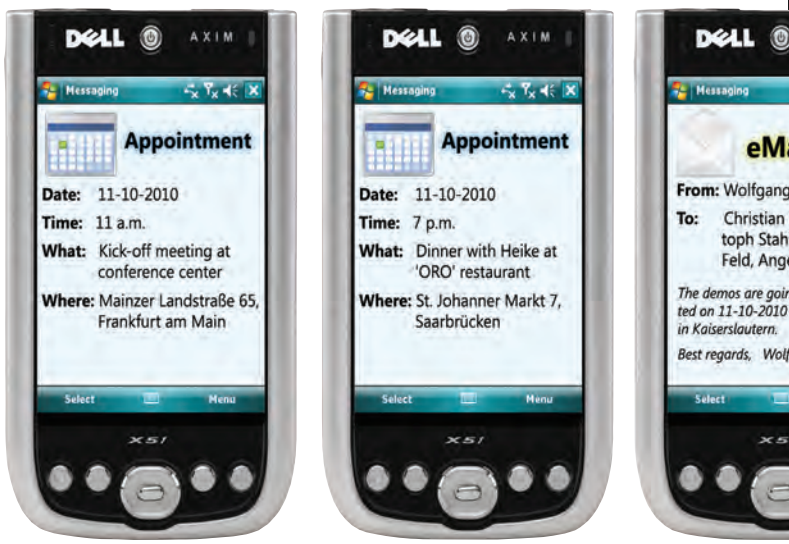
a certain place within the cockpit for controls yet isn't able to find them. Speech can also serve as a useful complementary input method to buttons or menu-driven systems, and DFKI has already researched the paradigm of multimodal interaction.[2] Entering destination addresses into a navigation system using turn-and-push dial or touchscreen also requires significant attention. However, by connecting the navigation system to personal email and calendar – either through a smartphone or cloud service – it could gain direct access to scheduled appointments and travel destinations.

Navigation with destination suggestions

Intuitive ways of combining existing interfaces and new technologies to further increase safety and driver comfort have already been developed at DFKI and Max-Planck Institute for Informatics (MPII) – and introduced at the User Modeling, Adaptation and Personalization Conference (UMAP) 2011.[3]

Navigation systems are an everyday tool often already integrated into the vehicle electronics. And even though entering address details has been simplified through speech input and dynamic filtering of the list of selectable locations during input, it nevertheless remains a tedious task. In a truly intelligent vehicle, manual destination entry only plays a subordinate role.

In many cases, the car can predict where the trip is supposed to go and take over the programming of the navigation system autonomously. If there are multiple possibilities, though, the driver can choose. In this case, the order in which the results are displayed is important, too. As with search engines where the first results are more visible than the rest, the same would occur here, although due to the limited screen space on a car display, only a few elements can be shown on a single page. Consequently, a simple rearrangement of the first entries can have a considerable impact. Through the use of artificial intelligence, relevant suggestions can be generated by using the appropriate information and methods.



(Figure 1, above) **Example scenario shows appointments and emails on the driver's cell phone** (Figure 2, in sidebar below) **Destination suggestions in the example scenario with a single user (driver)**

The scenario pictured in the *Personal touch* sidebar (left) already shows that the function proposed evaluates a large array of facts and creates complex relationships. Additional knowledge can also have an impact, however. For instance, if a colleague enters the car, all emails in which the passenger is listed as a recipient now receive a bigger weighting and the corresponding destinations appear higher up on the list. The colleague's home address would also be considered a possible destination and can be selected in the same way (Figure 3).

The car as an information hub

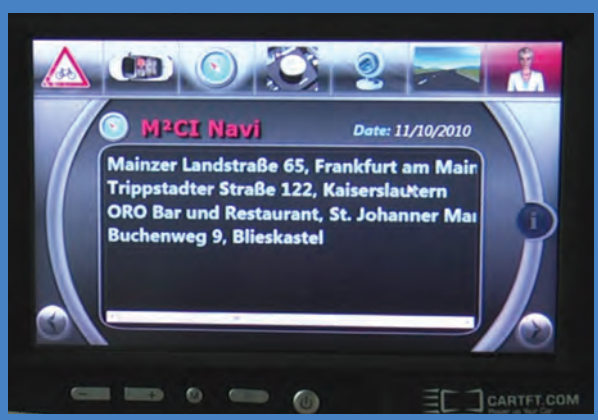
As the car accompanies the driver on many journeys, it can also 'learn' a great deal about habits – such as the route to work, typical shopping hours, preferred types of road, etc. The more knowledge that is available, the more powerful the application scenarios that can be realized. Figure 4 shows the information infrastructure in a 'smart car', split roughly into information sources, middleware, and applications.

Vehicle sensors (speed, temperature, rain, etc) in the interior and exterior are examples of information sources, as well as onboard electronic components (headlight state, window position, ventilation level, and so on). An option for accessing the data is the bus system, such as the CANbus. Supplementary information can be obtained from radio broadcasts sent by the traffic management roadside units (e.g. radio-equipped traffic lights or traffic signs), and other vehicles (V2V). Furthermore, the long-term history of certain sensors, such as position, may be relevant as it can be used to derive driving habits and preferences (favorite roads, for instance) as well as typical behaviors (driving style, reaction time, etc), which in turn play an important role for personalization.

Personal touch

The following shows what could be achieved as a result of this research. Imagine, for instance, that a driver enters his car in the morning to venture out to a business meeting. As a result of using his personal car key, the vehicle and his personalized navigation system automatically recognize him. As he invokes 'suggestions' in the navigation system, the car establishes a connection to his cell phone, where among other things the relevant appointments and emails depicted in Figure 1 are stored. The system then suggests four travel destinations, as shown in Figure 2. After the first location has been selected, the navigation can start.

As can be seen in the depiction of the user interface, most locations have been adopted from the email and calendar entries. The appointment in Frankfurt is listed first as it was added to the calendar manually. The second address has been extracted from an email, which contains the driver as one of the recipients (without being certain if the indicated meeting has been accepted however). The third appointment is also based on a calendar entry but referring to a dinner appointment later in the evening. The final entry is a location that is generally visited often – also without particular evidence given (the user's home address).



Those devices that are usually connected separately as a result of the data bandwidth – such as interior microphones, cameras, and (in the near future) eye-trackers – are also sensors. They commonly deliver their input to a special type of component that infers further knowledge from the raw data. Such complex inference systems fuse multiple knowledge sources but are not applications by themselves. An example would be a component that identifies users based on voice profile and weight. By incorporating emails and calendar, the car's knowledge base is extended to external user profiles stored on the cell phone, on the internet, or elsewhere, which can be fully transparent, depending on the middleware.

On the application side, there are ADAS, comfort functions, information and entertainment systems, which in principle are not limited to the driver but can also be developed for use by other passengers (e.g. sightseeing tips). When it comes to destination suggestions especially, the navigation system becomes an application as well. Although OEMs today still prefer a direct and fixed integration of functions and sensors, the future is likely to bring a shift toward open middleware platforms because they are essential for accessing the full benefit of the information hub car in conjunction with personalized HMI. This concept is brought forward by several projects such as OVERSEE.[2]

Two information sources: email and calendar

In order to generate destination suggestions, all information sources that might contain hints as to where the next trip may go should be considered. Aside from basic data about the driver – such as name, age, address, etc, and other passengers – the calendar and electronic messages are particularly suitable as they are quite often straightforward to access through the cell phone and provide valuable cues. The calendar usually contains location and attendee information, at least for business appointments, and the approximate driving time can be used to estimate the relevance. But emails are rich in content as well, as confirmed in another recent study (see Figure 5).[3] However, it also showed that the data is often incomplete, in that it is inherently less reliable than calendar entries.

Another difference between calendar and email is that an electronic calendar has access to appointments in a structured form – unlike email, which may be more detailed and a better source for hints on spontaneous meetings and informal or private undertakings, yet requires special methods to retrieve the essential information. Recent information extraction projects, such as DBpedia or the YAGO project at the Max-Planck Institute for Informatics, have successfully shown how to automatically construct and grow large semantic knowledge bases from web sources such as Wikipedia. These knowledge bases contain millions of RDF (Resource Description Framework) facts about people, locations, events, and the semantic relations between them all.

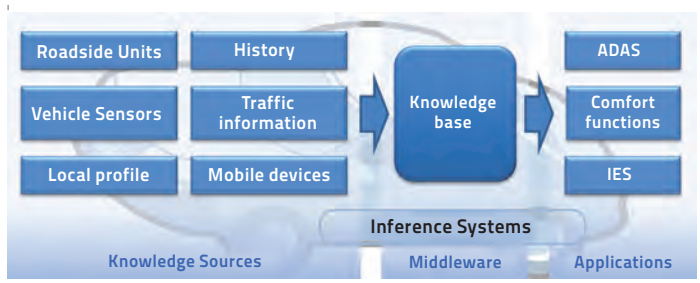
A particular challenge lies in the application of these web-based information-extraction techniques to user-specific calendar and email entries, in order to glean detailed hints on a user's appointments and to generate reliable navigation suggestions for possible destinations. Particular problems may arise in the correct identification of relative time and location information – for instance 'Let's meet tonight at the 'ORO' bar' – or in the analysis of entire email threads, which may span several iterations of a conversation and often contain complex, context-specific time and location references among each other. Often, the resulting information remains inherently ambiguous and for humans is not easily recognizable.

> In many cases, the car can predict where the trip is supposed to go, and take over the programming of the navigation autonomously

Inferring destinations intelligently

The application of logic-based inference techniques in such personalized knowledge bases therefore requires a particularly high degree of robustness with regard to vague, incomplete or sometimes even contradicting information about possible destinations. As a consequence, query processing techniques used in current database engines or purely logic-based expert systems quickly fail to deliver satisfying results in these scenarios. To cope with this challenge, the research in our current URDF project[4] specifically focuses on efficient reasoning techniques in these 'uncertain' RDF knowledge bases.

URDF applies a combination of rule-based inference techniques and probabilistic



(Figure 3, above) **Destination suggestions in the example scenario with driver and passenger** (Figure 4) **Overview of the information flow in the intelligent car**

models in order to suggest the most likely destinations – even for noisy input data with high precision. In particular, the link between user-specific calendar and email data with the car's navigation system enables us to provide a unique form of context-aware reasoning. For example, we can infer destinations from structured calendar entries with high confidence if we also know that this destination does not exceed a particular temporal and spatial distance to the driver's current location.

On the other hand, we can safely exclude the case that a driver will be able to reach two different locations that are spatially far away from each other, such that the system needs to decide for the single most likely destination in such a case. Moreover, we can also include the car's sensor data – including information about switching drivers or additional passengers – directly into the reasoning. As a result, these events need to trigger an immediate recomputation of the possible destinations as this updated information may substantially change the decisions made by the reasoner.

The enormous expressiveness that we obtain from combining rule-based and probabilistic inference techniques underlies a much higher combinatorial complexity than, for example, traditional query evaluation strategies employed by database systems. Our research therefore also concentrates on efficient approximation algorithms with good guarantees, which are tailored to these evaluation strategies (see *Challenges in development* sidebar).

Conclusion

We've already seen prototypes of a new generation of in-car functions that offer much more extensive and more personalized driver support than before. By combining email, calendar, and navigation, time can be saved while comfort is gained and safety is improved. Still, prior to market readiness, the systems need to prove themselves in user studies, and some aspects not considered in this article, such as privacy protection, need to be addressed. In parallel, research will look into many other possibilities for employing the vast amount of information available in the car.

Challenges in development

Overall, the development of knowledge-based applications for the intelligent vehicle comes with a number of challenges, with sub-task items that need to be considered within this context.

Identification of the user: The functionality focuses primarily on the user who is utilizing the system. Thus, he or she has to be recognized and be provided with a local user profile. Recognition options include the car key, Bluetooth phone, or speech (speaker identification).

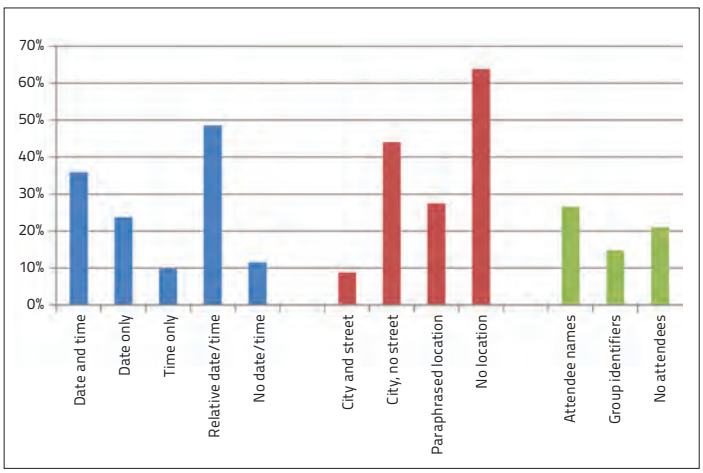
Data collection: The data from different sources and devices needs to be collected and be made available in a central place. A knowledge component can be installed for this purpose. In our case, data consists of user information, calendar entries, and emails, which can also be stored on the mobile phone or online.

Information extraction: From the collected data, the facts required for the particular function need to be extracted. In the case of emails, the text-based information extraction methods are applied.

Drawing conclusions: Based on facts, the system serves to answer concrete questions, e.g. 'What is the most likely travel destination of the driver?' Both knowledge and computation algorithms contribute to the quality of the answer, which are in this case the destination suggestions.

Result presentation: The visualization of the result and involved interaction concepts also play an important role for the usability of a function. This refers, for example, to the number of items per page or the addition of colors and icons, which has not yet been examined to improve efficiency.

> We've already seen prototypes of a new generation of in-car functions that offer much more extensive and more personalized driver support than before



(Figure 5) **Cues contained in appointment emails on time (blue), location (red), and attendees (green)**

• *Michael Feld works as a researcher in the Intelligent User Interfaces department of the DFKI in Saarbrücken. He would like to acknowledge the input of Dr Martin Theobald at the Max-Planck-Institute for Informatics (MPII) in Saarbrücken; Dr Christoph Stahl from the Ambient Assisted Living Lab at DFKI in Bremen; Timm Meiser, a PhD student at the MPII; and Dr Christian Müller, head of the Automotive Group at DFKI in Saarbrücken and Action Line Leader ITS at the European Institute of Innovation and Technology (EIT ICT labs)*

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Age concern

Recognizing that there will be a lot of older vehicles still on our roads as connected, self-driving, 'utopiamobiles' start arriving in force, **Bern Grush** suggests ways other vehicles can more easily participate in ITS innovations

Photographs courtesy of Mike Gerrard & GM

There are several important trends that could influence the makeup of our automobile fleets in the coming decades. Vehicle miles traveled in the developed world may be saturating and appears to have reached a plateau starting around 2004. Some describe this as a permanent peak, for which there is evidence in the USA, the EU, Japan, and Australia. If this remains so, the demand for new highway lanes might diminish (as many transport economists suggest should be considered by infrastructure planners).

What is somewhat implied by peak car but seldom stated explicitly is that congestion in the developed world might be stabilizing at current levels. If right, that would be good news as variable pricing can temporally distribute our current lane inventory and advanced ITS can make those lanes safer, cleaner and more efficient, thereby addressing the ongoing congestion crisis with little new road infrastructure.

Trends in motion

For the purposes of this article, the issue of induced demand will be ignored as peak-car advocates say this is a demographic change and demand saturation – not congestion avoidance. But perhaps we need a few more years to be certain about this VMT plateau or peak. In the meantime, most developed nations have constrained budgets for road-building, so there is diminished opportunity to build unneeded roads.

A second trend is that the average age of vehicles in the USA – and in many other countries, including the UK – is increasing (see Table 1 overleaf). An aging trend would have several effects including job reduction in the auto manufacturing sector, increased trade in the parts and maintenance sectors, a slowing of the electrification of our personal fleets, and inhibition of factory-installed ITS. It could also lead to an increase in the demand for aftermarket ITS, and a delay in the switch from fuel tax to road use charging as fleet aging slows the erosion of fuel tax efficacy. In short, fleet aging is likely to be a barrier to automotive efficiency and safety.

Built to last

An immediate reason for aging fleets might seem to be that the current recession postpones the purchase of some new automobiles. However, deeper and more sustainable mechanisms cause this trend.

(Right) **GM is now offering OnStar to used-car buyers and non-GM owners in a replacement rearview mirror;** (Below) **Aftermarket navigation devices and even smartphones now offer more features than US$3,000 factory-fitted systems**

Today's cars are engineered to last longer and they are lately being driven fewer miles. The reason for reduced mileage is that households have a fixed budget for automobility. In the USA, this figure has hovered steadily between eight and 10% of disposable income since the 1950s, according to R. O'Toole of the Cato Institute. Although this may differ elsewhere, the existence of a nationally consistent average budget for automobility would be evident in any country. Hence, declining average relative incomes – a trend older than the current recession – would have an evident effect on average household budgets for automobility.

Given such a constant budget, could fuel-price volatility – currently exacerbated by income uncertainty – remain a minor, underlying factor in postponing a new car purchase? Could this mean gas prices make fleets age, hence adding VMT to the cars we already have? Contradicting that notion is that our 'travel budget' reduces discretionary travel and sometimes increases mode switching, so that high gas prices are reducing automotive VMT, rather than new car purchases. Analysis suggests our fleets are maturing for long-term and sustainable reasons, and that we are unlikely to return to – or even maintain – high per-capita car ownership or VMT. Aging is a long-term if not permanent feature of our automotive fleets.

The way most cars cycle through a first, second, and third owner is that the oldest cars – especially those beyond the median age – create little demand for new cars but mostly for slightly newer used cars. Demand for new cars is created by cars that are generally only three to six years old, according to Tom Webb of Mannheim Consulting. What an aging fleet means is that improved engineering allows used vehicles to stay on the road longer, and perhaps to have a fourth owner. This demand cascade also supports used-car resale value.

Future thoughts

What does this mean for ITS? On the one hand, we entertain a vision of a transportation revolution of electric, self-driving, connected vehicles. We imagine large network-wide systems such as smart-grids for cars or Better Place's battery-swapping system. We look forward to the services and safety of USDOT's Connected Vehicle or EU programs such as eCall. These large-scale visionary programs are generally targeted at new vehicles and are phased in over decades. According to the *CET Technical Brief Electrical Vehicles in the USA*, for example, we can expect 64-86% of new vehicle sales for light vehicles to be EV by 2030, and for a total EV portion of the light-vehicle fleet to be 24-46%.

All the while, we will maintain an enormous, sunk investment in an existing, slowly diminishing fleet – many of these vehicles will have few of the innovations of the growing, soon-to-be-dominant, safer, and smarter vehicle population. An entrenched and aging fleet creates resistance to change, locking in existing combinations of technology and its organization, use, infrastructure, maintenance, and taxation. What will happen as 75, then 50, 25, or 10% of our fleet consists of older, IC engine and likely pre-connected vehicles?

> These large-scale visionary ITS programs are generally targeted at new vehicles and are phased in over decades

What will happen is an explosion in the number of aftermarket automotive innovations. These small devices and applications are already showing up as smartphone applications, hanging off of the OBD port or suction-cupped to the windscreen. These will give the older fleet a modicum of parity in services and communication. One instance of this is the scaled-down OnStar feature set available as an inexpensive, aftermarket rear-view mirror replacement. But a more instructive example is

Maintaining automobility

Surprisingly, keeping an older vehicle rather than buying a new one may be the greener choice (unless the older vehicle is an incredible polluter). The reason is the carbon footprint embodied in a manufactured car matches that exiting the tailpipe of a car over its average lifetime. Buying a well-made car, maintaining it properly, and keeping it an extra couple of years is better for both your wallet and the environment. Some other factors stand out in this aging trend. Cars tend to be better made now than in past decades. Longer-lasting cars combined with lower employment levels help maintain automobility among lower-income households. Why? Higher income households enjoy high vehicle turnover (paying for their rapid depreciation) so that lower income households benefit from cheaper automobility – a 'trickle-down' benefit frequently underappreciated.

Average age of passenger cars			
	2001	2004	Change in years
Belgium	5.6	7.6	2
Denmark	8.2	9.3	1.1
Finland	10.2	10.5	0.3
France	7.5	8	0.5
Italy	8.1	9.4	1.3
Spain	8.3	9.1	0.8
Sweden	8.7	9.6	0.9
UK	5.9	6.8	0.9

(Table 1) **Automotive fleets in developed countries are aging rapidly, which would have several effects – including inhibiting the installation of factory-fitted advanced ITS technologies such as eCall**

a US$200 GPS navigation device available at a local electronics shop that is superior to the US$3,000 factory-installed GPS system from only a few years ago. A friend of mine has both but uses the cheaper aftermarket version as it has better features.

In fact, her built-in system was out-of date before she picked up her new car from the dealer. It occupies a large portion of her dashboard and will never be used again. This mismatch of technology – a US$40,000 automobile with a lifecycle of 10-12 years and a US$200 digital gadget (US$2,000, if factory-installed) with a lifecycle of 10-12 months – is a form of technical impedance. And it will likely lower the resale value of her vehicle as a buyer would have little use for the space-wasting built-in GPS screen.

Worse, she now has a geeky suction-cup harness for her cheaper-but-better GPS navigator. This clutters her dashboard, and could become a flying object in the event of a collision.

Telematics update

We need to think more carefully about what we build-in at the factory and what we add afterward. Once a car is in its third year, it is unlikely any digital, built-in device would not be out of date and upgradable for US$200. And the number of small wireless telematics devices that can do some very reliable and useful things is growing rapidly. The problem is that many of these devices need power and most manufacturers provide too few auxiliary power outlets. And they are always placed sufficiently awkwardly so that the power cord gets draped over the armrest or the gear shift and hangs inconveniently over your stereo controls.

What we need is a secure docking area in or on the dashboard that brings power, adapters, read-only OBD, USB, and other connectors where they're needed most. It should include a secure attachment and an attractive bezel design to provide uncluttered organization for three of four devices for connected vehicles, hand-free communications, GPS, and other traveler services.

It would be disappointing if the car makers provided only proprietary connectors. Standard-form factors and connectors would make this open for innovation and would facilitate the participation of aging vehicles in connected vehicle or self-driving programs of the future.

Even though I might be driving a 2016 IC vehicle in 2030, I could still safely join a mostly EV platoon of two- or three-year old cars with a self-installed device I bought for US$350. Well, maybe that particular system needs to be professionally installed since it needs to write to the OBD, but you get the idea… ○

• Bern Grush of Bern Grush Associates consults to various parties seeking to deploy, pilot, trial or study technical and social issues surrounding the use of autonomous location-based technologies for road-use pricing

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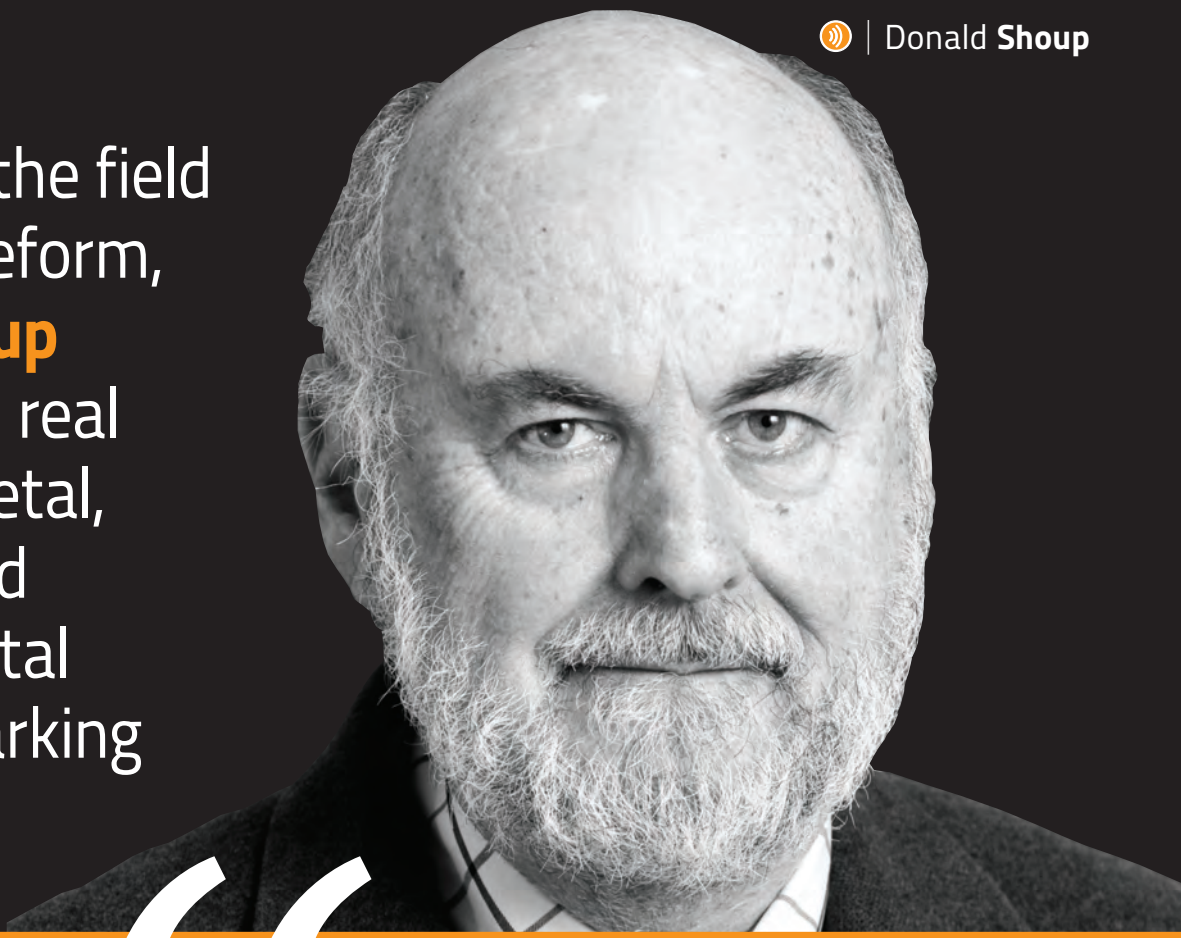
A legend in the field of parking reform, **Donald Shoup** explains the real costs – societal, financial, and environmental – of 'free' parking

Interviewed by Louise Smyth



> Free parking is not better than the alternative, which is to charge the lowest price you can and still have one or two open spaces on every block

On-street parking undoubtedly has a major impact on traffic management, with an oft-quoted statistic suggesting 30% or more of traffic in our built-up areas is caused by drivers circling around looking for a parking space. Yet around the world, this is a part of traffic management that has been consistently neglected by urban planners and traffic managers alike. There is one man, however, who recognized the importance of the parking/traffic relationship many years ago, spent decades offering suggestions as to how to improve the situation, and whose work is finally being vindicated. Donald Shoup is UCLA's Professor of Urban Planning.

The title of Shoup's seminal 2005 book, *The High Cost of Free Parking* (updated in its 2011 paperback edition) provides an indication of the central tenet to much of his work, which is simply the essential need for drivers to pay a fair price for parking – and the problems we've caused ourselves as a result of not doing so.

The mis-management of parking

Armed with both engineering and economics qualifications, Shoup is in the perfect position to offer a sound opinion on this issue: "Engineering is about problem-solving in many ways and I think parking is a big problem," he says. "On the economics side, parking affects the economy in so many ways – and yet it is so mis-managed. One of the things economists always advise for any problem is to 'get the prices right', and I don't think there is any part of transportation where the prices are so wrong as they are in parking."

Shoup's point is that although we may park for free when visiting friends, going shopping or while at work, the parking is not actually free – it's absorbed or hidden by other costs. "When you rent an apartment in a new building, usually one or two parking spaces come with it," he says, illustrating a prime example. So the cost of parking is hidden in the cost of housing? "Yes, this has two bad outcomes: it raises the price of housing and it hides the cost of parking – so you think that parking is free, which is an encouragement to have a car and drive everywhere you go.

"We have free parking for cars and expensive housing for people. We've got our priorities the wrong way around! And we expect planners and transportation engineers to be able to tell us how much parking we need when they really don't know – they have no training in estimating the demand for parking and they have no idea how much it costs – the costs vary enormously from one place to another. If you're out on a farm, it's potentially free but if you're in a city, the space generally costs more than the car parked in it!'

Shoup's theory is that an 85% occupancy rate of on-street parking spaces is what to aim for to avoid the congestion caused when the spaces are over 85% full – when drivers have to circle around looking for a free space. To achieve this occupancy rate requires variable pricing in the same model we see in high-occupancy toll lanes or other areas of transportation, such as public transit. Higher prices at peak times, lower prices at quieter times, and prices varied by location.

The theories are not hard to understand, nor are they truly controversial – Shoup's merely saying we should pay for what we use. But how do we reconcile that with the already cripplingly expensive cost of running a car today? It's surely an uphill

struggle to convince the general public that they ought to pay to park something that's already draining their finances? "Right: it is expensive to drive, but we pay for everything else – gasoline, tires, insurance, and so on. We pay for everything except parking," says a frustrated Shoup.

"But I have given up trying to convince people that they ought to pay for parking. Where it's more successful is to convince people that they ought to *charge* for parking. What's breaking the logjam here in the USA is that some cities are now telling neighborhoods and business districts that if they want to charge for curb parking at the right price, the city will put in parking meters and spend all of the revenue for added public services on those streets with the meters. So if a street has meters, it will get services, such as extra street cleaning and sidewalk repair, tree planting, and police protection. Basically, when someone feeds one of those meters, it comes right out the other side in the form of public services! They are offered a choice: free parking and the services they now have or market-priced curb parking and all the money for public services. The cities that offer this find that neighborhoods begin to think about parking differently. For them, it's like putting a cash register out on the curb – and the extra revenue is a real incentive."

