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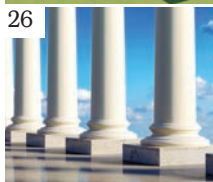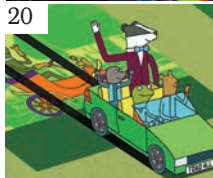
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Foreword

I'm not sure what it says about the way my mind works, but the slow cooker I recently received as a gift inspired a bit of a theme in this issue. Not slow-cooked pork, as our cover might suggest at first glance – but doing more with less, and in the case of my 6.5-liter Crock Pot trying to make something cooked on a Sunday last as far into the week as foodborne bacteria will allow.

Launched nearly 20 years ago to showcase the efficiency, reliability, safety and environmental benefits that smart thinking in advanced traffic management can bring, perhaps this publication hasn't focused enough on how investing wisely in the right technologies can save authorities money. Technology can quite clearly help you do more with less with your road networks – and one of the finest examples around is pretty much on my own doorstep.

The Active Traffic Management (ATM) scheme on the M42 in the West Midlands – a technological casserole of embedded sensors, variable speed limits posted on over-lane VMS, ramp metering, and hard shoulder running – costs just £5.6 million per kilometer compared to around £18 million for traditional motorway widening. Overall, making better use of the available existing capacity saved more than £6.2 billion than constructing extra lanes. And as our cover story shows (*p44*), the idea

has caught on elsewhere, particularly in the USA where 'Smart Lanes' in Minnesota are yielding similarly impressive savings for MnDOT.

Vendors have long accepted their roles in improving the cost-effectiveness of their offerings, whether in terms of energy savings, communications costs, installation, ongoing maintenance, or even durability. Increasingly, though, agencies are not only looking to ITS to reduce costs but also to generate revenue – Oregon's mileage-based road user charge pilot slated for September being a fine case in point (*p4*). Although the proposed VMT tax will initially only apply to electric and hybrid vehicles, if ODOT's Jim Whitty is successful in his attempts to convince the state legislature that pay-per-mile can alleviate the state's widening transportation funding gap, it could have far-reaching consequences for the way Oregon funds its highways in the future. Technologies on the table to make his vision a reality cover DSRC, GNSS, and in-car telematics – although I wouldn't mind betting that with the need to keep costs under control, a smartphone-based app comes to the fore.

The idea of a VMT charge to replace the gas tax has been cooking away slowly for years, but this is about as close as we've come to actually sampling it. Fingers crossed, we use the right ingredients and it tastes as good as many experts predict…

Nick Bradley,
Editor, *Traffic Technology International*

Oregon's state legislature increased the state gas tax from 24 cents to 30 cents a year ago as part of a major transportation bill. Oregonians now pay the seventh-highest state gas tax in the USA. The purpose of the bill was to reduce congestion, improve safety and speed freight delivery, and the bill had bipartisan support and the blessing of Oregon business leaders.

More than 200 Oregonians participated in the first pilot in 2006-2007 that tested the idea of being charged for each mile driven instead of the current gas tax. That study also included a congestion pricing piece, where participants would be charged more or less per mile depending on where they traveled and what time of day.

Miles ahead?

The gas tax hasn't kept up with inflation and is dwindling as Americans drive fewer miles and cars become more fuel-efficient and even electrified. **Nick Bradley** speaks with Oregon DOT's **James M. Whitty** to find out how he intends to replace this 'dinosaur' of a funding mechanism

Photographs courtesy of Oregon DOT

After several failed attempts within a decade to increase the state gas tax, the Oregon Legislative Assembly passed authorizing legislation in July 2001, directing the Governor, Senate President and Speaker of the House to form a 12-member Road User Fee Task Force. The legislature charged the task force with designing a new revenue collection strategy that could replace the gas tax with a long-term, stable source of funding.

The news from February that Oregon DOT was issuing an RFI for a mileage-based road user-charging pilot later in the year didn't exactly go viral, but it undeniably piqued an extraordinary level of interest – and not just in the tolling community. What lies beyond the pilot could have far-reaching consequences for the way transportation is funded in the west coast state, and may even herald in the much-discussed era of VMT charging nationwide.

"We had 28 global responses to the RFI – from South Korea and New Zealand to South Africa and Austria," reports James M. Whitty, manager of Oregon DOT's Office of Innovative Partnerships and Alternative Funding, who has spent the past decade trying to move the concept of pay-per-mile from the debating chambers to the real world. "Receiving so many confirmations of interest showed us that people want to play," he says, "so we'll give them an opportunity to prove to the world that a Road Usage Charge (RUC) system is viable, that the key system concepts and features are valid, and that the vendor community has the ability to provide and implement the system components required to operate an effective, efficient and open RUC system today."

Funding mechanism

So from RFI to RFP – the deadline for which was extended by a few days in April due to the huge response – the trials that are slated to take place in September are, for Whitty, an important chapter in a novel that he and Oregon DOT first started penning in 2001. "This is considered one of the most important things that ODOT is working on," he continues. "It's really about the future of transportation funding, not just in the USA but also further afield."

Initially, however, the aim is not to charge all vehicles but to address how a growing population of electric and hybrid vehicles will contribute their fair and equitable share to the state's transportation kitty. "That was one of the things that came out of the trial we staged in 2007," Whitty reveals. "We're approaching 2% of vehicles in the state of Oregon being hybrids, but with the plug-in versions coming along – with the added benefit that they can be recharged – we're expecting that figure to trend upward.

"We can't really predict what's going to happen, but current trends indicate that within a decade most new vehicles will likely feature some form of alternative power and as a result their collective fuel efficiency will continue to improve." That's great for the environment, of course, but not so great if your funding lifeblood is the gas tax. "In the past few of years, we've gone from around 21.6 mpg for the average new vehicle in the USA to around 24.1 mpg, then we have the looming CAFE standards," Whitty says. "And if you add the fact that a below-par

A fuel pump from the 2007 trial outfitted with mileage-reading equipment

> 66 It's really about the future of transportation funding, not just in the USA but also further afield

Battelle demonstrated its smartphone-based system for mileage charging at the 2011 ITS World Congress in Orlando last October

Oregon DOT's James M. Whitty

> 66 We got through the House Transportation Committee and the House Revenue Committee and we were heading toward the floor for a vote on a charge on EVs, but it got stopped by a lobbyist for the auto industry

The MRFT
(Minnesota Road Fee Test) combines Connected Vehicle applications with a mileage-based RUC application. It is due to end this December

The dashboard display from the 2007 trial, displaying miles driven

economy always drags driving down, it's true to say that there's been a bit of a hit to revenues, which is why we're pursuing the mileage charge as a more equitable base of charging."

Nuts, bolts and perception

So how will it work, which technology will be used – and more importantly how will you convince the people of Oregon? As Whitty reveals, the latter may not be the biggest problem, since it was the automotive industry that successfully opposed a previous attempt in 2011 to get the charge through the state legislature. "We got through the House Transportation Committee and the House Revenue Committee and we were heading toward the floor for a vote on a charge on EVs, but it got sidetracked by a lobbyist from the auto manufacturing industry," he recalls. That being the case, what makes Whitty think the situation will be any different in the future? "Our whole strategy since 2011 has been to clear up any concerns related to the system," he explains. "Our goal is for the legislators to turn around and say 'This isn't a difficult decision, it's an inexpensive proposition, and it's something that can be implemented easily', so they'll more likely agree to move forward."

Hence why members of the state legislature will be involved in the fall pilots. "We're not using everyday citizens," Whitty states. "We'll recruit a small group of 40 to 50 people made up of what we're calling 'VIPs' – ODOT managers, Oregon transportation commissioners and then state legislators sitting on the transportation and revenue committees. If the next step is to pass legislation, their involvement is critical, especially if they can see how the system works, how it offers a range of choices to motorists, how easy it is, doesn't impede driver privacy, etc."

Public opinion

Which brings us back to the issue of convincing Joe Public that a pay-per-mile fee is the long-term sustainable option – for everyone. "Despite designing our 2007 'black box' carefully so as not to be deemed as a tool for impinging on motorists' privacy, generally people in Oregon and across the USA didn't appreciate the project positively," Whitty says honestly. "They didn't like the fact that there was a government-mandated GPS-box in their car. But there was no transmission of coordinates, no tracking capability – it wasn't as invasive as, say, a satnav for instance. It was a thick-client device – other than the mileage tax application, everything else was performed on board the unit. So we've really spent the past couple of years looking at a public acceptance approach, and we're intent on embracing whatever new methods there are in the marketplace to make the system work.

"This time around, there will be no government box, no mandate for GPS," Whitty continues. "There will be more than one way to report your miles. We want the pilot tests to show that commercial off-the-shelf technology – which is already available and in use for other purposes in the marketplace – can be used to report miles driven." Crucially, in terms of public acceptance, motorists will be able to choose how they report their miles and even if technology is part of the process at all – and if so, which technology is employed. "Ultimately, Oregon DOT's vision is to have a certification process, but we're not going to require detailed engineering changes to what's already out there – it will be as minimal as possible, which will allow us to call upon technologies that will naturally evolve. We fully expect to witness customers preferring one technology today and perhaps something else tomorrow. This is what the trial is all about.

"But it goes beyond technology – it's about systems, too," Whitty stresses. "We want to have the private sector show us they can collect the miles and process and collect the taxes as well. This allays another concern raised following our 2007 pilot – that a large government bureaucracy would be required to manage that system. As a DOT, we will have to be involved to a certain extent because we need to have an audit and an enforcement function, but as much as is possibly feasible we would like to turn over the whole process to the private sector in an open system, an open-market environment.

Ready to play

That there was so much interest from the private sector to the RFI and RFP proves to Whitty that this part of the equation can easily be solved. Among the 28 companies eager to take part were tolling specialists such as ACS, BancPass, CS, Kapsch, Sanef, TransCore and Raytheon, sitting alongside household IT and telecommunications names including IBM, Intel, Accenture, Oracle and Verizon. Within this lineup, the host of

Topping the tax

The gas tax seems to have had its day for many transportation experts, although it does have its benefits. In Oregon, for instance, it raises substantial (albeit declining) revenue and provides approximately 60% of the state's road revenue (combined state and federal). For consumers, it's also an easy way to pay; the payment is included in the fuel bill and allows cash or credit payment. It's also easy to collect as it embeds collection within commercial transactions paid by distributors, reimbursed by retailers and, in turn, by consumers. Additionally, it's easy and cost-effective to administer – distributors comprise a small number of taxpayers, while auditing costs the state a mere US$1 million annually. Illegal gasoline sales are also rare in Oregon, meaning evasion potential is minimal. And being paid anonymously by consumers, privacy is protected. The gas tax also places a minimal burden on business – retail businesses, for instance, bear only the burden of lost revenue from evaporation of gasoline after purchase from a distributor and before sale to a customer.

On the flipside, though, the gas tax results in a disconnection from the highway system, as it is not directly connected to the burden the vehicle places on a state highway system and is therefore unable to support any form of road user charging. And as James M. Whitty discusses, it's eroding revenues, as vehicle fuel efficiency improvements reduce gas tax payments per vehicle mile traveled.

potential methodologies to turn Whitty's vision into reality appears to cover DSRC, GNSS, smartphone, and telematics innovations.

"What the RFI allowed us to do was produce four categories for the RFP," Whitty says. The first, the basic onboard unit, is simple and does not contain hardware to compute vehicle location (GPS/GNSS) – it is very much like the dongles used by insurance companies for PAYD. It doesn't report mileage by location – just mileage driven. That's important, in Whitty's opinion, as some motorists will never accept GPS, regardless of the validity of their fears.

A second group uses existing telematics that are proliferating in most new vehicle models. "The marketplace already offers OnStar with GM, Ford SYNC, Nissan CARWINGS and there's a host of others soon to be available," he says.

"The third category is pretty ingenious because it's based on the principles of the first – i.e. the dongle – but utilizes a Bluetooth connection to a smart device such as a tablet or a smartphone. A number of firms are interested in providing an app-based solution, which would be useful for someone who, ordinarily, didn't want to differentiate their miles but for some reason may choose to for a certain period.

"The fourth group is 'catch-all' – aftermarket devices such as navigation units or the familiar aftermarket GPS/GNSS units added to the vehicle rather than factory-installed as in the second category."

Interestingly, for users not wanting any form of technology to be involved, another strategy Whitty predicts could be considered involves allowing motorists to buy a set number of miles – 35,000 miles for a year's worth. You could even buy miles in 5,000- or 10,000-mile increments, for instance. "Over time, people will gravitate toward the easiest method," he believes. "Those who might be anti-technology now may move later to technologies such as a dongle for PAYD, a smartphone or a satnav system. They may eventually decide to opt for a payment solution that allows them to drive and forget about the

The GPS receiver, as used in the 2007 Oregon RUC trial

whole process operating in the background. We have to let that evolution happen, we can't force it. The market will tell us what's best and most appropriate, and it will probably be technology-based as that's the way things tend to move."

The road to VMT?

So, if everything goes according to plan, Whitty hopes the trials will lead to legislation, with electric and hybrid vehicles being charged on a per-mile basis in the near future, maybe as early as mid-2015. Is it therefore inevitable that this will be the first domino that leads to all other vehicles? "As different groups of vehicles start to become more fuel-efficient in the years ahead, we'll look at including them, too," he explains. "By then, there may be more of a desire to do that, just as today there is for green vehicles to pay their fair share. Over time further groupings may gravitate toward mileage charging, but it won't be an overnight transition."

Other US states will undoubtedly watch with massive interest – "My phone rings constantly," Whitty laughs – as they're facing exactly the same funding shortfalls as Oregon. "We are not doing this to reduce driving or congestion – it's all about revenues," he insists. "We will demonstrate not only to policymakers but to the industry, the entire nation, the world, that such a system can succeed, and isn't going to cause big problems, that it can easily accommodate and meet the needs of users.

"We're taking a risk to try even a rudimentary market-based system on VIPs, but even if we experience difficulty and lose the chance to pass legislation, the reward to have them entirely satisfied with first-hand experience is so great that it's well worth it."

You would expect a progressive state such as Oregon to succeed, too. In 1919, it was the first to pass a fuel tax on gasoline. "It then spread over the rest of the nation and became a national tax," Whitty concludes. "Creating a new road revenue system is something we've done before and we're hoping the new system may be the savior of transportation finance in the USA once again." ○

The 2007 system was designed to be easy, with motorists only doing one new thing – pay the new charge in lieu of the gas tax

The fifth amendment

A new system aims to harness the power of workplace peer pressure to persuade commuters to leave the car at home on one of their five working days a week. **Izzy Kington** examines how feasible this might be in real life

Images courtesy of Organiq New Media

The most obvious way to reduce traffic congestion is to reduce the number of cars on the road. The Netherlands' DTV Consultants believes it has come up with the answer in the form of From5to4, an online game that records workers' travel data and awards points to those who commute using alternative forms of transport, out of the rush-hour, share cars or work from home. The aim is to get everybody to do so at least one day out of the standard five-day working week. If it succeeds, congestion would be cut by 20%.

The incentives used are not financial. "In the Netherlands there are some projects where people can earn €5 a day from avoiding rush-hours," explains Sander Buningh, team leader of development and mobility at DTV Consultants. "That is a bit expensive and results show that people go back to their old behavior when you take the rewards away."

Pressure points

Instead, From5to4 relies on peer pressure and competition – the system is implemented by companies, whose employees compete against each other. "We tried to copy the atmosphere that is sometimes noticeable in offices during the Tour de France or European Championships, when everybody has filled in their predictions about the score, and then you follow the results," Buningh says. "We aim to stimulate discussions. For example, if you display the ranking near the coffee machine people will talk about who's doing well in the public transport top ten, or the car pool top ten – so people talk about it and share their ideas, motivations and experiences. That's very different from the more individual approach of offering financial incentives that go into your account but nobody notices."

The platform also shows participants other benefits to their changed behavior, displaying how many calories they've burned, how much CO_2 they've saved and so on. Companies can decide to offer rewards if they so choose. So far around 1,500 participants have played the game – which runs for four or six months. "We have four companies that have finished that period and three that are playing now," adds Buningh.
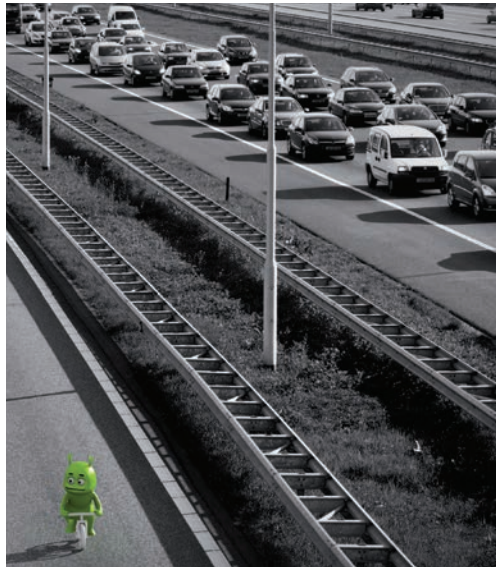
Clients include the school of management at Erasmus University of Rotterdam, which used the game as part of an effort to reduce its CO_2 footprint; a Dutch municipality that wanted to encourage more employees to cycle to work, to improve fitness; and a research company that wanted to learn more about changing behavior.

Buningh envisages others using the game to alleviate overcrowded car parks, to improve public image or to gain insight into workers' travel habits. "We adjust it to the company's goals and ambitions, and measures that are already there," Buningh continues. "If they have an electric bike system or encourage working from home, we can inform people about these measures with tips and information."

Buningh believes that the effects should be long-lasting, as participants have a lot of time to try various alternatives and see what works for them. Companies can maximize success by implementing extra measures during or after the game which they can base on the data produced. "It can be a starting point for a more sustainable mobility policy," he concludes. ○

Social climber

From5to4 resulted from the cooperation of traffic and transport expert DTV Consultants and Organiq New Media, which specializes in new media and digital learning. The idea was formed in 2010, and the companies later won government funding. After internal testing, the concept was ready for external participants in October 2011.

The six-month package, including reports, costs companies around €30 per participant, based on a game with 100 participants.

As well as several clients, the project has had awards success – topping the Smart Mobility category at the 2012 Intertraffic Innovation Awards.

Buningh says future versions of the game could incorporate apps, making it easier for people to fill in their data, as well as better integration with social media platforms such as LinkedIn, enabling participants to share best practice or stories.

The most successful US carsharing program to date has been Zipcar, which boasts a fleet of more than 9,000 vehicles used by 673,000 members

❝ If you display the ranking near the coffee machine people will talk about who's doing well

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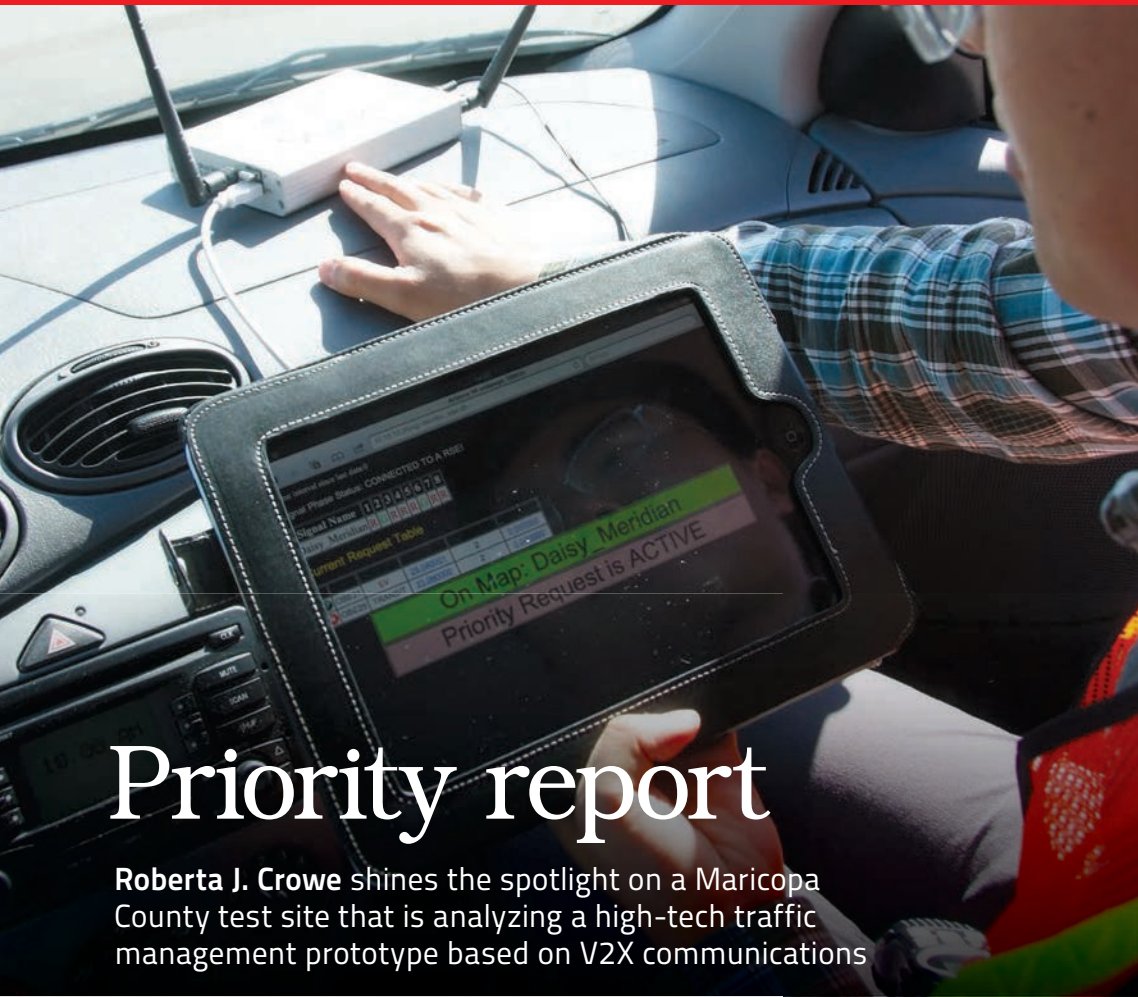
Priority report

Roberta J. Crowe shines the spotlight on a Maricopa County test site that is analyzing a high-tech traffic management prototype based on V2X communications

C riminals and fires are obvious threats for police and firefighters, but traffic accidents also pose a serious danger for these first responders. Nearly 13% of the firefighters and police officers who die in the line of duty are killed in vehicle-related incidents, and fire trucks are involved in 10 times as many collisions as other heavy trucks.

In response, Maricopa County Department of Transportation (MCDOT) Intelligent Transportation Systems (ITS) engineers and University of Arizona researchers are developing a system that will radically lower these statistics and make signalized intersections safer nationwide for emergency responders and the general public, according to Faisal Saleem, MCDOT ITS engineer, and UA Systems and Industrial Engineering researcher, Dr Larry Head. "MCDOT's testing is leading research in emerging technologies to fine-tune traffic control systems that will in the very near future link all drivers to both their surroundings and other vehicles on the road. This means fewer crashes and more saved lives," Saleem explains.

The SMART*Drive* prototype – an advanced field lab for testing new transportation technologies systems for vehicle-to-vehicle (V2V) and vehicle-to-roadway (V2I) communications, including vehicle prioritization at traffic lights –

lies along a 2.3-mile stretch of Daisy Mountain Drive in the Anthem community just north of Phoenix, Arizona.

Put to the test

The first MCDOT SMART*Drive* application being tested is a vehicle-prioritization system, which can simultaneously communicate and give traffic signal priority to multiple emergency vehicles converging at the same time at the same intersection. In the very near future, this experimental vehicle communication technology could help prevent emergency responders from colliding with one another at strategic intersections. Additionally, as more and more automobiles are equipped with onboard devices that can communicate with traffic signals, other vehicles on the roadway, and 'real-time' traffic control centers, this system will also help prevent collisions between emergency vehicles and private automobiles.

Currently, traffic signal emergency pre-emptive technology simply provides a red light in all directions and is unable to accommodate multiple requests for traffic signal priority, and emergency vehicles approaching an intersection are not aware of other emergency

Testing times for MCDOT

⊙ The MCDOT SMART*Drive* field test involves six interconnected traffic lights along Daisy Mountain Drive in Anthem. Test equipment including dedicated short-range communication (DSRC) devices, integrated WiFi Bluetooth connections, CCTV cameras, traffic detection and data collection software programs, fiber-optic signal interconnect systems and communication connections to MCDOT's TMC located in south Phoenix were installed over the summer and software application testing is currently under way.

The MCDOT SMART*Drive* field test corridor is helping to lay the groundwork toward the future deployment of smart vehicle systems throughout the USA. "It's unclear which will come first – the intelligent cars or the ITS infrastructure to support them," states MCDOT's Faisal Saleem. "The installation of vehicle prioritization systems for emergency vehicles at the intersections will also provide core infrastructure for the path to national deployment. What is clear is that over the next decade – as the nation's public and private vehicle fleets are renewed and equipped with this technology – this system will lead the way in making intersections significantly safer."

More than 250 US ambulance crashes were reported in 2010, with analysis revealing 43% of the crashes occurred where two or more roads cross

Multimodal, multi-agency

🔄 The MCDOT's SMART*Drive* (connected vehicle) test bed in Anthem, along with a Caltrans test site in California, were both selected to serve as national test sites for the Multi-Modal Intelligent Traffic Signal System applications funded by the USDOT and the Cooperative Transportation Systems Pooled Fund Study (CTS PFS). Over the next year, these sites will collect and exchange data to develop and design a test plan to implement system and operational requirements for the futuristic Multi-Modal Intelligent Traffic Signal System.

Led by the CTS PFS, the multi-agency study team will focus on the design, analysis, field testing and demonstration of the new intelligent traffic signal system that will allow traffic data to be shared between roadway infrastructure (ITS equipment/software) and passenger, transit, emergency and freight vehicles and even pedestrians, using the wireless communication system within MCDOT's SMART*Drive* connected vehicle environment.

FCD creates an accurate, real-time picture of traffic conditions, in this case in Toronto, Ontario
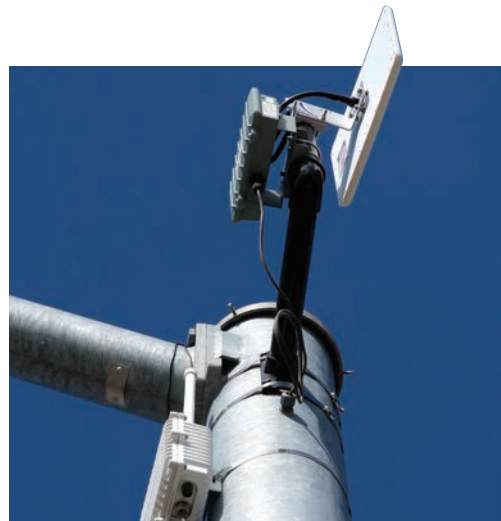
vehicles in the area, leading the drivers of both to think they have the right-of-way through an all-red intersection. "This situation has led not only to many serious collisions involving emergency vehicles colliding into each other, but also accidents involving private vehicles and pedestrians," Saleem reveals.

Two-way street

With this new technology, traffic control signals will have two-way communication with emergency vehicles, and the vehicles will be in communication with one another. When one or more emergency response vehicles are approaching an intersection from different directions, the SMART*Drive* Multi-Modal Intelligent Traffic Signal system will selectively prioritize and notify all approaching emergency vehicles which vehicle has the right-of-way, in doing so significantly improving both intersection operation and safety.

"SMART*Drive* testing will advance connected vehicle technology and make intersections safer for emergency responders," Saleem continues. "We also hope it will improve response times where seconds can mean the difference between life and death."

The first round of field tests involves MCDOT emergency traffic control REACT vehicles carrying vehicle communication prototype radios and tracked by GPS. The Daisy Mountain Fire District (DMFD) and Valley Metro buses will be participating in live SMARTDrive field testing to simulate real traffic conditions, according to Saleem. The final testing will involve fire trucks and public transit buses staging real-life emergency-response scenarios.

These combined efforts are part of a national push by the USDOT to create 'intelligent' vehicles that communicate with one another and with traffic control systems. NHTSA is already on board and is working to require that every vehicle sold in the USA be equipped with smart vehicle communication devices by 2013. "Connected vehicle technology has

The US Fire Administration reports that around 25% of on-duty firefighter fatalities per year occur while responding to or returning from incidents

the potential to nearly eliminate rear-end collisions, red light running and left-turn smashups at intersections," Saleem says.

Where to next?

In the future, with MCDOT SMART*Drive* technology, emergency vehicles will also be able to communicate with the Arizona 511 traveler advisory network to alert motorists to the traffic problems in the area. Forewarned, motorists will have the option to select alternate routes and avoid the area altogether, as a result helping to prevent secondary accidents that often occur near an accident scene, and the reduced traffic congestion near the incident scene will allow emergency vehicles to more rapidly enter or exit the area.

Transit priority systems can also be developed using SMART*Drive* technology. Valley Metro and school buses could run more efficiently, stay on schedule and provide a better service if they were given traffic signal priority at smart intersections. "If you have a bus that's behind schedule, you can have the traffic light hold the green longer or give an early green," suggests Dr Larry Head. "If they're running on time, they can go with the normal stream of traffic." Tying transit vehicles to the system could make this mode more attractive because the vehicles would run on time more often.

UA researchers are also working with ADOT to adapt the vehicle prioritization system to freeway entrance ramps that are controlled by traffic signals. "If we have a two-lane ramp, you can hold one lane red and turn one green to let everyone go, clearing the way for the emergency vehicle," Head says. "On one-lane ramps, you can just turn the light green and flush out the cars to clear the way. ADOT is considering testing the system on the Warner Road onramp for eastbound I-10 in Tempe."

"This study will result in reduced traffic accidents and safer, more efficient roadways all over the country," says chairman Andy Kunasek, Maricopa County Board of Supervisors. "SMART*Drive* has put MCDOT in the forefront of the signal system technology transformation." ○

Dynamic jewel

Closing the gap between decision-making urban authorities and the operators of their control systems made ImFlow an award-winner. **Nick Bradley** speaks with its creators to find out how they've achieved it

Use of ImFlow

ImFlow has been designed as a standalone ITS application that can be integrated with other ITS applications in a UTMS system. Its flexible architecture gives many options in deploying the system to meet the specific customer/local requirements. A powerful feature of ImFlow is the capability to easily configure networks by linking intersections together. For this, an ImFlow module can be added to existing traffic light controllers. Although it is designed to provide adaptive control in networks, its powerful algorithm also provides a very competitive solution for isolated intersections.

C lutching not one but two Intertraffic Innovation Awards – one for winning in the 'ITS/Traffic Management' category and the other the much-coveted 'Overall Winner' – Koos van Vliet is a very happy man. "It was a lengthy and expensive process to create ImFlow, our policy-based traffic management system, but we couldn't be more happy that it's now been acknowledged as being something special," enthuses Peek Traffic's product manager.

"Peek has been providing and installing traffic control solutions such as SCOOT and UTOPIA for many years," adds Andrew Hodge, project manager for Urban Traffic Management Systems at Peek. "We're always looking at ways to improve our existing products and services, but with ImFlow we've created something new from the ground up, building on our many years of experience but with full intention to make significant improvements." Clearly, the team behind ImFlow has achieved this.

Feature-rich traffic management

The idea at the outset was to retain the best features of previous products as well as avoid some of the pitfalls. "We wanted to make the product easier to use by closing the gap between policy setting and operation of the equipment on the street," Hodge explains – a

facet that was particularly noted by the Intertraffic Innovation Awards jury. "We also focused heavily on modeling the traffic better to improve the overall performance of the system."