Pilot project

A city that's embraced Shoup's approach is San Francisco, whose SF*park* pilot project is receiving wide acclaim both in the international media and indeed on the newly metered, dynamically priced streets themselves. Although too early for official results (these are expected later in 2012), it does appear SF*park* will be a fine proof of Shoup's concept. The only slightly controversial thing about it is that it's using US$20 million of USDOT funding – anything that spends federal money in today's climate is subject to scrutiny and quite often a chorus of disapproval. But Shoup feels the scheme is a very good use of USDOT dollars: "For the price of subsidizing one parking garage in San Francisco, they're paying for an experiment that could change the world," he insists.

> For the price of subsidizing one parking garage in San Francisco, they are paying for an experiment that could change the world

SF*park* collects and distributes real-time data about where parking is available so drivers can quickly find open spaces

However, playing devil's advocate for a moment, is there an argument to suggest that on-street parking could simply be better managed via technologies such as parking guidance systems and smartphone apps that tell drivers where vacant spaces are, without the need to charge for parking at all? Shoup thinks not. "It might help a little bit, but if all the spaces are full, what good is it to know they're all full? It would be much better if we could count on there being a vacant space wherever we want to go, instead of having to look at our iPhones and say 'I see a space six blocks over' and it being gone by the time you get there. It's better to use technology to manage parking rather than the shortage of parking.

"Free parking is not better than the alternative, which is to charge the lowest price you can and still have one or two open spaces on every block."

Now aged 73, Shoup has had plenty of time to observe the decline into the current malaise. And he thinks in 50 years' time, we'll cast our minds back in disbelief at this era. "We'll reflect upon it all and say 'My God, what were these people doing? They had some of the most valuable land on earth and they gave it away free to cars and wondered why they had congestion'.

"Everybody says that the invention of the cash register transformed commerce and I think the invention of today's new parking technologies will do the same for urban transportation. I think we'll look back at the evolution of technologies such as occupancy sensors, multi-space meters that charge different prices at different times, cashless payment, and payment by cell phone and realize that this technology transformed urban transportation."

The hidden cost of free parking

Requiring Peter to pay for Paul's parking, and Paul to pay for Peter's parking was a bad idea, according to Donald Shoup. "People should pay for their own parking, just as they pay for their own cars, tires, and fuel. Parking requirements hide the cost of parking, but they cannot make it go away. They have misshaped our cities into motor-friendly, sprawling agglomerations – almost without planners noticing it."

According to Shoup, free parking often means fully subsidized parking. Paradigm shifts in urban planning are often barely noticeable while they are happening. More often than not they take the form of a quiet revolution. "And a quiet revolution is probably what we are witnessing right now," he says. "Of course, all parking is political, but this political background may actually provide fertile soil for a reform of parking policies."

Charging performance prices for on-street parking, spending the revenue for local public services, and removing off-street parking requirements will achieve the goals of almost all interest groups. Different people can support performance parking policies for very different reasons: because they increase local public spending without increasing taxes or because they reduce government regulation, cut energy consumption, air pollution and carbon emissions, unburden enterprise, and enable people to live at high density without being overrun by cars. "There are many good reasons to reform parking policies – what we need now is the will to do it," Shoup concludes. "Parking wants to be paid for."

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3GPP
Public safety
4G
C2X
LTE
Wireless

The third coming

The benefits and issues surrounding the use of commercial LTE communication technologies for public safety requirements are many and varied, although the USA appears to be blazing the trail. **Jim Gunn** investigates the enormous potential for markets elsewhere

Illustration courtesy of Vladgrin

For many years there have been frequent discussions concerning the use of commercial communication technologies for public safety communication applications in transportation, law enforcement, fire, emergency management services (EMS), and so on. The current wave of 4G deployments by commercial cellular operators based on Long Term Evolution (LTE) standards has fueled new opportunities and interests by the public safety community to leverage an extensive emerging LTE ecosystem. This would include services, system components, user terminals, infrastructure equipment and software to cost-effectively evolve and upgrade public safety communication to modern broadband technologies and services. Economies of scale and interoperability benefits provided by commercial standards and deployments could also be achieved.

Current commercial LTE deployments focus on wireless broadband services (e.g. video, imaging, web access, email, gaming, etc), which is also an ongoing public safety focus. In the future, LTE will include VoIP capabilities that most believe will eventually replace legacy circuit-switched wireless voice services. Although commercial cellular services and public safety wireless services have many common requirements that create significant synergies, there are also many differing requirements that should be addressed.

As the current international leader in commercial LTE subscribers, the US framework provides a good basis for further discussion. But with appropriate modifications for varying international requirements, the conclusions of this article should have international applicability.

LTE benefits

LTE offers many benefits for public safety communications. Perhaps of leading significance are economies of scale. At year-end 2011, international cellular is approaching six billion subscriptions or more than 85% of the world population. Estimates of public safety communications users are typically 2-5% of the population. Economies of scale for cellular are therefore significant. To leverage this scale, the cellular community has developed specifications and standards to achieve international interoperability.

In early years, cellular standards were regionally fragmented. 3GPP has developed standards for GSM, HSPA, and emerging LTE deployments. 3GPP2 is a similar organization for CDMA cellular technologies. LTE appears on track to be the first cellular standard to be adopted

LTE explained

Long Term Evolution (LTE) is based on standards developed by the 3rd Generation Partnership Project (3GPP). 3GPP was initiated in the 1990s to evolve from historically incompatible regional cellular standards to standards that provide international interoperability and economies of scale. On its website, it states: "The 3GPP unites [six] telecommunications standards bodies, known as 'organizational partners' and provides members with a stable environment to produce the highly successful reports and specifications that define 3GPP technologies."

3GPP provides the reports and specification and the regional 'organizational partners' (e.g. regional standards bodies) translates to locally deployed standards. The cellular technologies in 3GPP's portfolio include GSM, HSPA, and LTE. 3GPP states that "from 3GPP release 10 onward, 3GPP is compliant with the latest ITU-R requirements for IMT-Advanced 'Systems beyond 3G'. The standard now allows for operation at peak speeds of 100Mbit/s for high mobility and 1Gbit/s for low-mobility communication."

internationally, and end regional technology wars and resulting fragmentation. All regions and countries appear to have accepted LTE (with some variations most covered in the LTE standards) as their 4G technology. Additionally, early LTE focus has been on broadband (high bit rate) services to enable new market demands for wireless data applications such as video, web access, imaging, social networks, games, and many other broadband applications. A key feature of LTE is its OFDM (orthogonal frequency division multiplexing) modulation technology. This offers two significant features. First, flexible channel bandwidths; and adaptive channels that mitigate impairments in the unfriendly broadband fading wireless environment. As public safety often has spectrum constraints, the flexible channel bandwidths should prove beneficial.

The value propositions for public safety in leveraging LTE commercial standards address many shortcomings of legacy public safety communications. An ongoing issue in public safety has been fragmented deployments. Public safety has many agencies such as law enforcement, fire, EMS, and transportation at international, national, state, regional, county, and city/local levels. While standards and ad hoc communication partnerships have been formed by some, historically each agency (or small group of agencies) has tended to procure and operate their own communication assets that are often not interoperable with assets of other agencies, even in local areas.

In emergency and mission-critical operations where coordinated multiple agency operations are becoming increasingly essential, communication assets have been critically inadequate. Public safety communication standards have been developed, such as P25 in the US and Tetra in Europe. However, these standards have focused on narrowband voice and low bit rate text/data. They do include functionality and features that address unique public safety requirements. Many of these unique requirements are not addressed in commercial wireless networks and standards. Interestingly, P25 initiatives originated in the early 1990s and slowly converged on narrower 12.5/6.25kHz channels to achieve higher capacity digital voice deployments. Simultaneously, the commercial sector 2G/3G/4G standards evolved broadband digital channels (LTE supports 20MHz RF carriers) that can be configured for high bit rate data channels or many low bit rate voice channels. Interestingly, public safety has addressed spectrum efficiency with narrower channels that don't efficiently scale for broadband. A better option for public safety broadband is to adopt LTE's 'commercial sector' technologies and standards that efficiently support high bit rate channels for emerging broadband services.

(Main) **LTE meets the mission-critical needs of first responders in the field by providing greater data sharing in both directions;** (Below) **LTE 4G mobile broadband generation is an evolution of the current 3G wireless network standard**

Issues with using LTE

The issues for use of LTE in public safety include unique user terminal requirements, infrastructure and related coverage requirements, features and applications requirements, and privacy and security requirements. Many envision use of rapidly emerging commercial cellular smartphones as user terminals for public safety applications. And, in fact, they are already being used successfully in many public safety applications. They are often preferred for administrative tasks and are lower cost than tailored public safety user terminals. However, many public safety applications have requirements that are not addressed by commercial handsets. Some

(Left) **LTE will allow public safety responders to send live streaming video, photos and other data from an incident back to command posts;** (Below) **LTE technology opens a wide range of applications for ITS**

of these shortcomings can be addressed by software additions. Others are best addressed by using commercial handset intellectual property, components, and subsystems, augmented as required with other components to manufacture user terminals that meet unique public safety requirements including applications, functionality, user interfaces, more stringent equipment environmental requirements, and different RF bands. Utilizing components and standards as extensively as possible from the commercial cellular ecosystem would certainly support more cost effective solutions. It should be noted that tailored public safety terminals already use many commercial components (e.g. programmable microprocessors, digital signal processors [DSP], etc). Evolving to more extensively leverage LTE's emerging ecosystem should further enhance the cost effectiveness of public safety broadband initiatives and eventually overall communication assets.

Functionality requirements

Public safety has many special applications and functionality requirements. Push-to-Talk (PTT), broadcast, multicast, talk-group, and related functionality are frequently identified examples. Many cellular operators offer PTT services (defined in commercial standards) that appear focused on non-public safety applications such as dispatch. It is doubtful that these commercial PTT functions, as currently implemented, adequately meet many public safety requirements without enhancements. Another concern is environmental specifications of commercial terminals to meet extended temperature range, shock, waterproof, etc, requirements. Additionally, many public safety applications require special user interfaces. Examples include belt-mounted portables with appropriate microphone and ear-piece configurations to free, for example, fire or police hands and focus for mission tasks. Public safety has considerable vehicle-mount terminal requirements with enhanced display and keyboard needs. It also has direct user terminal-to-user terminal (no infrastructure) requirements that typical commercial services have not historically provided. Many mission-critical tasks will require specially manufactured terminals based as extensively as possible on commercial standards, technologies, components, etc, supplemented with features and components to address specific public safety requirements.

Use of commercial LTE services and infrastructure also has issues. Although commercial operators have extensive cellular sites, towers, base station equipment, backhaul, assets, etc, they have tended to focus on population coverage, often not providing service in low population density areas. In the USA, the larger cellular providers quote population coverage in the upper 90% range. High population density areas offer the best revenue opportunities. However, inspection of US cellular coverage maps reveals much lower percentage land area coverage. Public safety in the USA typically desires much higher percentage land area coverage than is typically provided by cellular operators (although multiple operators might mitigate this somewhat).

> The value propositions for public safety in leveraging LTE commercial standards address many shortcomings of legacy public safety communications

Even in a single state (e.g. Texas), coverage might require several operators and still have gaps. LTE in initial years will focus on broadband data services and provide voice services with legacy circuit switched services (e.g. GSM, CDMA). Thus initial operator plans indicate that LTE will largely be commercially available only in high density urban, suburban, and select other areas. Although it certainly seems likely that public safety will initially focus on higher population areas, longer-term planning should consider longer-term public safety land area coverage goals.

In the USA, VHF and UHF bands are extensively used for public safety wireless systems, particularly in lower population rural areas. Use of these bands is essential in rural areas, as propagation is much better in these lower frequency bands at providing desired rural area coverage with fewer base station sites and lower system costs. Conversely, higher population density areas typically deploy higher frequency bands, such as the 700MHz (D block) band and the 800MHz (TV rebanding) band, as these have higher capacities than are required for public safety communication in urban and suburban areas.

Another issue is emergency capacity. In emergency situations (e.g. hurricanes, tornados, riots, floods, cellular and public safety communication traffic tends to be several orders of magnitude greater than in routine situations. Thus, public safety needs to have dedicated or shared priority access adequate for such situations.

Another important consideration is availability. Even in routine operations, communication networks do fail. And in an emergency situation, failure may occur due to damage to network elements. Legacy voice telephone network operators have historically carefully designed their core networks with appropriate strength buildings, poles, cables, equipment, emergency power, backup/alternative redundancies, etc, to provide desired availability (e.g. 5-9s or 99.999% uptime). Wireless operators, with shorter histories, have not consistently designed their networks for comparable availability goals (although more so in recent years). Public safety communication officials often state that high availability is a critical requirement for their communication network. Thus, public safety and commercial operator initiatives and/or partnerships should carefully plan for appropriate capacity and availability for their programs.

As commercial operators prioritize population coverage and public safety land coverage priorities, it seems likely that public safety might want to deploy dedicated LTE infrastructure in areas where commercial services are not cost-effectively available. In addition, public safety should be able to integrate these dedicated assets into operators' core networks for seamless operations.

Additionally, the FCC has a significant public safety mandated narrowband deadline upcoming on January 1, 2013 that provides interesting considerations. The FCC in 1991 began initiatives requiring communication equipment operating under public safety and industrial/business licenses to be narrowband capable. Subsequent rulings required all (newly licensed) equipment to be narrowband capable in 1996. In later Report and Orders (R&Os) in 2003 and 2004, the FCC established a deadline that all licensees must migrate "to 12.5kHz technology or utilize a technology that achieves equivalent (spectrum) efficiency by January 1, 2013". This more than 10-year timeframe is longer than the typical depreciated life of communication equipment. These FCC narrowband requirements apply to 150-174MHz (VHF) and 421-512MHz (UHF) public safety bands, and do not include the 700MHz and 800MHz public safety bands – something the P25 communities have been addressing over the timeframe. Most public safety upgrades and deployments in bands under 512MHz will undoubtedly use P25 equipment and will address digital voice as well as some limited data capabilities. The 700MHz and 800Mhz bands will provide higher voice capacities and broadband data capabilities. LTE in these higher bands appears well suited to serve public safety needs for public safety broadband services.

Security and privacy are also important issues that will require appropriate enhancements for some public safety communication applications. Detailed discussions will not be provided here, but deserve careful attention in system planning and design.

A wealth of opportunity

The emergence of LTE as a single international commercial standard offers public safety the chance to address its broadband communication needs by leveraging the emerging extensive LTE ecosystem. These include partnerships, services, intellectual property, user terminals, infrastructure, components, software, etc. The public safety community has increasingly been expressing an interest in shared communication as opposed to dedicated agency assets. Utilizing commercial LTE technologies, standards, and services appear to offer enhanced sharing opportunities and substantial cost-effectiveness benefits. However, unique public safety requirements – not adequately addressed by LTE – should be addressed or supplemented by appropriate enhancements.

• *Jim Gunn has more than 25 years' experience in advanced communication and related technologies. Contact him on jimgunn@jgunnresearch.com*

The wonder of wireless

Although state and local government see huge potential for LTE in public safety, it's a technology that knows no bounds. The car-making giant, Ford, for instance, is utilizing LTE as part of its CoCarX (Cooperative Cars Extended) research project. The inherent faster data transmission rates were critical for a C2X demonstration, which saw information about road hazards, changing driving conditions and updated traffic information passed seamlessly from vehicle to vehicle. An emergency signal was displayed in the car following the S-MAX within 100ms. The benefit of such speed for collision avoidance systems is self-evident.

For more traditional traffic management duties, though, LTE will provide just as many opportunities. In Seattle, for example, plans are afoot to not only use LTE for the entire spectrum of public safety, but also other services such as transportation. With LTE, field units would be able to monitor traffic throughout the Emerald City to more quickly dispatch units to effectively deal with congestion or incidents on the roadway. The city's entire ITS could essentially become wireless, allowing the many and varied benefits offered by ITS technologies to reach areas that are challenging (or not cost-effective) to wire into the network.

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MANUFACTURED IN THE NETHERLANDS

Following years of growth in the VMS market, **Michele Ganz** details the new developments enabling even more progress for his company

Interviewed by Louise Smyth

Given the technical audience of our readership, salespeople are rarely the focus of our interviews – we tend to chat exclusively with engineers, R&D managers, academics, and other technical experts. But Michele Ganz from Aesys is not your typical sales guy. The Italian display solutions specialist has a strict policy that if you want to sell products, a thorough technical understanding of what they do and how they work is a prerequisite. So when Ganz joined Aesys seven years ago as international sales manager, the young International Law graduate dove straight into acquiring an in-depth technical knowledge of the electronic signage sector.

Now 33, he has been there to watch – and contribute to – the rise of Aesys within the traffic management field. Although the company has been working with LED technology since the 1970s, and is highly successful in a number of different sectors (its display solutions are used in Formula 1 racing, in the manufacturing industry and on public transport, for instance), the ITS sphere has only more recently become a key market – and one that Aesys is actively pursuing. "Around 50% of our business now comes from the traffic market and we are trying to increase that figure by bringing our products to an international audience," Ganz explains. "We've gone from being an Italian company selling in Italy to having six branches around the world, selling to more than 40 countries on four continents. And throughout this growth, we have kept one thing consistent: all of our production is conducted in-house with no outsourcing, which is very rare these days.

"Within the traffic sector, our main business is in South America, particularly in Brazil. But the clever thing is that regardless of whether a sign is deployed in Brazil or Saudi Arabia, it's the same product – it's the layout that's customized to suit the individual customer." Such customization is a vital part of Aesys's competitive edge.

VMS technology is very well established and not a fast-moving sector when it comes to technical innovation. VMS usage tends to be quite thoroughly legislated, and all serious vendors must adhere to various standards and regulations (such as EN 12966 in Europe). This standardization means it is tough for vendors to stand out from the crowd. Aesys invests a pretty standard 10% of turnover back into R&D – and this department's main goal is not to create new products but to enhance existing offerings.

"This adaptation is the key industry trend," Ganz feels. "The concept remains the same: it's the technology going into the signs that changes. Talking about optical performance is not a useful differentiator between VMS manufacturers; everyone who meets the legal standards can claim 'I am the best', so it's really what lies beneath that allows differentiation between suppliers."

Low power, high performance

One example of how Aesys has managed to adapt its signs to take a lead is in the area of power consumption and energy efficiency. "Our R&D team has recently developed some low-power technology that optimizes VMS performance for standalone operation using only photovoltaic energy," Ganz explains. "With this technology, the power consumption can be 80% less than the standard power consumption of a non-low-power sign. The aim is to save thousands of kilowatts of energy a year, enabling a greener approach to business by us and by our customers."

Of course, developing signs that can operate without being plugged in is not only environmentally altruistic, it is sound business sense. The benefits of not having to excavate roads, to install costly cabling and then run VMS on electricity are obvious. Buying VMS suddenly becomes a viable option for authorities that once would have dismissed the idea entirely – such as those that manage roads in very remote locations.

Ganz is more than familiar with the issue of challenging locations and he's keen to promote another technical evolution that he says makes Aesys signs unique. "We have just created a new cooling system to allow the VMS to cope with the extreme heat in locations such as deserts. It has a rear door with a double skin that is used

to pump cool air between the layers and keep the electronics cool. An extra roof was also added to the sign to allow warm air to escape and protect against solar radiation."

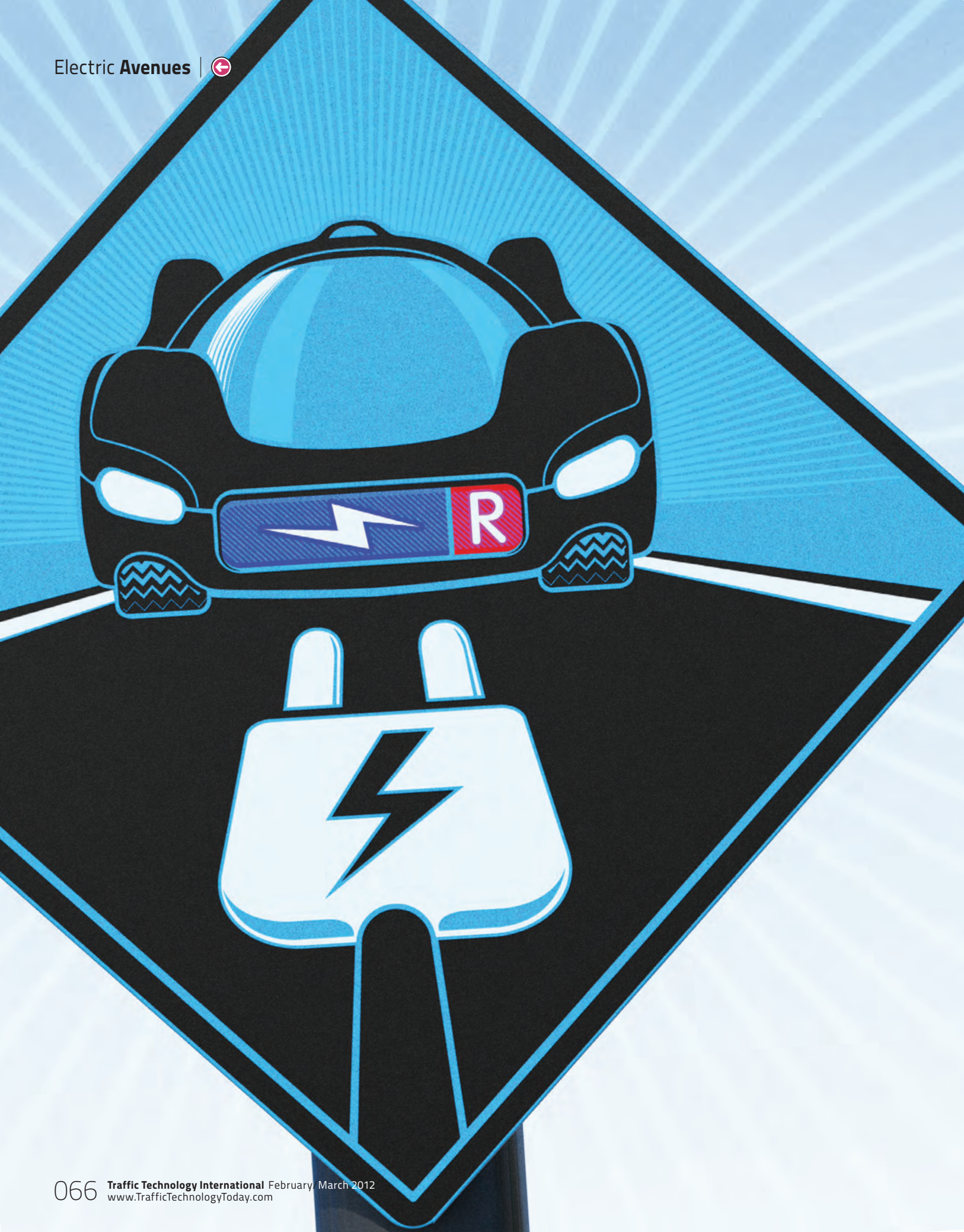
As the deployment of VMS has evolved to include locations such as deserts, so their application has also evolved. Standard highway VMS have gone from fairly simple signs showing a few characters to today's full-matrix (and frequently full-color) displays that offer far more sophisticated messages. With this has come the opportunity for VMS to go beyond the display of text and start showing pictograms (e.g. roadsigns) or other visual elements. One interesting function that Aesys offers is the ability to display a map of the local area and its current traffic conditions. And it's a popular function, too. "We are noticing a lot of demand for this, especially in developing countries, where they see VMS as part of their wider traffic management strategies. The highway concessionaires want to inform drivers of conditions both on the highway and off it – for example, if there's congestion on the arterials, showing it on these maps can help stop drivers exiting the highway and hitting a jam."

The demand for new functions such as maps shows that some authorities are still relying on VMS as an essential part of their traffic management strategies, despite much recent debate about how in-car information could signal the end of roadside displays.

However, it's no coincidence that such functions are finding their niche in developing nations. Legislation elsewhere (to prevent the signs from being distracting to drivers) is far more stringent. In Aesys's home country Italy, for instance, it's forbidden to show maps or scrolling text – and the rules are similar in much of Europe.

Ganz is reluctant to be drawn into a debate on the legality of these 'added extra' functions but does make a fair point about how such tools are developed: "Aesys has to provide all the instruments that customers ask for to enable them to use the signs in a way that fits into their traffic management vision. And it's our in-house production and customization that allows us to do so. What the customer demands, we will deliver."

> We have always kept one thing consistent: our entire production is all done in-house with absolutely no outsourcing, which is very rare these days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Motion picture

Could digging up existing highways in order to embed power lines for charging electric vehicles be the ultimate alternative-powered transportation solution? **John Challen** investigates projects that are looking to electrify road networks and their effect on ITS

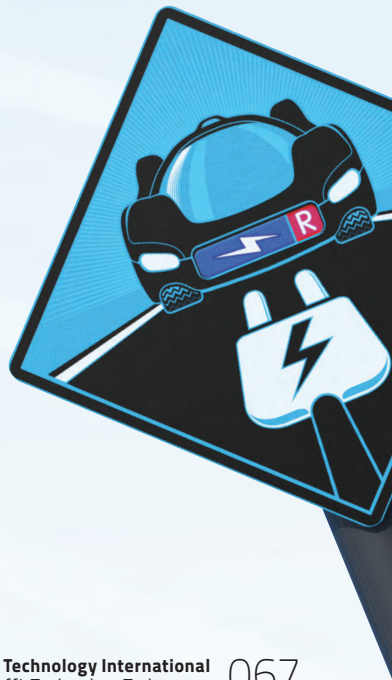


Illustration courtesy of Magictorch

One of the major problems car manufacturers have – and will continue to face – with the introduction of alternative-powered vehicles is the ability to keep them moving for long journeys without refueling. Fuel cell vehicles have been promised for years, only to be repeatedly hindered by a lack of government investment in a hydrogen filling station infrastructure. Having overcome the challenges of limited range and poor performance, electric vehicles are now starting to break through, supported by an increasing number of charging stations. Progress (and the charging process) however is slow.

Static charging for electric vehicles is nothing new, but recently several projects have emerged around the principle of in-motion charging. Using wireless power transfer measures, projects are being carried out to try and find a solution to the charging conundrum, with arguably the most ambitious project taking place in North America. Beyond charging, the program could also impact on the ITS infrastructure, power delivery of the systems, and improve the benefits that they currently provide.

Dynamic duel

Energy Dynamics Lab (EDL) – a wholly owned subsidiary of Utah State University – started a wireless power project in June 2010 and the program has now reached an advanced stage. Having proved that the technology works in a static scenario, attention has turned to the in-motion element. "The goal of the project is to make wireless power practical for electric vehicles, starting with stationary charging applications and then moving to in-motion applications on electric roadways," explains Jeff Muhs, director of business development, EDL. "The research is focused on improving efficiency, power levels and ensuring the safety of wireless power in those applications."

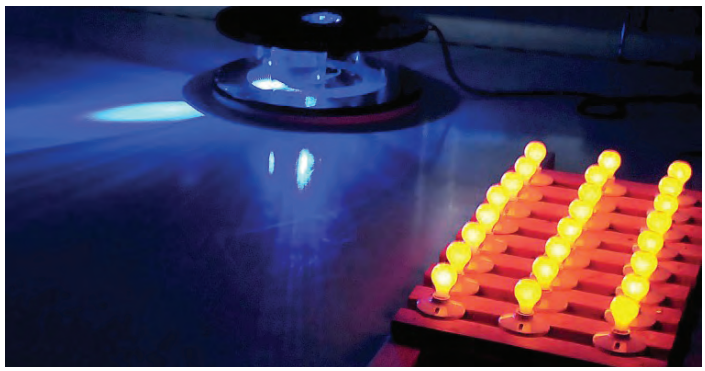
In practice, an electric coil or pad is placed under the road surface, with a similar coil or pad placed on vehicle. The magnetic field passes between one and the other in order to create energy – the upper pad inducing a higher current. In development, EDL has used a series of plastic cylinders to replicate the distance between road and underside of the vehicle, and Muhs says that stationary wireless charging has indicated an output of 5-10kW over a distance of eight to 12in, with a transfer efficiency of 97%.

EDL believes one of the benefits of such a system would be a battery that is 80% smaller than the current offering, bringing down the cost of the vehicle. Muhs also hopes eventually to prove the technology at speeds up to 70mph. "Efficient in-motion charging is possible but it will require a bit of reconfiguration of some of the hardware and software," he continues. The EDL director is fairly tight-lipped about exactly what is needed, although he does hint at modification of the power electronics and the design of the wireless power transfer mechanisms. The theory is that an electric vehicle could operate in a similar fashion to that of a slot car with the aid of the transmitting coil under the road, spaced a few feet apart. Power drawn from the road surface would allow people to travel very long distances without needing to use the more traditional charging station.

Coming soon

Now 18 months into the project, the technology has already been proven in the lab, and a demonstration is slated for Utah in the next 12 months. "The research is now shifting toward in-motion, or at least configurations that are applicable to both stationary and in-motion applications," Muhs reveals. "Not all wireless applications will operate sufficiently with one or the other, so we are looking for something specifically related to both."

Muhs believes there are mutual benefits of what EDL is doing and the wider ITS community. "The apparatus in the road might help in lane tracking where the ITS technology could help keep the



pads aligned and boost the power transfer accordingly. If the coils are not aligned properly, you get less power transfer, so the two areas can help each other. We certainly see a lot of synergies between the two."

Muhs also feels that ITS can help identify vehicles that are most in need of the power. "Some of the intermittence on the supply side could be leveled on the demand side by taking vehicles off the grid for a short amount of time, and having them rely purely on their battery," he suggests. "There will be a certain number of local vehicles running during rush-hour that would not need electrified roadways for propulsion so the energy could essentially be directed to avoid power transfer to those vehicles going longer distances that would need the power."