"Keeping the network optimization benefits of previous systems was vital, but we were keen to improve this at local intersections, too, as we found that traditional products only really focused on the network traffic flows," says van Vliet. "The system is effectively upside-down – we started off by optimizing individual intersections and then continued at the network level." This scalability means that traffic managers can start with one intersection and build up to many – or start with many and work their way back down.

Such flexibility is key for cities, towns and authorities, as they strive to make their transportation systems more sustainable. And as policies change, ImFlow enables the way traffic flow is managed and orchestrated to change with them.

By optimizing traffic flows based on configured policies, ImFlow assists traffic managers in making optimal use of their existing infrastructure. The real secret, though, is a real-time adaptive algorithm

Among the other winners in the Innovation Awards was Kapsch with its ACC system, which came out on top in the 'Safety' category

> ❝ This policy-based signal timing optimization per intersection allows the system to respond faster to changes in the traffic demand and as a result better service public transport and emergency vehicles

that automatically translates these policies into optimal traffic flow. "Developing an algorithm of this nature was a highly mathematical process, so we contracted Delcan in Canada to help us with that process," Hodge reveals.

The 'policies' represent specific scenarios, within which a level of importance is assigned to allow users to balance the significance of traffic flows, priority vehicles, pedestrians and cyclists. Using 'distributed control' and the concept of 'distributed processing', each intersection in the ImFlow system has its own processing unit to optimize the signal timing based on whatever policy has been established. They also exchange information with adjacent intersections and each acts as an intelligent node in the network. "This policy-based signal timing optimization per intersection allows the system to respond faster to changes in the traffic demand and as a result better serve public transport and emergency vehicles," confirms van Vliet.

Route 1 Route 2

Policy parameters

"The idea behind the policy parameters is that you give traffic engineers the tools to fine-tune the system once it is in operation," van Vliet continues. Controlling the system is achieved by way of a simple sliding scale on a GUI, which allows users to adjust the 'importance' of the configured policies. Policy plans can be selected based on time of day, allowing different strategies to be applied during the morning and evening rush-hours, for instance. You can also select a policy plan to counter conditions that might be experienced during a special event, such as a soccer match or a concert. Policy plans can even be linked to environmental conditions by connecting environmental sensors directly into ImFlow. So, whatever your transportation goals – whether that be reducing traffic congestion, wait times, pollution, accidents, improving public transport, giving priority to emergency vehicles or saving energy – ImFlow can provide optimal control, all by balancing these varying stakeholder objectives.

"The algorithm itself has a few more mathematical building blocks and effectively the sliding scales, the policy settings, are controlling these building blocks," van Vliet suggests. "These algorithms are based on sound traffic engineering principals, the basics so to speak, but in the future we are looking to extend them."

A game changer?

Clearly a break from tradition, then, the big question is why has nobody thought of this before? "That's a fair question," admits Hodge. "The force to do something like this is not new, although until now no-one has achieved it. Over the past few years, there has been a trend for operational staff to become less orientated in traffic engineering so one of our intentions was to create something that could be used by operators that might not have expert knowledge. Traffic management and networked systems are a very dynamic and complex process, so with ImFlow we have made things much simpler."

But van Vliet counters the suggestion that this is 'traffic management for dummies': "The tool is still intended for traffic specialists.

Although to a certain extent, we do see a degree of de-skilling taking place, we hope that ImFlow will help traffic engineers to better understand the dynamics in urban areas, and that it may help to improve traffic flows in cities in the future."

Positive feedback

Helmond has been using ImFlow at four intersections in the Dutch city since September 2011. "The feedback we are getting from the customer is very positive," reports van Vliet. "We sat down with them before the start of the project to evaluate their objectives and policies. We documented the measurements before and after and they're very pleased that we're doing even better than we had promised. We have firm interest from a number of other major cities in Europe that want to do it, but that's all under wraps until we get confirmations of orders."

"Effective and environmentally friendly transportation is the key to a city or region's economy and environment, making it a better place to live and work," concludes Jan Casteleijn, managing director of Imtech Traffic & Infra. "A city's long-term strategy drives its policies, programs, design criteria, and projects that will further enhance the city or region's mobility. ImFlow works directly with these policies. We are proud to introduce it as the tool to reduce congestion and to maximize the effectiveness of public transport." ○

With

33 million vehicles on roads in the UK, road transport is one of the biggest sources of pollution in the country, accounting for 22% of total CO_2

Peek Traffic/Imtech, was recognized as the 'Overall Winner' and winner of the 'ITS/Traffic Management' category at Intertraffic 2012

End of
the wild ride?

Predicting the price of gas will continue to rise in the long term is not difficult. But will the paradigm shift away from SOV travel as the preferred mobility option? **Bern Grush** analyzes a recently published white paper to search for an answer

Illustration courtesy of Tim Ellis

Governments

1 Governments might encourage an efficiency shift by continuing to enforce fuel standards that promote hybrid and EVs, and by furthering zoning paradigms that separate residential locations from work, school, and worship locations. They might prefer to invest in roads rather than bike or pedestrian infrastructure. Such actions would tend to keep cars affordable, required, and preferred.

Alternatively, governments might be less concerned with fuel standards and road infrastructure and more concerned with zoning for walkable and bikeable neighborhoods, with building 'well-rounded, high-density neighborhoods' or with more – and more suitable – public transportation targeting reduction in SOV use.

Although there is some evidence for such programming in niche, urban communities, this is not a majority trend in North America. The facts of rapid economic expansion in some Asian countries and poverty in the Third World means that most of this kind of programming experimentation is in European communities. The foreseeable net influence of government programs on automobility is to stay with efficiency programming.

As gas prices rise, will drivers abandon the single-occupant vehicle (SOV)? Or will the personal car remain dominant and simply evolve into a cleaner, safer, and more efficient part of our transportation system – i.e. will there be a personal mobility revolution or a gradual evolution? And what will be the determinants of the change we experience?

Most of us tend to answer these questions in a framework that corresponds to our stated preferences: I'm keeping my car!; I'm moving into the city and getting rid of my car; I'm going to switch to car sharing; A few weeks ago, my 15 year-old told me, "I'll never drive a car!".

These questions were posed by the Mobility Collaborative – a recently established think tank focused on creating mobility access for the next generation of communities. Comprised of national and international thought leaders in the areas of cityscape design, psychology of the masses, hyper-connectivity, mobile media, entertainment, governance, shared public resources and more, the Collaborative receives funding support from the Arlington County Commuter Services through their Mobility Lab.

Mobility trends

The Mobility Collaborative, author of *Mr Toad's Wild Ride and the Long-Term Impact of the Rising Price of Gas*,[1] looked to trends such as the longstanding preference for the SOV, or to energy prices that might force people out of cars. Some predictions reflect planning ideals such as greater investment in public transportation or a new era of walkability and bikeability. A recent spark has been the uptick in interest in carsharing, especially peer-to-peer (P2P) carsharing.

Car manufacturers

2 Car manufacturers might continue to design and advertise cars as lifestyle enhancers while making them more fuel-efficient, attractive, comfortable – even 'connected' and safer. Even with fuel costs rising, car manufacturers can continue for now – to out-achieve average fuel-price increases even as spikes provide uncomfortable reminders. Note that the EV is a strong efficiency play, not a full paradigm shift.

On the other hand, there are car manufacturers preparing for alternative uses such as carsharing, including P2P carsharing. This may be seen as an enlightened paradigm shift (fewer vehicles) or a marketing exercise for manufacturers polishing their social license to operate. It is certainly not yet a mainstream market force. The net effect of car manufacturers' influence is largely weighted toward efficiency and it's difficult to imagine them choosing otherwise.
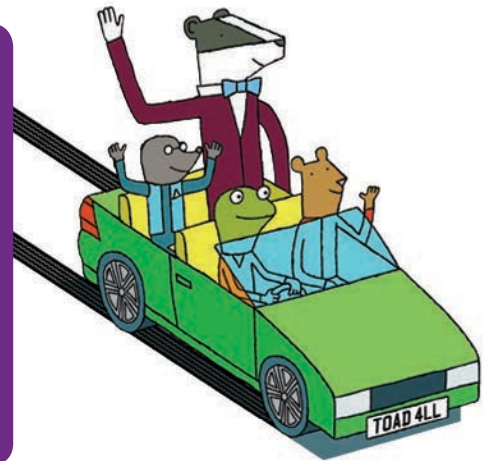
Third-party players

3 Third-party players include power utilities, employers, and others whose business decisions contribute to keeping the SOV in demand and in efficiency mode. Utilities can distribute power or batteries for EVs, making them viable. Employers can continue to offer free parking, keeping private vehicles affordable, or they might continue to prefer on-site work and five-day weeks over telework – in doing so keeping cars necessary, or at least convenient. Although it may be unlikely for power utilities to turn their backs on the opportunity presented by EVs, it is possible for employers to change work and parking policies for a paradigm shift. It is also possible for auto insurance companies to provide usage-based insurance but that provides more efficiency rather than a paradigm shift.

The 'connected vehicle' promises better, safer, and more efficient car use. Some of the more captivating predictions are romantic in outlook and utopian in expectation, with others more sobering.

Although all of these factors and trends may play a future role, the Collaborative's white paper seeks a measured, consensus direction. Will we finally depart from an oil-starved and congestion-sated automobility, ready for a dramatic paradigm shift? Or will we largely stick with the SOV – a gradual 'efficiency shift' – as we have done for the past century?

The Collaborative looked at a far-reaching paradigm shift involving everything from cities and employers that ended free parking to more heterogeneous transportation systems, zoning changes, and rearrangements of communities to shrink the 'home range' – arranging for school, shopping, work, and churches to be more often within walking or biking distance. This would entail radical changes in how we think about building cities and demand management. It would mean replacing automobility – the current urban planning backbone – with a focus on alternate modalities.

Population-wide, paradigm shifts in personal transportation are rare – efficiency has dominated since the replacement of the horse. An efficiency shift today might include government fuel consumption standards and lower speed limits combined with incremental mileage improvements from car manufacturers. For the commuter, efficiency could mean a smaller car, less weekend driving, less aggressive driving, a move closer to work, telework an extra day a month or switching to usage-based insurance. The employer that locates nearer a labor pool or implements a four-day week provides efficiency. An efficiency shift doesn't mean vehicle populations shrink but fuel use and per-capita VMT drops a bit. Carsharers are early paradigm-shifters as they lower vehicle counts.

The white paper opens with a critical look at the assumption there might be a tipping point, triggered by passing a high-watermark gas price, say US$4 or US$6 a gallon. Given evidence that historical spikes in prices create only a small and temporary reduction in VMT – most of which are from lower-income drivers – the Collaborative could not defend the proposal that gas prices would jolt the USA into a paradigm shift. Far higher gas prices in other countries have at best reduced per-capita VMT and haven't caused such a dramatic shift, although per-capita ownership is lower than that of the USA. It is wishful thinking to expect gas prices alone to generate the change many believe necessary.

Infrastructure

4 Transportation infrastructure funding is focused more on autonomous private and commercial vehicles; funding for alternative infrastructure is lower. To the degree that this continues, the efficiency shift is supported. To promote a paradigm shift, public transportation would need to be 'less stressful and more pleasant than using an SOV', and public parking priced for occupancy performance. We'd need to engage in much more transit-oriented development and experiment more with 'car-free ... urban villages ... created within major metropolitan areas'.

Technological gains

5 The automobile is expected to become connected, self-parking, self-driving, more efficient, more convenient – and more desirable.

A potential paradigm shifter is telecommunications and policies to make telework more effective. Although the white paper mentioned telework, it was critically underplayed. Chuck Wilsker, co-founder of www.telcoa.org, recently wrote: "Telework affects fuel usage including reduction of dependency on imported oil and energy security, reduction of wear and tear on transportation infrastructures, and improved air and water quality – and the reduction of VMT is documented. Also, the idea of bringing jobs to people over the 'information super highway' instead of necessitating the inefficient use of legacy highways for commuting is a great economic benefit to workers worldwide."

Telework may not consign the car to history, but we know it reduces VMT and potentially a degree of ownership. However, the Telecommuter Tax Fairness Act (proposed federal legislation that would eliminate the double tax penalty imposed on interstate telecommuters) was just set aside as an amendment to the current Senate transportation package. Policy can matter more than technology, and in this case existing policy is helping prevent the paradigm shift – likely an unintended consequence.

asphalt and three or four parking spaces, so EV efficiency is only at the margin of use. Hence the total efficiency shift for the EV would likely be under 10% and given we are expecting perhaps 10% of the fleet to be electric over the next few decades, this would mean fewer than 1% annual improvement by then, assuming no increase in global car population – which doesn't seem to be on the cards either. Certainly, the Collaborative's questions are worth considering. And I think they settled on the correct conclusion – we appear to be stuck with an efficiency shift. Perhaps some of the Collaborative's authors were disappointed with that. As they stated in the conclusion – something has to change.

Consider that efficiency shifts are a thousand times easier than paradigm shifts. On one hand, we are comparing incremental changes that can be adjusted and teased along using small economic prods and rewards. On the other, we are looking at a monumental and disruptive change that carries enormous risk and incalculable price tags. Maybe we are stuck with efficiency changes for systemic reasons that run even deeper than all of the engrained cultural habit and love we have for our cars. For that reason, we need to find a thousand efficiency changes. ○

References
[1] *http://mobilitylab.org/collaborative/white-paper-1/*

The authors conclude that we will elect an efficiency course: "… Large-scale societal flight to travel options other than SOV travel will be checked by consumer adaptation," and, it should be emphasized, technical innovation.

Fuel costs are hardly the only factor in an individual's mobility decision, so the Collaborative looked at seven other 'forces' that might influence the direction of SOV use, which are detailed in the sidebars.

Thinking differently
A lot has been written over the past several years about why or how we ought to change our thinking about cars. Effort is being put into making the car more efficient. But even an electric vehicle (EV) consumes power, must be manufactured, requires

Personal needs

6 Personal needs such as connection and privacy can be satisfied by the SOV, but there is now some question how much the smartphone is beginning to displace – or becoming preferred to – automobility. Enabling WiFi in transit vehicles is hailed as a way to make transit use more productive. This is expected to attract younger commuters who are already significantly delaying acquisition of their first vehicle and driving license.

Perhaps we can displace a significant amount of commuting with telecommuting. Whenever pure connection and pure information exchange is the only purpose of a commute, then telecommuting often suffices. But more than just reducing VMT, could it reduce vehicle counts if some car owners are more likely to become car sharers? Maybe it could...

Cultural positioning of automobiles

7 Until just a few years ago, cultural positioning of the automobile had been entirely about autonomy and discovery. It is hard to ignore the stuff of speed, heroes, romance, and movie legends. But in the past few years, a shift has started to occur – especially among the young who 'do not associate a Mustang or a Porsche with status in the same way their Boomer parents did'. The growing acceptance of carsharing and the new P2P companies and lowered ownership enthusiasm among young drivers predicts that per-capita ownership could decline. In any case, it is risky to predict per-capita ownership increasing in the developed world.