Predictably there is a lot of excitement within the laboratories and research centers conducting these projects. In the wider ITS world, however, there is a more pragmatic response. "The breakthrough in EVs will only really take off when we have implementation of real cooperative systems," believes Richard Harris, member of the board of directors for the World Congress on ITS. "But these systems are something we have been talking about for a long time and something for which there is a lot of hope – but actually we haven't got anywhere with them. There have been demonstrations and trials and pushes toward operation but nobody has really taken the plunge yet. Although I support the idea, launching it too early could prove a disadvantage in the long-term."

Harris is also at odds with Muhs' view that WPT could benefit ITS. "It may be a hinderance as it stops investment in other areas," he warns. "Do we even have the budget to repaint white lines on our roads? I don't think it's going to happen – moreover, I don't think many governments like the 'big bang' approach. They prefer to buy one system that works properly and replicate it."

Muhs does concede that cost is clearly a hurdle – he puts a very rough per lane/mile cost at between US$1 million and US$5 million

> The breakthrough in EVs will only really take off when we have implementation of real cooperative systems
>
> **Richard Harris, board of directors, World Congress on ITS, UK**

(Top left) **Future versions of the system architecture developed at EDL have the potential to be embedded under pavement and transfer power wirelessly to vehicles at speeds of 75mph or more**

– but also knows that the process will be slow. "Research on a single vehicle will only likely occur in the next three years, and we are still five to 10 years away from having data from hundreds of vehicles," he reasons. "For commercialization, we are talking decades – not years!"

Eastern promise

Shifting continents from North America to Japan, and it is perhaps understandable that Toyota – pioneer of the hybrid powertrain – has teamed up Toyohashi University of Technology on a program that is based on the theory of electric railways. Taking the source of energy from power lines, researchers have proposed converting this energy into radio frequency (RF) by high-speed inverters that are integrated into tracks in the road. This RF voltage would be picked up by the electric vehicle via a specially fitted steel belt in the tires, generating an electrical charge to boost the vehicle's battery. The belt in the tire and the metal plate on the road is claimed to be a more cost-effective measure than the coils employed by Utah. Toyohashi also believes that leakage through the electromagnetic field is very small, further boosting the efficiency of the system. It has even been suggested by some industry experts that these communication lines could be used to the benefit of ITS from the point of view of

Key moments in wireless power

1899: Nikola Tesla demonstrates the wireless illumination of phosphorescent lamps in Chicago before displaying a wireless power concept to a meeting of the National Electric Light Association.

1964: Electrical engineer William C. Brown demonstrates a model helicopter that is powered by a microwave beam. During 1969 and 1975, as technical director of JPL Raytheon, the American leads a project that successfully beams 30kW over a 1,600m (one mile) at 84% efficiency.

1988: The University of Auckland's Professor John Boys leads a power electronics group that develops an inverter using power electronics – and concludes that power transmission by means of electrodynamic induction should be achievable. The first contactless prototype is built.

1989: Japanese company Daifuku approaches Auckland Uniservices (holder of the patents from University of Aukland) to develop wireless technology for car assembly plants and materials handling. The project provides challenging technical requirements, including multiplicity of vehicles.

1990: Boys' team develops technology that enables multiple vehicles to be run on the same inductive power loop and provide independent control of each vehicle. >

The OLEV is remotely charged via electromagnetic fields created by electric cables buried beneath the road

relaying information from existing technologies, although the researchers haven't commented on these reports.

Forward-thinking

Jack Opiola from D'Artagnan Consulting in the USA, however, is currently working on projects involving charging stations in Oregon, but accepts that in-motion ideas and vehicle WPT should have its place – especially with public transport. With more than 35 years' business experience specializing in project management, PPP/PFI projects and business planning for technology projects spanning electronic road pricing and ETC to advanced parking markets, Opiola also has a keen interest in the electric vehicle movement and highlights the Korea Advanced Institute of Science and Technology (KAIST) project.

KAIST is employing a similar approach to that of Utah on four prototype buses, although it is using strips of metallic materials placed at the bus terminal. "I think what the Koreans are doing is more like the transition; electrification of our highways is more like a glimpse of the future," Opiola states. "At the moment, people are solving the problem with the obvious rather than the elegant. Currently, you pull over, get charged and then move on again – instead of getting recharged as you drive down a stretch of highway.

The waiting game

Despite being the 'customer' for many of these proposed solutions, car-makers have their reservations about the electrification of roads. Although not ruling the technology out, at the same time they don't expect to see any major breakthroughs anytime soon.

"We believe that inductive charging while moving is technically feasible," admits Larry Haddad, general manager, Product Strategy and Planning, Nissan. "But currently it is cost-prohibitive as it would require massive amounts of expense for the metals alone, that would be inlaid into the road."

Johan Konnberg, manager of Volvo's C30 electric vehicle, and head of the company's inductive charging project, is also au fait with contactless charging, but says the company is not planning to get involved in WPT projects for its cars. "We follow the development in the market but the main drawback is the infrastructure," he says. "A system like this would require huge investments, and you have to consider the so far unexplored effects from magnetic fields. I think such a network is realistic, but within a very long timeframe – 50 years or so."

> The apparatus in the road might help in lane tracking where the ITS technology could help keep the pads aligned and boost the power transfer accordingly
>
> **Jeff Muhs, executive director of the Utah State University Energy Laboratory, USA**

"Like many other projects in the ITS field, they've got the idea right – and it's certainly a more elegant solution for the users – but the world as we know would have to change to adapt to this," Opiola adds. "It's the cost of the change that worries me," he concludes. "You'd have to effectively close a lane to lay the cable and put the connector in, and for roads that aren't heavily used in Utah that can be done, but for the M25 – or a major road in or out of London or Los Angeles? The delay and the impact of trying to lay that would be unbearable and the cost would surely be too high. On a new road it's fine, but the costs of retrofitting it would be huge."

2009: Nissan develops a plug-free technology that it claims will make charging electric cars easier and faster. The system is demonstrated on its Zero Emission Vehicle (ZEV) and can charge in a parking bay normally reserved for plug-in vehicles.

2009: German electronics and powertrain developer IAV secures a patent on technology that allows vehicles to be charged as they drive over a road embedded with a rechargeable strip. Researchers promise commercial availability within three years.

2010: South Korean researchers develop a system for zero-emission buses and cars to be charged wirelessly, via magnetic components that are embedded in the road surface, which interact with similar items placed in the vehicle's tires.

2011: Toyohasi University of Technology and Toyota begin investigations into the use of magnetic strips embedded under the road surface and in tires to provide power to electric vehicles.

2011 (May) An electric Volvo C30 arrives at Flanders' Drive. The company's Belgian technology partner modifies the vehicle for inductive charging as part of a project that also involved bus manufacturer Van Hool and Bombardier, the tram builder.

2011 (December): German giant Audi and architects BIG Group display their vision of the 'Urban Future' at Design Miami 2011. The exhibit features a concept car from the German manufacturer that communicates with its surroundings, and streets that communicate with every road user.

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Show business

In terms of size, number of visitors and exhibitors – and not forgetting technology on show – there really is nothing quite like Intertraffic in Amsterdam. **Louise Smyth** presents 20 highlights to whet your appetite

Illustration courtesy of Tim Ellis

The global traffic community will soon be gathering in the Netherlands to attend the bi-annual Intertraffic Amsterdam event (March 27-30, 2012). The most recent edition in 2010 was a behemoth of a trade show – and 2012's exhibition is set to be even bigger. In an enormous display of industry expertise, more than 800 companies from 45 countries will be showcasing their latest offerings. Visitors are well advised to pack some comfortable shoes!

One of the aspects visitors particularly appreciate about Intertraffic Amsterdam – and which keeps them coming back every two years – is how comprehensive the show is. The sheer scope of industry sectors represented at the exhibition is simply unparalleled.

The greatest show on earth

Because it's such a huge showcase, the event is rather sensibly divided into categories, so visitors can immediately see where they need to head to find exhibits relevant to their individual interests – they're even color-coded for the navigationally challenged! As well as the regular focus areas that attendees have come to expect – Parking, Infrastructure, Traffic Management and Safety – this year also sees the launch of a new dedicated zone called the Smart Mobility Centre (Hall 9). The organizers at the RAI say the Smart Mobility Centre is designed to bring together "innovations, new concepts and knowledge that improve traffic flow and accessibility, liveability, and traffic safety in the field of sustainable mobility solutions". Well worth a look, then!

For our purposes, however, we wanted to highlight some innovations from our established subject areas. We've therefore hand-picked a number of must-see exhibitors from each – and asked them to tell us why they deserve the 'must-see' tag! Over the following pages, they have exclusively allowed *Traffic Technology International* to preview new product launches and real-world case studies, as well as interview senior staff – who you'll be able to meet at the event.

We trust you will find this preview informative if you're attending – and even if you're not. But if you are making your way to the Netherlands this March, the *Traffic Technology International* team looks forward to meeting you in Hall 11 at our booth (415).

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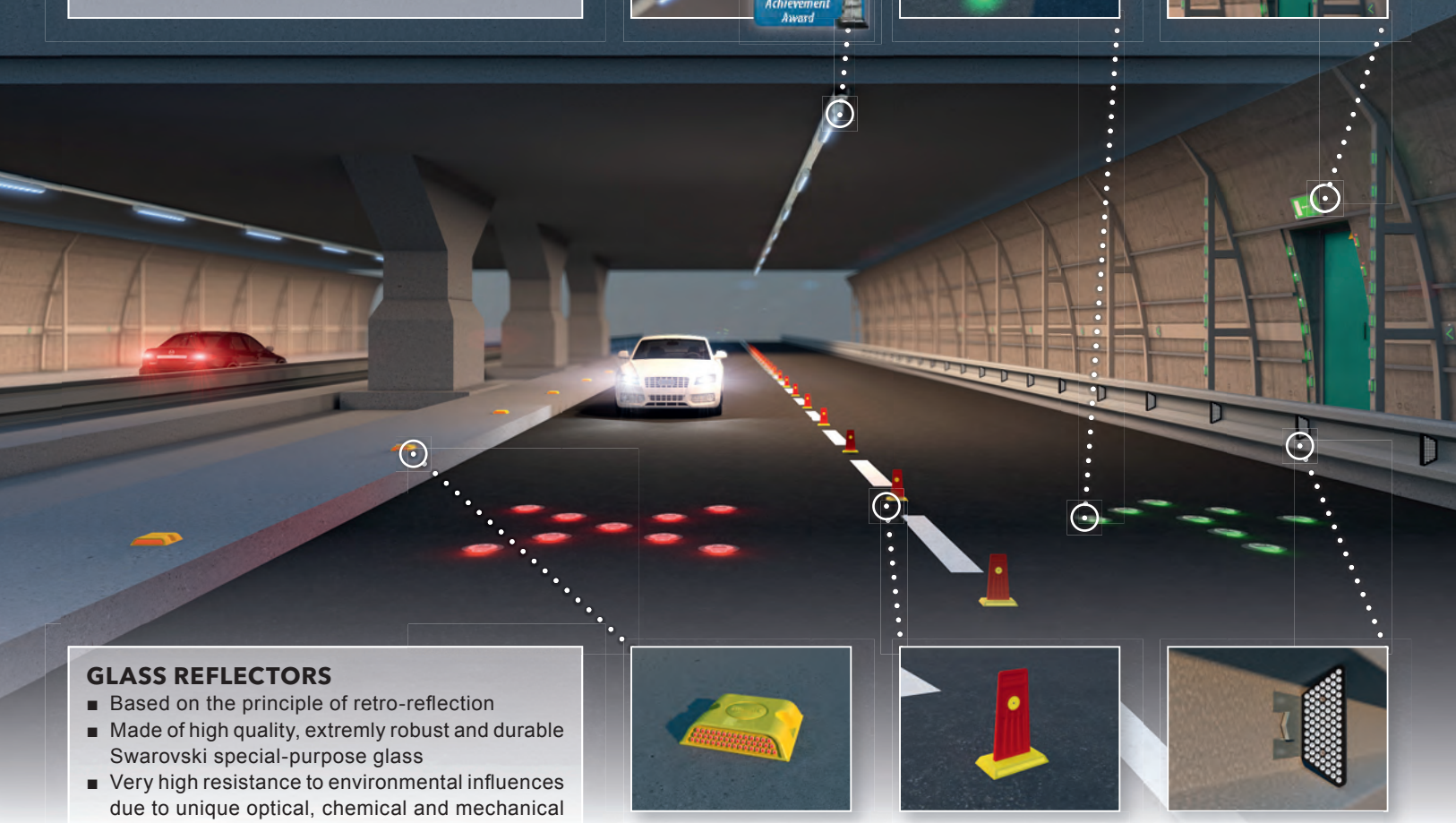

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INFRASTRUCTURE HALL 1

Transforming road repairs

Nu-Phalt
Booth 01.413

Nu-Phalt recently announced the formal launch of its Jetpatcher European operations. The collaboration with Jetpatcher is set to enable a cheaper and more sustainable solution for rural road defects. The ultimate aim is to provide a single-source solution for both urban and rural road repairs. It will give highway authorities the opportunity to transform highway maintenance delivery in respect to the management and repair of pothole damage to urban and rural roads. The addition of Jetpatcher is part of a strategic worldwide partnership. Bringing a greater focus and investment to developing a transport infrastructure service will help both companies' customers extract the best value from their road repair investment. Nu-Phalt has already been formally accredited for its expertise in this area, winning numerous awards for its highly efficient and eco-friendly Nu-Phalt Road Repair System. The system is being used by a growing number of councils in the UK, Europe and international markets. The combination of the two systems offers a cost-saving solution for road repair needs across all networks.

An example of the benefits the Nu-Phalt system can bring is seen in Dorset, a county in the southwest of England. Although much of Dorset is rural, the county is a popular holiday destination, which takes its toll on roads and car parks. Dorset County Council has a progressive approach to road maintenance. The county recognizes the scale of the challenge posed by the UK's road maintenance burden and the reality of countrywide spending cuts, combined with a determination to deliver the best possible service to the council's road users in the medium- to long-term, not just short-term fixes during peak pothole season.

Breaking the reactive cycle of road maintenance is critical for councils if proactive repairs are to be made. But in the meantime, potholes can no more be ignored than the long-term route of their cause. Dorset Works Organisation (DWO) has been using the Nu-Phalt system for almost two years, finding it to deliver efficiencies in many ways.

The system offers a high quality of finish and is BBA HAPAS-approved to give a 'seamless repair,' reducing the risk of joint failure common to conventional repair methods. It also offers more cost-effective repairs – up to a third saved on each pothole. Meanwhile the fast repair time and the self-contained unit bring less disruption to road users than traditional systems. The system is also easy to operate and environmentally friendly.

DWO has two Nu-Phalt units and is running both on tanked LPG (liquefied petroleum gas) –an energy source that reduces gas costs by around 50% as well as reducing manual handling and overall weight.

"Nu-Phalt repairs give us a greater capacity to address proactive maintenance projects without worrying about attending to the same recurrent defects," says Tony Stevens, Dorset Works maintenance manager. "The true value far exceeds the immediate savings."

EXHIBITOR CASE STUDY

Hans van Strien

Managing director, TrafIQ
Booth 01.210

What can visitors expect to see on your stand at Intertraffic this year?

We will be presenting our fully modified Mobile Automatic Roadblock System (MARS) vehicle, with a capacity of over 600 cones and a rumblestrip for mounting on a DIN plate on the front of the vehicle. This is a unique invention designed to protect road workers when they are placing roadblock systems. MARS is a vehicle that can be controlled by only one driver. It automatically places and picks up a rumblestrip, a crash cushion and traffic cones. One or more lanes can be closed quickly, safely and efficiently and the driver can stay in the vehicle.

What's your latest company news?

We have recently selected Dähler Verkehrs Technik from Basel as our agent for the Swiss market.

What trends are you noticing in your particular sector of the traffic industry?

Safety for road workers is increasingly important for road authorities. With the MARS vehicle, TrafiQ is delivering a substantial contribution to this safety.

Can you tell us about a recent success story that highlights your capabilities in the traffic sector?

We recently sold a MARS vehicle in the Netherlands to TrafRENT, and we sold another one to the Swiss Government (Bauamt Kanton Zürich).

INFRASTRUCTURE HALL 1

EXHIBITOR SHOWCASE

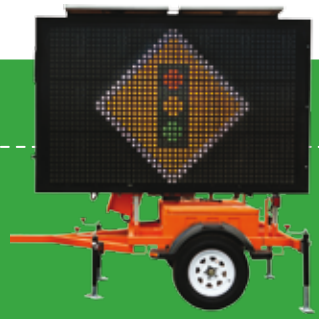
Socket and see

IPL Group
Booth 01.416

IPL Group is using Intertraffic to launch a new cast-steel RS76 socket within its range of reusable, high-strength retention system sockets. "This approach replaces traditional foundation methods for easy installation and removal of posts in a safe and efficient, environmentally responsible and cost-effective way, explains IPL's Ciara Hall. "We are currently seeing international implementation of RS sockets as the foundation to provide cost-effective environmental solutions for passive safety engineering, infrastructure maintenance requirements and replacement of posts in repeat knock-down areas. By eliminating repeat excavation, congestion on the road network is significantly reduced and roadside work and driver safety are improved, delivering time and cost savings."

In a success story on domestic soil, Dublin Bus, the primary mode of public transport in Ireland's capital city has successfully used (and continues to use) the IPL Group Retention System sockets for a significant period of time.

SIGN OF THE TIMES



PWS SIGNS
Booth 01.101

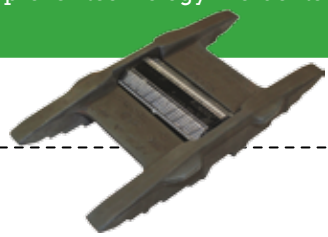
"Of particular interest this year will be our newest product offering, a temporary intelligent traffic management system we call 'SmartZone'," explains PWS managing director John McAteer. "SmartZone is entirely portable and solar-powered, incorporating variable message signs, sensor trailers (radar, microwave and video) and our unique, adaptive JamLogic software, which relays traffic information in real time and supports a wide range of protocols and standards. We work collaboratively with specifiers and contractors to provide bespoke, scalable, turnkey solutions for all road projects.

"There are many studies available documenting the cost-effectiveness of these systems, yet few specify or deploy them," McAteer continues. "However, with roadworks and special events posing a risk for both delays and incidents, the need for portable active traffic management systems, such as our SmartZone, is ever increasing. Reviewing the available effective applications and existing system features may enable those pre-project decision-makers to establish with greater ease if smarter roadworks are warranted. In addition, project managers can more easily make informed decisions as to how best to specify and utilize this proven technology in order to reduce accidents and delays, and better inform the driving public before and during their travels, thus enabling them to anticipate unavoidable delays or make alternative plans."

PWS will be demonstrating the SmartZone technology live at Intertraffic. There will be access to live traffic feeds across the globe, displaying how the technology controls traffic in real time to reduce delays, accidents and costs during roadworks, allowing the timely completion of roads projects.

EXHIBITOR SHOWCASE

On your marks



Ennis Prismo
Booth 01.418

The Ennis Prismo stand will be 'magical', according to Jonathan Fish, marketing manager: "Our resident magician will be entertaining visitors and demonstrating our new road marking system, Paintmark, and surface graphic imaging system, Digimark."

Paintmark is suitable for providing temporary or permanent road markings. "It is the first (and only) preformed, cold-applied road paint. Quick and easy to apply and remove, it dispels all the problems associated with lengthy drying/curing processes and high installation temperatures. The area can be trafficked immediately, in doing so minimizing costly road closures," Fish explains.

The Digimark surface graphics image system is a self-adhesive, digitally-imaged display sheet, which enables full-color graphics to be applied to practically all vehicular and pedestrian ground surfaces. Any digital image or graphic can be reproduced, meaning the system is suitable for a wide range of applications.

In addition, the company recently announced the first installation of its Stimsonite model 101/944 snow-plowable road studs in Estonia. The studs were installed by Road Service Ltd, Ennis Prismo's partner in the country, on behalf of the Estonian Road Administration. These studs were specified because of the relatively harsh climate in Estonia, which sees many months of snow and thus snow plowing. Standard milled or surface-mounted road studs are of no use as the plows would either damage them or strip them away completely. The outer body of the Stimsonite 101/944 is made from hardened cast iron, specifically designed to withstand the harshest conditions. It is also designed to be sunk in to the road surface and its curved shape means that the snow plow blades can pass safely over it without damage to the reflective inserts.

The studs were applied on two projects recently – the Tallinn-Tartu road (E263) and the Tallinn-Narva road (E20); the latter of these highways being the biggest road construction project in Estonia to date.

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SAFETY HALLS 4 & 5

The StarTraq system allows PSNI to automatically issue the penalty relevant to the individual driver's profile and the nature of the offense

Progressive approach to enforcement processing

StarTraq
Booth 01.215

The Police Service of Northern Ireland (PSNI) has one key purpose: to make Northern Ireland safer for everyone, through professional, progressive policing. One of PSNI's primary aims is to target speeding in order to reduce collisions.

PSNI identified speed as the single biggest killer on the roads in the country and put in place a new operation to target and detect speeding motorists. The Northern Ireland Safety Camera Scheme was launched in 2003 with the aim of changing drivers' attitudes toward speeding and reducing the number of road traffic casualties through speed detection, at locations with a history of injury collisions. However, PSNI did not want to simply fine or ban motorists but instead enlist motorists, where appropriate, to driver education courses.

Depending on their age and the severity of the offense, appropriate speeding motorists were offered a place on one of three courses, all provided by DriveTech UK (a subsidiary of AA): the National Speed Awareness Course, for drivers who have marginally exceeded the speed limit; the Northern Ireland Speed Awareness Course, for drivers who had exceeded the speed limit by a more significant margin; or the Northern Ireland Young Driver Scheme, for drivers aged between 17 and 25, which aims to teach these drivers the dangers and consequences of their driving decisions.

PSNI was faced with five possible paths down which each offender could be sent: a court appearance, payment of a fine and points or one of three possible driver education courses. However, the PSNI needed to ensure that this extra complexity did not cause additional costs or time delays on processing these offenses. A sophisticated back-office system was required that would automate the processing of the offenses and correctly identify the appropriate outcome.

PSNI worked with traffic offense management specialist StarTraq to implement a back-office system to process the offenses. The StarTraq platform automates the complex workflow needed by PSNI, creating a more streamlined, effective and cost-efficient system than the cumbersome, manual approach that was previously used.

StarTraq's systems allow PSNI to automatically issue the penalty relevant to the individual driver's profile and the nature of the offense.

In addition, the system streamlines the whole process of offense management. Information from speed cameras is fed to the system, which then goes through a series of processes, including automatic license plate recognition. Once verified, individual offenses are processed and documents archived. The efficiency of the automated system increases the number of offenses that can be handled and improves accuracy, so reducing the number of 'offenses issued but not resolved' – the so-called 'justice gap'.

StarTraq worked closely with PSNI to quickly implement the system and it was installed, tested and live (with staff fully trained) within three months.

Heinz Marburger

Sales, Jenoptik
Booth 01.422

What can visitors expect to see on your stand?

We will be presenting a whole lot more to traffic enforcement than just the technology!

What's your latest company news?

We will be presenting three new products at Intertraffic. The first is a new concept for automated evaluation and processing of traffic surveillance data. Next, we have a new software series that boasts substantial performance benefits and innovation in the area of back-office automation. Finally, we will be the first in the traffic law enforcement sector to provide measurement technology across all sensors – be it radar, laser, loop or piezo. This means we can always provide the customer with the technology suited for their application."

What trends are you noticing in your particular sector of the traffic industry?

One noteworthy trend is that whereas in the analog past we mainly saw orders for single units, in the digital present we are challenged with very complex projects – spanning from technology to consultancy, finance, violation processing and service. We innovate to integrate along the entire process chain.

Can you tell us about a recent success story that highlights your capabilities in the traffic sector?

The Middle East is proving to be a key market for our technology. On a recent project in Qatar, we successfully delivered 60 speed cameras and more than 20 red-light sites.

SAFETY HALLS 4 & 5

EXHIBITOR SHOWCASE

New and approved

Truvelo
Booth 01.221

"We'll present several of our latest products at the show," says Peter Hill, Truvelo's director of UK operations. "These include the Truvelo D-Cam P dual-capability speed and speed/red light camera, the Kustom LaserWitness digital video speed enforcement camera, the ProLaser III and ProLite handheld lasers, and the Falcon HR radar."

The D-Cam P is a versatile system that can be used just as a speed camera, or deployed at a red light intersection where it will monitor red light offenses and also act as a speed camera on the green and amber phases.

Hill hopes to have even more news (including a contract win and a product announcement) to share by the time Intertraffic takes place, but in the meantime there is one snippet he is allowed to share: "We have a variant of the LaserWitness camera that is going to receive UK Home Office approval any day now."

DUAL IN THE CROWN

Redflex
Booth 01.314

The Redflex stand will be used to showcase the company's NK7 fixed and mobile enforcement product range. "The range offers excellent, non-intrusive dual-radar enforcement technology," says technology manager Adrian Onea. "Through extensive R&D, we have developed a radar solution that eliminates reflectivity issues, providing a far greater level of accuracy and flexibility in enforcement than traditional radar and laser. This dual radar can be used in built-up areas and enables diagnosis of the vehicle's speed with lane determination. The technology is supported with a new modern enclosure that compliments its environment while withstanding extreme climatic conditions."

The company will also be promoting its latest news, including a new major contract for the supply of camera systems, back-office software and related services for the large Automated Enforcement (AES) project in Malaysia. The contract – worth over AU$50 million – will see Redflex provide 450 fixed speed cameras, 140 mobile cameras, as well as extensive enterprise back-office software and implementation services.

Redflex will also be using Intertraffic to showcase its efforts on another project, this time in Europe. The company is one of the service providers behind the Go Safe program in Ireland, which deploys a number of mobile camera vehicles to detect speeding offenses. This program has been in operation for just over 12 months and is already seeing positive results. The introduction of the system has been credited with saving as many as 32 lives and preventing 100 serious injuries by getting drivers to slow down in accident blackspots.

Bright thinking

Lumix
Booth 01.424

Marc Humbert from Lumix reveals that his company will be offering an 'illuminating' experience at Intertraffic. "We will be conducting a live experiment of photographs across the exhibition hall, using the light shed by a remote flash illuminator," he says. "For this show, the flash illuminator will be powered by ordinary AA batteries. It is not magic: it is simply the nature of flash technology!"

Humbert hints that he will also be sharing some company news at the event: "After a 32% increase in turnover from 2010 to 2011, a major process is on its way to reinforce the company structure in order to cope with the increasing demand for flash illuminators."

This demand is likely to continue for some time, and Humbert predicts a strong future for Lumix. "Among many people, even high-ranking technicians, there is a strong tendency to believe that LEDs and Xenon flash illuminators are equivalent," he observes. "This mistake leads some operators to serious disappointments. But the extreme power of Xenon flash systems guarantees them a comfortable future.

"Some of our technological achievements speak volumes, such as 13 million shots without failure, produced in 11 months by one of our flash illuminators. This has already changed the mind of many people; they now know that reliability does exist in Xenon flash illuminators."

The Lumix remote flash illuminator can be powered by ordinary AA batteries

SAFETY HALLS 4 & 5

The StarTraq system allows PSNI to automatically issue the penalty relevant to the individual driver's profile and the nature of the offense

EXHIBITOR CASE STUDY

Progressive approach to enforcement processing

StarTraq
Booth 10.100

The Police Service of Northern Ireland (PSNI) has one key purpose: to make Northern Ireland safer for everyone, through professional, progressive policing. One of PSNI's primary aims is to target speeding in order to reduce collisions.

PSNI identified speed as the single biggest killer on the roads in the country and put in place a new operation to target and detect speeding motorists. The Northern Ireland Safety Camera Scheme was launched in 2003 with the aim of changing drivers' attitudes toward speeding and reducing the number of road traffic casualties through speed detection, at locations with a history of injury collisions. However, PSNI did not want to simply fine or ban motorists but instead enlist motorists, where appropriate, to driver education courses.

Depending on their age and the severity of the offense, appropriate speeding motorists were offered a place on one of three courses, all provided by DriveTech UK (a subsidiary of AA): the National Speed Awareness Course, for drivers who have marginally exceeded the speed limit; the Northern Ireland Speed Awareness Course, for drivers who had exceeded the speed limit by a more significant margin; or the Northern Ireland Young Driver Scheme, for drivers aged between 17 and 25, which aims to teach these drivers the dangers and consequences of their driving decisions.

PSNI was faced with five possible paths down which each offender could be sent: a court appearance, payment of a fine and points or one of three possible driver education courses. However, the PSNI needed to ensure that this extra complexity did not cause additional costs or time delays on processing these offenses. A sophisticated back-office system was required that would automate the processing of the offenses and correctly identify the appropriate outcome.

PSNI worked with traffic offense management specialist StarTraq to implement a back-office system to process the offenses. The StarTraq platform automates the complex workflow needed by PSNI, creating a more streamlined, effective and cost-efficient system than the cumbersome, manual approach that was previously used.

StarTraq's systems allow PSNI to automatically issue the penalty relevant to the individual driver's profile and the nature of the offense.

In addition, the system streamlines the whole process of offense management. Information from speed cameras is fed to the system, which then goes through a series of processes, including automatic license plate recognition. Once verified, individual offenses are processed and documents archived. The efficiency of the automated system increases the number of offenses that can be handled and improves accuracy, so reducing the number of 'offenses issued but not resolved' – the so-called 'justice gap'.

StarTraq worked closely with PSNI to quickly implement the system and it was installed, tested and live (with staff fully trained) within three months.

Heinz Marburger

Sales, Jenoptik
Booth 01.422

What can visitors expect to see on your stand?

We will be presenting a whole lot more to traffic enforcement than just the technology!

What's your latest company news?