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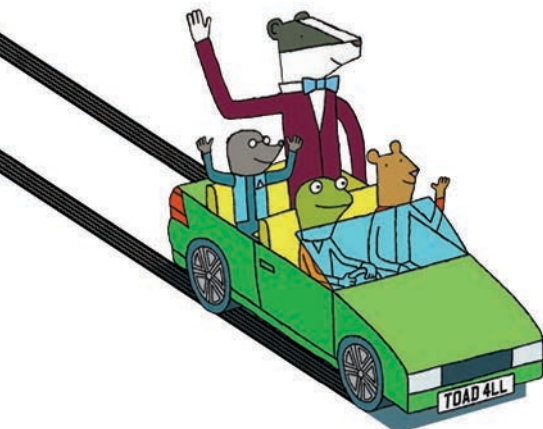
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THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2011

Pillars of
strength

Despite Greece's undeniable economic problems, there
are beacons of hope within its ITS industry. **Louise Smyth**
meets the practitioners exhibiting a core of steel

Illustration courtesy of ArtyFree/shutterstock.com

When in early 2010 we spoke with Bill Halkias, CEO of Attikes Diadromes – the organization that runs the Attica Tollway – it was a time of great optimism and pride for him. His toll road was successfully proving that a PPP business model could work perfectly in Greece and he was looking ahead to technological progress with regard to both ITS adoption and interoperable electronic tolling. The economy in general may have been a worry, but Halkias could not have known just how bad things would get – and how quickly…

Greenfield and Brownfield

Today, it is a sombre and reflective Halkias, who also serves as president of the Hellenic Institute of Transportation Engineers, that takes our call. He is keen to explain how the complex economic and political situation in Greek tolling today has a history of two distinct parts. "When we talk about PPPs and tolled roads in Greece, we talk in terms of two generations of projects," he begins. "In the first – the 'Greenfield' projects such as the Attica Tollway and the Rion Antirion Bridge – there was a maximum concession period and a maximum RoE (Return on Equity). Financial reward was on an either-or basis: you either reach the maximum concession period (if your RoE is less than the maximum RoE), or you reach the RoE earlier, so don't go to the maximum concession period. So, since the loans during the operational period were guaranteed by the Greek state, while there was also a maximum toll level not to be exceeded, there was room for the concessionaire to plan the tolling strategy. The concessionaire was taking a risk if it ended up with lower traffic than anticipated, but if that happened, it could raise the toll level to make up any shortfall in paying back its equity."

The second generation – being 'Brownfield' projects, where existing facilities were expanded – were different. "People knew what the traffic levels were," Halkias continues. "The National Highway projects were similar to the Gefyra project, for instance, where a ferry service was replaced by a bridge: you knew exactly how much traffic was crossing the two sides. So this time, the government thought it was easier to opt out of taking any risk with the traffic levels."

So the government created the idea of setting up a 30-year fixed concession period for all projects. And it also set up a unified toll rate not to be exceeded, which was four cents per kilometer in 2003 prices without VAT. "From day one, politicians obscured

the issue of numbers and even now some still talk about that four cents per kilometer as it sounds better than the reality that is 6.5 cents in today's prices," Halkias explains.

Toll division

That all happened in 2008. The entire Greek motorway network was divided into five of these PPPs, all using the same model. This initial 'mistake' on the government's part was confounded by the concessionaires themselves. Halkias reports that although they had the option of setting a lower toll level, for every single project the financial and traffic models each concessionaire came up with were based on the highest toll level. Regardless of capacity, operational costs, construction costs – or what was needed to pay back their equity – every concessionaire was aiming to charge the highest level of toll it was allowed to. So, because of this provision, the 'market' dictated a flat toll rate per kilometer in all projects. Where the government could be labeled as simply naive in setting up a 'maximum' toll level and perhaps expecting variations in what was actually charged, the only appropriate label for these concessionaires is 'greedy'.

Halkias also cites another problem from the start with regard to how the new schemes were described: "When you talk to people in terms of price per kilometer, you give the impression that the system will be closed, and people will pay per kilometer based on the distance they travel," he explains. "These existing toll roads had too many interchanges however. The government was not willing to shut down some of the interchanges and create a truly closed system where you get a ticket at the entry and you pay at the exit. They never considered ORT and ETC as a method; they left the concessionaires to decide if they wanted a fully closed, an open or a mixed system. Every single one came up with a proposal that had an open system."

What this meant was that concessionaires could implement confusing and dubiously designed toll tariffs – such as charging someone for the distance between two toll stations, say 50km, regardless of whether that driver actually gets off the road 5km after the first station.

Halkias says that the misleading charging scheme and the fake notion of a maximum 'four cents per kilometer' charge caused huge problems, irrespective of the state of the economy. "The first reaction occurred when people realized that they were making short journeys and they were forced to pay the full toll, so a movement began – which basically said 'I won't pay'," he says. "And they didn't – people just started to lift up the toll barriers and drive through without paying.

> **"**The EC is involved, and everybody involved is trying to revive these projects. Everybody agrees that they're needed – in terms of development, of putting people back to work, and of completing our network

Bill Halkias, CEO, Attikes Diadromes, Greece

The big bang

"At the same time, we underwent a huge financial crisis. This meant an automatic increase in gasoline prices," Halkias adds. "In one day alone, the price increased by 50% because the government increased the tax on gasoline as well as VAT." There were two impacts on the toll roads as a result: "The first was that we had lower traffic because it was now costing more to drive. The other was that this 'I won't pay' movement turned into full-on civil unrest."

It's almost predictable that when the financial crisis deepened, tolls were one of the first expenses people opted out of paying, a situation not helped by the fact that toll enforcement is nigh-on impossible in Greece. Although there has been a slight change in the antiquated law where non-payment of tolls was deemed a dispute between two private individuals – and therefore non-payment of a €3 toll would require taking the individual to court, and non-payment is now regarded as a traffic violation – it has to be witnessed by a police officer. The idea of automated enforcement in this arena is laughable.

For Halkias, though, the Attica Tollway – as part of one of the original Greenfield projects – has not suffered so much from people refusing to pay tolls. Drivers simply don't object to paying the tolls on these first-generation, transparent and efficient toll roads. Yet it is undeniable that traffic levels are down. Halkias reports a loss of 8.5% of traffic in 2010 compared with 2009, and another 11% in 2011 versus 2010 figures and the downturn continues. At time of press, traffic levels were 15% down compared with 2011 figures.

(Left) **Open road section of the Attica Tollway** (Above) **the Metamorphosis Interchange, a four level interchange of Attica Tollway with the Athens - Lamia National Road**

Toll revenues are down cumulatively speaking, too. Before the crisis hit (and even now) the Attica Tollway was not charging the maximum toll level. It charges a €2.80 flat toll fee against a maximum allowable toll of €3.70 – which is fine when there are enough cars on the road paying that €2.80. As a result, Halkias is worried that things could get worse before they get better – after all, he is not in a position (politically) to even consider raising toll rates. Yet no staff have been lost and the Greek tolling expert claims the Attica Tollway is maintaining the same level of service and is still paying its debt – it remains financially viable.

And the situation could be worse – for four of those five Brownfield projects, construction has halted entirely. Less traffic means fewer tolls – which were used to fund the new projects – and it goes without saying the banks are no longer able to provide all of their funding.

Remaining upbeat

Despite all this, Halkias believes that the future is not all bleak: "Now people are taking a second look at the numbers," he reveals. "The European Commission is involved, and everybody involved is trying to revive these projects. Everybody agrees that they're

needed – in terms of development, of putting people back to work, and of completing our highway network."

It is, of course, not only Greece's tolling industry that's been affected by the economic situation. Its entire ITS industry has felt the repercussions, including some unexpected effects that are not all bad. A colleague of Halkias, Fanis Papadimitriou, is traffic and maintenance manager at Attikes Diadromes as well as chair of the Hellenic Institute of Transportation Engineers' ITS Committee, and well placed to comment on the evolution of Greek ITS. Having been heavily involved with the Athens 2004 Olympic Games Organizing Committee, Papadimitriou was also responsible for the operational management of transport to the Olympic venues. Overseeing the first major deployments of ITS anywhere in Greece, he then watched the money run out for further progress…

Olympic legacy

"The Attica Tollway has always had extensive use of ITS," Papadimitriou reveals. "We've had loop detectors measuring traffic in real-time, VMS, incident detection, etc, since the start in 2001. We were the first example of traffic management on a motorway environment in Greece and the TMC that was developed for the Olympics was built using us as its model. That TMC was the second big ITS deployment in Greece and remains in operation.

"But following these years of growth around the Olympics came the deep recession we are currently in," he laments. "The fear of going back to the Drachma has not disappeared, even after the help with the national debt, and the recession has affected the construction industry more than anything. Yet it is acknowledged by everybody that to go back to positive GDP growth, we need to boost construction – to boost the new tolled motorway projects that

Connecting concessions

Another facet of ITS where Greece is still making progress is in interoperable tolling. "Two concessionaires with fully completed projects - Attiki Odos and Gefyra – have agreed to implement interoperability with three concessionaires that have projects under way, the latter being the Olympia Odos, Aegean Motorway and the Moreas Motorway," reports Bill Halkias.

Interoperability is developing in three stages: "In the first,

Attiki Odos ETC users can use their OBU on the Moreas motorway and Olympia Odos toll stations. This step has already been implemented (one-way interoperability). The next stage due to be completed by the end of

2012, is two-way interoperability of the four projects using Kapsch transponders (Attiki Odos, Moreas Motorway, Olympia Odos and Aegean Motorway)."

Stage three will occur later when Gefyra (the Rion Antirion Bridge project), which uses Thales transponders, will also join. Halkias reveals that the reason for delaying this last stage is economic rather than technical: "The toll at the bridge is expensive; you need something like €12 or €13 to

cross if you're driving a passenger car. Most existing ETC accounts are prepaid, and in the current economic climate, people are not maintaining huge balances on their accounts. So going interoperable now could cause more problems than it solves. If someone has a transponder from Attiki Odos with around €5 in his account (enough to make two or three transactions on that road) and he crosses the bridge, he wouldn't have sufficient funds to pay for the crossing."

Infotrip has brought real-time information systems to Greece

started in a very ambitious way in 2006 and have now stopped."

Papadimitriou believes that if these projects do start up again, we'll see a lot of ITS implemented on a regional level. And he can cite various other projects that are still progressing, so it's not all bad news. "Right now there is a bid in progress for the PPP on telematics for the Athens public transport organization, with the aim being to have VMS at every bus stop to inform travelers of the time of the next bus," he says. "Another PPP that's under the bid process is the implementation of a smartcard (similar to London's Oyster card). Meanwhile, in Thessaloniki, the second largest city in Greece, we have buses that are fully operated now under a traveler information system, so each stop has a VMS. Also, back in Athens, the new tramway lines that were opened for the Olympics are also having a travel information system installed."

What's interesting is that these examples are all in the public transit sphere, which you could easily attribute to many Greeks simply being priced out of their cars. Papadimitirou, though, is not so sure: "There has been a decrease in traffic – city center volumes have reduced by around 10%," he says. "But we still need to do more to make our public transport systems more easily accessible and attractive to the average Greek commuter, who still uses his car – despite the fact that petrol prices have gone almost twice as high compared with two or three years ago."

Side effects
Papadimitriou is also seeing reduced traffic during his day job at the Attica Tollway. So, has there been a corresponding reduction in accidents too? "Yes, it's equivalent to the traffic drop. Last year traffic decreased by 11% and accidents decreased by 10%. However, we are seeing more incidents such as vehicle breakdowns, because people are not spending so much money on vehicle maintenance. We're also seeing more

drivers running out of fuel because, instead of topping up with €50, they are trying to get by on €10. That may sound trivial compared with accidents, but it's these little things here and there that keep us occupied as operators. And there is an ongoing need for ITS.

"One thing we always say in the Hellenic Institute of Transportation Engineers is that, in times like this when there's no money for building new infrastructure, it is much more effective to implement a simple ITS strategy. Coordination of signal timings in a network, for instance, is cost-effective and makes a big difference. With just a little money, you can have a significant effect on traffic. ITS can be cheap and it can solve problems locally."

Joining forces
In a bid to get this message across to a wider audience, Papadimitriou's ITS Committee is collaborating closely with ITS Hellas. As well as being MD of Greek ITS company, Infotrip, Vassilis Mizaras is also the outgoing president of ITS Hellas. "The ITS industry in Greece is unique because we don't have the big industries that they do in other countries," he says. "We don't have automotive industries, we don't have the equivalent of a Nokia like Finland does. So ITS Hellas is a group of small- to medium-sized enterprises – coupled with research centers, local authorities and some transport operators – and we're all working together to evolve ITS. And over the past few years, we have been successful at this. We did our own report for the European ITS Directive and it was adopted by the Ministry and integrated into their official report."

Mizaras's own company is also reporting a great homegrown success story, as he details: "Our biggest project today is in Thessaloniki," he reveals. "This concerns urban traffic control and adaptive traffic control systems as well as traffic management, by

> ❝ We are seeing more incidents such as vehicle breakdowns, because people are not spending so much money on vehicle maintenance. We're also seeing more drivers running out of fuel

Fanis Papadimitriou, traffic and maintenance manager, Attikes Diadromes, Greece

deploying mainly Swarco systems such as OMNIA, with incident detection, VMS, driver information and so on. It is a huge scheme."

Now in its final stages of deployment, the new project is 50% funded by the EC, which likely explains why it was able to continue throughout this turbulent period when other projects have ground to a halt. Mizaras would agree that bringing in money from outside of Greece is the way forward – but not only in the form of financial bailouts: "At first, ITS Hellas was just Greek companies, but we realized early on that we needed to involve people from abroad with great ITS expertise. Now we're trying to attract big foreign companies and are getting the likes of Ericsson to join ITS Hellas."

Geographical collaboration is also something Mizaras regards as crucial for moving ahead: "We are part of the network of ITS Associations and I recently attended a conference in Cyprus to put forward the idea of creating an ITS Cyprus. Because of our close relationship with Cyprus, I expect to have some cooperation there.

"The ITS industry in Greece is in a recession, but for the first time I think we have the opportunities to overcome the situation. It's not only about the money, it was the instability. For two years, we didn't know what was going to happen. Now, I think we can be optimistic. The big money will come from the EC so the challenge for the Greek government now is to make the best use of that money." ○

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All around
the world

Whether you're a local, state or federal government agency, reliable communications are a prerequisite to get the job done. **Jim Gunn** assesses how Verizon Wireless hopes to use the new 4G LTE standard to transform public safety communications

Illustration courtesy of Anna Davie

Wireline 108
COLTs
public safety
functions
More efficien
the radio net
700MHz U
Emergency situ
California
IPv6
Dual
stack
Enhanced security features
International applicability
1x1 screen
compliance testing
Vehicle and Highway Gateways to the Cloud

Based on subscriptions, the USA is currently the largest international market for 4G Long Term Evolution (LTE). Consequently, Verizon Wireless's US public safety initiatives for supporting public-private applications on its commercial 4G LTE network offer prime examples and guidance for the global community as to opportunities and issues on the subject. With appropriate modification for varying international requirements, the conclusions here should have international applicability.

Emerging data services

Wireless operators have traditionally focused on growth by adding new subscribers and required network coverage. They had inadequate resources to support other opportunities such as public safety partnerships. With most operators approaching voice service saturation, though, emerging data services offer a wide range of opportunities to grow their businesses that would otherwise be impossible. 4G LTE provides further benefits as it appears on track to be the first wireless standard that will be adopted by essentially all international wireless markets and operators for their commercial data services. Verizon Wireless would seem to be leading the way in its recognition of the potential opportunity to leverage its commercial 4G LTE assets to address public safety communication initiatives.

LTE can enable first responders to take advantage of the latest mobile technologies to communicate and collaborate and to access the information needed – including data and live video – to deal with emergency situations even more quickly. Offering substantially faster download speed (5-12Mbps) and upload speed (2-5Mbps) as well as reduced roundtrip latency below 50ms, it will facilitate high-resolution video conferencing and large data-file transfers on mobile devices, in doing so improving responders' situational awareness and collaboration during incidents or emergencies.