We will be presenting three new products at Intertraffic. The first is a new concept for automated evaluation and processing of traffic surveillance data. Next, we have a new software series that boasts substantial performance benefits and innovation in the area of back-office automation. Finally, we will be the first in the traffic law enforcement sector to provide measurement technology across all sensors – be it radar, laser, loop or piezo. This means we can always provide the customer with the technology suited for their application."

What trends are you noticing in your particular sector of the traffic industry?

One noteworthy trend is that whereas in the analog past we mainly saw orders for single units, in the digital present we are challenged with very complex projects – spanning from technology to consultancy, finance, violation processing and service. We innovate to integrate along the entire process chain.

Can you tell us about a recent success story that highlights your capabilities in the traffic sector?

The Middle East is proving to be a key market for our technology. On a recent project in Qatar, we successfully delivered 60 speed cameras and more than 20 red-light sites.

SAFETY HALLS 4 & 5

New and approved

Truvelo
Booth 01.221

"We'll present several of our latest products at the show," says Peter Hill, Truvelo's director of UK operations. "These include the Truvelo D-Cam P dual-capability speed and speed/red light camera, the Kustom LaserWitness digital video speed enforcement camera, the ProLaser III and ProLite handheld lasers, and the Falcon HR radar."

The D-Cam P is a versatile system that can be used just as a speed camera, or deployed at a red light intersection where it will monitor red light offenses and also act as a speed camera on the green and amber phases.

Hill hopes to have even more news (including a contract win and a product announcement) to share by the time Intertraffic takes place, but in the meantime there is one snippet he is allowed to share: "We have a variant of the LaserWitness camera that is going to receive UK Home Office approval any day now."

EXHIBITOR SHOWCASE

DUAL IN THE CROWN

Redflex
Booth 10.100

The Redflex stand will be used to showcase the company's NK7 fixed and mobile enforcement product range. "The range offers excellent, non-intrusive dual-radar enforcement technology," says technology manager Adrian Onea. "Through extensive R&D, we have developed a radar solution that eliminates reflectivity issues, providing a far greater level of accuracy and flexibility in enforcement than traditional radar and laser. This dual radar can be used in built-up areas and enables diagnosis of the vehicle's speed with lane determination. The technology is supported with a new modern enclosure that compliments its environment while withstanding extreme climatic conditions."

The company will also be promoting its latest news, including a new major contract for the supply of camera systems, back-office software and related services for the large Automated Enforcement (AES) project in Malaysia. The contract – worth over AU$50 million – will see Redflex provide 450 fixed speed cameras, 140 mobile cameras, as well as extensive enterprise back-office software and implementation services.

Redflex will also be using Intertraffic to showcase its efforts on another project, this time in Europe. The company is one of the service providers behind the Go Safe program in Ireland, which deploys a number of mobile camera vehicles to detect speeding offenses. This program has been in operation for just over 12 months and is already seeing positive results. The introduction of the system has been credited with saving as many as 32 lives and preventing 100 serious injuries by getting drivers to slow down in accident blackspots.

Bright thinking

Lumix
Booth 01.424

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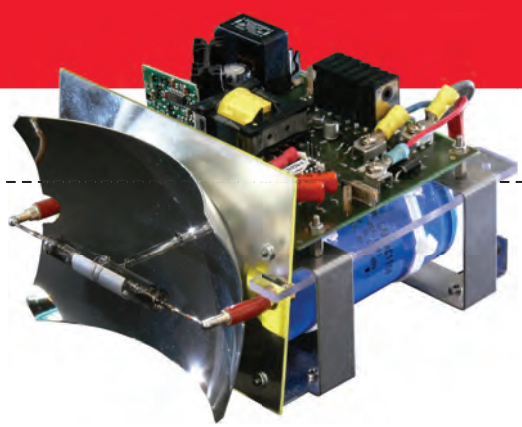

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P PARKING HALLS 2 & 3

EXHIBITOR CASE STUDY

Blackpool benefits from P&D upgrade

Parkeon
Booth 02.202

In the UK, Blackpool Council has installed a number of Parkeon Strada terminals as part of a rolling program to replace its aging on-street Pay & Display (P&D) machines. The new, solar-powered terminals accept Chip & PIN credit/debit cards and coin payments.

They are also equipped with contactless card readers, anticipating the introduction of contactless payment-enabled cell phones and the continuing rollout of Wave & Pay bank cards.

"We chose Parkeon's Stradas because they are sturdy, very reliable, and easy to maintain. Our customers find them easy to use, too," states Paolo Pertica, the Council's head of neighborhood services town centre and promenade.

"The Council opted for solar-powered Stradas to reduce its carbon footprint and the installation was quick and easy as no electrical work was needed," he adds. "Parkeon's solar option is also capable of reliably supporting multiple payment options together with a centralized management system."

"I believe that Parkeon still has the only integrated Chip & PIN/contactless card payment solution approved by the UK banking industry," explains Danny Hassett, the company's parking director UK/Ireland. "This provides a seamless transition from a contactless to a Chip & PIN transaction on the occasions when contactless card users are asked to confirm their ID with a PIN."

Parkeon has minimized the power requirements of the Strada's major components, enabling the terminal to support a range of functions, including wireless centralized management and bank/credit card payment solutions. A discrete 5W photovoltaic panel is housed on top of solar-powered Stradas, continuously maintaining the charge in the terminals' batteries. The machines go into sleep mode when not being used.

Parkeon was the driving force behind the development of the Epsum MR40 integrated card reader and associated Epsum P40 PIN-pad used in the Strada, working in partnership with Ingenico (formerly known as Sagem Monetel), the device's manufacturer. Its specification demanded that the reader should have a low-power requirement and operate 24/7, in all weather and environmental conditions. Parkeon has exclusive rights to the Epsum MR40 and P40 for on-street parking applications.

A wireless GPRS modem and a single SIM card are installed in the Stradas to carry all the telemetry for processing payments and transmitting financial, operational, and statistical data to the appropriate back offices.

Parkeon has also retrofitted 500 Stradas with MR40 readers in the UK.

Robert Weiskopf

Senior VP Car Access, Skidata
Booth 01.106/09.217

What can visitors expect to see on your stand?

Our highlights include Barrier. Gate 'online', our new unit that is monitored and managed from the Skidata Cloud. Open, close, scan ticket – by bundling the computing power, the gate responds faster than during offline operation and thereby increases throughput. You no longer need servers or PCs on-site, only a power connection and internet access.

What's your latest company news?

Cell phones are quickly becoming the universal medium for real-time information, simple planning, and secure payment. Navteq maps power navigation on these devices as well as on automotive navigation systems and internet-based mapping applications around the world. Skidata web-based services are now enhancing Navteq maps with real-time parking information that you provide.

What trends are you noticing in your particular sector of the traffic industry?

The main trends are cloud computing and online business: more online applications for parking facilities.

Can you tell us about a recent success story that highlights your capabilities in the traffic sector?

In parking management, the best way to describe the last year was 'full steam ahead in North America'. Alongside Dallas/Fort Worth, other airports are also benefiting from Skidata's expertise, such as John Wayne Airport near Los Angeles and Canada's Montreal Airport.

P PARKING HALLS 2 & 3

Aura of success

Metric Parking
Booth 01.112

"We have launched the Elite version of the Aura model – the flagship in our range of payment machines," reveals Richard Boultbee from Metric Parking. "Increased functionality will be demonstrated at Intertraffic Amsterdam, including full registration entry and all payment options, driven by the requirements of ALPR operators – a growing market in recent years."

As well as the advances in the Elite pay and display machine, Metric Parking will also be unveiling enhancements to its webASLAN back-office suite.

In terms of current industry trends, Boultbee says he's noticing a shift back to terminal-based payments from phone-based payments as the parking industry joins in the contactless revolution. "Contactless credit and debit card payment terminals are on the rise. Another trend is the growth of ALPR-based parking control."

A recent success story for the company was in Nottingham, UK, where it claimed the contract to install new on-street ticket machines in the city. In total, around 200 Aura Elite machines are currently being installed.

EXHIBITOR SHOWCASE

PARKING PORTFOLIO

FAAC
Booth 02.204

"The theme of our stand is 'Everything is parking' – from the smallest solutions up to the most complex airport systems," says Lorenzo Candini, FAAC's product manager Parking systems and Access Control.

Visitors to its stand will see the latest version of the Orion system from Zeag. "The update is the addition of an optional 10.4in full-color touchscreen display," Candini says. "This will initially be available with the automatic pay station and over the next few months will be across the whole Orion product range."

Visitors will also see the new multifunction Entry and Exit stations, designed principally for airports and large car parking solutions, featuring large color screens and Chip & PIN modules for access and payment.

"Conceived for small and medium parking lots, we also have the new Parkplus solution," Candini adds. "The system provides simplicity for users and installers while maintaining the reliability and precision required by managers. We are also showing the Parkplus Gate column with a hydraulic automatic retractable bollard J275HA as a new vehicle access control solution."

Intertraffic is also the first show where FAAC and its two recent acquisitions, Zeag and DataPark, will present their solutions together.

Candini cites the current trend for integration of the 'whole' parking system – e.g. combined parking and EV charging to multiple-function entry and exit stations – as a key demand that vendors must respond to. "Last August, Zeag South Africa was contracted by the V&A Waterfront in Cape Town to replace its existing parking system with the Orion XR solution, to be implemented at all of the malls and commercial parking areas within the precinct. The scope of the project included the replacement of 41 automated pay stations (APS), 60 entry/exit lane stations, along with introducing additional features such as ALPR, VMS, and online credit card payment."

Making Sense

Nedap
Booth 02.309

Parking specialist Nedap AVI will launch Sensit E-Parking License (EPL), which detects abuse of parking spaces that are reserved for disabled drivers and permit holders. The EPL is an expansion of Nedap's Sensit system for wireless parking occupancy detection. As well as guiding traffic to available spaces as the Sensit system does, EPL can also detect if a parking space is legitimately used by the right target group.

"To ensure enforcement officers are only sent to those parking spaces that are not legitimately used, we needed to identify if the parked vehicle is a disabled or permit badge holder," reveals Evelien O'Sullivan, Nedap's business development manager. "We therefore designed a small in-vehicle device called E-parking, which acts as a digital permit. When a vehicle parks, EPL contacts the wireless Sensit network to register the bay is used by a genuine user. This information is combined with the occupancy information of the sensor installed in the car park. If a space is occupied by a vehicle and the required E-parking license is not detected, the system will alert an enforcement officer."

O'Sullivan reports positive interest from Local Authorities. "They can offer a better service to disabled drivers and ensure their bays are available through more effective enforcement."

In the Netherlands, the new system is being trialed in an office building with limited disabled parking spaces. When employees without the EPL park their vehicle in the designated disabled bay, the system sends an alert message, and the employee parked in the space is informed to remove their vehicle. "The result we saw was that normally disabled bays are used by non-disabled motorists as the bays are located close to the entrance," O'Sullivan says. "With the EPL, though, there is immediate enforcement and therefore parking in a disabled bay is not without consequence. After just a short while, people realize this and no longer use the disabled bays, hence they become available for the intended user group."

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TRAFFIC MANAGEMENT HALLS 9/10/11

Rome videowall aids traffic control

EXHIBITOR CASE STUDY

Eyevis
Booth 11.806

The Rome Agency Services Mobility was created as part of ATAC, the Roman public transport company, to fulfill several integrative functions. It deals with joint planning and control as well as with presenting effective information on both public and private mobility.

The agency's essential duties involve projects and network planning of public transport whether by road or rail, developing and introducing changes in the road and rail networks, studying and recording transport and flows of private goods, road safety and establishing rules for the definition and evolution of private mobility (prohibitions, etc).

As a part of a recent project, eyevis set up a new videowall in the control room – the Central

della Mobilità, which plays a fundamental role for the integrated management of public and private mobility in the Italian capital. The emphasis is on finding tools and solutions to enable a progressive improvement of living standards and thereby respect the safety of the citizens and protect the environment.

Central Mobility has an open, modular, and expandable structure based on two levels of control. A supervisor and the central system are on the first level, with distributed intelligence into peripheral equipment. The ITS of this level supports the regulation of the urban road network and should lead to greater efficiency and sustainability of the flow of traffic in Rome. The second level, meanwhile, includes the main system: the sensors that measure the flow of traffic and travel times; the video surveillance cameras; traffic light installations; electronic cabinets for special areas, etc. This system uses different communication channels that enable real-time information and therefore significantly improve mobility for the inhabitants of Rome.

For the videowall in the control room, eyevis installed 12 DLP rear-projection cubes (type EC-50-XT-CP-DL) and a graphic controller with IP decoding unit (type NPX-3812R-V16-D4-IP24-G2.3).

Detector gadget

EXHIBITOR SHOWCASE

Wavetronix
Booth 11.529

"We will be demonstrating SmartSensor HD, the only non-intrusive device to offer radar that is designed and manufactured specifically for vehicle traffic detection," reveals Mike Rose from Wavetronix. "We have recently completed the installation of 1,241 SmartSensor HD units in Russia as part of the massive ITS Moscow project. These will allow officials to collect real-time traffic data and monitor flow conditions on the major ring roads and spokes that surround the city of Moscow."

This latest project illustrates an industry trend that Rose has observed since the SmartSensor HD hit the market in 2006: the surge in demand for radar-based systems. "Our system has set a high standard for traffic detection. Its success has led to greater adoption of radar for ITS and traffic applications, and now several radar-based

detectors have joined the market. We believe this reinforces the value of radar in vehicle detection," he says.

Wavetronix recently completed the MCH 1529 performance assessment overseen by the UK's Highways Agency ITS Research Group. "This certifies SmartSensor HD as an acceptable alternative to loop detection at any MIDAS outstation on the agency's network," Rose explains. "MIDAS stations monitor vehicle data on a 'per-lane' basis and report traffic conditions. One HD unit can replace up to 10 loop pairs at single stations."

Gavin Jackman

TRL
Booth 11.619

What's in store for visitors?

"We're using the show to launch TRANSYT Online, which extends TRANSYT's functionality and allows its optimized Signal Plans to be sent directly to on-street controllers to allow frequent retiming without the need to go out on the street."

Latest company news?

"We've just launched the latest version of ARCADY for the assessment of roundabout capacity, delay, and accident risk. This latest version, ARCADY8, combines both ARCADY and PICADY functionality together in one interface. The PICADY functionality is delivered by the new Priority Intersection Module – which was a complete rewrite in itself! This means PICADY users can now model alternative layouts to an intersection with multiple time periods simultaneously, something which up until now only ARCADY users have been able to do.

What trends are you noticing in your sector?

The big corporations are becoming more cautious, while the SMEs and new start-ups are becoming more adventurous. This is specifically seen in the results of recent software sales.

Can you tell us about a recent success story that highlights your capabilities in the traffic sector?

We have recently become the first authorised distributor for STREAMS, the traffic management solution from Transmax, for distribution across the northern hemisphere.

EXHIBITOR SHOWCASE

On patrol

Vaisala
Booth 11.802

"We have just introduced the Condition Patrol DSP310, which is the first-of-its-kind mobile weather sensor solution that is installed on a vehicle," reveals Vaisala's marketing manager Jon Tarleton. "The data can be viewed on a smartphone in the vehicle, or transmitted back to a certain location to be viewed over the internet. Condition Patrol is easy to use, easy to install, and will improve decision making by providing better information."

It's been developed to meet the industry demand for new cost-effective ways to improve decision making when it comes to road weather operations. Tarleton comments that "lower cost solutions, such as mobile products, are becoming increasingly popular".

PLATE EXPECTATIONS

Inex/Zamir
Booth 11.921

"This year we are adding a five megapixel camera to our line-up, which gives customers the ability to monitor a lane width in excess of 5.5m," says Inex/Zamir's president, Jim Kennedy. "Also important, particularly with such a large-format camera, we are still able to capture images at the rate of 60/sec, as with all our camera/illuminators.

"Our TaP (Time and Place) system, meanwhile, is a database analysis tool providing markedly greater confidence levels of the registration/license plate read result. This makes use of existing historical data to verify the plate read and it greatly enhances the overall accuracy of the system."

So what trends will Kennedy be discussing with visitors? "Firstly, in toll roads, there is a demand for greater overall accuracy on the results forwarded for processing – with an aim to save costs in the human review area. This was one of the driving forces behind TaP as well as behind our constant R&D regarding software improvements.

"In parking, the acceptance of ALPR at the major airport parking facilities – where we have deployed our equipment to deter fraud – is migrating to the second- and third-tier airport hubs as well. We believe this technology will ultimately be as commonplace as barrier gates and ticket machines.

"Finally, the access control sector has shown a remarkable increase over the past 18 months and this is very much due to the gradual acceptance of the technology. ALPR has gone from the 'gee whiz' stage to the 'must have' in that time, as customers have realized the value of having an additional means of credentialing for access control systems."

The IP labyrinth

The many potential intellectual property issues associated with the growing area of roadside-based technologies can be something of a maze. **Jackie Maguire** and **David Segal** explain how to point your IP in the right direction

Illustration courtesy of Charlie Standley

Technology developments of all kinds have a huge impact on everyday life. In healthcare, for instance, magnetic resonance imaging (MRI) and computerized tomography are accepted as routine diagnostic tools. In communications, smartphones have become an essential tool both for business and social activities, while social media networks such as Facebook and Twitter give a voice to millions of people across the world.

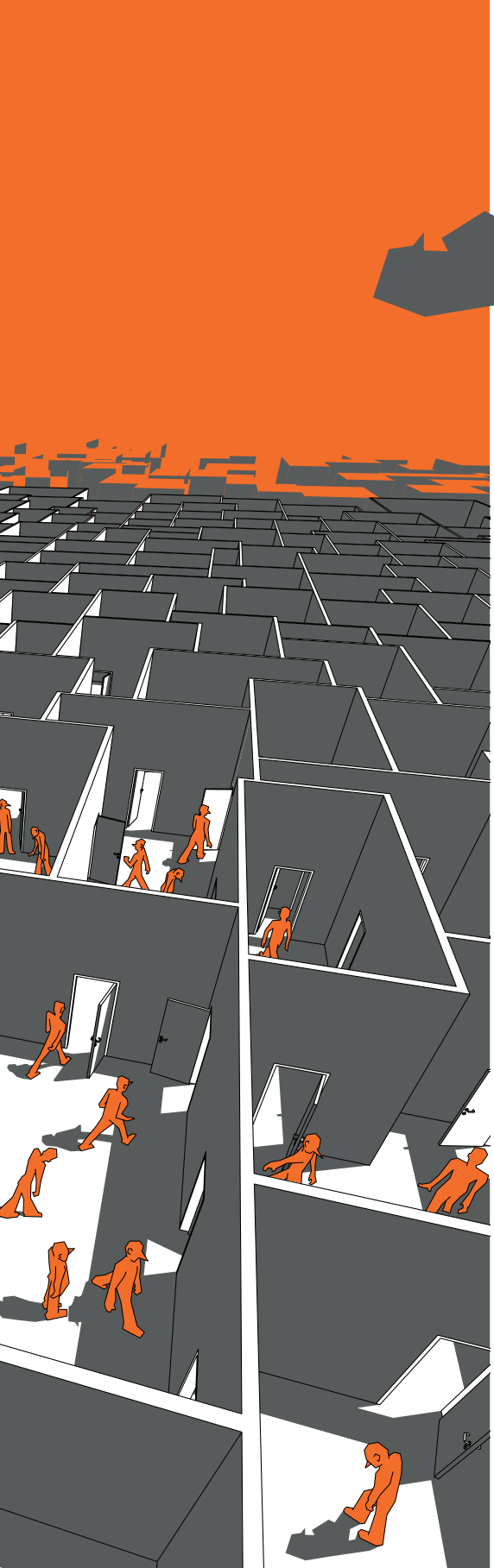
Imaging techniques, smartphones and social media are all inventions – and inventions, which are especially abundant in the field of ITS, are described in worldwide patent literature. ITS in particular is a fertile breeding ground for such technological creations. As motorization increases globally, so too does the need for more intelligent roadside-based solutions. Such technologies are represented by inventions such as automatic license plate recognition, embedded road sensors and loops, enforcement technologies for speeding and red light running, vehicle classification and apparatus, as well as methods and systems for tolling technologies.

All of these inventions form part of the creator's intellectual property and need to be part of an IP strategy, which includes a clear understanding of the value of the IP inherent in the invention, full protection from copying in all the jurisdictions in which the invention is to be marketed, as well as an understanding of how to commercialize the IP in the future.

Tolling technologies and IP

Tolling is a prime sector to analyze in more detail. Technologies in the field are associated with determination of vehicle position and distance traveled, vehicle classification, communication between vehicles and roadside sensors, as well as methods for payment. Trademarks can be used for branding commercial systems while software has copyright protection. There are, however, specific features of the wider patent landscape that can affect the success of product offerings for tolling technologies.

But there are a number of questions that are pertinent to the discussion of IP in the field of tolling technologies. Is, for instance, this a growing or shrinking field of technical activity? Who are the major patent holders and what are their activities? Are there core technologies common to the product offerings of the patent holders?



How is the technical field changing over time? Are your activities novel – or are they used by your competitors? Who are your nearest competitors in terms of technology? Will your activities result in infringement of third-party patents? How valuable is your IP?

Databases of published patent information are publicly available through national patent offices and through the World Intellectual Property Organisation (WIPO) for international publications. Commercially available software is also available that simplifies the searching process for these databases.

Patent searches on tolling technologies identify more than 1,500 patent families that have been filed over the past 20 years. Closer inspection of the patent filing dates shows that the area of tolling technologies is one of growing activity, with studies of the patent literature highlighting many active players, including Siemens, Mitsubishi, Robert Bosch and Kapsch TrafficCom.

Crowded house

The literature highlights core technical areas associated with tolling technologies – antennae, vehicle-to-roadside short-range communications, vehicle location technologies, and onboard units. In a crowded patent landscape, there is always the possibility of a new entrant infringing third-party patents, although professional advisors can help steer them through this maze. Some of the patents on this landscape will be of significant value, and understanding the relative position of the new development to the existing patents is important for business decisions relating to investment in an enterprise, development of a product, or sale of a business.

Anyone with business interests in tolling technologies will want to know who their nearest competitors are and what patents they hold. One way of homing in on nearest competitors is through the generation of a patent landscape, which can help a company in the process of evaluating their IP. In general, documents that lie close together on such a landscape can be considered to be related technically. A patent landscape for tolling, for example, reveals patents concerning antennae, license plates, cameras, terminals, payment systems, parking spaces and readers occur across the landscape as these are important features of tolling technologies. In many cases, patents for a particular player are dispersed across the landscape suggesting a set of technologies that any player with interests in tolling technologies requires access to. Where patents are clustered for a player in a specific region of the landscape then there is an indication that the player has focused on a specific technology or application for the technology.

> One way of homing in on nearest competitors is through the generation of a patent landscape, which can help a company in the process of evaluating their IP

Tolling technologies have been an area of growing patenting activity in the past 20 years. Assessment of the wider patent landscape illuminates the intellectual property held by both by existing players and new entrants in tolling technologies, essential information in today's world of business.

• *Jackie Maguire is the CEO of Coller IP Management, while David Segal is a senior IP analyst with the company – a specialist in commercial IP management and valuation, which helps organizations protect, evaluate and commercialize their intangible assets. Please email jackie.maguire@colleripmanagement.com for more information*

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Pittsburgh stealers

A Carnegie research team has evaluated the potential of LED-based streetlighting for the City of Bridges. Delivering improved performance and energy-savings, principal investigator **Donald K. Carter** believes the technology has stolen the show

Main photograph courtesy of Simon Reid

The City of Pittsburgh in Pennsylvania currently operates 39,779 streetlights. These use 2.2 million kilowatt hours at an annual electricity and maintenance cost of around US$4.2 million. In order to address budget issues and environmental concerns, city officials have been considering replacing all of the existing fixtures with LED streetlights, which is expected to save an estimated US$1.7 million a year in reduced energy and maintenance costs as well as 6,818 metric tons of CO_2 emissions. In addition to reducing its cost load and share of greenhouse gas (GHG) emissions, the City of Pittsburgh is also interested in the opportunities that LED streetlighting and related sensor and control technologies offer for placemaking and wayfinding in its business districts.

Replacement therapy

So, in late 2010, the powers-that-be in Pittsburgh engaged Carnegie Mellon University's Remaking Cities Institute (RCI) to investigate the full range of potential options and benefits of an LED streetlight-replacement program for 3,000 streetlights in downtown Pittsburgh, Oakland and the city's more than 50 neighborhood business districts. As a result, between February and June 2011, an interdisciplinary research team led by the RCI investigated the technological and aesthetic potential offered by the technology.

When fully implemented, the Pittsburgh project is expected to save an estimated US$1.7 million (70% savings) annually in energy and maintenance costs

The 'Pittsburgh LED Streetlight Research Project' research team worked with the premise that public streetlighting can and should be designed to meet the needs of people of all ages, including those with age-related vision loss, so the research included best management practices and lessons learned from cities where LED streetlighting had been installed. The report also outlines general recommendations

regarding streetlighting as well as technical specifications for replacement LED fixtures on existing luminaire poles. Moreover, it provides direction on ways to capitalize on the additional benefits of LED technology, such as the use of control systems for dimming, changing color, emergency events, and the use of accessory color lights for use in wayfinding, placemaking and event planning. It also suggests ways in which cities can go beyond streetlighting to consider all public and private outdoor lighting in a comprehensive manner.

Climate concerns

Although LED technology offers a wide range of potential benefits, a review of available literature finds that cities are primarily interested in the energy-reducing promise of LEDs for street and traffic light applications, with little focus on the performance issues or aesthetic and placemaking opportunities presented by the technology in general. This emphasis is in response to the high priority concerns of global climate change and financial restraints of governments across all levels.

The US Department of Energy (DOE) estimates that converting to LED lighting over the next two decades could reduce energy consumption by 25%, saving US$120 billion in energy costs and diverting 246 million metric tons of carbon emissions. Although older technologies are concurrently being improved, LED lighting sources are expected to continue to surpass other technologies in terms of efficacy. As a result, the Energy Policy Act of 2005 (EPACT 2005) and Energy Independence and Security Act of 2007 (EISA 2007) mandates the DOE to expedite the development of solid-state lighting (SSL) technology with an emphasis on advancing core technology research, product development, and manufacturing support.

Recommendations

Following its in-depth investigation, the RCI team endorsed the conversion of Pittsburgh's streetlights to LED with two principal recommendations. First, the light sources and luminaires should both be replaced, because the standard city luminaires didn't have reflectors or lenses to control glare (see sidebar). Cobra head, shoe box, and pendant luminaires, meanwhile, should be replaced with new models that have the proper characteristics. The team recommended, however, that 'acorn' luminaires not be retrofitted because it wasn't possible to control glare or dark sky impact with a fixture that radiates light in all directions. Acorns should therefore be phased out of the inventory just as the obsolete globe luminaires have been discontinued. Secondly, all replacement luminaires and new luminaires should be tested and certified to meet the performance criteria set forth in the report.

Of course, the current purchase cost of LED lighting products is higher than standard options and varies widely, with good-quality products at a cost premium. However, the DOE reports that the cost per lumen of LEDs falls by a factor of 10 every decade while the amount of light generated increases by a factor of 20. From 2009 to 2010, the prices for warm white LED packages declined by half, from approximately US$36 to US$18 per 1,000 lumens (kilolumens/klm). Prices are expected to fall to US$2/klm by 2015. When operational costs, such as electricity, maintenance, and lamp replacement, are considered, the overall value of LED rises.

Results

The City of Pittsburgh began retrofitting all traffic signals and accompanying crosswalk signals with LED light fixtures in 2006. To date, it has updated 3,668 traffic lights at nearly 800 intersections with LED fixtures, resulting in 958,945kWh of annual energy savings and a CO_2 reduction of over 1,000 tons.

• *Donald K. Carter is the principal investigator for the Remaking Cities Institute at Carnegie Mellon University, Pennsylvania. For more detail on the report, please log on to www.cmu.edu/rci/projects/current-projects/Pittsburgh-LED.html*

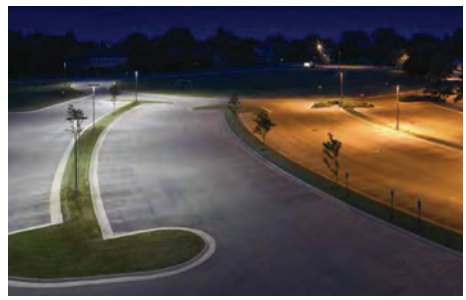
Color rendering and glare

For all of the benefits of LED technology, there are some things you need to consider before making the switch. The need for color consistency, for instance, spans all illumination technologies. With LEDs specifically, color (including white) is produced by mixing red, green, and blue LEDs. The wavelength distribution of these LEDs is narrow, which allows for a very pure, saturated color. Any shift in the dominant wavelength, however, particularly with green, will create color inconsistency.

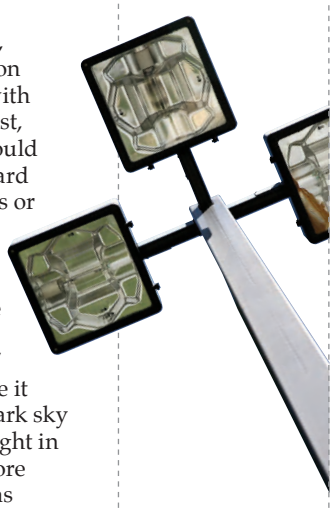
It is impossible for manufacturers to produce uniform color points in white LEDs. But manufacturers overcome this by sorting their LEDs into color bins based on identical or very similar specifications for color and flux. Customers may then specify from which color bins they want to purchase.

Reputable manufacturers provide binning so that LED fixtures bought at one time will be identical to those coming off of the production line at any other time. Light fixture customers that use a wider collection of color bins will be able to purchase their LEDs at a lower cost than those who are restricted to a single bin.

Glare is another issue with LED streetlighting (pictured left). The RCI research team's literature review and interviews with manufacturers and municipal agencies in cities with LED replacement projects indicate that the emphasis is being placed almost entirely on energy savings, to the exclusion of visual quality issues. The substantial glare caused by LEDs is not typically included as a measurable criterion in evaluation processes, and when it is, the tools of measurement are inadequate. As a result, glare persists as an issue.



(Above left) **LED lights for pedestrian crosswalk** (Above right) **Color rendering of LEDs as compared with high-pressure sodium (HPS)**



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Getting the most out of streetlighting

Streetlighting is not only something that everyone has grown used to having – it's expected in a night-time environment.

Such systems are not limited to a Local Authority's streetlighting installation, though, but extend into numerous public areas, including parking lots and other amenities. However, with the increase in energy costs in recent years, both the public and private sectors are closely reviewing their energy usage to manage costs downward. Energy is now measured in terms of carbon usage as well as pure financial costs and every user needs to consider the impact they are having both financially and environmentally. A range of solutions and products developed by SELC enable customers to optimize lighting levels while minimizing energy costs, and are aimed at helping Local Authorities in achieving their goals.

READER ENQUIRY NO. 501

SELC Wireless RF Photocell allows monitoring and control all types of LED and HID lamps for electronic and magnetic control gear

Optimum lighting, minimum energy

Through the use of intelligent controls utilizing trimming, dimming, and a central management system (CMS), considerable energy savings can be achieved in exterior lighting installations. In fact, Local Authorities can achieve energy savings in the order of 30%-50% by implementing lighting equipment that enables them to 'trim' and 'dim' light levels at different times of the night to suit particular environments within their public lighting infrastructures.

Dimming and trimming

Firstly, the installation of photocells with a part-night facility allow for the use of a 'calculated midnight' derived from the middle point of the night and the dusk/dawn switch on/off time. The lights are then switched-off for predetermined hours either side of the 'calculated midnight'. This approach has been used successfully throughout the UK and projects installing the part-night solution have yielded return on investment (ROI) within one year.

Secondly, another measure that is being adopted is to use the photocell to 'trim' the number of burning hours to reduce energy usage. Traditionally, the light source being used was low-pressure sodium or mercury lamps, which can take up to 15 minutes to achieve full light output. Photocells were developed and their switch on/off time ensured the light was

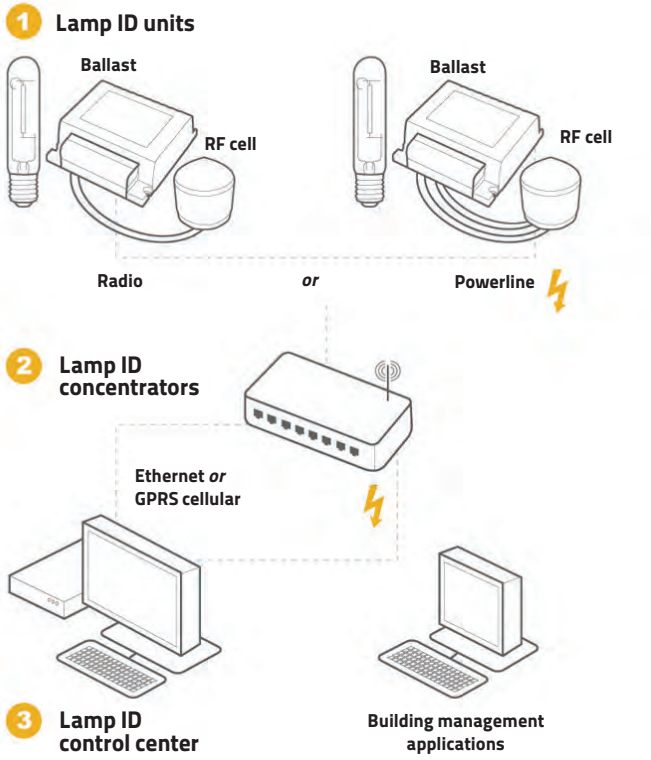
Need to know?

A comprehensive wireless solution for monitoring, controlling, and energy metering of outdoor lighting

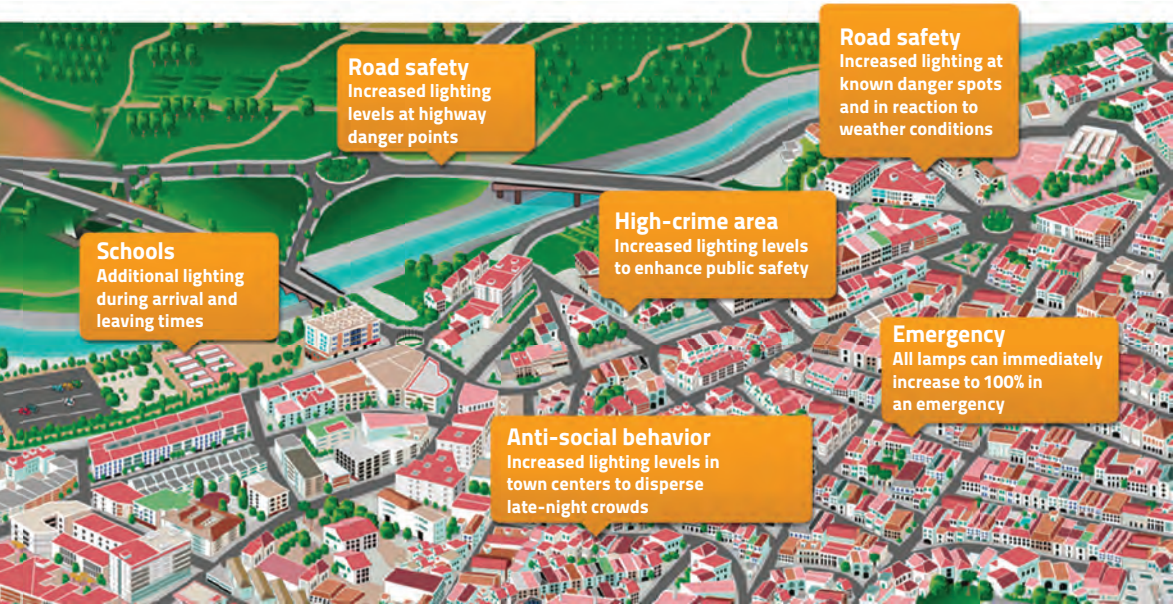
- Solution can easily be scaled to cover an entire city or combination of cities as needed
- Provides energy and carbon emission reduction, reduced operating costs, and can easily be retrofitted into existing lighting installations
- System operators can easily interact with the lighting control, monitor live data from the lamps, and perform on/off and dimming operations for lamps and groups of lamps

switched on and fully operational before dusk. This approach resulted in the use of a 70 Lux switch on level and 35 Lux switch off. Modern High Intensity Discharge (HID) light sources now ignite and achieve full light output in fewer than five minutes. If the existing 70:35 photocell is replaced with a 20:20 photocell, an annual saving of circa 60 hours in burning hours can be realized. Equating to a 6% energy saving, this small investment in technology should see an ROI within five years based on a 150W lamp. This approach has been adopted on several motorway networks following research carried out to confirm the lighting was fully operational and the lamp at full output prior to dusk.

Standalone dimming solutions are also available to reduce energy consumption of individual lights using the same approach as the part-night photocell without switching the light off. This requires the use of electronic control gear (ballasts) to be installed in the streetlights. These ballasts can be individually programmed to cater for tailor-made dimming. Many Local Authorities have found that this approach is more acceptable to the public because – although at a reduced level – the light is never switched off during the night. On traffic routes, for which the lighting class is determined based upon traffic flow volumes, the dimming profile can be set to allow for reduction in traffic flow outside of peak commuter hours. When installed, this enables the lighting to be dimmed for pre-set hours – for example from 10pm to 6am. A streetlight dimmed by 30% power will save approximately 22% energy using this regime and provides an ROI of around five years. There is also the potential to allow for multi-step dimming to take place based on the traffic volumes. A typical traffic route can be reduced by two lighting classes between midnight and 6am due to the significant reduction in traffic flow during this time, while additional savings can be made using this approach.



(Above) **The schematic shows a lighting triple-layer architecture**
(Below) **The many benefits of a more intelligent lighting strategy**



Central management systems explained

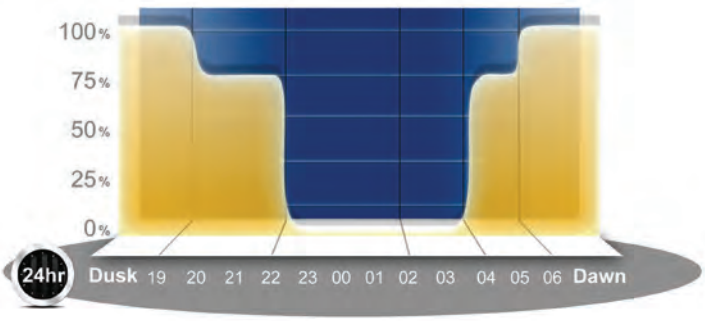
The final step that can be taken is the use of a Central Management System (CMS), which when combined with electronic control gear offers the ability to both increase and decrease lighting levels to suit both vehicle and pedestrian movement and usage. CMS have the ability to react to real-time events and can be connected to a variety of sensors and adjust the lighting accordingly. The use of a vehicle or traffic counter enables the system to adjust the lighting to real-time traffic conditions rather than the assumed traffic conditions provided by traffic counts and

historic information. The use of presence detection devices can dim or switch off lights when there is no pedestrian activity and switch it back on when activity is detected. Weather sensors can also be used to adjust the lighting to best suit the drivers' requirements in conditions such as heavy rain, fog or snow.

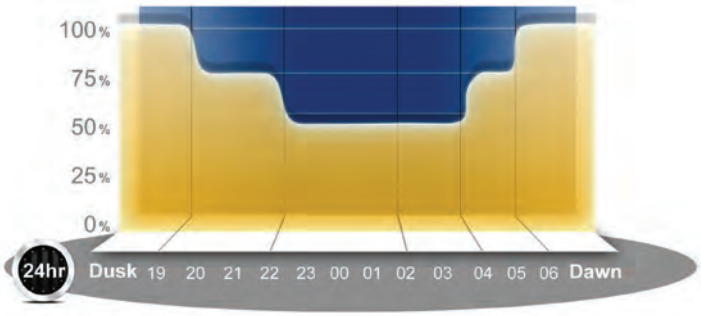
There are two approaches to this within the streetlighting market – either the use of power line solution or with a radio solution.

Powerline solution

Powerline communication is a well-recognized form of transmitting data and takes advantage of the underground cable network as the means of transmitting this data. In terms of security, this is one of the most secure methods of communication available, the most common of which are based around Echelon Lonworks. The systems typically have a smart server located in a control cabinet, which has either an Ethernet connection or more commonly a 3G or GPRS connection back to a web-based hosting user interface. The smart server then communicates with each lighting point via an outdoor luminaire controller (OLC). Data is collected and stored on the smart server and downloaded to the web-based hosting server. Information is available on the number of hours the lamp has burned, the power consumption, the ballast temperature, voltage, current, and wattage values.



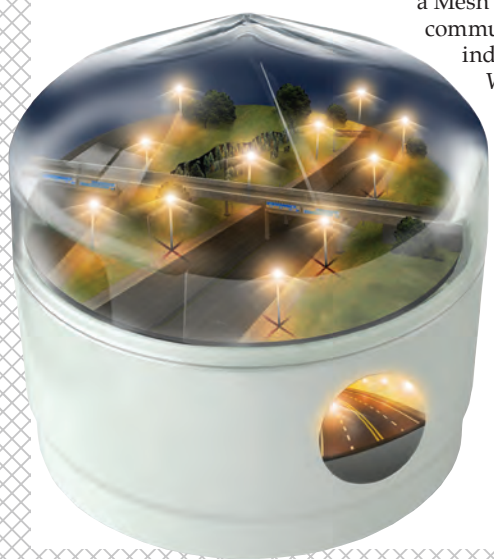
Part-night lighting: Lamps are switched off for a period of time during the night



Dimming solution: Lighting is dimmed in two stages to suit vehicle or pedestrian requirements, reducing energy consumption of individual lights without resorting to switching off lamps

Radio solution

Radio- or wireless-based CMS utilize a similar device to the smart server to facilitate communication with the web-based hosting service. Communication can either be line-of-sight or through a Mesh network to achieve communication with the individual streetlights. Wireless systems also offer all of the benefits that the power line system offers, although the smart server is typically located at the top of the lighting column and therefore there is no requirement for control cabinets. The node used for transmitting and receiving data normally replaces the photocell and can use either hard-wired, miniature or nema socket connection to the luminaire.



Powerline CMS underground cable network and can operate where wireless signals cannot penetrate

Choosing a CMS

The choice of system is usually determined by the type of cable network present in a location. In the UK, the majority of the cable network used for the supply of lighting columns is owned by the Distribution Network Operators (DNO) and the lighting columns are each connected to a separate connection. In these instances, a radio-based CMS is usually selected. If the cable network is a Private Cable Network (PCN), then the use of power line communication is far more common, and is the most widely employed form of cable network found in mainland Europe.

CMS can be developed for the full infrastructure or tailored to suit different areas or lamps. The main advantage of using a CMS is the ability to change the lighting to suit specific scenarios. An example of this could be a town center where pedestrian usage is minimal for part of the week but at weekends increases significantly. The system can be set up using higher-wattage HID ballast to operate in a dimmed condition for the majority of the week and be increased at weekends to a higher level to take into consideration the increased pedestrian usage.

A second scenario could be where a part-night lighting regime has been implemented but due to unsocial behavior a request is made by the police to have all night lighting reinstated. This would typically involve a new photocell being installed and the cost savings made by the initial implementation of the regime would be negated. The CMS has the capability to revert to the required regime through the system being reset remotely. The system can also be used to manually override any preset regime in the event of a request from the emergency services.

The system enables real-time monitoring of lighting performance that allows more efficient and effective maintenance of the infrastructure. The information that can be received on a daily basis from each light includes data on lamp condition, burning hours, faults from the previous night and over- or under-voltage data. Once fully installed, a CMS system will monitor the lighting 24 hours a day, in doing so reducing the need for regular night-time inspections, which provides additional staff and transport savings.

Quality, efficiency and affordability are key Local Authorities requirements in investing in public lighting – requirements that are fully met by SELC products.

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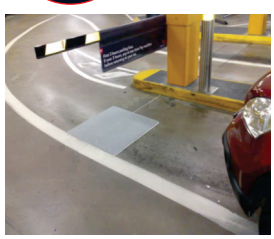

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Save energy without endangering lives

With an increasing number of authorities and councils looking to cut costs and energy consumption by switching streetlights off completely, it's no surprise that many experts are questioning the potential adverse impacts on traffic safety. The talk of the town in the sphere of streetlighting, though, is about 'added intelligence': smarter control systems, energy metering, stepless dimming and two-way communications, for example, are all being integrated into modern solutions. Adaptive dynamic systems, meanwhile, have been investigated under the auspices of EU-funded projects such as the concluded E-street and the ongoing BLISS.

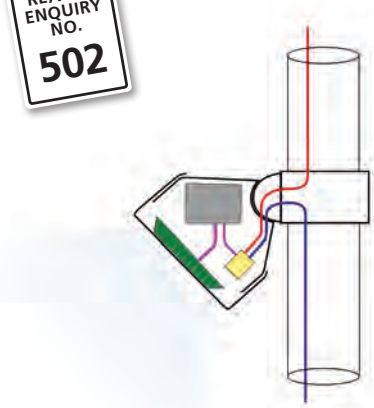
Simplicity in motion

But Siri Skøien from Norway's Comlight believes the answer to reducing energy without cutting safety could actually be quite straightforward: "Light when and where we need it!" she insists. "We teach our children to switch off lights every time we leave a room, so why shouldn't we do the same in the outside world? Why should streetlights be lit to 100% of their brightness when there's nobody around? What if we could provide optimum light only when it was needed? These questions guided the creation of our Comlight activity-based lighting concept."

Several years of intensive development, testing and certification have gone into a solution that not only ticks the sustainability box, but importantly for Skøien does so without endangering the lives of both pedestrians and road users. How? "Central to the technology is a radar detector and wireless WiFi," she reveals. "The radar senses the real-time activity on the street. When one detector is triggered, it communicates to a number of adjacent light poles via the wireless communication system to illuminate the street a set distance ahead. As a driver, it appears lit as normal but if you were looking down from an aerial view, what you see is a 'light wave' guiding the car. And if say, a unit has been vandalised, the communication will bypass the 'dead' one so the 'light wave' continues upstream.

"All other streetlight control systems on the market dim down the light even when there's traffic during the night," Skøien states. "Ours is the only system that will adjust to real-time activity and maintain that vital traffic safety element. The problem with segment-dimming based on historical data is that people will experience reduced illumination during the dimming hours, and the consequence of reduced lighting is increased accidents. As of May 2012, our system is ready to go. It's been tested in trials in Norway with the Norwegian Public Roads Administration and we have several installations in other countries such as Switzerland, Canada and France. We also have patents granted in nine countries, including the UK, so

READER ENQUIRY NO. 502



Need to know?

A brand-new concept fit for past, present and future streetlighting installations

- Patent-approved activity-based lighting concept means light when – and where – it is needed
- Radar detection is based on next-generation real-time sensing – not historical traffic data
- Maintenance-free 'plug-and-play' technology is easily installed onto existing and new luminaires
- Urban, street and road deployments can save 40-50% on energy costs – the safe way

(Top right) **Comlight's solution combines radar sensor with WiFi communications** (Below left) **Illumination at 100% and** (right) **at 50% illumination**

we're well beyond the pilot and research phases."

Real-world results

That being the case, what success has Skøien to report? "We are expecting concrete evidence from Norway in March, but early indications show comparable energy savings of 40%," she reveals.

Importantly, though, Skøien stresses these are brand-new streetlighting installations. "I see a lot of comparisons being published that conduct tests on 20-year-old installations, so claims of energy savings of 60, 70 and 80% are believable but not impressive. It's a bit like comparing a modern diesel engine with one from the early 1980s. We benchmark with new installations and equipment – the latest luminaires, LED technology, and so on."

Safety is sacrosanct

Although energy savings are an important part of Skøien's philosophy, it was vital that sustainability wouldn't be to the detriment of traffic safety. "Various studies have shown that reducing streetlight brightness from 100 to 50% while cars are on the road reduces safety by 25% – hence traffic accidents are more likely. Our solution is able to detect all objects on the street that pose a traffic danger – and at that point provide 100% light. Trucks, cars and motorcycles traveling above a certain speed, for example, represent a hazard. But pedestrians on their own need no more than 50% light for sufficient visibility, but once a vehicle comes into the equation and there's potential danger, full light is provided in that area – meaning maximum safety."

Continuing, Skøien says the Comlight solution can be retrofitted to new or old installations. "Once a street has been scheduled for new luminaires – or if a new road is constructed – we can install our product at the same time. But it's equally easy to mount the product onto existing installations. Either way, you save energy and lives.

"All that's required is an electronic or magnetic dimmable ballast," the Comlight founder continues. "We can even provide alternative control systems for step-wise or continuous dimming. It is also compatible with all streetlight luminaires, both traditional gas lamps and LED – and it runs with 1-10V, DALI or relay. You simply clamp it on the streetlight pole just below the luminaire – it takes two or three minutes per streetlight and it's entirely plug and play."

Operation of Comlight, meanwhile, is equally simplistic, according to Skøien. "The system is maintenance-free during the whole lifecycle," she says. "Preset factory settings can be used or your own parameters can be set with additional PC software, conducted remotely using a USB radio 'dongle'. The system self-initiates on power-up at dusk and then shuts down at dawn. Other parameters can also be preset at the production stage, for instance for special applications such as pedestrian crosswalks or other critical areas where light needs to be maintained at 100%."

(Left) **Siri Skøien is the founder of Comlight, which manufactures the activity-based sensor for streetlight installations** (Bottom left) **The activity-based lighting concept in action**

Coming soon

On the subject of pedestrians, Skøien alludes to a new version of Comlight currently under development. "This will detect pedestrians and cars at all speeds," she says. "When combined with LED lamps, this will be a tremendous asset due to the fact that LED lamps can be swiched off or dimmed to an even lower level when there is no activity on the road – yet still provide sufficient light where and when it is needed. I would imagine this forthcoming product to be perfect for areas such as parks and pathways. It will provide 100% safety for the people in the parks and save energy while simultaneously safeguarding biodiversity."

Return on investment

Back on the road, the Comlight solution is best suited to lighting applications in areas of lower traffic intensity. "For a street in the center of Paris where there's continuous traffic, this is perhaps not the solution," Skøien admits. "But in lower-trafficked and residential zones where the intensity is not too high at night – yet where there is still a need for light for safety reasons – Comlight is ideal. There are a huge number of installations around the world with lower night-time traffic that can benefit from significant energy savings from an easy-to-install, standalone system that enables you to maintain traffic safety." And in terms of payback, Skøien says the Comlight solution will allow authorities to save energy from day one. "It has a very short payback time – three to six years depending on the traffic intensity for the installation. We can even calculate your exact saving for a certain deployment.

"We envisage great demand for this solution on the market and I truly believe that now is the time for a new generation of streetlight control in the form of activity-based lighting."

What happens next?

In addition to Skøien looking for sales and distribution partners, she also says talks are ongoing with luminaire manufacturers to potentially license the technology for integration into their own solutions.

"Obviously, because the radar cannot see through an aluminum housing, as with a forward-crash sensor in a car, it needs to be able to 'see' the road so some design tweaks would have to be made to account for this," she notes. "There are many avenues we can take with this solution and we're open to discussions about advancing it to the next stage. People shouldn't have to think too hard about this: you need to save energy from an ecological standpoint but you also have a responsibility for road users. In both cases, our activity-based solution makes perfect sense."

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"We already have several pilot installations with the Norwegian Public Roads Administration; globally, there is a huge demand for this type of a solution. It's time for the next generation of streetlight control"

Siri Skøien, founder and managing director, Comlight

Q: Can you reduce energy without endangering road users?

A: Yes…

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Simulation software for ADAS

READER ENQUIRY NO. 503

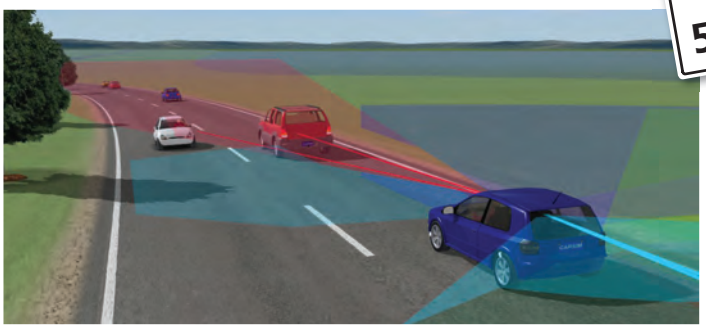
The application of dedicated short-range wireless communications (DSRC) offers some of the most promising, near-term opportunities for improving safety, traffic efficiency, and reducing the environmental impact of vehicles. This mix of innovations creates communication links with other vehicles (V2V) and with the infrastructure (V2I) that may include pavement sensors, traffic signals, workzone equipment, and other elements.

Vehicles will be able to broadcast information about their operating state up to 10 times per second to surrounding vehicles on DSRC. The message content consists of a Basic Safety Message conforming to the SAE J2735 standard. This includes such information as: geographic position, heading, and speed; Vehicle Safety Extension messages containing path history and predicted path; as well as other optional Vehicle Status information.

Intelligent vehicles

In 2010, a consortium (VSC 3) of eight major automotive manufacturers (Ford, GM, Honda, Hyundai-Kia, Mercedes, Nissan, Toyota, and VW-Audi) was formed under the Crash Avoidance Metrics Partnership (CAMP), in collaboration with the USDOT, to further develop and test prototype V2V safety applications. One of the overarching goals is to determine how this broadcast technology can address crash scenarios above and beyond existing safety systems limited to onboard sensors.

In searching for a vehicle dynamics simulation tool with which to develop V2V and V2I technology, the CAMP VSC 3 consortium settled on the CarSim software program produced by Mechanical Simulation Corporation of Michigan. An ITS Extension has been developed for CarSim to enable users to generate SAE J2735-compliant output data from vehicles during simulated maneuvers. The data can be broadcast into an output log file that is later read into a running simulation to emulate surrounding traffic.



(Above) **Vehicles communicating via DSRC broadcast systems** (Left) **ADAS technologies using onboard sensors**

Advanced users can use the MatLab Simulink environment to simultaneously simulate multiple vehicles and have them 'broadcast' J2735 messages to each other (and react to those broadcasts).

The CarSim ITS Extension represents a valuable tool for developing future safety systems. Under the right conditions, these advanced driver assistance systems (ADAS) could even take control if the driver doesn't respond fast enough during precrash warnings. A number of functions can be envisioned for the control systems in future automotive vehicles.

Safety applications

Blind Spot Warning/Lane Change Warning is a key function, the aim being to warn drivers when they try to change lanes if there is a car in the blind spot or an overtaking vehicle.

Need to know?

Looking at the future of ADAS and how V2V and V2I will help enhance system effectiveness

- DSRC as an enabler for road safety applications
- How an established vehicle dynamics software tool has now added an ITS function to assist in the development of future safety systems
- The benefits of combining a simulated driving environment with high-fidelity vehicle dynamics models

Another prime function is Forward Collision Warning, which alerts and then warns drivers if they fail to brake when a vehicle in their path is stopped or traveling slower.

There is also great potential for an Emergency Electronic Brake Lights function, which notifies drivers when a vehicle ahead that they can't see is braking hard for some reason.

Intersection Movement Assist is another feature that ADAS developers are keen to have, the idea being to warn the driver when it is not safe to enter an intersection – for example, when something is blocking a driver's view of cross traffic.

Two further functions are also desirable. Do Not Pass Warning alerts drivers if they attempt to change lanes and pass when there will be a vehicle in the opposing lane within the passing zone. Control Loss Warning, meanwhile, warns the driver when another nearby vehicle has lost control.

In effect, controls designers are emulating the complex task of maintaining situational awareness faced by drivers and reducing it to algorithms and decision processes to evaluate when and in what way to intervene when a potential driving conflict arises. Being able to do this in a simulated environment with high-fidelity CarSim vehicle dynamic models accelerates the development process while minimizing the risks of empirical testing. The new CarSim ITS software will help major OEMs and Tier 1 suppliers from Asia, Europe, Australia, and the USA who have been using CarSim vehicle dynamics software for ADAS development for 15 years.

Contact

Mechanical Simulation
+ 1 734 668 2930
tdg@carsim.com
www.carsim.com

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Investment in speed enforcement pays off

READER ENQUIRY NO. 504

When, in 2010, a speeding driver lost control of his car in a residential area of the city of Garbsen, Germany, and burst through a picket fence to end up next to the swings of a local kindergarten, this shocking incident provided the basis for the implementation of modern speed enforcement technology in the city. Today, this exact spot and others are monitored by a laser-based speed enforcement system. Now speeders are reliably captured and a change in driver behavior has already been observed.

As well as being one of the main causes of road accidents, speeding also causes the most severe accidents. The UN has therefore nominated this the Decade of Action for Road Safety and has encouraged countries worldwide to participate. Many nations have set up their own programs in which speed enforcement is usually one of the most important ways of improving road safety. Australia has launched the National Road Safety Strategy, and in its annual report for 2011, the Western Australia Police highlighted the success of its laser-based Vitronic systems.

Long-term speed reduction

Studies and practical experience show that the implementation of stationary speed enforcement systems discourages drivers from speeding. In countries with high numbers of road fatalities, there is significant correlation between speed enforcement and the decreasing number of accidents. Recently, researchers from Weill Cornell Medical College in Qatar found that after the implementation of speed enforcement systems in Qatar, there was a dramatic decrease in fatal road accidents.

(Left) **Designed to integrate into the urban environment, the bullet-proof aluminum pole protects the internal system from vandalism** (Far left); **Safety has been improved in Germany through enforcement**

Lidar brightens black spots

With more and more vehicles now on the roads, it becomes especially dangerous for the most vulnerable road users such as children, the elderly, or cyclists – who make up almost half of those killed on the roads. Sophisticated lidar speed enforcement provides the technology to make accident blackspots such as curves, road work areas, or school zones safer. Obstacles such as parked vehicles or guard railings do not affect the technology. Unlike radars, laser-based systems do not rely on electromagnetic waves; instead, a laser captures the position of each vehicle in the tracking zone. The measurement data set comprises the road and the speed traveled at any specific time within the tracking zone.

For residents, safety is not the only major issue; noise reduction is also important. Permanent exposure to noise can significantly reduce the quality of life, and speed enforcement as a means of ensuring that a certain speed is not exceeded also contributes to the reduction of traffic-related noise. As lidar speed enforcement is known to catch all kinds of vehicles, the location of the enforcement system will soon become known and discourage potential speeders.

Need to know?

Persuasive reasons why speed enforcement is beneficial for everyone

- Speed enforcement helps prevent severe accidents
- Evidence that systems discourage speeders and therefore provide for a long-term speed reduction
- Accident blackspots such as road work areas, schools, or curves become safer
- Modern systems need little maintenance and road-work effort, but are highly efficient
- The environment also benefits from reduced speeds

With modern systems, even motorcycles can be captured reliably. Vitronic's PoliScan*speed* technology, for example, combines a regular speed enforcement system with an additional remote camera so that front and rear images of motorcycles can be taken at the same time. The system can also track virtually any number of vehicles in multiple lanes, and is therefore potentially able to capture more speeders than other systems. Recent statistics for 2011 from the Dubai Police compare three kinds of operative speed enforcement systems. The results showed that Vitronic's lidar technology systems capture between 2.5 and 5.8 times more speeding vehicles than competing systems.