Verizon Wireless's 4G LTE network is based on an IP Multimedia Subsystem (IMS) core, which simplifies the delivery of applications across multiple networks. Service compatibility can therefore be provided across wireline, wireless, fiber, and private networks. By including Land Mobile Radio (LMR) and WiFi networks currently utilized by public safety, this offers unique opportunities for national interoperability. The 4G LTE technologies used by Verizon are based on all-IP, flat,

3.7 million

2-5Mbps

Long Term Evolution

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SA

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LTE FIPS

Latency reduction

Wireless data prioritization

temporary importation at nominal expense

Growth opportunities

Service compatability

Enhanced security features

International applicability

COWs

cost-effective

data-file transfers

mobile devices

National interoperability

wireless device gateway

hazmat sensors

higher frequency bands

National interoperability

features

GOATs

All roads lead to LTE

operations classified as commercial

fiber

partner

IPv4 protocols

gyros

shared resources

Emergency situations

cost-effective

Automatic vehicle location

higher bandwidth

Latency reduction and improved mobility

WiFi

Public safety

4G LTE

Texas

US$59.2 billion

4G LTE

Wireless data prioritization

Faster download speed

A true world cellular standard

Public safety

Vehicle as a wireless device gateway

Land mobile radio

700MHz

communication networks

cloud

Automatic license plate recognition

hazmat sensors

1x1 screen

The Saturn V

The Saturn V was the largest, most powerful rocket ever built and, having served as the launch platform for the Apollo manned moon mission, probably qualifies as the most famous rocket as well.

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Verizon Wireless is a joint venture formed in April 2000 by the combination of the US wireless operations and interests of Verizon and Vodafone of the UK, with the former owning 55% and the latter 45%. At December 31 2011, VZW had 108.7 million wireless connections and was the largest US operator based on total wireless subscriptions. Also at year-end, VZW reported 2011 wireless service revenues of US$59.2 billion with 40% being derived from growing data services.

As with most wireless operators, VZW indicates that voice services are saturated and that future growth opportunities are focused on data services. VZW's current LTE network provides coverage to more than 200 million Americans and is deployed in 203 US cities. The company believes, however, that its 4G LTE coverage will match its 3G coverage by year-end 2013.

fiber-based backhaul that enhances reliability and on-demand scalability, capable of handling the demanding data loads of public safety agencies. 4G LTE also provides enhanced security features compared with earlier wireless standards, including strong mutual authentication, user identity confidentiality, plus other security enhancements. Verizon's networks support IPv6 Dual Stack for smooth evolution from legacy (and still dominant) IPv4 protocols as well as emerging future IPv6 protocols. The communications giant is targeting support of public safety in the 700MHz band.

Global appeal

Verizon believes LTE will be the dominant global standard for 4G wireless technologies, meaning public safety will gain use of many commercial user devices such as smartphones, tablets, notebooks, cameras, etc, for the many applications that don't require unique user interfaces, functions, or features. This includes applications that can be addressed on commercial devices with added software.

For applications requiring tailored terminal features, Verizon has identified a portfolio of solutions. One example is a firefighter biometric solution offered by Blueforce that provides a belt to be worn around firefighters' chests that has a WiFi mesh network capability and is connected to the 4G LTE network. It also features biotelemetry and hazmat sensors as well as gyros to track their safety; heart rate, respiration, and body temperature are measured and communicated back. Equipped with user interfaces and sensors to enable firefighters to rapidly process information and keep their support teams apprised of their safety. There are also solutions that include a helmet-mounted camera and a 1 x 1 screen positioned in front of their eyes with voice activated capabilities to easily pull up vital information and view it real-time. Verizon intends to offer

Traffic operators will be able to access the main network from remote locations through vehicle mounted or portable devices

numerous devices in its machine-to-machine program that will support public safety applications.

Multi-vendor terminal interoperability and compliance testing have long been problems for public safety, although Verizon and its 4G LTE offerings provide support to the public safety community in these areas. By adopting the commercial 4G LTE standards and technologies, public safety gains access to models, methods, and an ecosystem with successes in providing international interoperable wireless terminals, networks, and applications. Key to this success has been that operators test each device from all terminal vendors for interoperability prior to offering a device to customers on Verizon's network. Public safety customers are thus offered access to its terminal-testing programs, which should substantially enhance public safety interoperability on a national scale, and on an international scale in the longer term. In further promotion of interoperability, the Federal Information Processing Standards (FIPS) are also supported for security certification.

Different requirements

Although commercial wireless operators and public safety wireless operators have many synergies, it is also widely understood that they have many different requirements that include applications, terminal features and user interfaces, usage models, funding scenarios, business models, etc. Our first instalment on this subject in the February/March edition discussed these differences. Thus, public safety decision-makers should carefully evaluate potential business relationships with wireless operators to ensure that a 'win-win' relationship will be achieved that will provide cost-effective public safety communication. These business relationships could possibly range from operator services for a fee to public-private partnerships with shared resources that will undoubtedly be supplemented with private-public safety networks.

Commercial wireless operators and Public Safety Organization have traditionally not been able to develop workable business relationships. Verizon, though, offers some very interesting opportunities for public safety organizations to partner with it for 4G LTE migration, a strategy that is pioneering an industry change in philosophy.

In willing to support public safety organizations to develop their own private 4G LTE networks, it is a very important recognition as it is clear that commercial wireless networks cannot meet all public safety requirements without appropriate enhancements, build-outs, supplements,

and so on. Verizon, though, will support hybrid commercial-private operations, hosted operations, and roaming operations dependent on a public safety organization's requirements and budgets. In support of private network build-out, it says that public safety organizations can use existing Verizon towers, sites, and other infrastructure to install antennae, equipment, etc, when cost-advantageous.

Emergency response

It has long been observed in both private and public networks that in disaster and emergency situations, network communication traffic substantially increases so network capacity must be provided to accommodate these peak disaster loads. In a hybrid commercial-public safety network, these will undoubtedly become a more significant issue. Verizon, though, has long supported wireless priority service over its voice network and is exploring options to provide wireless data prioritization for public safety organizations.

A historically identified issue on the use of commercial wireless networks for public safety has been network availability and reliability, especially during disaster, emergency and special operations. However, Verizon counters that today it builds its networks for continuity of operations. For example, backup power is included at all sites and provides redundant switching facilities and backhaul. Furthermore, disaster-response equipment such as Cells on Wheels (COWs), Cells on Light Trucks (COLTs), and Generator on Trailers (GOATs) are strategically deployed. This is recognition from Verizon that public safety must have appropriate plans and equipment in place to respond to emergency situations.

Unlike many other international markets, the USA is a large country with many high population density urban and suburban areas and significant low density rural areas. California and Texas are examples of large states that require cost-effective high-density coverage and low-density rural public safety communication coverage.

> " … in disaster and emergency situations, network communication traffic substantially increases and network capacity must be provided to accommodate these peak disaster loads

(Above) **Public safety LTE will enable state-of-the-art solutions for protecting first responders and the communities they serve** (Below) **The new standard will help cities and municipalities cope with the challenges of road safety, increased traffic and emergency traffic diversion**

Rural coverage is most cost-effectively achieved in lower frequency VHF and UHF bands that provides required coverage and adequate capacity with fewer base station sites. The USA has substantial VHF and UHF deployments for cost-effective rural coverage. Higher density population areas require higher capacity that is most cost-effectively achieved in higher frequency bands with more capacity. The 700MHz band that Verizon is supporting for its public safety initiatives will generally be more appropriate for urban and suburban areas, so 4G LTE for rural US areas consequently appears to be an open issue.

A fitting conclusion appears to be to offer a comparison of Verizon's initiatives with those in the article in the February/March edition: "The emergence of LTE as a single international commercial standard offers public safety the chance to address its broadband communication requirements 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 interest in shared communication assets 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."

Verizon appears to be providing programs that offer 'win-win' partnership opportunities, although the saying 'the devil is in the detail' appears appropriate here as communication networks are very complex. Despite the company being in the early phases of its initiatives, the benefits of success can potentially be enormous. ○

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In an illuminating chat with **Ken Philmus**, we discover that there is much more to him than his well-known expertise in US tolling

Interviewed by Louise Smyth

Ken Philmus has a similar public image conundrum to that of his employer. As senior vice president of Xerox, the 62-year-old former engineer spends much of his time trying hard to let people know that Xerox is in transportation; that it's not ACS any more. "We're now fully Xerox and we're in transportation to stay!", he says. And, as much as Xerox is heavily present in the toll sector, it accounts for just one third of its overall transportation business. Similarly, tolling probably only makes up one third of Philmus's varied expertise, although he's widely known as the 'go-to guy' for all things toll-related.

Philmus has certainly had a huge impact in his toll industry roles – at ACS/Xerox, AECOM and in his public career at the Port Authority of New York and New Jersey (PANYNJ). He's also been a well-regarded member of the IBTTA and helped to drive things forward on the policy side of toll operations in numerous ways. What people may not know, however, is that as well as his vast knowledge of the US toll industry, Philmus is actually an expert in multimodal transportation. Jokingly describing himself as a "transportation junkie", his 40-year career in the field clearly demonstrates an enduring passion for mobility.

Around 34 of those years were spent in a variety of roles with the PANYNJ, where

> ❝ I was able to work on airports one day, ports the next and rail the day after – for a guy who likes the field, it was tremendously exciting!

he was involved in too many innovative projects to list here. One of the things he especially liked about the Authority was that its duties encompassed every mode of transport you can think of. "When I was managing the authority's vehicle fleet (2,000 vehicles that included airport fire trucks, tunnel tow trucks, and maintenance vehicles), that got me into every sort of facility," he recalls. "It was like the movie *Planes, Trains and Automobiles*. I was able to work on airports one day, ports the next and rail the day after – and for a guy who likes the field, it was tremendously exciting!"

After this fleet management work, Philmus moved into what he describes as "one of the best jobs I ever had", manager of the George Washington Bridge. "It's a beautiful, wonderful facility," he enthuses. "It's the busiest bridge in the world, with around 325,000 vehicle crossings a day. It's just huge: it is double-decked and has 14 lanes. I loved that job – I got to walk

the bridge, walk the cables and all that sort of fun stuff!

"I also felt that I really was providing a service," Philmus continues. "I think one of the reasons I liked my public career so much was that I always felt that whatever job I had, you had the opportunity to make a difference. And when you manage a facility like the George Washington Bridge, the slightest change you make to impact traffic or minimize congestion truly impacts people's individual lives."

The bus boy
From the bridge, Philmus moved to run the PANYNJ's huge bus terminal (dealing with more than 7,000 buses and 225,000 people a day), subsequently did a stint as deputy general manager at JFK airport before taking on the role as director of tunnels, bridges and bus terminals. "I ran the George Washington Bridge, the Lincoln Tunnel, the Holland Tunnel, three other bridges between Staten Island and New Jersey, and

> ❝ All of a sudden, everything you have and everything you know is gone. We had nothing
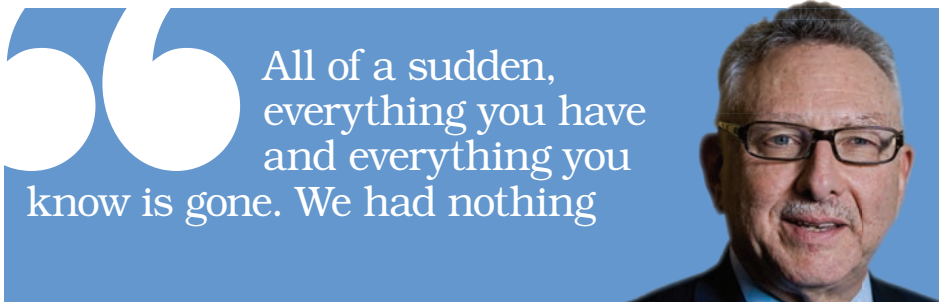
two bus terminals – the one I used to manage as well as another one that the Port Authority had up at the George Washington Bridge," he details. "It was just a dream job for me – I don't know how else to put it! I had all this experience and concern about impact and here I was managing facilities that kept New York running." And then came 9/11…

Philmus was in Boston at the IBTTA Annual Meeting that morning. A decade after, he was in Berlin for the IBTTA's 2011 Annual Meeting, at which he delivered an emotive opening speech reflecting on this harrowing time. The PANYNJ built and owned the World Trade Center and had its headquarters there. "As I traveled back from Boston, I didn't know if I *was* the Port Authority," Philmus says. The PANYNJ lost 84 staff that day, including a dozen who were under his direct control. "All of a sudden, everything you had and everything you knew was gone. You no longer have an office, your records – we had nothing. We kept the facilities operating in the days and weeks after but at the same time, you just wanted to go down to the wreckage and try to find your friends. That's the way I felt but I had a responsibility. I had people working 12-hour shifts to keep the Lincoln Tunnel and George Washington Bridge open and secure, then after a 12-hour

shift they were running down to the World Trade Center to work with the teams there to try and find co-workers and friends. It was extremely difficult but I immediately had to start thinking about keeping the facilities safe and keeping the economy of New York and New Jersey running."

Ultimately, Philmus is pragmatic about the opportunity presented by 9/11 to improve transportation security: "In the immediate aftermath, although we were doing a lot of things by the seat of our pants, many of those things I made decisions about then were things I'd been thinking about for years. For example, separating the two levels of the George Washington bridge into one level for passenger vehicles and one for trucks mixed with passenger vehicles. We banned trucks from the lower level for security reasons, and the knock-on effect was that our accident rate and our congestion level decreased tremendously.

"Then we moved on and began very thorough risk and vulnerability studies," he continues. "These showed things such as the risk of losing the George Washington Bridge was much worse than losing an airport terminal; you can rebuild an airport terminal pretty quickly but you can't rebuild the George Washington Bridge. So we began prioritizing our decision-making against these analyses."

Time for change

Philmus spent the three years after 9/11 working on such projects and explains that , sadly, he ended up being "more of a security expert than a transportation expert". So the time was right for a change. He left the PANYJ and moved to AECOM to become national tolls director for the engineering firm. Although happy at the company, he had began thinking about winding down his workload a little, maybe even looking to retire – that was until he got a call offering him the job of running ACS's entire toll business.

Philmus relished the chance to get back into operations management, with the responsibility for everything from back-offices to call centers and everything else that went hand in hand with the big chunk of the ETC market that ACS handled. And then came the Xerox acquisition, which Philmus regards as rather fortuitous: "Xerox is all about technology in transportation – and not only in tolling, in all of the other businesses, whether that be parking or PPPs or public transit ticketing systems. Xerox brings true R&D – at ACS we had the 'D' but not so much of the 'R'!

"What Xerox is bringing to the table is to help facilities perform their long-range planning with all the data that's being gathered from ITS technologies today. And it's great having access to their staff

◉ | A weighty issue

As well as his day job with Xerox and his industry association work, Philmus also works with the administration of the Pre-Pass scheme. This is a national service (30 states and counting) that allows around 425,000 transponder-equipped trucks to bypass designated weighstations and port-of-entry facilities. For this task alone, it's a hugely successful program, but it's interesting for another reason, too: "Pre-Pass includes tolling

as well, which is something most people don't realize! In the northeast of the USA, that Pre-Pass transponder is also an E-ZPass tag. In fact, Pre-Pass is the largest single toll collector for E-ZPass in the USA. Whenever those 425,000 trucks are on toll roads between Virginia, Maine and all the way out to Illinois, the PrePass system also collects their toll. It's a very efficient system and was fun to manage!"

Xerox handles around 70% of all E-ZPass transactions in

the northeast and "about 50% of tolling in the USA in one way or another", according to Philmus. "In New Jersey alone we handle 520 million transactions a year – I live in New Jersey, so that goes back to me feeling like I'm having a real impact! Pre-Pass is a great program and is one of most unique PPPs I've ever seen. As opposed to the type that are building toll roads, this is simply the public sector working with the private sector on a day-to-day basis and it just works."

too. I had lunch with a bunch of Xerox researchers and they were so excited about buying ACS. I asked why and they said 'Ken, if you had worked on printers and copiers for the past 20 years, you would understand! What transportation has done for the Xerox staff as much as ACS staff is fill the business with new blood. It's been a wonderful synergy."