High efficiency, little effort

Modern enforcement technology not only brings impressive results, it also requires little maintenance or road-work effort. As no in-road equipment is used, loops or sensors don't have to be regularly exchanged, and this saves a considerable amount of money.

Speed enforcement also has a positive impact on the environment as exhaust and greenhouse gas emissions are significantly reduced at lower speeds. So even though speed enforcement is – first and foremost – a tool that helps make the roads safer for everyone, it also helps to keep the air cleaner.

Contact

Vitronic
+ 49 611 7152 636
julia.stolle@vitronic.com
www.vitronic.com

Automatic camera calibration for incident detection systems

READER ENQUIRY NO. 505

Advances in incident detection technologies are very much welcomed by traffic managers. By continuing to reduce the response time from the incident occurring to it being cleared, lives can be saved, serious injuries can be swiftly treated, while vehicles removed from the scene more quickly will mean fewer secondary incidents and hold-ups – and cleaner air as a consequence.

Rising star of ITS

Although incident detection systems have been around since the 1970s, in recent years they have evolved a much greater level of artificial intelligence, with neural networks among the most common of the algorithms utilized. Smarter behavioral-based solutions benefiting from machine vision developments are likely to improve overall effectiveness in the future. The trend is likely to be an increasing number of cameras being deployed and more areas of the network under surveillance.

AID specialists at Kapsch have introduced a new and easy way of calibrating incident detection cameras (tunnels, open roads, etc)

According to Kapsch's Marcus Braun, however, this presents more challenges and complexity in terms of calibrating the cameras before switching them on. "Whether out on the open road or within a tunnel, this is traditionally a lengthy process," reveals the product manager for the Austrian company's Video & Sensor Solutions unit. "In the case of a tunnel, you would have to walk from camera to camera, manually taking calibrations relating to field-of-view, distance to markers, most commonly using a measuring wheel or a laser-based device."

Depending on the environment, Braun says the process might take 20-30 minutes per camera and is subject to a number of potential errors, not least from the mistyping of figures (114m instead of 11.4m, for instance). "It's quite common for the measurement data to be taken down with pen and paper before being input into a configuration on an industry PC somewhere else," he explains.

"These measurements are never precise as figures are rounded up, while others have to be approximated due to obstructions at the site – it's not an exact science, which for tunnel safety is the least you should expect."

Exact science

Together with colleagues in Kapsch's Vienna R&D department, Braun set about developing a system to make the task simpler, quicker, and more accurate.

The result, after nearly a year of intense effort, is Kapsch's 'IDS ACC' – a 3D Automatic Camera Calibration system for on-highway and tunnel incident detection systems. "For the moment, the system has been designed to calibrate our own incident detection cameras, but we have a patent pending so there's a lot of avenues we can take in the future," he reveals. Theoretically, though, the ACC could calibrate systems from other manufacturers.

The best way to illustrate the benefits of ACC is to focus on one of the projects in which it's already been used on the A73 in the Netherlands. "We completed this at the end of 2011 and it was pretty much the optimal testing environment," Braun recalls. "In all, there were 134 Kapsch IDS cameras to calibrate – 67 on the open road and 67 in the Roermond and the Swalmen tunnels – each of which had a left and a right tube. If using the 'classic' method, this may have taken maybe 60 hours, would have involved road closures, delays, safety concerns, etc, but because our system is attached to a vehicle and moves at much higher speeds, we were able to complete the whole process in around three hours." Braun also stresses the result of this improved speed efficiency in financial terms. "Closing 30km of tolled highway in Austria for two days, for instance, could result in a loss of toll revenues amounting to €100,000," he confirms.

The ACC system itself is compact enough when in pieces to fit within a flight case, while setup and affixing it to a vehicle takes no time at all – Braun

Need to know?

A new calibration tool that speeds up camera calibration, resulting time, accuracy, and safety benefits

- Time used to take measurements and calibrate the detections has been greatly minimized
- Accuracy is up to 10 times greater than classic methods, allowing for more precision in speed detection
- A height reference has been added to the former 2D calibration data, allowing the detection algorithms to use this 3D data for more precise classification and detection
- A 100-camera section takes one to two hours to calibrate rather than 35-50

performed tests using a standard Ford Galaxy. "When you are conducting a passage (one run through a camera zone), the detection algorithms recognize the triangular markers and the cameras switch automatically to calibration mode. Once calibration is complete, the data is available immediately and can be viewed on a GUI for engineers to assess the appropriate parameters."

Braun also reinforces the importance of accuracy, which with the ACC system is around 10 times greater than traditional methods. "Calculating the speed and distance of objects is most important for any detection algorithm – if you know it's below 10km/h, it's a slow vehicle, if it's 0km/h it's stationary, and if it's negative, it's likely a wrong-way driver."

So with the advantages to customers clearly mapped out, what are the benefits of ACC to Kapsch? "Clearly, there are advantages for our field staff to calibrating in hours rather than days. I know of only one other supplier in the sector that doesn't calibrate in the conventional way, but the calibration quality of their method doesn't compare to ours – not to mention their process also takes a lot of time per camera. The availability of ACC to our existing and future customers is a big USP for us."

Industry experts seem to agree, too, as ACC was shortlisted for an Intertraffic Innovation Award in the Safety category in February 2012.

Contact

Kapsch TrafficCom
+43 50 811 1721
petra.hamm-fierthner@kapsch.net
www.kapsch.net

Eric **Sampson**

eric.sampson1@btinternet.com

Many years ago, I worked for the boss of the Engineering & Physical Sciences Research Council – an internationally recognized theoretical physicist. He regularly reviewed the priority research areas of what he considered the six or so leading overseas countries to see how UK activities related. His argument was something like: "The fact that they are all doing 'X' doesn't necessarily make them right to do it but in my experience it makes us likely to be wrong if we don't." (He is Welsh.)

So why am I sharing the wisdom of Sir Sam Edwards FRS? Because the USA, China, Germany, the EU, South Korea, Japan, Canada, France, Australia, and Sweden all have research or pilot projects into systems of vehicles connected to infrastructure and the UK doesn't – and I think it is we who are wrong. Cooperative Vehicle-Highway Systems (CVHS) means fitting a car, truck, bus, etc, with a wireless link so information can be exchanged with the local infrastructure as well as with other vehicles.

The infrastructure is primarily but not exclusively the roads network. The potential stakeholders include telecoms companies, parking services, power distribution companies for hybrid or EV recharging, retail outlets, value-added service providers, the entertainment industry, healthcare providers, and services aimed at travelers of all types.

The reason I think this matters is that we are slowly but surely running out of tools to get more productivity out of our roads infrastructure or to get further reductions in serious or fatal accidents. CVHS can deliver either or both as well as emissions reductions. Let's start with roads. Currently we maximize capacity by 'calming' the flows and packing the units a bit closer together, which we do by imposing a small reduction in maximum speed, dissuading drivers from lane-switching and permitting controlled use of the hard shoulder. To put it a little bluntly, we take away some of the driver's freedom of choice but trade it for reduced congestion and far more consistent transit times.

Getting the potential safety gains is more complicated and essentially rests on vehicles alerting each other to their behavior – so if onboard systems detect a potential collision, drivers can be warned or even over-ridden. The USA has enthusiastically embraced this concept and will soon launch a 3,000+ vehicle trial of collision avoidance.

The potential environmental gains from CVHS have been demonstrated in the UK using autonomous onboard systems. A vehicle monitors its location against a three-dimensional map and the driver is advised what speed will minimize fuel consumption by taking advantage of gradients. A full CVHS takes this even further by taking account of wider traffic flow information to advise the driver on speed, acceleration and braking so that transit time, fuel consumption, and tailpipe emissions are all minimized.

We really need to start to develop a CVHS strategy – perhaps DfT and BIS could work jointly on this starting from December's Automotive Council report on mobility? If government doesn't get involved, it will have no say on what products are mandated by international legislation, the standards used, and the human factors designs. It will have no knowledge regarding the best ways to deploy systems to deliver national transport policies, and UK companies will be isolated from market opportunities. We will get what Munich, Detroit, Tokyo, Seoul, and Gothenberg think should be sold – not what the UK needs. And none of that seems very desirable.

> We will get what Munich, Detroit, Tokyo, Seoul, and Gothenberg think should be sold – not what the UK needs … none of which seems very desirable
>
> **Professor Eric Sampson, Newcastle University/ITS-UK, UK**

Industrial cameras meeting the tough demands of the ITS sector

Need to know?

The changing landscape of machine vision and how this will affect ITS applications

- How the demands from one challenging sector – that of industrial cameras – are similar to the demands in the equally challenging traffic sector
- Evolution of cameras and their functionality and how this shapes applications
- Why integration is as important as imaging
- New camera series designed to meet ITS demands

Even to a casual observer, it is evident that there is a fair amount of crossover between the machine vision and traffic management sectors. The demands of both industries are strikingly similar, so it's no surprise that trends we observe in the machine vision sector often filter across to the traffic sector. Technological developments in machine vision frequently prove equally as valuable to the traffic market.

The development of industrial cameras still has many opportunities ahead to create real value-added factors in the electrical and mechanical environments of the industrial image processing world.

Mechanics, control engineering, and industrial image processing are three technologies that ideally should build a perfect team, but in reality often require a good deal of effort to work together. So how can the integration of image processing components in system design be effective and quickly adapted? And which tasks and interfaces should the 'industrial camera' component take over or offer?

The use of camera systems for monitoring and evaluating individual production steps or final inspection has enriched the machine building industry over the past two decades. Quality control through the use of image processing in the planning of new production concepts is now almost taken for granted. Gone are the days when the advantages of this technology had to be 'sold' to users.

The rapid development of computers and their data interfaces to memory and graphics processors has given wings to the resulting potential applications. The shift toward the use of commercial interfaces such as IEEE 1394, USB, and the availability of Gigabit Ethernet technology have been a particular boost to the digital camera industry. GigE is by far the most suitable interface for roadside applications. There is almost no limit for cable length, particularly because there are many suitable components (such as fiber optic cable) available to expand the 100m limit of Cat 5e.

The BlackLine series has been designed to meet the needs of the traffic market

The camera's changing role

Previously, the heart of image processing (or the manager of the image data) was the image-acquisition card – the so-called frame grabber – which captured the analog or already digitized image data and coordinated the processing of this data. The frame grabber often took on the role of manager for peripheral signals such as triggers, flash control, and even G/NG decision signals, which were generated according to precise timing relative to the image acquisition.

This communication and coordination function has now become a potential job for the camera. With the optimal design, the camera can become the 'master' of the vision system that generates the important timing signals at the right time. The use of current computer interfaces together with an optimally designed camera can eliminate the need for frame grabbers and therefore facilitate the ease of integration and availability, while fulfilling the demands of today's customers.

It is important to standardize the signals as much as possible and make them practically available so that the cabling system remains professional and the effort expended on it is kept to a minimum. Many industrial cameras perform well in the core competency of imaging, but through the use of atypical power requirements, I/O levels, cable and connector systems, and so on, they create indirect paths of integration into machines and PLC systems. Additional external control

READER ENQUIRY NO. 506

Three inputs are available, plus two outputs (optional four with high-current LED drivers) and a real RS232 accessible via Ethernet

devices such as LED lighting controllers or signal conditioners are frequently part of the cabling equation. Also, the low protection class of a camera often leads to the requirement for an additional protective housing.

With its new BlackLine camera platform, SVS-Vistek is providing innovative solutions to these integration issues, as well as new possibilities to bring camera technology closer to the needs of machine builders and control engineering. The designer of a demanding traffic application will always keep the range of available industrial cameras at the forefront of his mind and check their usability for his specific project.

From the vendor's perspective, new industrial cameras will have more features that directly target the needs of a broad application field or that can enable new solutions.

SVS-Vistek's latest big design step is the clever and robust control of a high-quality lens (focus, zoom, iris) without the need for an external cable. This new member of the BlackLine series will be shown at Intertraffic Amsterdam 2012.

The housing of the BlackLine is sealed against dust and water spray. Together with an attached protective tube for the most common lenses, a rating of IP67 is achieved, eliminating the need for an additional protective housing in many applications.

In mechanical engineering and especially in the design of PLC systems and sensors, M12 connectors and sockets have a proven track record. The global offering of off-the-shelf components from different vendors is therefore huge. This is why the new BlackLine cameras have been outfitted with standard M12 connectors. The M12-12 is used for power and I/O communication and the M12-8 is used for image data transmission, cross-coded in accordance with the GigE-Vision standard. This connection is already rated for 10 GigE and is therefore a truly future-oriented selection and a step toward industry standardization.

Better connected

With regard to the voltage and I/O signal levels, SVS-Vistek does not see the variety of individual solutions available on the market as an advantage for customers. The Hirose connector used on most cameras is, since the advent of the digital age, no longer uniformly coded. Supply voltage of 12-24V ±20% and 0-24V I/O signals are good prerequisites for building interference-free dialog with the PLC system. The days of standard TTL signals and high-impedance, interference-prone drivers in the camera industry should be numbered.

The I/O systems of the Eco- and Evo-BlackLine series are very communicative. There are three inputs (up to 24V), three outputs (two with high-current LED drivers), and real RS232 and RS422 (differential) communication channels, which can be accessed via the Ethernet. The correct activation (trigger) and the correct exposure time (shutter) with the correct lighting (LED control) are the foundations of a good image that can then be processed. The required computing effort and even the feasibility of success at all are decisively influenced by these image acquisition factors.

The complexity and therefore costs for the cabling and commissioning of a system grow in relation to the number of external components required. Because the industrial camera has already mutated into the heart of the image processing system, the idea not only to control the LED lighting but also to drive it directly from the camera was obvious. In many cases, the use of an external flash controller can be eliminated. The timing of the signals for CCD exposure and LED flash is generated by a single component (the camera) and programmed via the GUI.

With SVS-Vistek's cameras, up to four LED lighting units can be controlled and driven to achieve the right illumination results for the job.

The many different trigger modes also allow almost any system configuration. For example, the new logical trigger function can link several inputs together through logic functions to synchronize encoders and photoelectric relays.

Contact

SVS-Vistek
+49 8152 9985 0
info@svs-vistek.com
www.svs-vistek.com

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VITRONIC
machine vision people

VITRONIC Dr.-Ing. Stein
Bildverarbeitungssysteme GmbH
Hasengartenstr. 14
D-65189 Wiesbaden
Germany
Fon + 49 [0] 611-7152-0
Fax + 49 [0] 611-7152-133
www.vitronic.com
sales@vitronic.com

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ALPR for tolling in South America

In South America, the first examples of automatic license plate recognition (ALPR) technology being applied to toll payments were seen in open road tolling (ORT) and free-flow systems. In these systems, ALPR supplemented the automatic payment conducted by reading RFID tags. If the tags were not read by the antennas or if a vehicle did not have a tag, license plate reading via computer vision would come into play.

Since this initial usage, the technology behind the hardware supporting ALPR has advanced greatly. Processors have become faster, traffic cameras ever more accessible and the license plates themselves have also improved in quality. Today, one can't help but be impressed that license plates can now be read in a matter of milliseconds.

Systems integrators and motorway licensees are now looking favorably upon the integration of ALPR technology in traditional toll systems at plazas and booths.

Just as in ORT systems, ALPR back-up technology already exists, should the ETC technology (based on RFID tags for automated toll roads) fail.

Others have fully replaced RFID technology with ALPR, primarily to save on costs. When a toll scheme has to give a significant discount or exempt neighborhood users, for instance, RFID technology can be costly – despite it being based on passive sticker tags.

ALPR technology does not use consumables like RFID does, as the identification process needs only the license plate itself, and therefore the investment costs are limited to the reading equipment. Also, it does not present the usual problems with interoperability, since the device only has to read the license plate, whereas in some countries cars can have three different tags, creating interference problems and complications in calibrating the RFID equipment.

In some cases, ALPR systems are also used to monitor fraud. For example, at closed tolls the license plate is recorded upon exit to verify that it coincides with the user's ticket and the license plate that entered. At toll stations with clearing systems (payment is made in the first toll plaza and free in the second), license plates are monitored to avoid the resale of tickets during the trip. There are some monitoring cases in which ALPR backs up the RFID technology with interchangeable active tags, keeping heavy vehicles from using lightweight vehicle tags.

(Top) **Screenshot of the Neural Labs ALPR software** (Left) **Many traditional toll systems in South America now use ALPR technology**

READER ENQUIRY NO. 507

Need to know?

The evolution – and incredible value – of ALPR within South American toll projects

- Outlining the story of the growing adoption of ALPR technology for use in tolling
- How in some schemes, ALPR has gone from a supplementary solution to the primary solution
- Detail on the advantages of ALPR over alternative technologies
- The benefits that concessionaires are reaping in terms of accuracies and efficiencies on various toll schemes

Personal touch

Some concessionaries in certain countries have to comply with tax regulations that require a toll booth to provide a printed personalized bill. Naturally, this operation takes longer than usual (more than the average eight seconds), creating the resulting traffic tailbacks. ALPR technology has helped speed up these times – as the systems associate the license plates with the companies, a personalized bill takes up the same amount of time as a generic one.

Except for ORT systems where almost all of the vehicles have tags, in the rest of the toll schemes (whether open or closed), the best-case scenarios achieve a 40% collection rate using ETC. The rest is paid in cash at the booth. That means that almost 60% of the flow of traffic is unknown.

Knowing the total consumer profile is invaluable information and is possible wherever ALPR technology is applied. By way of example, this information can estimate the average speed by stretch of road, for instance, it can recognize customer behavior, supply information on vehicles passing by to law enforcement, detect and collect on non-payment, etc.

From the beginning, Neural Labs has supplied toll system integration companies with its VPAR vehicle plate recognition engines for both stop-and-go and free-flow applications, and the company has learned along with them all about the specific problems facing the business.

Contact

Neural Labs
+34 935 912 451
info@neurallabs.net
www.neurallabs.net

Cloud-based automation for offense management

READER ENQUIRY NO. 508

The implementation of Cloud-based systems has brought clear improvements in efficiencies across all types of processes. In the current economic climate, where organizations worldwide are under increasing pressure to deliver more in terms of results with less in terms of budget, Cloud-based systems are helping improve productivity and accuracy.

One space where this is particularly crucial is traffic offense management. Organizations manually processing thousands of offenses per day often experience a 'justice gap', when a backlog of offenses builds up due to administrative delay and human error, resulting in some offenses being lost or timed-out, so offenders simply get away with them. How then, can this information be quickly, efficiently and cost-effectively processed?

UK-based company StarTraq is providing the answer with the launch of its innovative browser-based back office for enforcement. StarTraq Dome (Dynamic Offense Management and Enforcement) is a Cloud-based service for processing repetitive workflows such as civil or criminal traffic offenses.

StarTraq's Dome solution creates efficiencies and best practice for offense management

Need to know?

A solution designed to streamline efficiencies in the enforcement processing sector

- How to meet the global demand to achieve more with less budget
- The unique demands of traffic offense processing
- A new Cloud-based system that has great potential to improve efficiency and productivity
- The solution is secure, easy to install and relies on an advanced workflow engine that handles every step of the offense handling process
- Remote access enables smarter working practices

StarTraq Dome provides local authorities and police forces with an automated software solution to create efficiencies and best practice for offense management. The system is secure and easy to install anywhere in the world.

How it works...

Let's take the example of processing a traffic offense such as exceeding the speed limit. Offenses are captured by camera – from a variety of media including wet-film, DVD or digital formats – or by enforcement officer-issued ticket. This information is uploaded to the StarTraq Dome system, where users verify the offense online. The sophisticated workflow engine handles the entire process of offense management, including correspondence and document archiving, to the final outcome – whether this is issuing a fine, court prosecution or referral to driver education.

The system can be installed internally within a customer's own network or hosted securely on the internet. It can be deployed remotely with minimal or no upfront investment. It is also possible to enable remote working via internet or VPN (virtual private network) access.

This is a versatile and scalable solution that can handle any offense type. It can be used for processing both civil and criminal offenses, including speeding, red-light running, bus lane and congestion charge enforcement, cell phone and seatbelt usage, parking, yellow box infringements and any moving traffic offenses.

The software facilitates the sharing of administration across offenses, locations and agencies. For example, one customer is planning to deploy StarTraq

Dome as a portal for enforcing access and speed control in luxury gated communities in South Africa. The service will be hosted on a single server in South Africa, with a single back office providing a service for multiple communities, which achieves big improvements in efficiency and productivity.

Driving up efficiencies

StarTraq Dome's automation reduces the level of human error when handling repetitive tasks and avoids any backlog of offenses building up.

The remote access and the intuitive user interface both make smart working practices easier, and administrators are able to view the system on a micro and macro level, so that they can, for example, monitor individual user performance, and produce management statistics for multiple regions. Multiple users can access the system simultaneously from any web-enabled computer anywhere in the world. As users only pay for what they use, it can be cost-effective for both large and small installations.

StarTraq Dome can be installed on the Cloud or on a private secure network. For new users, it can be deployed remotely via the internet by StarTraq or its resellers without even sending an engineer, and support is UK based.

It is available in any language, and can be customized to reflect local legislation and can even be branded with the customer's own logo and identity.

Contact

StarTraq
+44 1295 273 000
info@startraq.com
www.startraq.com

misener_james@bah.com

Last week, I attended the Transportation Research Board (TRB) Annual Meeting, a rather large gathering of like-minded folks from academia, industry and government – all with a research bent – and presenting peer-reviewed papers, talking to peers from across the dais in panels and of course imbibing with peers at a nearby Irish Bar, Murphy's. There were something in the order of 8,000 attendees, so we crossed the gamut of transportation topics. (Care to talk about pavement restoration, anyone? Or how about bridge scour?) However, there was a growing, palpable trend detected at least by this rather biased observer: research and discussions on autonomous vehicles.

Recently, in this column I admitted that these things might be real. Google and others have driven, or rather ridden, cars on real roads, with generally good success. However, what about operational reliability, with pedestrians, bad weather and poor visibility? All engineering challenges. But now, non-engineers in high positions, that is, policy makers, have entered the fray. They attend TRB, and they give notice. Cars that drive by themselves might aid elderly drivers. Trucks that drive by themselves may provide an interesting business case, to fleet operators (due to decreased aerodynamic drag) and to society (as close platoon-following allows dense lanes of commercial vehicle to drive hither and yon – just like a train).

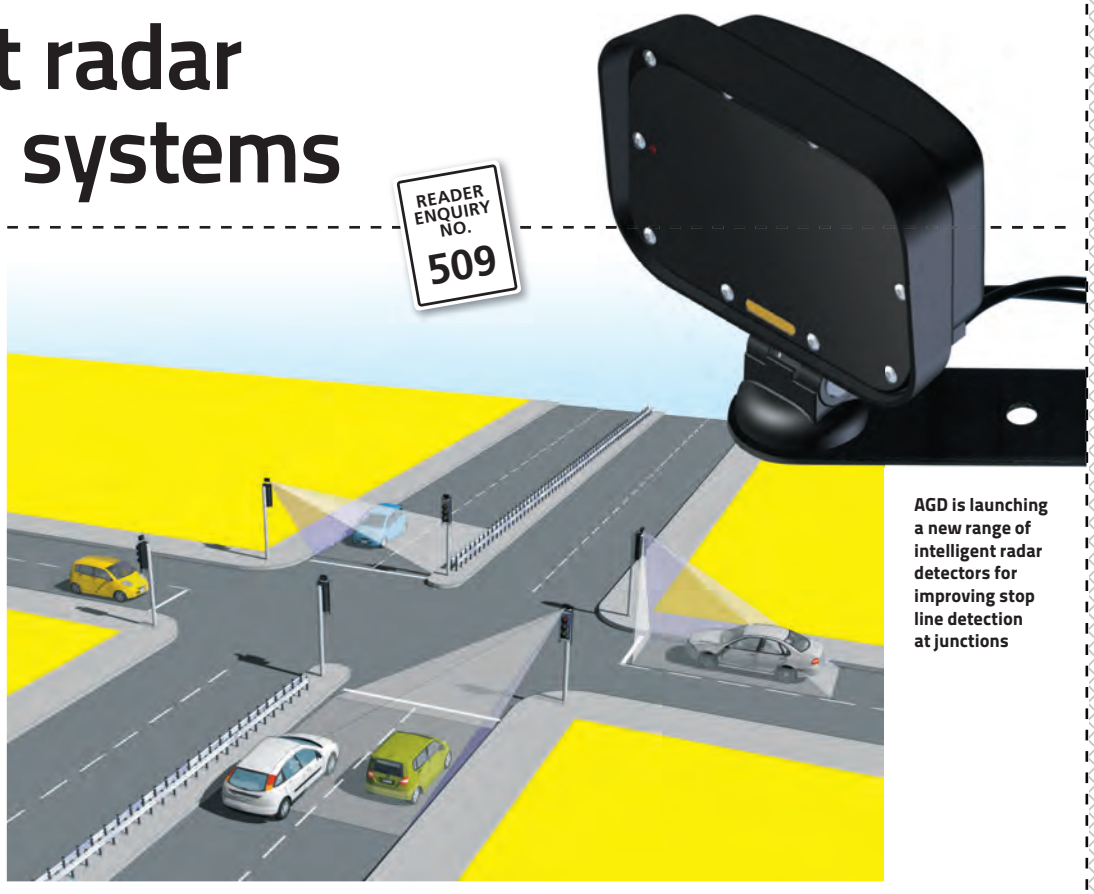
If one conveniently bypasses the Vienna Convention on Road Traffic from the late 1960s, which by the way defines vehicles as being driven by humans, then as revealed by TRB attendees as well as the popular press, there is a movement to determine licensure laws within several states within the United States. Moreover, these states have been communicating through their associations; they are determined to give due justice to the serious concept of licensing automated vehicles for on-the-road driving. Imagine that, a robot driving a car. Will he violate the speed limit? What if he is distraught over an argument with a fellow robot? But I digress. This is serious business. The potential for safety – or lack thereof – and for advances in mobility – or not – are tremendous. According to proponents, we are on the cusp of a revolution in mobility and choice of conveyance, whether the travel be via small, pod-like vehicles in well-defined routes or a real alternative to the cars of today, operating on the roads of today. Research must be done, as perception and reaction to other road users let alone other cars, some driven by Hal and others by you and me, would be essential, as are the human factors of all this. Is the human supposed to be a vigilant operator? What about transition of control if the automation is not door-to-door?

These are interesting questions, but answered well, we could collectively have an interesting proposition. The smart car will literally transform into the smart transportation system, with another class of road user, cold, calculating and safe.

> Imagine that, a robot driving a car. Will he violate the speed limit? What if he is distraught over an argument with a fellow robot?
>
> **Jim Misener, executive advisor, Booz Allen Hamilton, USA**

Intelligent radar detection systems

READER ENQUIRY NO. 509



AGD is launching a new range of intelligent radar detectors for improving stop line detection at junctions

Drive up to the stop line at a set of traffic signals and you are likely to see evidence of a buried inductive loop detector providing vehicle information to the local junction controller. Employed for many decades, loops offered a solution that historically was not available by other means.

International requirements for stop line detection vary greatly by jurisdiction and local traffic management policies. Lane approaches can be single (such as from side roads onto main routes), dual, or multiple (such as the approaches present at busy city junctions). In all instances traffic engineers will be looking for reliable detection outputs from the chosen detection platform.

Different technologies have been employed for this purpose, including inductive loops and vision-based equipment. Loop-based equipment suffers from degradation of the road surfaces in harsher climates. It's also at risk from damage by utilities companies as they re-lay pipelines and cables. Vision-based equipment offers the flexibility of setting multiple detection zones but it can be affected by differing light levels and the presence of low sun.

Installation/commissioning engineers will typically prefer a detection platform that is easy to install and offers user-friendly tools for set-up. This task needs to be completed in a relatively short time and the communication protocol should avoid the need for a wired interface to the detector.

Reliability and robustness

Reliability is key in successive product developments and no more so than in above-ground radar detection. Detect outputs have historically been provided by relay contacts, but latterly the use of solid state opto-coupler outputs has increased the longevity of operation in the field and eliminates the need for replacement of mechanical relay parts over time. Introduction of RS422 interfaces on detection platforms provides transfer of more detailed vehicle data to local controllers.

Working closely with local partners, manufacturers must identify the specific modes of operation that are required from their detection platform – but more importantly, the way in which the local infrastructure/controller expects to see the vehicle detection information conveyed to it. It will often be necessary for a manufacturer to customize its equipment.

At Intertraffic Amsterdam 2012, visitors will see a new frequency modulated continuous wave (FMCW) vehicle radar designed for the detection of stationary vehicles at the stop line. Following on from successful earlier FMCW radar platforms developed a number of years ago for SCOOT, MOVA and queue detection applications, AGD's new range takes lessons from the earlier radar families and also applies the latest planar antenna technology and embedded DSP processing.

This new radar family is able to simultaneously track multiple targets approaching the stop line. It then provides solid detect outputs to the local controller for stationary vehicles waiting at the stop line/traffic lights, thereby replacing high-maintenance inductive loops.

Bluetooth set-up of the detection zone is provided in a user-friendly GUI and can be performed in minutes. Ideally mounted at a height of 3m-5m to existing street furniture, this robust yet lightweight detector will be popular with junction designers and installers.