Xerox is encouraging Philmus to develop another string to his transportation bow – policy-making. Philmus sits on a number of association boards and delights in being able to make long-term differences. As well as the usual industry debate fodder – interoperable tolling, the gas tax and its sustainability, PPPs, etc. (on all of which he can proffer an expert opinion) – a topic he is currently keen to discuss is the need to integrate different modes of transportation within overall policies. And he admits the ITS sector has neglected the role of non-passenger car modes in the past. "You can't ignore the fact that if transit doesn't work, the highways don't work," he states. "Take the Lincoln Tunnel as an example: in the morning it has an express lane where 1,700 buses get priority and they move around 90,000 people each morning. Yet I used to describe the tunnel as a mass-transit facility and people looked at me as if I was crazy! We have to combine all of the different modes to be complementary to each other.

"We recently won the HOT lanes contract in Los Angeles, which will be one of the biggest HOT lane networks in the USA," Philmus says. "But what's neat is that they're looking at integrating the modes, so not only allowing buses to operate for free in the HOT lanes but considering schemes that offer drivers a 'reward' – something like a free journey in the HOT lane after they take four trips on transit, for instance. This multi-disciplinary integration of the modes is crucial to future mobility. As much as I'm a tolling guy, ultimately I am a transportation guy. There can be no silos – it has to be multimodal." ○

Safe passage

As **Emilio Dabul** explains, a Guatemalan port is reaping the benefits of integrated LPR, facial and container recognition to improve both traffic management and port security

Main image courtesy of Binkski/Shutterstock

The shipping port of Santo Tomas is the largest in Guatemala for exports and imports. It is privately owned and for many years the primary security involved a private staff hired to make the rounds, monitor vehicles, check identification of those entering and exiting, count cargo, and generally act as the eyes and ears of the port.

However, as the port has grown substantially over the years so have security problems. These have included increased instances of illegal entry of unauthorized vehicles and individuals, theft, and

> ❝ Today, all vehicles and cargo entering and exiting the secure port areas are monitored through license plate recognition and cargo recognition

SecurOS FACE is a video analytics/ biometrics module for ISS SecurOS and is a face-capture and -recognition solution

problems with illicit cargo such as weapons and drugs. Consequently, it was simply too much for security staff to handle, even with three full-time shifts. To address these problems, in 2011, the port's management team decided to deploy video surveillance cameras along with a number of advanced software solutions to assist the human operators.

Ports are a unique example of locations where extremely different modes of transport overlap. They therefore present their own specific set of challenges. Cargo needs to be transferred from sea to road in an efficient manner, while also keeping stringent measures in place to stop it being tampered with in any way – or indeed stolen. This is not a regular form of traffic management.

As well as being vulnerable to security breaches, ports are effectively a form of business district. Time is money. Getting cargos off boats and onto dry land to continue their journeys (and vice versa) requires a sophisticated, well-orchestrated operation – and

ISS solutions are improving security at the Santo Tomas port

one that cannot be hindered by lengthy security procedures. Conflicting aims, perhaps, but the need for integration is evident.

After investigating various vendors, the Santo Tomas port authorities decided to buy 200 Samsung cameras (models SNC-570, SNO-5080R, SNP-3371, and SNZ-5200) and SecurOS software from Intelligent Security Systems (ISS) for the license plate recognition (LPR), facial recognition, and cargo recognition solutions.

"Their decision was motivated in part by the need for an all-in-one solution," explains Arlen Encarnacion, ISS's director of business development for the Americas. "They wanted to be able to purchase all the analytics from one vendor and have the assurance that if they needed to build out the solution, it could easily be done."

The authorities also needed to be able to control multiple security points with one central station, which ISS has done for various facilities around the world. "We also have many customers throughout Latin America, including other ports," says Encarnacion. "The fact that we had solved similar problems for other ports made it easy for Santo Tomas to choose us."
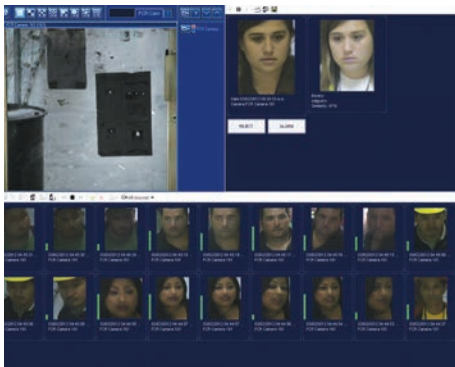
The merits of integrating various security solutions

"Today, all vehicles and cargo entering and exiting the secure port areas are monitored through LPR and cargo recognition," continues Encarnacion.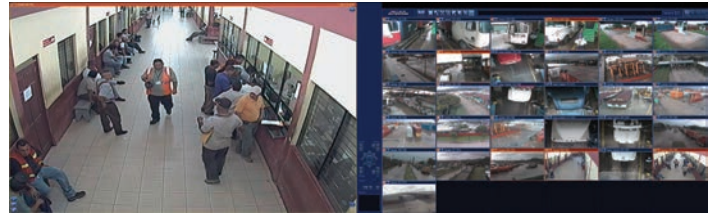 "The authorities know the weight of the vehicle when it comes in and when it leaves, and can make sure the container and truck match. Travel time can also be tracked. LPR can flag up potential security issues – such as a vehicle not authorized to enter, or one that has had a troublesome history with the port and is therefore blacklisted. Any 'after-the-fact' issues can also be followed up on far more easily as a result of the identifying information

proved by LPR." The port has two SecurOS LPR channels and 22 SecurOS cargo recognition channels.

ISS's SecurOs facial recognition can also spot individuals who have had any sort of problematic history with the port, and the facial images recorded by the system can also be used for forensic evidence.

SecurOS cargo recognition solutions have the advantage of providing views from all sides (as well as above) and can read identifying information in the most challenging types of weather. This ability to provide accurate reads in fog and thick rainstorms – or other sorts of extreme weather – is also true for the LPR feature, and is crucial for around-the-clock security.

The integrated camera and definition video server (DVS) platform coupled with intelligent video analytics in one unified security topography has provided a number of key benefits. Multiple security points are managed by one central station (with Pivot 3 servers) with centralized command and control of all security systems. This is a huge advantage for port security staff, giving them a view of everything going on at any given time. With a system able to see into any given area of the port, and LPR, facial and cargo-recognition features further enhancing security, there is less need for constant foot and vehicle patrols as officers can be dispatched to areas on an 'as needed' basis. With security needs automated in this way, the port's overall security staff needs have been streamlined, which is a cost saving that recoups part of the investment in security cameras and software.

"This is a case where the right cameras and software have completely transformed security for the port," comments Encarnacion. "The automated features of this security system have made things more effective all round, keeping watch on vehicles, cargo and suspicious individuals in a way that was inconceivable before. It has resulted in a tremendous decrease in theft – both employee-related as well as from outsiders – and driven out dealers in illegal drugs and weapons. In that way, potentially dangerous situations at the port and on the roads leading into and out of it are also being curtailed." ⊙

• Emilio Dabul is a writer, PR professional and surveillance technology expert

Savings
accounts

In a challenging financial climate, innovators often rise to the top with solutions to do more with less. **Timothy Compston** seeks out the thoughts of those responsible for our road networks to discover where intelligent traffic technology is enhancing their operations – without breaking the bank

Illustration courtesy of Magictorch

For DOTs trying to cope with growing traffic volumes at a time when funding is not flowing quite as freely as it once was, there is a light at the end of the tunnel in the form of ever more innovative technology-based strategies to keep traffic on the move.

One person who, given the current climate, remains unsurprised that the application of intelligent transportation systems is sitting high on the agenda for DOTs is Washington DC-based John Horsley, executive director at AASHTO (American Association of State Highway and Transportation Officials). "If you need

to deal with congestion and move traffic but don't have enough for major capital construction, the key question should be "What's the better use of your dollars?'" Horsley says. "Experience has shown that you can realize a greater return with technology-based solutions than traditional asphalt, concrete, and steel."

In fact, this, Horsley relates, was the clear message he communicated during a recent ITS America Board of Directors meeting, in which he stressed to representatives from technology providers that they need to reach out and promote the economic arguments to DOTs. Against this backdrop,
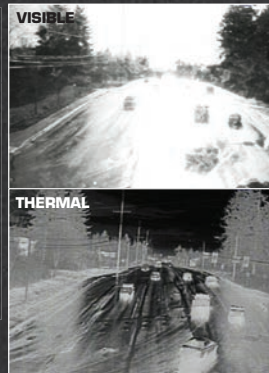
National network

David Laoide-Kemp from the Republic of Ireland's National Roads Authority (NRA) says ITS is starting to gain more traction with year-on-year growth over the past five years.

When it comes to VMS, these are being tailored to NRA's requirements for a better ROI, says the ITS project manager: "We wanted to future-proof these systems so we had the potential to use pictograms as well as text. We looked at an MS3 model, which was mostly text but had small areas for pictograms, and the MS4 where you could basically put text and pictures anywhere. The result brings together the idea of the MS4 fitted into the MS3 casing, which is much wider and has the performance to meet our strategic needs."

A landmark in the NRA's ITS development, though, was a cross-border project called 'Instant' – a joint effort with the Roads Service for Northern Ireland focusing on the corridor between Dublin and Belfast. "The idea was to develop a cross-border travel information service between the authorities," says Laoide-Kemp. In practice, it involved the roll-out of multiple VMS at strategic intersections, the deployment of CCTV in some places, and crucially, a series of ALPR cameras. "We are now able to monitor the whole route based on real-time data so we have a good indication of how the road is performing – it is not for enforcement purposes."

The anonymized ALPR data can be applied to produce real-time journey times: "This is displayed on our VMS near key locations such as interchanges and typically shows the time to the next two closest major destinations," explains Laoide-Kemp.

the AASHTO chief points out that there is a growing trend toward the adoption of active traffic management solutions: "With variable electronic speed limit signs you can, for instance, alter the speed posted depending on the traffic conditions ahead, helping to adjust the flow of vehicles. Seattle and the Bay Area are two examples that come to mind, and the technique certainly has wider potential."

Another area of technology that Horsley believes is having a positive impact relates to weather information: "Good data on storm events for the trucking industry and the traveling public is now considered by state DOTs to be an essential function," he reveals. The USA's Road Weather Information System (RWIS) is partly fed by a series of remote sensing stations that the states are installing on their highways, supplemented by meteorological data from the government. Horsley feels the operational benefit is the ability of these remote sensors to measure the pavement temperature and the dew point in the atmosphere: "This data helps DOTs to be much more precise in their response to snow and ice. Maintenance crews can use less salt, which is better for the environment, and apply it more effectively, in doing so saving resources."

Considering technology-based projects underway at the moment, Horsley singles out one in the Washington DC area for attention:

The Capital Beltway in the Washington DC area

"Here on the Beltway (I-495) Transurban is implementing variable charging rates on special HOT lanes. As they are contracted to maintain traffic flow at a speed of 45mph, varying the rate charged is an intelligent tool to achieve this.

"We are hitting a political stalemate right now in terms of investment; people don't want to see spending reduced but they also don't want to pay more taxes," Horsley says of the overall funding picture. "There are still challenging times ahead; we are stuck very much in a holding pattern and it could be five years until we see investment really pick up again."

> ❝ We are hitting a political stalemate right now in terms of investment; people don't want to see spending reduced but they also don't want to pay more taxes

John Horsley, executive director, AASHTO, USA

Smarter lanes

Turning to Minnesota DOT, Nick Thompson, director of the Policy, Safety, and Strategic Initiatives Division, outlines the primary ITS strategy being taken to maximize the use of their urban highway infrastructure: "We are applying active traffic management systems, including the ability to open up the shoulders for traffic during peak times. This makes it possible to re-use existing road surfaces while at the same time dealing with safety and other operational issues."

Lane-by-lane VMS or 'Smart Lanes' have been adopted to great effect in Minnesota: "In some instances these have been combined with a tolling component for the shoulder to manage demand," Thompson says. Since last summer, he reveals that Minnesota DOT has

Bang for your buck

Via *Traffic Technology International*'s LinkedIn group page, vendors in the industry detail their latest advances to ensure traffic managers can do more with less

Light idea

Hoeflake from the Netherlands has worked with Swarco's Austria-based Futurit lighting division to develop a solution for controlling the company's Futurlux LED streetlighting that uses powerline communication. "New sensor-based services to reduce energy and maintenance costs can be realized without adding new communication infrastructure," suggests Henk Hoeflake. "Each streetlight can be monitored and controlled, while the ability to dim them to reflect low traffic volumes can result in extra energy savings."

Double act

The Autoscope Duo from Econolite and Image Sensing Systems is the first of a new generation of hybrid sensor technologies. Having been field-tested for nearly a year, the new system has proven to be a superior alternative to in-ground detection systems, according to the companies. Integrating radar and video detection algorithms expands the benefits of non-intrusive detection, and ensures low maintenance when compared to the expense of installing and maintaining inductive loop detectors. "It provides transportation agencies not only with a powerful ITS solution, but a high return on their investment," suggests Mike Doyle, Econolite Group CEO.

Saving grace

Designed to save installation costs and deployment time, the CitySync Fox-i One Intelligent ALPR camera from Image Sensing Systems (ISS) incorporates an infrared ALPR camera, color overview camera and an onboard processor. As it processes images at the time of capture, smaller packets of data can be transferred via wireless 3G or wired connections to a central server for review or directly to an agency's back-office facility. And because it is easily installed onto existing street furniture, it is rapidly deployable without the expense of extra poles, so is ideal for temporary and semi-mobile installations.

Finance deal

The new 3.2 version of GridSmart from Aldis uses 3D object-tracking technology, which is intended to go beyond traditional detection alternatives and enable greater functionality at a lower total cost of ownership. One of the most visible new features is the 'Replay' function, which allows users to record and playback image data complete with information on zone presence and signal state. Even in the replay mode, users are still able to take advantage of the virtual pan-tilt-zoom (PTZ) feature and other standard facilities. The Replay feature is useful for traffic engineers wishing to review traffic patterns and driver behavior during certain times of day, special events or other incidents.

Cost control

A new traffic signal control system has been launched by SMART Signal Technologies that the company's Professor Henry Liu believes will save taxpayers millions of dollars annually, as it improves traffic signal performance along the USA's signalized arterial corridors. The new product is a compact device with powerful data collection and communication features that allow for the gathering of high-resolution data for processing into actionable real-time information, in order to measure and monitor signal and corridor performance. Using 'AdaptiTrol' technology that has been licensed from the University of Minnesota, Liu says it will be significantly less expensive than the cost of new controllers, which are used to regulate phase changes at signalized intersections.

Wider focus

One of the most cost-effective ways to address the issue of traffic-related fatalities in rural areas could be to increase the width of edge lines on rural two-lane highways, according to a recent Texas Transportation Institute study.

The research found that wider edge lines have been shown to reduce total crashes by 15-30% and fatal-plus-injury crashes by 15-38%. In addition, the benefit-cost ratio for wide edge lines is US$33 to US$55 for each US$1 spent, which is similar to rumble strips.

Fatalities on the USA's rural roadways have decreased in recent years, but despite only making up 23% of the total US mileage, fatalities on rural two-lane highways made up 57% of all traffic fatalities in 2009. Rural motorists are 2.7 times more likely to be involved in a fatal crash per mile traveled than their urban counterpart.

On the radar

Able to detect vehicles, people and debris at up to 500m, Navtech Radar's ClearWay system also provides 360° coverage, meaning a single system can monitor up to 1,000m of open highway. Consequently, longer stretches of road can be monitored with fewer installed systems, which makes it a highly cost-effective incident detection answer for road authorities. "A mean-time-between-failure rate of 75,000 hours equates to eight to nine years of continuous operation without having to intervene for maintenance reasons,"

says the company's Dr Steve Clarke. "Further savings arise from the fact that, unlike with cameras' lenses, there is no cleaning requirement associated with radar. Costly road and tunnel closures can therefore be avoided."

Solar flair

The Ohio Department of Transportation has deployed more than 1,000 solar-powered Vehicle Radar sensors from SpeedInfo along important metropolitan corridor interstate and state roads. Mounted on existing light or signage poles, they're collecting traffic speed information continuously.