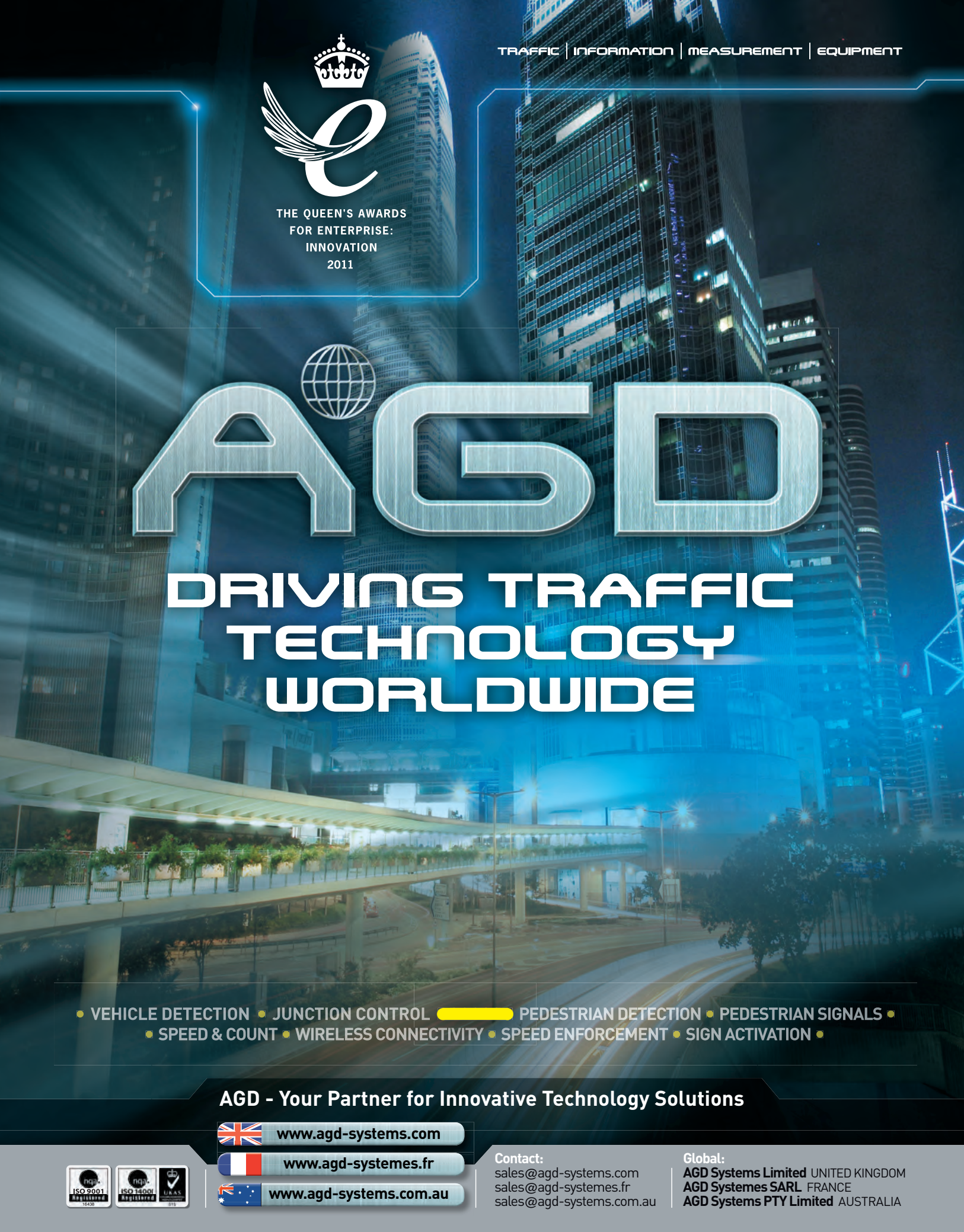
Need to know?

The enormous potential of a new breed of above-ground radar detection

- The ability to detect vehicles at stop lines is a necessity for traffic management across the world
- Where inductive loops were once the dominant detection solution, other technologies are now viable alternatives
- How above-ground radar detectors meet every need – from ease of installation and deployment to long-term reliability of detection

Contact

AGD Systems Ltd
robert@agd-systems.com.au
+61 2 9653 9934
www.agd-systems.com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Raising detection standards Down Under

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VicRoads is the road authority for the state of Victoria, whose capital city Melbourne is Australia's largest container port and the country's second-most populous city, with around four million people. As with other cities of this size, motorists are delayed every day due to roadworks or congestion. VicRoads works tirelessly to improve mobility on its network, however, and is managing about 3,500 signalized intersections to keep things running smoothly.

"Inductive loops have worked well and have been a relatively cost-effective and reliable means of detection," reveals Steve Bean, manager of ITS performance and standards for VicRoads. "They have certain drawbacks, however, including the need for extensive traffic management and damage to road surfaces. As a result of these drawbacks, VicRoads is in the process of investigating alternative, non-intrusive means of vehicle detection.

GridSmart has been installed for two years in three locations as part of VicRoads' evaluation

"We want a solution that can be easily maintained to provide acceptable levels of accuracy and reliability, without great expense and disruption to traffic," Bean continues. Working with Detector Loop Services (DLS) toward this goal, in 2010 DLS introduced VicRoads to a relatively new product known as GridSmart.

A new technology

Manufactured by USA-headquartered Aldis, GridSmart leverages three-dimensional omni-directional object tracking to provide vehicle detection and traffic data collection for a complete intersection using a single ultra-wide-angle lensed camera. The no-aim, no-focus camera is connected to a processor by a single CAT 5e cable and provides image data to GridSmart's software.

The tracking technology in the software analyzes each image and locates objects of interest by assigning tracking points to the edges of moving objects. Based on the makeup and movement of these tracking points, a 3D model is assigned to the object (vehicle, bicycle, pedestrian) and tracked throughout the intersection. The models are used to activate zones, anticipate shadows, record true turning movements, record vehicle length for classification, capture volume data, and much more.

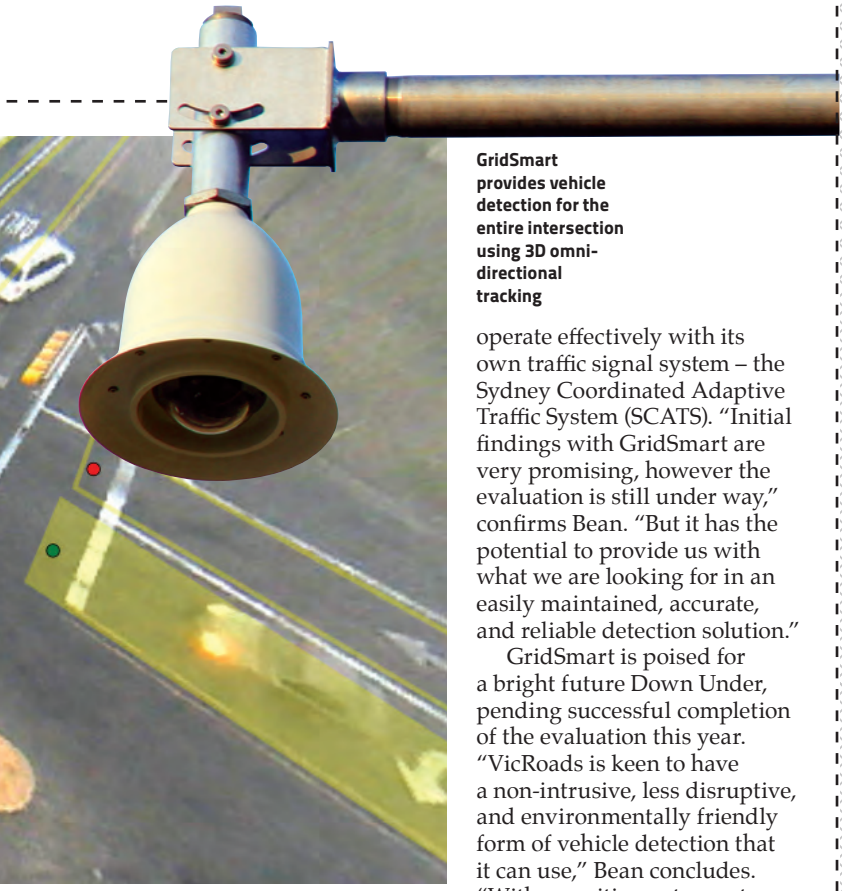
Another key feature of GridSmart is enabled by its horizon-to-horizon visibility. Within the software, the image is digitally flattened from its native 'fish-eye' view, so users can easily visualize the intersection, make changes to zone plans, and more. This flattened view provides a virtual PTZ feature, so users can pan-tilt-zoom around the intersection at any time without movement of the camera and without affecting the tracking or data collection. This PTZ software can improve situational awareness at a TMC, and can also aid in incident response. Historical image data – complete with light state and phase information – can also be reviewed and played back using GridSmart's smart Virtual DVR feature.

DLS became an authorized distributor for Aldis in Australia shortly after learning about the product and its capabilities. "GridSmart's 'single camera'

Need to know?

Australian case study on the merits of a new form of vehicle detection

- Outlining the story of Melbourne's shift from loop-based detection to a novel, camera-based solution
- How three-dimensional object tracking technology works and what its benefits are
- As well as wanting a non-intrusive, less disruptive form of detection, VicRoads also wanted a solution that would easily integrate with its SCATS control system



GridSmart provides vehicle detection for the entire intersection using 3D omni-directional tracking

solution was the first thing that attracted us," states Noel Stoddart, manager at DLS. "We immediately saw the promise in a single, non-intrusive sensor to greatly reduce the amount of site downtime, cost, and traffic disruptions. We're also able to equip a GridSmart intersection in three hours or less."

The evaluation

Shortly after the introduction to GridSmart, VicRoads installed its first trial site for freeway data collection. Later in 2010, a second system was installed in Melbourne's Surrey Hills suburb for intersection stop-bar detection. A third site was installed for close observation at an intersection near VicRoads' office in Kew.

In addition to accuracy and reliability, VicRoads required that any new system would operate effectively with its own traffic signal system – the Sydney Coordinated Adaptive Traffic System (SCATS). "Initial findings with GridSmart are very promising, however the evaluation is still under way," confirms Bean. "But it has the potential to provide us with what we are looking for in an easily maintained, accurate, and reliable detection solution."

GridSmart is poised for a bright future Down Under, pending successful completion of the evaluation this year. "VicRoads is keen to have a non-intrusive, less disruptive, and environmentally friendly form of vehicle detection that it can use," Bean concludes. "With a positive outcome to our trials, GridSmart may offer a real solution."

"As road authorities across Australia become more sensitive to road damage and traffic delays caused by sensor installation and maintenance, we believe GridSmart is the future of vehicle detection," Stoddart adds. "After extensive site evaluations, it has performed flawlessly, far surpassing the performance and capabilities of other products that we have used, and includes many features that others simply do not offer." ○

Contact

Aldis
+1 865 622 9217
brian.shockley@aldiscorp.com
www.aldiscorp.com

Reliable measurements for road surface conditions

READER ENQUIRY NO. 511

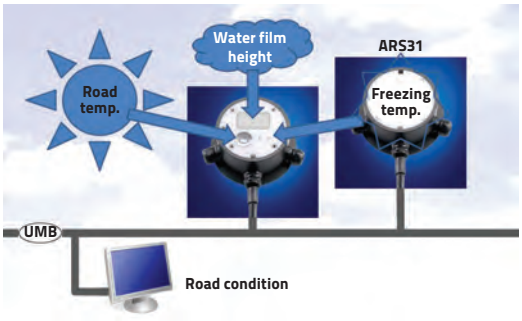
Reliable, easy to operate and cost-effective monitoring stations at the roadside are the most important data source for winter maintenance decision support.

A new sensor generation for surface condition detection was recently developed by Lufft, which belongs to its smart and modular universal management bus (UMB) technology range. Surface in-pavement sensors with passive and active freeze point detection are available. Non-invasive road surface sensors able to report freezing temperature are also available.

Now Lufft is introducing a new method of combining both passive surface sensors (IRS) with active freeze point detection sensors (ARS). This method (ARS Pro) provides a highly reliable and accurate measurement of freeze temperature and detection of road condition.

Intelligent in-pavement sensor devices have proven their reliability in hundreds of installations. One of the mechanical advantages of such sensors is the possibility of easily removing the electronic transducer inlet in order to exchange it into a calibrated new device. Repair or recalibration can be done in a laboratory environment. Therefore the live time cost of an installation can be significantly reduced.

Lufft's road surface detector comprises the following measurement capabilities in an 'all in one' unit: road surface temperature; up to two subsurface temperature probes (e.g. for a depth of 30cm); water film depth measurement by means of a microwave radar transducer; freeze point temperature from the chemical concentration of the solution by its conductivity measured with gold electrodes and under consideration of the water film thickness and the temperature; and road surface condition (dry, ice, wet, slush) measured by the dielectric characteristics of the cover.



(Above) **The ARS31-UMB active freeze point sensor** (Left) **Passive/active combination for determining road surface condition**

Microwave radar transducer

Accurate measurement of water film height is achieved by a microwave radar transducer built in the pavement sensor device. The water film height is reported with a resolution of 0.01mm. The maximum range is typically 3mm. Due to the method used, the measurement of the water film is not influenced by the concentration of de-icing chemicals.

Active measurement method for freeze temperature detection

The ARS31-UMB sensor device measures the freeze point temperature by means of cooling and heating up a small sensitive area on top of the sensor surface. This active measurement method enables the sensor to measure the actual freeze temperature of the liquid solution on the pavement surface. This sensor can also be installed in combination with the passive sensor, described above, to enable a comprehensive knowledge about the condition on the surface. Other than the passive measurement of freeze temperature via conductivity, the active method is totally independent of the used de-icing chemical. The mechanical concept is exactly the same as with the passive IRS31 sensor device.

Bus combination of passive and active sensors

A combination of passive and active sensors is the preferred solution for reliable data for winter on-time treatments. Information such as surface temperature, water film height and freeze point temperature are a prerequisite for good

Need to know?

The optimum methods for measuring road surface parameters under winter conditions

- The enabling role of universal bus management (UBM) technology in aiding road surface measurement
- Following the successful launch of a new generation of UBM sensors, the company behind the technology is now introducing a new way to combine both passive surface sensors and active freeze point detection sensors
- The merits of combining these technologies are considerable when it comes to accuracy

decision making. Lufft offers a perfect sensor combination, the passive IRS31 and the active ARS31. Both sensors belong to the company's UMB technology range and use the same bus technology.

That combination now offers a significant improvement. Working together, the IRS31 measures the road conditions, while at the same time taking the active freeze point measurement of the ARS31 into consideration. Independent of any de-icing chemical in use, the IRS31 and ARS31 together deliver accurate and reliable road surface information.

Smoothing of active freeze point temperature

For decades, experts have been aware of the permanent and frequent changes of surface conditions due to quickly changing conditions of de-icing chemicals and water layers (caused by traffic, precipitation etc.). Embedded sensors measure a very small spot. And this leads to frequently changing 'raw data'. This is mainly to do with external influences, not with the measurement procedure itself. To ease the interpretation of the measurements, Lufft has implemented a software algorithm into the ARS31 firmware for smoothing the values. The degree of smoothing (0 to 100) is selectable and can be switched off or switched on. A default value of 30 has been approved in field tests.

Contact

Lufft
+49 711 51822 0
info@lufft.de
www.lufft.com

Adrian **Walsh**

awalsh@roadsafe.com

In December 2011, across Europe, police conducted in excess of one million breath tests, of which 13,388 were positive. At the same time, in a program coordinated by the European Police organization TISPOL, drug tests were conducted in 28 countries.

In the UK, where government has refused to lower its drink-drive limit to European levels, more than 7,200 people were arrested in the month-long Christmas and New Year campaign targeting drink and drug drivers.

Revealing these shocking figures, deputy chief constable Suzette Davenport, who heads up national roads policing, said: "During the crackdown nearly 157,000 people were stopped and tested. Despite clear messages that driving while under the influence of drink or drugs isn't accepted, more than 7,000 drivers ignored the messages and placed their own lives and the lives of fellow road users in jeopardy anyway.

"The consequences of drunk and drug driving are far reaching," she continued. "It's not only socially irresponsible but it raises serious issues for those that ignore the risks. Those convicted are likely to face a lengthy driving ban and possible loss of jobs and livelihoods, with some even facing imprisonment."

This year police forces undertook intelligence-led testing. The result was that a larger percentage of the smaller sample of drivers tested, failed the test.

Young drivers continue to have a higher rate of offending at 5.7% compared with over 25s at 4%. This highlights the important role that the police, government, parents and society as a whole have to play to educate the newest generation of drivers. Figures also supported claims that those driving under the influence are more likely to be involved in a collision.

The clear, demonstrable link between drug and drunk driving and crashing is again illustrated. Seven percent of people tested after a collision were found to be under the influence compared with 4.1% for routine tests. An increased number of field impairment tests were carried out on drivers to see if they were driving under the influence of drugs. The 36% increase in tests shows that forces are taking the issue seriously and are determined to reduce the number of killed and seriously injured on our roads through drug use.

Across Europe governments are slowly increasing pressure on drivers with strong campaigns and regulatory developments. The requirement for drivers to carry a breathalyzer has been introduced by the French authorities as part of an ongoing program by the French Government to reduce the number of road deaths. Alcolocks, which are incorporated into rehabilitation programs in seven European countries are also under consideration in France, and their wider introduction is being piloted in five more countries.

Impaired driving is one of the highest areas of risk but all too often drivers take risks and have 'one too many', so good publicity campaigns supported by well managed enforcement programs are an essential element of any road safety plan. Individuals and businesses have a responsibility to ensure that driving beyond the limit does not occur, but it is clear from the British Christmas experience and indeed from the continuing interest across Europe that alcolocks will play a far greater role in the future.

> This highlights the important role that the police, government, parents and society as a whole have to play to educate the newest generation of drivers
>
> **Adrian Walsh, director, Roadsafe, UK**

Australia setting standards for ITS

Australian transport agencies and governments were among the first in the world to realize the potential of telematics to drive the transport reform agenda, so much so that six years ago they established Transport Certification Australia (TCA), a national body with the initial role to implement and administer the Intelligent Access Program (IAP).

Chris Koniditsiotis, TCA's CEO, explains that, "Our stakeholders have more recently come to realize that TCA is not simply the administrator of the IAP. This is not surprising, because we at TCA are acutely aware that telematics and broader ITS are well placed to support and deliver public policy outcomes.

"TCA provides high-quality advice, accreditation and administration services to improve mobility. These accreditation services in the type-approval and certification of telematics and other intelligent technologies give confidence to all stakeholders for their consideration of use. Finally, we are administrators of programs such as the IAP."

Describing the IAP as a 'regulatory world first', Koniditsiotis explains exactly what it is: "The IAP uses GNSS technology to allow government to monitor heavy vehicle road use, providing them with the confidence they need to allow access or offer improved access to the road network for larger and more productive vehicles.

"In short, the IAP provides regulators with assurance that the right vehicle is on the right road at the right time. We can even set a parameter for speed so that regulators can be assured that vehicles are not traveling above a maximum speed threshold."

(Left) **TCA works in a variety of areas to improve mobility** (Below) **The new generation of higher productivity heavy good vehicles**

Need to know?

The benefits being reaped in Australia following the creation of a national body designed to improve standards in ITS

- Story of Australia's Intelligent Access Program (IAP) – a 'regulatory world first'
- The role of Transport Certification Australia (TCA) in a number of pioneering new schemes
- How a national telematics framework has been developed and delivered
- Real-world benefits being experienced on a variety of roads

Future-proof framework

As well as the IAP, TCA has also pioneered a national telematics framework. Koniditsiotis explains: "When we developed the IAP we wanted to avoid creating a rigid solution that could not adapt to meet changes in technology and society. So we established the TCA National Telematics Framework (Framework), which was designed to house the IAP as well as innovative new applications (regulatory and commercial) that had not yet been thought of.

The Framework recognizes the relationships between four essential and interconnected pillars, each crucial to advance telematics or other intelligent technologies. These pillars are: policy; technical; operational; and commercial.

The Framework's strategic timing and sustainable setting provides a nationally agreed environment to support the current and future telematics needs of governments, end users and industry.

The Framework has a number of key features,

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including: administration by TCA as the policy-taker separate to the application (or end use) delivered by the policy-maker; nationally recognized certification, audit and recertification services; and an open approach (performance based) to functional and technical solutions, only being prescriptive to achieve interoperability. Another key feature is the leveraging of existing standards and investments. Provision of a 'single' in-vehicle box supporting both multiple regulatory and commercial applications is also key.

Benefits of the Framework are already being recognized by government, industry and the community alike.

The IAP provides a different paradigm in the way governments and industry can do business, and is not just another incremental step in the transport reform agenda. This is evidenced by the opening up of road access to state-of-the-art, high productivity heavy vehicles.

(Top) **Australian roads are reaping the benefits of TCA's hard work** (Above) **The newer breed of vehicles offers huge payload increases**

Real-world case studies

An access scheme that includes the monitoring of route, speed and mass compliance within a single application has been implemented along the strategic Toowoomba to Port of Brisbane freight corridor. The scheme has provided regulators with the confidence to open up access to a new generation of higher productivity vehicles, 30 meters long and carrying 79 tonne gross combination mass.

Transport operators can now carry up to two 40ft containers of grain whereas previously they could only carry one, and are reporting estimated payload increases of up to 100%. Modeling suggests that the scheme delivers an annual reduction, for each vehicle, of up to 624,000 truck kilometers, savings of approximately 230,000 liters of fuel and a reduction in greenhouse gas emissions of around 490 tonnes (or 40%).

It is not only this one corridor that is reaping the benefits; much of New South Wales and Queensland now have higher mass limits on their road networks. Monitoring for route compliance has provided regulators with the confidence to open up access to large sections of the network to hundreds of heavy vehicles carrying 10% more payload.

This 10% payload gain generally aligns with an up to 10% reduction in emissions per tonne kilometer per vehicle.

Meanwhile, monitoring for route compliance in Victoria's Green Triangle region has provided regulators with the confidence to open up access to higher productivity freight vehicles carrying up to 77.5 tonnes, resulting in a 12% payload increase, which again generally aligns with a 12% reduction in emissions per tonne kilometer per vehicle.

Implementing the learning accrued from the trials of onboard mass (OBM) systems, TCA is finalizing a national specification for type-approved OBM systems.

Like the IAP, a type-approved OBM system will: meet a regulatory standard for security, with regulators alerted if tampering or attempted tampering occurs; and meet a regulatory standard for robustness, so that it is capable of operating in Australia's road environment (defined requirements for protection from vibration, dust and water ingress and interferences). When combined with IAP, OBM provides regulators with the highest available assurance around compliance with route, mass and speed; delivering to regulators the confidence they need to open up further access to a new generation of higher productivity vehicles.

TCA is actively working with Australian governments to advance the development of electronic systems that can record heavy vehicle driver work and rest periods. Electronic Work Diaries (EWDs) provide an opportunity for the heavy vehicle and logistics sectors to move beyond paper-based work diaries for the management of driver fatigue.

In 2010 TCA was engaged to develop a performance-based specification for EWDs under the auspices of Austroads and direction of the Australian Transport Council. Following this, TCA was asked to conduct a national pilot of EWDs on behalf of the New South Wales Roads and Maritime Services.

As well as its national efforts, TCA is also leading in the international development of a standard for regulatory telematics through the ISO TC 204 Technical Committee, ISO 15638 'Framework for collaborative telematics applications for regulated commercial freight vehicles'.

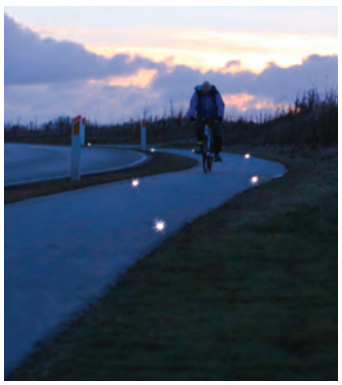
Contact

TCA
+61 3 8601 4600
matthewk@tca.gov.au
www.tca.gov.au

The potential of solar road studs to increase traffic safety

Since the dawn of the new millennium, R&D work with solar road studs has been ongoing, and a few companies have led the way in showing what is possible. Today, it is a well-known fact that solar road studs can increase traffic safety, because they increase the visibility of roads and cycle paths dramatically during dawn/dusk and at night. Now is the time for attention to turn to a more active use of this technology, with the sole purpose of increasing traffic safety and reducing the number of traffic casualties.

Solar road studs are a better way to increase safety than traditional road warning signs because they are placed directly where the driver's focus is. Placing the road studs at the side of the road is enough if their only purpose is to warn the motorists well in advance of any sharp curves, or just to help visualize the road far ahead. The regulations in some countries say that the distance between each road stud should be 12-15m when the studs are used for line delineation or placed at the side of the road. This makes the road look like a casino in Las Vegas, and leaving aside the budgetary aspects of using such a high number of solar road studs, there is another problem, namely the intense light pollution that these installations cause.



Geveko ITS has introduced a solar road stud called LED-Mark, which is characterized by emitting light in a very narrow angle of 3° horizontally and 7° vertically. Since the angle is so narrow, the light is primarily visible where it should be; in the driver's eyeline. "It is one of our governing principles in all that we do," says Geveko ITS's general manager, Bruno Hansen. "It is our goal to slightly interrupt the attention of the driver with a highly visible light effect, so that he becomes aware of the risk that lies ahead."

The light characteristics of the LED-Mark mean that it is possible to reduce the number used to one third without decreasing the safety effect. On some stretches of road it is even possible to reduce the number further, e.g. when the road is not curved at all. In these cases, a distance of 50m would be enough to make the road visible far ahead, and in any case, it is advisable for road authorities to ask the solar road stud experts to evaluate a specific stretch of road in order to find the optimum solution for that road.

When you look at traditional solar road studs, they are actually visible to drivers in both directions. Geveko's new solar road stud is equipped with up to four LEDs and the color of each one can be different. This makes it possible to show white LED lights to the motorist driving in the right direction, and red LED lights to potential ghost drivers. Those driving on the other side of the motorway would then also clearly see that they are driving in the right direction, and not confuse it with the lane going in the other direction. A simple, yet intuitively easily understood benefit for anyone working with increasing traffic safety.

Need to know?

The rise of the solar road stud: its development, future potential, and current impact on road traffic safety

- Since the initial concept of a solar road stud was devised, its application and beneficial impact on safety has been thoroughly proven
- The latest generation of solar road stud enables far fewer of the studs to be used on a stretch of road – giving an immediate and obvious economical benefit
- The importance of asking vendors the right questions

Visible from 2km

These new solar road studs can make the road visible up to 2km ahead, and the advantages of this are numerous. The high visibility makes it possible to show road merges well in advance by placing the studs as line delineation between the lines, and in the side of the lane being merged.

The stud's design means that the high visibility is maintained over time, because the LED light is controlled by a lens, which is protected from snow plows and the rough environment on the road. The studs have been in operation over the past four winters in Sweden, and a

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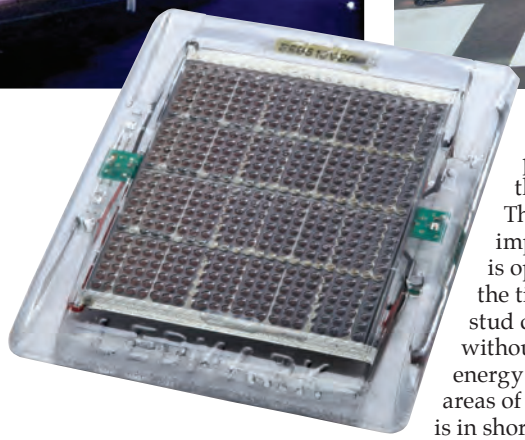


The LED-Mark is designed to improve road safety while being an economical solution for road owners

number of installations across Europe have been made, but Geveko wants to ask road authorities to look at the potential to take it even further. "We think we can increase traffic safety by using LED-Mark, and challenge any road authority to tell us about the areas that give particular concerns so that we can develop a sustainable solution together, for the advantage of drivers, cyclists, and pedestrians in all countries," says Hansen. "We are showing our technologies at Intertraffic Amsterdam 2012 and invite everyone to visit us and find out more about what can be achieved with solar road studs."

Asking the right questions

When a road owner is tasked with selecting a solar road stud, it is very important to be aware of some key parameters to ask the suppliers about. The first and most important parameter is operational time, i.e. the time the solar road stud can remain lit up without sourcing new energy (sunlight). In most areas of the world, sunlight is in short supply in the darker periods of the year, so there's always the risk of the stud not lighting when it is supposed to. Some studs are also placed partly in the shade, which reduces their charging time. The operational time should be around 2,000 hours for a standard solar road stud. The second parameter relates to physical characteristics and installation. A thin solar road stud made from a flexible material is easy to mount (and easy to mount straight), so application time and the need to secure the work zone is reduced. Furthermore, thin road studs can be mounted onto bridges and similar infrastructure by means of one-way screws.

Solar road studs cost around one tenth of the installation and one third of the running costs when compared to threaded technologies. On top of this, they are CO_2-neutral in operation and are a 'green' way to enhance traffic safety without having to increase budgets.

Contact

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

Laser scanning systems for traffic monitoring projects

Speeding and running red lights cause countless accidents resulting in injuries and fatalities all over the world. The recording and enforcing of traffic violations plays an important part in reducing the number of traffic accidents. The traffic situations that need to be monitored are as diverse as the technologies that are suitable for this purpose.

To cover all the many applications and ever-evolving customer requirements, Jenoptik Robot has a variable range of system components that can be combined to create individual systems. In the area of sensor systems, this includes both invasive technologies (induction loops and piezo sensors) and non-invasive sensors (radar and image processing). The aim is to offer customers a solution that goes beyond regular, off-the-shelf systems and is tailored to their real-world demands.

Jenoptik Robot has been a successful provider of handheld laser speed measuring devices for two decades. 2012 will mark the arrival of an important new component – laser scanner technology for stationary and mobile systems.

The company has vast experience in laser technology, and its specialists have developed a speed measuring system that fills the final gap in the application portfolio.

The position, driving direction, speed and size of moving and stationary objects can be recorded without contact using the laser system. To do this, a wide laser beam is used to create a plane that is parallel to the road surface, covering the entire area to be monitored. Modern technology makes it possible to monitor a measuring area of up to 70m (with 10% remission) without loss of measurements, with lasers in the eye-safe laser class 1.