"In a 'do-more-with-less' environment, our low-cost approach of offering a turnkey data services business model that includes sensor network installation and maintenance, near real-time information with service performance guarantees,

up-to-the-minute updates and high ROI continues to be well received," says Charlie Armiger, SpeedInfo's vice president of program development.

Minnesota's Smart Lanes are the electronic signs providing real-time information to help motorists make informed decisions about their commutes

implemented Smart Lanes technology on a key urban route – minus the tolling element: "In normal operations we allow buses on the shoulder, then when there is an incident we can rapidly open up the shoulder to other traffic utilizing the VMS over the lanes and shoulders to keep things moving. Basically we have eliminated a major bottleneck," he says of the impact.

The investment to implement Smart Lanes was substantially smaller than building a new lane, according to

> ❝ Where traffic volumes aren't that high you are never going to be able to justify converting a stop approach signal to an interchange

Nick Thompson, director of the Policy, Safety and Strategic Initiatives Division, Minnesota DOT, USA

Thompson: "For just the shoulder portion, we estimate that we spent about US$15 million on a 2.2-mile section of urban interstate. If we had gone for a traditional fix of rebuilding bridges, interchanges, and the whole road, this would have amounted to hundreds of millions of dollars."

The overall project time was another advantage, Thompson says. The lower cost, technology-based option took only five months, whereas, in his view, a traditional alternative could have been anything up to five years.

Looking ahead, the MnDOT man expects optional toll lanes to be a longer-term infrastructure management strategy for urban freeways: "Rather than continuing to build and build to deal with congestion, you create one lane and guarantee its pricing, in doing so giving road users the choice."

For Minnesota, the traffic challenges are not just in urban areas – technology is also

Media savvy

Mississippi DOT is saving money by installing a Media Server software system from Wowza to simplify and improve video streaming from its statewide network of nearly 400 traffic cameras.

The installation was part of an upgrade to MDOT's ITS, with the new software enabling the streaming of live content from all of its cameras simultaneously to multiple devices. It also does away with the need for specialized, client-specific encoders and servers, so can reach more people than the previous streaming method.

The software is a single extensible foundation for Wowza's 'Any Screen Done Right' media delivery, making streaming to computers, smartphones, tablets, and TVs simple and cost-effective. Improved economies of scale and reduced encoding, storage, and management expense, enable organizations to stream live and on-demand video with ease, while saving money, improving efficiency, and streamlining workflow.

"With our previous workflow, the TMC received analog video feeds from roadside cameras to be encoded/decoded and then displayed internally on video screens," explains MDOT's ITS systems specialist, Timothy Bean. "From there, video had to be re-encoded to go out to the internet. The Wowza software has made it possible to forego all that, saving us money and space, while cutting down energy consumption. We removed about 10 racks worth of equipment and replaced it with a single server that's running the new software."
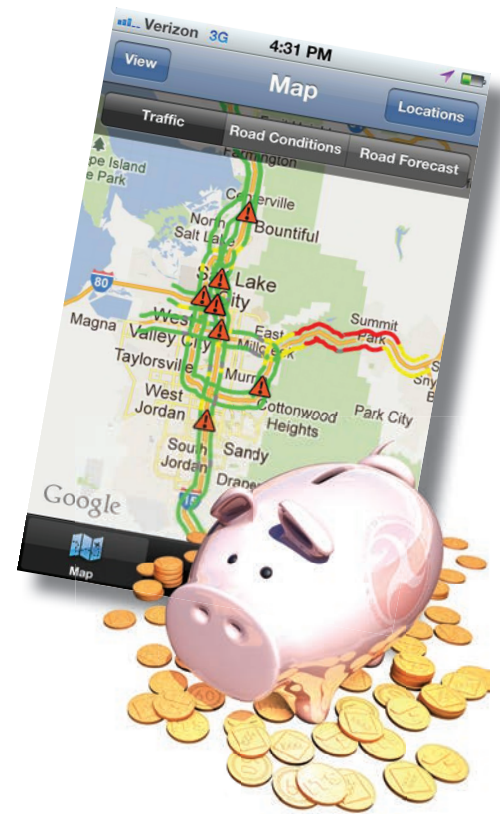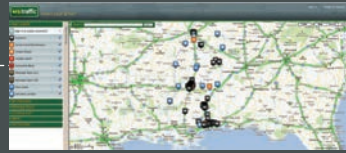
being applied as an economical solution to address worrying accident rates at many rural intersections: "Where traffic volumes aren't that high you're never going to be able to justify converting a stop approach signal to an interchange," Thompson says. MnDOT's answer is a simple warning system: "Our intersection decision-support system basically comprises a sign and a detection component, and it can be replicated across our rural intersections and doesn't require cameras or being linked back centrally. Drivers are alerted by the sign if a car is approaching from left to right."

Intelligent solutions

In Edmonton, Canada, Gord Cebryk, the city's director of signals, streetlighting and infrastructure rehabilitation, is enthusiastic about the difference that traffic technology can make: "Dollar-wise, we only have a certain amount of resources, so we don't have a lot of money to build or expand our roadways. Our focus is really on two things – public transit and ITS."

Cebryk sees Edmonton's traffic-response network – which is able to automatically change signal timings through real-time measurements via sensors in the roadway – as being an extremely shrewd investment: "Around the Edmonton Oilers ice hockey team's venue we have a traffic-response system in place so we can move vehicles in and out of the area as quickly as possible."

"Our app has been downloaded 50,000 times ... For a cost of US$70,000, the application has turned out to be a tremendous way for us to communicate directly with road users

Rob Clayton, lead traffic engineer, Utah DOT, USA

(Top right) **Utah DOT's new traffic app, which has delivered significant ROI** (Left) **Dynamic message signs strategically deployed on Edmonton freeways**

Considering the Dynamic Message Signs (DMS) used by Edmonton, Cebryk points out that they have a mixture of permanent and portable units: "The portable systems are particularly good when there are temporary situations such as construction work and you want to reverse a lane's direction of usage, open the shoulder, or just provide travel time delays."

One issue with portable DMS units is how to power them. In Edmonton, Cebryk says that solar technology has helped: "All of our portable signs use photovoltaics, which are more energy efficient and, fortunately, most of our construction work takes place in the summertime. The alternative is to run them off gas-powered generators, which creates a noise issue for residential areas in the evening."

Cebryk also reveals that Edmonton is focusing on other programs to enhance its ITS capabilities, with the city in the initial

stages of a new predictive traffic modeling system: "This will enable us to better model traffic in real-time with respect to the major arterial roadway and truck route through Edmonton – the Yellowhead Trail. This should allow us to adjust signal timings on parallel routes so people choosing to go different ways have better access."

Another approach Edmonton is investigating is the use of GPS signals from cell phones to monitor traffic volumes. "The major advantage here is that you don't have to put sensor loops in the roadway – devices can be placed at the roadside," Cebryk says.

Building ITS

Utah DOT (UDOT) is a strong advocate of smarter implementations of ITS, as Rob Clayton, UDOT's lead traffic engineer explains: "We have really seen the benefits of our ITS program and are committed to supporting and implementing it."

These are certainly interesting times for Utah, which is in the midst of the largest construction project in the state's history, the I-15 corridor. The US$1.7 billion design and build project involves 24 miles of reconstructed freeway, 60 bridges and around seven interchanges. "Continued ITS functionality during construction was built into the contractor's performance specification so we could still report travel times and things like that," Clayton says. A number of portable message signs were installed to highlight travel times on the key arterial streets surrounding the construction corridor.

A development that Clayton believes has had a quick and positive return, however, is the DOT's smartphone app for iPhone and Android: "This has been downloaded 50,000 times and mirrors the travel information on our website and 511 service," he says. "For a cost of US$70,000, the application has turned out to be a tremendous way for us to communicate directly with road users."

Save in the Cloud

The UK government's latest Information and Communication Technology (ICT) Strategy is intended to shave millions of pounds off the costs of ICT procurement. Getting away from the monopolizing of the market by just a few big names, it encourages public-sector sharing and re-use of ICT solutions and services via a common infrastructure, asset register, and online applications store.

This is embodied in cloud procurement – 50% of new ICT spend is expected to be on cloud by 2015 – and the iterative G-Cloud framework, through which local authorities and other public-sector bodies can use cloud computing to gain access to presecured and accredited solutions. "G-Cloud is about a whole host of other issues besides hosting solutions for clients," says Scott Hutchinson of Symology, which supplied its Insight for Street Works coordination solution for Phase 1 of the G-Cloud. "It's about how easy it is to on- and off-board data; determining pricing models to allow customers to pay only for what they use; allowing users to scale their access to the system as required; and how you manage these scenarios from a technical perspective, considering the impact of 12-month minimum contracts, and so on."

G-Cloud procurement does not involve the Official Journal of the European Community (OJEU) process or mini-competitions, which saves authorities money and dramatically shortens implementation times. It will also increase standardization, reducing cost and vendor lock-in, providing more flexible pricing models. Vendors will no longer be able to insist on minimum numbers of software licenses and contract periods; instead, a user-defined number-of-licenses-per-month model will be encouraged.

Real-time arterial traffic information during the I-15 corridor expansion

When incidents occur – or lanes need to be closed – Clayton says that the ability to disseminate information in a more timely fashion is extremely important: "Even small adjustments of the traffic stream can make a big difference. If we can reach 10-20% of the people – and they change their behavior – it can have a significant impact on traffic flow."

One of the things that Utah has pioneered that Clayton believes could be a huge opportunity for other DOTs is the effort to expand its fiber-optic network: "Fiber is a very fast and reliable means of communication, especially for ITS devices. Despite the fact that we are largely a rural state, our network is very comprehensive." Clayton says that the way that they have been able to achieve this is through a public-private partnership: "Essentially we trade our excess conduit capacity with private companies that do not have additional capacity in other areas that we need to reach."

The upshot, he goes on to explain, is that Utah has been able to increase its network by 150% in the past five years. "We now have more than 1,800 miles of fiber-optic cable in the ground and estimate that the value added to our system is almost US$50 million. Additionally, we have control over the majority of our devices statewide, which is impressive for a mainly rural state."

Utah is also looking at two pilot projects for adaptive traffic signal control: "One is based on SCATS and the other is ACS Lite, and in both cases we have seen similar results," Clayton reports. The greatest benefit, though, comes in off-peak periods. "This is when there are big fluctuations in traffic and the adaptive systems perform really well. We have seen reductions of as much as 10% in travel times and a similar decrease in the number of vehicle stops."

An intelligent future

From energy-saving solar-powered VMS so hard shoulders can be used to ease congestion at peak times or advanced adaptive signal control to smooth traffic flow, the embracing of intelligent traffic systems is unsurprising. Technology isn't always the answer, of course, but as shown in Utah, Minnesota, and Edmonton, can go a long way to helping balance the books, if spent wisely. ○

Super
highways

The deployment of increasingly sophisticated
ITS technologies places ever-greater demands
on bandwidth capacity, so having the right
communications backbone in place is a must.
Joshua Gans delves into some cases where
fiber-optic networks are paying dividends

Illustration courtesy of Nadla

Barely a week goes by without one transportation department or another announcing fiber-optic upgrades for their ITS networks. One of the most recent was the Saxony Highway Authority in Germany, which is busy building a borderless broadband network throughout the region that it believes will result in roads that are not only more efficient and green but will also lead to safer highways for drivers, with less traffic.

Millions of vehicles drive on Saxony's highways every year, but now there's an underground information highway running alongside the asphalt that's transmitting digital data traveling at gigabit speeds over fiber optic. According to Frank Weirauch, head of the Dresden-based Authority's telecommunications office, there are more than 68,000 data points generating 30 billion data records a year along Saxony's 562 highway kilometers. "Our number one priority is to operate all applications,

Saxony's highways will not only be safer, but fewer traffic jams are also to be expected

equipment, and systems as efficiently and inexpensively as possible using a standardized platform," he explains.

High speed next to the road

Running on this Cisco fiber-optic network will be information about how many vehicles are currently on the road and whether or not traffic warnings are necessary. Temperature and other road-condition parameters, meanwhile, provide the decision-making variables for issuing ice warnings and deploying snow plows and gritters. All signals from Saxony's 16.8km of highway tunnels are also included, generated by 142 emergency telephones, 120 fans, 194 video cameras, 300 loudspeakers, and 4,300 tunnel lights.

"All of these systems supply measurement and monitoring data to the universal IP network and are remotely monitored by us here at the telecommunications office," Weirauch continues. "The fire detectors, for example – which are fixed every 8m along the tunnel ceiling – trigger an alarm in just 10 seconds if there's a temperature difference of 3°C." To gain a clearer picture of the situation, the network in the tunnel control center rotates the cameras to focus on the fire detectors. "This advanced networking improves operating efficiency as well as traffic and tunnel safety," Weirauch adds. "More power supplies from diverse auxiliary power stations are integrated so that

(Below) **LA County won an award for saving an estimated US$7.0 million in costs over traditional copper or fiber-optic installations**

the IP platform reduces overall power consumption, in doing so making highway operations more ecologically friendly."

Ethernet-over-copper

Wyoming Department of Transportation (WYDOT) had similar goals to Saxony for its traffic system in the City of Cheyenne, but couldn't justify a fiber-optic network, so opted for an Ethernet-over-copper solution from Actelis Networks. "Our main goal was to easily communicate with all of our traffic controllers, in doing so enabling us to improve the efficiency of how we move and monitor traffic throughout the city," explains Jerry Downs, state electrical engineer for operations at Wyoming DOT.

Equipment in the field was upgraded from a legacy system to a centralized Ethernet-based ITS network, which Downs says offers greater reliability, while lowering the ongoing complexity of maintaining the network. Actelis's ML690 aggregation switches and ML622/ML680 Ethernet Access Devices (EAD) were deployed across the existing copper network to provide real-time troubleshooting and monitoring capabilities.

WYDOT also called upon solutions from Actelis to backhaul data from wireless vehicle-detection systems. Pucks located on the ground transmit vehicle presence data wirelessly back to a receiver, which is subsequently transported back to the TOC where it is used to synchronize traffic lights and ensure the smooth flow of traffic.

↘ Efficiency drives ITS deployment

Bay County in Florida is continuing to expand its intelligent transport systems capability, which since its inception 10 years ago has decreased travel times and saved drivers millions of dollars.

Last year, the county's Board of Commissioners approved a US$2.25 million contract with Georgia's World Fiber Technologies for the expansion of its ITS west along US 98 to SR 79, and Front Beach Road to the intersection with Hutchinson Boulevard, north on US 231 to County 2301, and east on SR-22 to Star Avenue. The project has been entirely funded through a Florida Department of Transportation (FDOT) grant, with work commencing on the project in August 2011.

The technology will allow Bay County traffic controllers to change the timing of traffic signals in order to move people through congested areas with more efficiency. "Every time a new ITS service is added, the goal is to decrease travel time by 20% in that area," suggests Keith Bryant, Bay County traffic engineer. "The expansion of the ITS along Back Beach Road (US 98) is the highlight of this project. Although the other arteries are also important to travel in the county, this is the primary means by which visitors enter and exit Panama City Beach. Traffic in the area is frequently heavy and varies greatly depending on the time of year and when there are special events."

> **"** Having the new cameras and roadway data loops in place help us spot and respond to collisions much faster and quickly share that information with drivers

Chris Thomas, TMC supervisor, Washington State DOT, USA

Using the existing copper infrastructure, Downs and his colleagues are able to reliably communicate with any traffic controller, at any intersection, from any location. "The previous system was slow, connected by 1,200-baud modems, radio systems and multiple protocols, and could communicate with only one traffic controller at a time," he explains. "With the new high-speed, Ethernet-based system, we can instantaneously retrieve data about any intersection centrally from the TOC or remotely at any of the city's traffic controllers by plugging a laptop into the equipment."