READER ENQUIRY NO. 514

(Above) **The Trafistar S350** (Left and above left) **Computer renderings of the laser scanner**

Need to know?

Bringing powerful laser technology to an array of traffic monitoring applications

- The positive impact of speed and red light enforcement means that authorities across the world want to adopt the latest technologies: vendors must respond to their demands
- Laser measurement technology can create reliable, accurate systems
- The flexibility of individually tailored solutions and the benefits they bring

Vehicle identification

By determining the main vehicle dimensions, the system can determine whether it is a truck or a car with an extremely high degree of certainty before the incident photo is taken. This is important if different speed limits apply to trucks and cars.

Jenoptik Robot has set itself the goal of being able to monitor traffic and record and document incidents with extremely high accuracy in any location. This is a major challenge, since the locations that customers require range from unsurfaced roads without supply lines at tropical temperatures to eight-lane inner city intersections with temperatures as low as -20°C.

The volume of traffic can range from a few vehicles a day to up to 3,000 per hour. In all of these situations, the wide range of measuring systems that is available from Jenoptik Robot provides high detection rates and gap-free documentation.

The laser scanner system is now adding another intelligent, non-invasive measuring procedure to this range.

The TraffiStar S350 measuring system makes it possible to take classical speed measurements in oncoming and departing traffic, and can also be used as a combined red light/speed measuring system.

The camera/laser scanner unit can be operated either stationary or mobile. This provides possible usage variants such as mobile measurements from the vehicle from Monday to Friday and deployment in a stationary housing at weekends.

The stationary external housing is a new generation of the award-winning TraffiTower.

The TraffiStar S350 measuring system is highly flexible. Two complete systems can be installed in one housing

as a stationary system and aligned independently. If required, this can be supplemented by additional image-based documentation (HD video or IP camera) or a slave system. Slave systems do not have their own sensors and intelligence. They are controlled by a master system. A typical example of this is a speed measuring system that can also record motorcycles. The master system measures the speed and produces a frontal photo. At the same time, a photo is triggered at a slave system further away, producing a rear photo with the motorcycle's license plate. The two photos are connected by synchronizing the time.

Up to six lanes can be measured per system. Driver and licence plate recognition can be enhanced by an optional external flash (triggered via a WAN connection).

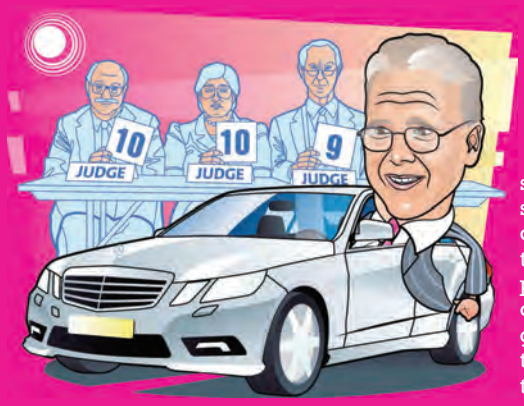
Through 2012 and beyond, Jenoptik Robot is expanding in three dimensions: classical equipment business; international project business; and acceptance of end-to-end operator responsibility.

The international project and operator business has been particularly instrumental in major developments of complex and powerful back-office software solutions, which have been successfully deployed in several large projects.

And last but not least, the company has greatly extended its global after-sales structure to support large projects and operator activities.

Contact

Jenoptik
+49 2173 3940 190
sabine.roettgen@jenoptik.com
www.jenoptik.com



bg@berngrush.com

Much has been written about the future of automotive efficiency and safety – including self-driving vehicles – in the service of rescuing automobility from the evils of congestion, distracted driving, rising oil prices and traffic deaths. However close we think we are to solving its myriad technical problems, we are a long way from converting a billion-vehicle fleet. I think it more likely we will reach two billion vehicles before we can fix a plan for such a massive conversion. We're going to creep our way to this bright future.

Meanwhile, we'd like drivers to drive better – less aggressively, less distracted, more safely and with fewer tailpipe emissions. Until cars drive themselves – which some of us think is the only sustainable solution to wasteful and risky driving behavior – how can we have drivers drive a little smarter?

The confluence of cheap telematics sensors, onboard diagnostics, GPS, cameras, telecommunications bandwidth, and the intelligent algorithms to turn all this into reliable gauges of driving behavior is giving rise to an ITS aftermarket that measures things with names like driver style, driver score and driver report. Automated driver behavior ratings have many applications, including young-driver safety, fleet management for reduced fuel use, maintenance costs, traffic violations, fewer accidents, and potentially lower insurance premiums under schemes labeled Pay-How-You-Drive that distinguish them from Pay-by-Distance schemes all falling under the umbrella of usage-based insurance (UBI).

I estimate at least 25 firms provide such kit. Most use OBD/CANbus data, some include GPS, one uses image capture to read speed signs, which could then be used to calculate speed-over-posted-speed without requiring map data or location. For historical reasons, the great majority of these companies serve the logistics industry with applications that promise to reduce operator costs.

Newer entrants target families. Their pitch focuses on teen drivers, older drivers or families especially concerned about road safety. Many suggest savings via UBI, but without connection to an insurance product. I wonder how much driver coaching can be sold without offering insurance savings – after all, if how one drives affects claims rates and if that can be reliably measured, then the insurance companies stand to win big. Progressive Insurance is at the front of the pack, here, but they simply use a six-month driving sample to segment the market. Once a driver score is determined, measurement stops. That is behavior-based segmentation, a poor cousin to UBI. But it serves to grow an insured-base of drivers who self-select as safer drivers.

Why the laggard response to the full potential of UBI? Some say the equipment is too costly, but that is no longer true. Some say privacy is the barrier. It isn't, because location information needn't leave the vehicle, only aggregated scores do. Some say there are patent barriers, but these can be negotiated.

The real reason is most insurers don't have the data needed to set premiums based on driving style. We know that driving behavior matters, but it is complicated by other circumstances. For example, speed may be insufficient without surface temperature and humidity. We know that frequent hard braking indicates distraction, but can we show causality in an accident?

I predict that over the next several years driving style will be used to coach fleet drivers and young drivers, and this will help pave the way for more of us to pay for insurance based on how we drive.

> I wonder how much driver coaching can be sold without offering insurance savings
>
> **Bern Grush, principal, Bern Grush Associates, Canada**

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The administration of telematics programs that monitor heavy and/or light vehicles with government regulations such as the Intelligent Access Program (IAP).

Non-Regulatory Telematics

The administration of telematics programs that monitor performance, compliance and service delivery with non-regulatory uses such as contract management services.

Visit www.tca.gov.au to learn more

TCA and Queensland Department of Transport and Main Roads jointly won the Intelligent Transport Systems (ITS) Australia, National Excellence Award 2011 for implementation of IAP and OBM on the Toowoomba to Port of Brisbane Corridor.

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ATC improves Mumbai traffic

READER ENQUIRY NO. 515

With more than four million vehicles using its roads and highways system each day, greater Mumbai in India has some formidable traffic management challenges. To improve the city's urban mobility and reduce air pollution, the Municipal Corporation of Greater Mumbai (MCGM) launched an area traffic control (ATC) project to deploy advanced technologies and intelligent solutions that optimize traffic management. Initial results? Waiting time at traffic signals has been cut by almost 50%, and traveler time has been reduced by 30%.

Now the MCGM has won an award for its efforts: for its improvement of urban mobility in Mumbai, in December 2011 India's Ministry of Urban Development honored the MCGM with its Award for Excellence for the Best ITS 2011 Project in the country.

What was the strategy for improving traffic flow in such serious congestion? The ATC project called for the installation of 700 video-based vehicle presence detectors at various busy road junctions controlled by traffic signals. A Telvent/CMS joint venture awarded the contract for delivering the intelligent traffic control technology to Traficon, which provided its TrafiCam and TrafiCam x-stream products.

Video detection systems offer a wealth of benefits to traffic management and road safety

Need to know?

The story of an ambitious Indian ITS project that has enabled huge progress

- Improving mobility and reducing pollution were the two key goals of the Mumbai ATC project
- The starring role played by video-based vehicle detection systems
- Outlining the merits of video-based systems
- The benefits that Mumbai is reaping with regard to journey time, congestion and environmental pollution
- Impressive statistical proof

TrafiCam is an intelligent camera for vehicle presence detection at intersections; it uses video images to position and verify vehicle presence and count at as many as eight detection zones. It provides 24/7 reliable detection in all weather conditions. By detecting both waiting and approaching vehicles, these 'all-in-one' cameras are being used to optimize traffic signal timings and to cut down waiting time at Mumbai's traffic lights.

The TrafiCam x-stream sensor – an integrated camera and detector for vehicle presence detection and counting applications – has been implemented at various busy road junctions. TrafiCam x-stream provides MPEG-4 color streaming video for general intersection surveillance at 24 detection zones.

Replacing inductive loops

Until the start of this ATC project, Mumbai had reflected traffic signal controllers working under fixed-time control with no demand dependency. Inductive loops were tried out, but often failed during the monsoon season. Moreover, when they need maintenance, the intersection is disrupted physically by the road works, and their unreliability (nearly a third of the loops installed in Mumbai experienced operational problems) means that expensive maintenance is often needed. Convinced of the benefits of video detection, the MCGM elected to implement Traficon's above-ground detector solutions.

The Traficon products are key components of the Adaptive Traffic Control System (ATCS), which was integrated and coordinated by Telvent. This intelligent system provides detection and monitoring of moving and stationary vehicles at signalized intersections. Via detection outputs coming from the TrafiCam sensors, vehicle presence information is transmitted to the traffic controller so that signal timing can be adjusted dynamically in real time to respond to changing traffic conditions.

"I appreciate Traficon's structured engineering approach to product development and delivery," says Gordon Wilson, consulting engineer at Pell Frischmann, who provided consultancy on this ATC project. "The company has a unique philosophy that reflects quality management throughout its various activities. Their equipment performs well, requires little maintenance, and has attained a high level of accuracy and performance."

The ATC project has been highly effective in reducing periodic congestion: statistical analysis shows that waiting time at traffic signals has been cut by almost half, and traveler time has been reduced by 30%. The city reports that improved traffic flow has helped create safer traffic (a 15 % reduction in road deaths) and has also resulted in reduced air pollution levels. These results have even inspired the city to install LED lights in the traffic signals – reducing the signal system's energy consumption by 85%.

Contact

Traficon
+32 56 36.30.41
kristof.maddelein@traficon.com
www.traficon.com

New centralized ATMS

READER ENQUIRY NO. 518

In a large ITS project, it is common to have a centralized traffic management system to aid the operators in managing the ITS on a unified User Interface (UI).

Through its new Olympex ATMS, Industronics is offering an affordable solution for centralized traffic management.

Built on a client/server platform, Olympex ATMS features a point-and-click unified UI that is easy to use, putting all useful information from multiple subsystems into a single management window. Subsystems can be linked such that data or events from one subsystem can be configured to provide the trigger to an action on another subsystem. The benefit of this is that users can now create pre-programmed actions. For example, VMS can be pre-programmed to display a

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bsktang@industronics.com.my
www.industronics.com.my

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Contact

Fijen
+31 416 759 401
info@fijenbv.com
www.fijenbv.com

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With the option of overt systems or covert imaging, TESS supports any deployment requirement.

The same product core can also be used in combination

with the TESS RFID numberplate and registration label systems, where passive chip technology has been extended to real-world monitoring distances and speeds. TESS's innovative product has removed character recognition from the equation, to provide guaranteed accuracy of vehicle identification, with limitless ITS applications.

Contact

TESS
+61 3 9877 8088
scottw@tess-solutions.com
www.tess-solutions.com

Standalone sensor unit

READER ENQUIRY NO. 521

At Intertraffic Amsterdam 2012, Traffic Tech will be launching the new standalone iStud vehicle detection modules.

This system uses a three-axis magnetic sensor to detect vehicle presence and direction. Jim Morris from Traffic Tech says: "We are excited about the launch of the new standalone flush-mount iStud and our relationship with Traffic Innovations, who developed the entire iStud range of products."

The standalone unit is specifically designed for installation in car park and access control situations. Two variants are available. The flush-mount (or subsurface) detector can be embedded into a concrete or asphalt pavement during construction of the pavement or as a retrofit. The surface-mounted iStud (in its protective rubber capsule) is designed to be adhered directly to the surface of a concrete or asphalt pavement, negating the need for any saw cuts. Its low profile of less than 30mm makes it ideal for areas where pedestrian traffic is possible.

Because of the size of the unit and ease of installation, the iStud surface-mounted unit is very low cost compared to more traditional saw-cut loop systems. It's ideal for car park boom gates and security applications.

Contact

Traffic Tech
+61 2 9477 7262
jmorris@traffictech.com.au
www.traffictech.com.au

The crucial role of WIM systems

READER ENQUIRY NO. 516

Governments around the world are looking for ways to reduce infrastructure costs. One way is to reduce expenditures on roadway maintenance. Parallel to this, the trucking industry is looking for ways to increase profits at the same time as its expenses continue to rise. The net result is that there are strong incentives both to monitor overweight trucks and to overload them in the first place.

The damage done to roadways by heavy trucks (not necessarily illegally overweight) rises exponentially as the weight of the trucks increase. For example, a 10% increase in weight can cause a 33% increase in damage – meaning that a 24,000 lb axle load will cause twice as much damage as a 20,000 lb axle load.

A study taken in the Fujian province in China quantitatively shows the high costs associated with overweight trucks. It found that 80% of trucks were overweight and that they reduce the lifespan of roads to just 8.5 years, as opposed to the expected 30 years.

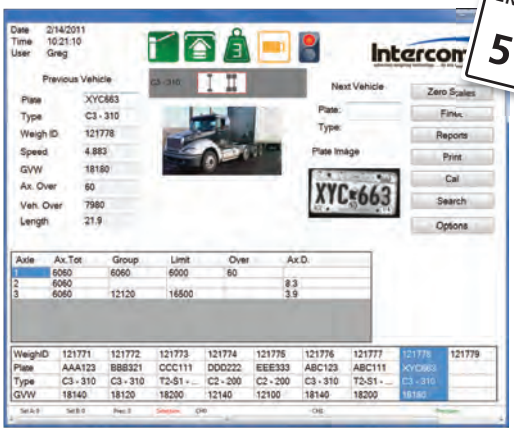
Intercomp has the tools needed to efficiently enforce truck weight limits.

The right tools for the job

A variety of components for WIM are on offer. These include both high-speed WIM (HSWIM) and low-speed WIM (LSWIM) systems.

Intercomp offers two types of HSWIM scales. One system is a strain-gauge based strip scale. The scale is only 9 x 178cm (20 x 69in) and covers an entire lane. The strip scale's small size makes it an ideal low-cost method of selecting overweight trucks to be weighed on a high-precision WIM scale off the main roadway. This reduces traffic delays and allows the weighstation to concentrate on vehicles that are overweight. The scale's small size makes installation and maintenance a relatively low cost endeavor.

The other system uses two 50 x 175cm (20 x 69in) scales that are placed into the roadway. Both types are sealed and will provide years of trouble-free service.



Intercomp offers a variety of WIM solutions

Need to know?

How WIM systems help to prevent the damage caused by overweight vehicles

- The conflicting issues of the incentive to overload vehicles and the need to enforce weight limits
- How introducing WIM systems can help authorities across the world to protect their roads from damage
- The components on offer from an established player in the sector
- The differences between high-speed and low-speed WIM systems and their applications

A portable WIM system allows the user to monitor secondary roads that may be used to bypass major roadway weighstations. This system consists of an indicator, two scales and roll-up ramps. It can be set up by one person in 15 minutes. This allows testing almost anywhere with a cost-effective, efficient system.

LSWIM is used for applications requiring an even higher degree of accuracy. The LSWIM scales are used for monitoring compliance, issuing citations or charging by weight in a toll application. Regardless of axle configuration or off-center loading, they accurately weigh the vehicle. The scales use stainless steel hermetically sealed load cells that are certified for use by NIST/OIML. The scales are accurate to within 1-3% up to 32km/h (20mph) and +/-0.5% accuracy in static mode. The 25-ton capacity provides a low-cost solution to traditional truck scales.

The ALPR component will automatically read the license plate regardless of the speed of the vehicle. The information, including the state or country of origin, is recorded and made available for record keeping or searching databases.

Character recognition of information printed on vehicles or shipping containers can be read and recorded. The information can be used, for example, to check against databases for past infractions.

Photo images of the vehicle are recorded along with the other data from the vehicle. The photos can be used for record keeping and law enforcement.

Traffic lights, variable message signs and traffic control gates are also available.

There are many reasons to invest in overweight vehicle enforcement. Safety is one concern but investment can actually end up being a net financial gain to an economy – if the reduction in roadway maintenance is considered.

Research has shown that compliance with weight limit laws increases as enforcement increases. So enforcement acts as a 'force multiplier' that will reduce overweight vehicles in general.

Contact

Intercomp
+1 763 476 2531
info@intercompcompany.com
www.intercompcompany.com

Transformation in transportation

READER ENQUIRY NO. 517

The theme of the 12th Asia-Pacific ITS Forum and Exhibition is 'Powering Transformation in Transportation', which relates to using ITS as the means to energize the way we think, plan, design, and deploy transportation projects toward sustainable mobility.

Transportation affects our daily lives but is usually planned and executed independently by way of construction (physical environment such as road/rail infrastructure), vehicles, users/drivers, information, and technology. It provides a way to bind these elemental forms so that transportation can be viewed as a more complete and coherent ecosystem. We need to apply these concepts to 'power' the way we transform our transportation systems.

One of the key objectives of this forum and exhibition is to showcase the latest and best practices in planning, funding, deploying, managing, maintaining, and operating ITS solutions and technologies. A further goal is to review the latest and emerging developments in standards and harmonization of system architectures, as well as to present various innovations in the varied fields of ITS. This April in Kuala Lumpur, there will be much discussion about collective operational experiences and lessons learned, as well as a will to establish continuing dialogs on (national) policy directions, strategic initiatives, barriers, and challenges to the industry. Overall, the organizers hope to report on R&D needs and findings, and to present the industry's vision and anticipation for the future.

The 12th ITS Asia-Pacific Forum and Exhibition is a significant part of the continuing efforts by the ITS Asia-Pacific Body to facilitate ITS in the region

Need to know?

Reasons to visit the 12th ITS Asia-Pacific Conference, April 16-18, 2012

- Exciting opportunities to increase your presence in the region
- Why ITS deployments in Malaysia will become more pervasive in the coming years
- Help to facilitate ITS cooperation and coordination between member countries in the Asia-Pacific region
- A platform for knowledge sharing, networking, and cooperative collaborations

The event

The event will be staged over three days from April 16-18, 2012, and will cover three plenary sessions, 13 technical sessions, a special panel session on ITS research and deployment in Asia-Pacific countries, and two executive sessions. Overall, the event will include more than 70 technical presentations and 11 country reports. Delegates will have the opportunity to listen to speakers from a total of 16 different countries. Keynote presentations will also come from ITS Japan, ITS America, and ERTICO. The event will also provide a showcase for 50 or so exhibitors and their ITS products and services.

Among the session subjects will be transformative technologies in communications and broadband, tolling technologies and systems, network management and operations, vehicle telematics, enforcement, driver response and behavioral systems, detection systems, public transport, and traffic analytics.

Delegates will also have the opportunity to learn and see first-hand the latest ITS deployments in Malaysia from five optioned technical visits to key traffic monitoring centers, the much publicized SMART (Stormwater Management and Road Tunnel System), the latest work in progress on Malaysia's first Mass Rapid Transit Project, as well as a tour of Malaysia's flagship car manufacturing facility, Proton.

The event will be preceded by an International Symposium on ITS and a Regional Workshop on ITS by the Asian Development Bank, and expects to draw wide representation from more than 600 delegates from the public sector, academia, and the private sector.

The venue

The 12th ITS APF 2012 will be held at the Sunway Pyramid Convention Center (SPCC), which is located about 30 minutes from the city center. The SPCC is within the 800-acre upscale premier township of Sunway Integrated Report City and is well served by a mega shopping center, the 1,200+ room five-star luxury Sunway Resort Hotel and Spa, the Sunway Pyramid Tower Hotel, and the Sunway Lagoon water theme park. The 12,000ft² SPCC is complemented with fine dining, entertainment, leisure, shopping, and healthcare facilities, and is an ideal venue for the forum and exhibition.

Contact

ITS Asia-Pacific Conference
+603 2610 8639
enquiries@itsasiapacific2012.com
www.itsasiapacific2012.com

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WismaPPK,Lot2354 JalanSungai Putat, Batu Berendam, 75350 Melaka, Malaysia.
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Website : www.ppktechnology.com E-mail: info@ppktechnology.com

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New centralized ATMS

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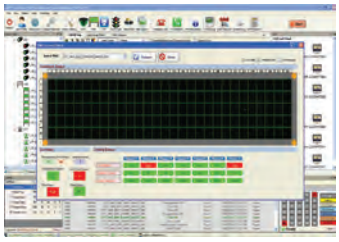

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With the option of overt systems or covert imaging, TESS supports any deployment requirement.

The same product core can also be used in combination

with the TESS RFID numberplate and registration label systems, where passive chip technology has been extended to real-world monitoring distances and speeds. TESS's innovative product has removed character recognition from the equation, to provide guaranteed accuracy of vehicle identification, with limitless ITS applications.

Contact

TESS
+61 3 9877 8088
scottw@tess-solutions.com
www. tess-solutions.com

Standalone sensor unit

READER ENQUIRY NO. 521

At Intertraffic Amsterdam 2012, Traffic Tech will be launching the new standalone iStud vehicle detection modules.

This system uses a three-axis magnetic sensor to detect vehicle presence and direction. Jim Morris from Traffic Tech says: "We are excited about the launch of the new standalone flush-mount iStud and our relationship with Traffic Innovations, who developed the entire iStud range of products."

The standalone unit is specifically designed for installation in car park and access control situations. Two variants are available. The flush-mount (or subsurface) detector can be embedded into a concrete or asphalt pavement during construction of the pavement or as a retrofit. The surface-mounted iStud (in its protective rubber capsule) is designed to be adhered directly to the surface of a concrete or asphalt pavement, negating the need for any saw cuts. Its low profile of less than 30mm makes it ideal for areas where pedestrian traffic is possible.

Because of the size of the unit and ease of installation, the iStud surface-mounted unit is very low cost compared to more traditional saw-cut loop systems. It's ideal for car park boom gates and security applications.

Contact

Traffic Tech
+61 2 9477 7262
jmorris@traffictech.com.au
www. traffictech.com.au

Traffic modeling software has come on leaps and bounds in recent years. How has it impacted positively on your job – and what more do you need from vendors?

"Traffic modeling software has long been recognized as the best tool to analyze complex traffic situations, and has been invaluable in our prior and ongoing analysis of light-rail transit expansion throughout the city of Edmonton. As we fine-tune our modeling of real-world light-rail transit operation, the model is becoming the focal point of more than just the traffic signals engineers. Transit planning and operations groups are looking to the model to provide insights on light-rail operation and integration. Modeling of congested truck route corridors has proven to be very beneficial in optimizing traffic flow; the capability to accurately model the interaction between cars and a high percentage of trucks cannot be matched by traditional pipeflow analysis tools. These traffic models also provide the ideal tool for testing advanced ITS technologies. Traffic models have also been extremely useful for presenting existing and future traffic conditions to the public. Models have the unique ability to instantly convey traffic operations without the need for any traffic engineering jargon or theory and are always well received. As is the case with almost all agencies, the future will be focused on improving traffic management of the infrastructure that already exists with no expectation of building more capacity. The impact on the environment will also be an important part of any traffic management solution, so traffic modeling software will therefore need to readily and easily provide environmental impacts of those solutions to provide a complete picture."

Wai Cheung
the City of Edmonton traffic engineer, Alberta, Canada

"Advancements in processing power and software performance have given us the ability to develop large-scale, highly complex traffic models incorporating the latest ITS strategies. The reduction in simulation run-time and improvement in data processing time has reduced the amount of resource assigned to these menial tasks, allowing our team to focus additional time on what is important to our clients – model calibration and design alternative sensitivity analysis! Unfortunately, however, some vendors have focused on new functionality and ignored performance, whereas what we really want is for vendors to improve functionality and improve performance simultaneously."

Richard Braidwood
managing director, Braidwood Associates, UK

"The interest in building roundabouts in the state of Indiana is one our Commissioner's highest priorities. The effects of safety and decreased congestion at numerous intersections are very significant and many of our urban roads and semi-rural roads benefit greatly from this type of design. The Transport Research Laboratory (TRL) in the UK has emerged as a leader in training and software, and INDOT was very fortunate to adopt the ARCADY software. We now have 50 INDOT engineers trained and fully engaged in investigating all of our upcoming projects for the feasibility of using a roundabout. The continued work toward integrating different programs such as AutoTrack Junctions from Savoy Computing enhances the functionality of all the products on the market. The continued refinement of integrating design software with roundabout software is a key component to success."

John E. Wright, P.E.
director of Highway Design & Tech Support,
Office of Engineering Services and Technical Support
Indiana Department of Transportation, USA

"The massive advances in traffic modeling software have allowed us to expand our modeling capability, and provided us with new approaches to handle conventional traffic issues. Hence, we have seen the development of comprehensive evidence-based modeling approaches – such as integrated pedestrian and vehicular microsimulation. From platform to model, this provides the interaction between pedestrian and vehicular traffic – delays incurred while passengers are boarding/alighting, and vehicles giving way to pedestrians at a cautionary crossing, especially at public transport interchanges, for example. Continued collaboration with vendors is vital to the success of developing robust and yet adequate traffic models. Through our collaboration with software vendors, we have seen great steps forward in terms of enhanced software functionality. It is also of great value to maintain regular dialog with vendors to share modeling concepts and techniques, as well as pushing the software development boundary with innovative functionalities."

Clement Ho
senior transport planner, Ove Arup & Partners, Hong Kong

Readers are invited to answer the Burning Question for the April/May 2012 issue:

What impact do you think the Long-Term Evolution wireless communications standard will have on ITS and what benefits do you think you will experience?

email answers to:
louise.smyth@ukipme.com

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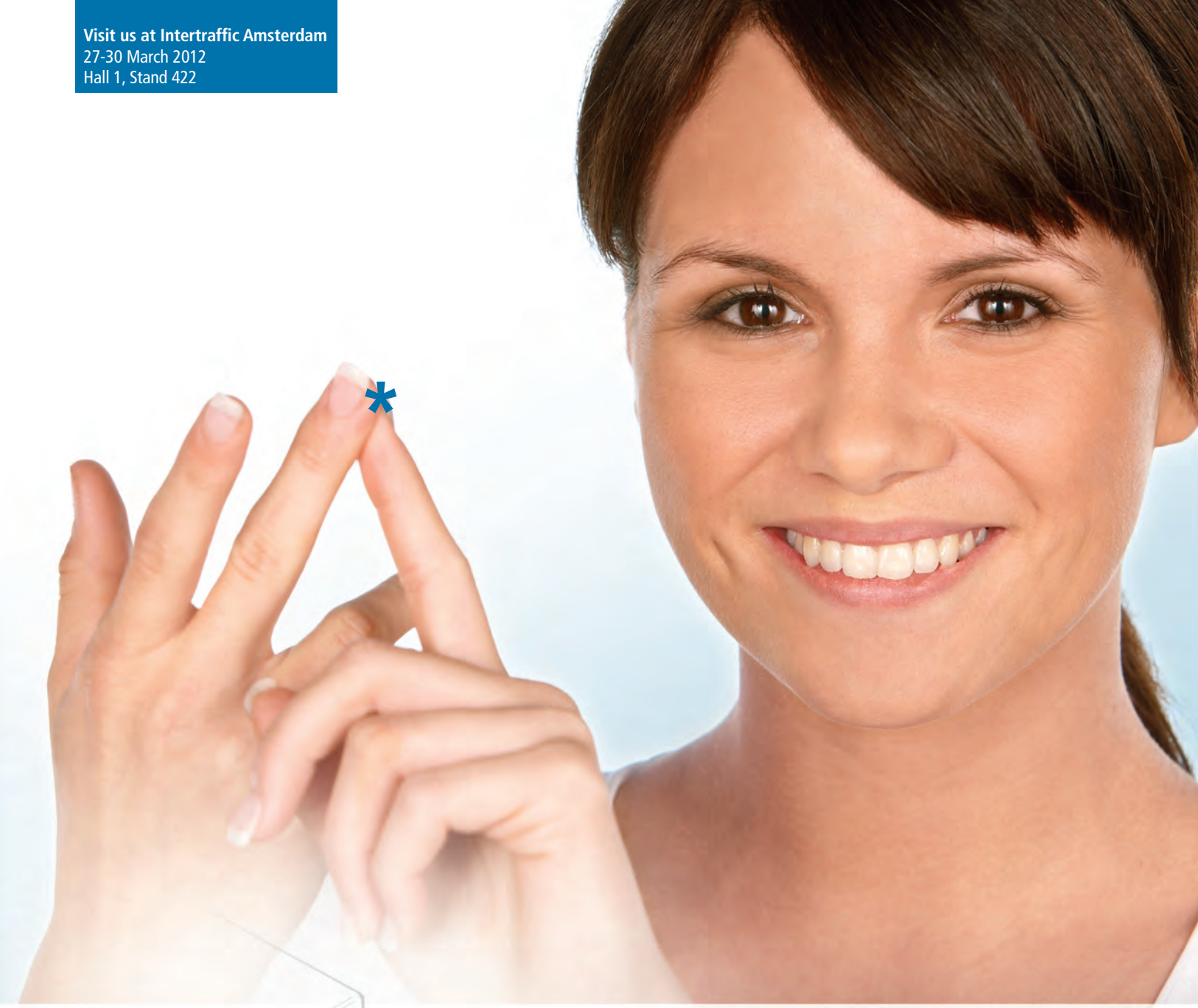

Jenny, Apprentice

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