Fiber was also deemed unfeasible and too costly to install for Jane White, senior civil engineer for Los Angeles County in California, which recently opted for wireless backhaul systems from Proxim Wireless Corporation. In adding Proxim's Tsunami GX800 18GHz radios to the existing citywide traffic control system, it is estimated to have saved US$7 million in costs over traditional copper or fiber-optic installations. "To enable us to reduce the number of leased telephone lines and – more importantly – to provide high-capacity communications over a non-contiguous geographic area spanning hundreds of square miles, we needed to be able to transmit all the traffic control system data and video images back to our TMC," she says.

Many US states are embracing fiber-optic however. With modern

(Main) **In Cheyenne, Wyoming, the decision was made to use the Actelis copper-based solution** (inset) **to replace existing modems** (Below) **Proxim's Tsunami GX800, as deployed in LA County**

ITS networks, there is a demand for ever-increasing data rates as well as payload-carrying capabilities to facilitate real-time communications between numerous field devices and TMCs. In both urban and rural environments, the trend is seemingly toward single-mode optical fiber-based ITS infrastructures, which appear to be displacing traditional twisted pair copper and coax for both data and video transmission requirements.

The ideal conduit, then, to future-proof ITS investments, many DOTs are filling in the gaps in their fiber networks. Washington State DOT (WSDOT), for example, recently completed a major ITS hardware installation on I-5 in Snohomish County, the US$3.2 million project completing a key fiber-optic network and bringing traffic information and camera views online for the busy 25.7km (16 mile) section of the I-5 between Everett and Arlington. Work that started in summer 2011 has also filled in a 6.4km (four mile)

Centres (RCC). This network is made up of fiber-optic and copper cables that transmit data and voice signals between the devices and the RCCs.

The HA's biggest move toward a digital communications network is seen in the National Roads Telecommunications Services (NRTS) contract, a 10-year deal that was awarded to the GeneSYS consortium in 2005. Although in time, the NRTS contract will allow the HA to realize the development of a national, high-speed telecommunications network, the Agency appears to be looking much further ahead, to a future where much of the traffic information and data currently collected by detectors in the road surface and delivered by message signs will be provided more effectively, directly to drivers using 'in-car' technology.

Flexibility and scalability

But as far as it's interesting to look at what lies on the horizon, the here and now is what concerns traffic managers most. In Leeds, UK, the current Urban Traffic Management Control (UTMC) system controls around 400 traffic signals in the city and neighboring Calderdale, so reliable communications are therefore crucial for Leeds City Council. Up until now, this has come at a significant cost in terms of fixed communication lines. "Our proposed city-wide IP communications network solution is extremely cost-effective to install and offers considerable flexibility and scalability," says Siemens' Gary Cox. "With the ongoing cost of ownership being key, the chosen technologies offer both reliability and reduced operating costs. We are confident that the design has the potential to reduce future revenue costs by more than two thirds of the current revenue spend."

The project will maximize the benefits of new IP communication and IP-compatible traffic signal equipment. Siemens started surveying the traffic signal sites this February, with completion of the 400-site program expected next January.

Two specialist suppliers in the region were contracted by Siemens to assist in the project. SCD is providing new DSL-based (Digital Subscriber Line) circuits and

⬇ | An international dimension

In Macedonia, the European Bank for Reconstruction and Development (EBRD) is supporting the modernization of the urban road system in the capital city of Skopje with a US$7.7 million loan in order for the city to introduce a modern traffic management system and upgrade one of its key arteries. The installation will involve new traffic signals and traffic signal controllers that will be linked through a dedicated fiber-optic network to the automated traffic control center, as well as new traffic surveillance CCTV cameras and VMS at key intersections. "This project will considerably improve traffic safety for motorists and pedestrians in the Macedonian capital," believes Lin O'Grady, deputy director for municipal and environmental infrastructure at the EBRD. "It will also reduce travel times and ease congestion. Overall, it will serve as an excellent example of how direct lending can help municipalities improve local infrastructure and services."

(Top left) **The NRTS handles data and CCTV images, which provides the Highways Agency – and ultimately road users – with moment-by-moment information on traffic congestion and delays** (Bottom) **A minimum of US$100 million will be spent in Abu Dhabi to improve and modernize traffic technologies**

fiber-optic equipment while IDT is manufacturing and supplying the system's wireless equipment. A private core of DSL circuits will provide the backbone, with 3G and wireless technologies being used where, Cox says, "the detailed design determines the required performance criteria can be achieved".

Further afield

Around 200km (124 miles) of fiber-optic has already been buried by the Municipality of Abu Dhabi City, in cooperation with the Department of Transport in Abu Dhabi, which is seen as a key ingredient as a further US$100 million is being invested to expand and upgrade the city's traffic management system. "Presently, there are 250 new signal junctions, as well as surveillance devices deployed in areas under development, coupled with the construction of three traffic control centers in these areas," details Abdulla Al Shamsi, executive director of municipal infrastructure and assets for Abu Dhabi City. Numerous other intelligent traffic system projects will shortly be implemented, though, including the installation of a traffic signal network in Mohammed bin Zayed City, the introduction of VMS, expansion of the CCTV camera network, upgrading the traffic and control systems on Abu Dhabi island, and the deployment of fixed electronic traffic counters.

What these examples from Abu Dhabi, Saxony, Leeds, Los Angeles County, Hattiesburg and Snohomish County highlight is that a reliable communications backbone, whatever the medium, is crucial for an increasingly complex yet efficient ITS infrastructure. Clearly, a fiber-optic spine is not right for everyone, but there is plenty of evidence to suggest it will likely remain the most widely used transmission type for future ITS telecommunication needs. ○

In the frame

As **Goran Nikolic** reveals, the pioneering proof-of-concept for the simulation framework of the Greater Toronto Area highway system is now complete

Images courtesy of iStockphoto and TSS

As with many large metropolitan areas throughout the world, the Greater Toronto Area (GTA) faces major challenges with traffic congestion. Many travelers experience long commutes and even relatively minor lane blocking incidents or adverse weather can create significant additional delays. The Ontario Ministry of Transportation's Central Region must carefully examine design alternatives, construction staging and incident/event management to optimize its complex highway system's safety and efficiency. As part of this work, MTO makes extensive use of traffic simulation modeling for highway planning and design, construction, operational reviews and traffic management strategies.

MTO's Central Region Traffic Office has completed the proof-of-concept (POC) for its pioneering Simulation Framework (or SimFrame): a multipurpose, multilayer traffic simulation framework for the freeway and major arterial road network in the GTA. The MTO project team, which included engineering consultants Delcan Corporation and McCormick Rankin (MRC), developed a single master model that will not only consolidate local knowledge and best practices but also optimize modeling performance and efficiency. The intent of this new model is to become MTO Central Region's primary tool for future traffic analysis as part of planning and design, operational reviews and traffic management strategy decision-making.

Traffic management in Ontario is set to improve via the use of the SimFrame

With the POC completed, the goal is to expand the framework to encompass the entire highway system in the GTA and embark on large-scale, network-wide applications. This includes traffic planning and analysis of advanced traffic management strategies and a more comprehensive operational assessment of Central Region's options for managed lanes such as high-occupancy vehicle (HOV) or other priority facilities.

Preliminary work has focused on urban portions of Highways 400, 401, 404, and 407; part of Ontario's 400-Series highway system. The 400-Series is a complex network of 1,500kms of controlled-access highway in Southern Ontario that is expanding into Northern Ontario. Segments of the 400-Series include various innovative traffic technology and systems such as HOV lanes, advanced traffic management systems (ATMS), an electronically tolled highway and a collector-express roadway configuration in the Toronto area.

Highway 401 stands out in particular as the centerpiece of the 400-Series network and as one of the busiest highways in the world. Together with Quebec Autoroute 20, it forms the transportation backbone of the Quebec City – Windsor corridor, along which over half of Canada's population resides. At one location in Toronto, the average traffic level exceeds 420,000 vehicles per day.

The size and complexity of the highway network means that in terms of traffic modeling, the MTO team faced some very demanding situations. This was further complicated by needing to model heavy congestion and challenging physical features such as short sections between entry and exit ramps and transfer lanes between express and collector roadways.

Because of this combination of great size and dense detail, the MTO team was looking for an all-in-one approach that could integrate macroscopic, mesoscopic and microscopic layers of modeling. With its integrated three-tier approach, Aimsun was a good candidate for the modeling platform, and was evaluated as the best fit from among the nine proposals submitted as potential software platforms for the POC.

Aimsun has a single common network and database that supports all levels of modeling, and it has a good interface with MTO's existing Emme travel demand model. MTO already possesses a strong Emme model for Ontario's Greater Golden Horseshoe Area (GGHM). The SimFrame is able to fully utilize the GGHM output. so nothing is wasted. It was also necessary for

Testing times

In parallel with the POC effort and under the watchful eye of the MTO Traffic Office, Delcan and MRC have been putting the Aimsun platform through an extensive evaluation process since 2008. The testing is an ongoing process of assessment, calibration, validation, feedback and algorithmic enhancements, and has included everything from the importation of existing traffic demand models to regional-scale evacuation of over a million vehicles. The consultants have checked that the framework is able to simulate every aspect of the 400-Series network: reproducing queue lengths and shapes at ramps on multilane highways with peak flows; incorporating cost functions that allow faithful modeling of tollways and HOV lanes; and reproducing the process of traffic flow balancing between the express and collector lanes. In almost every case, feedback from these projects has led to important enhancements in the underlying software platform to tackle the complexity of Ontario's highway network.

In total, more than 12 real-life projects have been completed in this period as part of the testing process. These include the impact of a new LRT line, a BRT facility in York Region, and specialty applications such as developing evacuation travel time estimates for two nuclear power generation facilities.

" The size and complexity of the network means very demanding situations in terms of modeling

(Top left) **Construction project on Highway 401** (Below) **Modeling traffic flow in Aimsun**

the product to have proven consistency in modeling results from the micro and meso layers, plus powerful and efficient 'zooming in' to focus on sub-areas for detailed analysis.

The SimFrame is the culmination of over 12 years of innovative modeling solutions from MTO. The MTO has made extensive use of microscopic simulation with more than 100 projects, including: evaluation of the impact of proposed highway or interchange improvements; provision of travel-time estimates for use in forecasting HOV use, the operation of HOV lanes and on-street transit; and the operation of toll facilities, roundabouts and ATMS.

Reduce, reuse and recycle

The theme of reusing and recycling past projects is central to the objectives of the SimFrame development. The SimFrame streamlines the simulation process as a centralized modeling framework and avoids a situation where the same road section appears in different models with potentially different results. Consolidation also brings the benefits of standardized calibration, which assists in achieving consistency across studies. In addition, the SimFrame will lower costs by moving away from single-use models to a model that can be re-used time and time again. Finally, starting from an existing base model means swifter results, as it's no longer necessary to build and calibrate a new model from scratch for each new project.

Wide-area projects that cannot be modeled efficiently at the microscopic level due to the large size of the study area, but that require more detail than that provided at the macroscopic level, can now be addressed using the mesoscopic level. Furthermore, with SimFrame, there is no need to maintain and update separate models with independent networks and databases. ○

• *Goran Nikolic is head of traffic planning at the MTO*

When you think of thermal imaging, it's hard to disassociate the defense, security and law enforcement sectors where the technology made its mark. To the layman, then, although it seems more 007 than ITS, Dan Dietrich, business development manager for FLIR's traffic and ITS division, believes that's all about to change. So to quote the company's own tagline, what exactly is 'the thermal advantage'? "We position it as battlefield-proven technology that has become commercialized," he says. "We've put thermal technology to good use in extremely challenging environments, so for us it was no great leap to transfer this expertise to the traffic sector.

"Our first foray into ITS was in 2010 when an agency in Nevada asked us if a thermal system could help for stop-bar signal detection. But as we've been learning about the traffic market, we've discovered applications in bicycle detection, pedestrian detection, animal-warning systems, and many data-collection duties. For any task where agencies are using an optical camera, a thermal imager is going to perform better as it's unaffected by all the various lighting conditions and weather-related issues that can pose problems."

This actually gets to the crux of the real benefit of thermal cameras: they're utterly impervious to the everyday conditions that so often sabotage their non-thermal cousins. Immune to direct sunlight, night-time headlight glare, reflection from wet surfaces, shadows and light fog, thermal cameras tick many boxes. The knock-on effect of this for a systems integrator is that as a result of the cameras' immunity to environmental factors, they can be placed wherever they'll be most effective – even looking directly into the sun. There's no need for complicated installations or to compromise on detection capability. And as well as placing them wherever best suits the application, FLIR's cameras have a rugged pan/tilt system that allows for complete roadway coverage.

But how do they work? "The thermal technology receives heat energy from all the objects in the scene that are above absolute zero," Dietrich explains. "The easiest way to paint a picture is if you put your arm outside a window on a sunny day, you can feel the heat on your skin but you can't feel

a bright flashlight or a laser pointed at it. That's the same kind of way that our cameras work; they're sensitive like your skin is to heat but they don't see visible light like a laser pointer or a flashlight."

So they can literally see things that other systems can't? "Absolutely. Shadows, for example, are a property of visible light. It's just we don't see the visible light; we don't see the shadow."

On first inspection, then, it seems as if there is a legitimate gap in the market, perhaps confirmed by some industry partnerships already blossoming. "Traficon has really embraced the fact that we can grow and preserve video accounts for them. Traficon has added a mode optimized for thermal cameras to its systems and we're working on a number of projects with their US distributors to use thermal to optimize the performance of their detection systems."

Spreading the word
Dietrich's background is in the security sector, where he was previously managing critical infrastructure projects. So his introduction to the traffic sector has been almost organic, with people frequently informing him FLIR's thermal technology should have been developed for ITS years ago. One of his first big opportunities to meet the ITS community was at the World Congress last year, which saw a steady stream of curious visitors to FLIR's booth.

"Today we have several hundred agencies using our technology, and we're actively deployed in 45 of the 50 states. Those states are using our cameras with whatever video processes they have in place, so every one of those is tied in to either an AutoScope, Iteris, Peek or a Traficon system, for example. As well as that fast growth, our other big news is that we have recently launched a camera series that we developed especially for the ITS market. The FC-Series is a drop-in replacement for legacy video cameras and can run off 110VAC power, output industry-standard video signals, and work with all third-party video detection."

When it comes to replacing 'legacy' equipment, there is always the subtext that the replacement equipment will be vastly more expensive, although Dietrich is quick to dispel this: "Our cameras are actually a

Using thermal cameras for ITS applications opens up a world of possibilities, as **Dan Dietrich** reveals

Interviewed by Nick Bradley

highly cost-effective solution because we're very close in price to the optical cameras; some are more expensive, some less so," the FLIR man says. "But as volumes grow and technology advances, thermal will become even more competitive. We also have a 10-year detector warranty on our cameras, which is almost double the life that you can expect from an optical camera. We're using Germanium optics with our systems that you can't see through, so no lens cleaning is required, which is a big issue for a lot of agencies. Overall, they see the cost saving for maintenance, the cost saving from the life of the camera itself, and the cost saving of not having to go out and continually deal with the optical problems many experience with video detection."

The best of both worlds

Dietrich is not saying that optical cameras have had their day though – far from it. FLIR is in fact working on projects that see thermal and regular optical cameras combined into one. "We have systems that can look a mile out from one location," he reveals. "So if you think about an ITS-type application, they can see a mile from either side of the pole. Consider also an incident detection deployment. If you look at the scene on the freeway, there could be a piece of a bumper, a strip of metal or a dead animal on the road. And if you can't see it in the lane with the optical camera, you would with the thermal camera. That can really increase safety. Several states are using our multisensor optical plus thermal cameras. And the big key driver for them to do that is the ability to see in all conditions." ○

◉ | Growth strategy

FLIR is manufacturing the cameras itself, although how they ultimately wind up on our streets is not your usual 'sell directly or via distributors' tale. "What's unique about us is that we're basically providing an aftermarket product that doesn't do its own detection," says Dan Dietrich. "So we're a drop-and-replacement for the optical camera that people are using with their Iteris, Peek, AutoScope or Traficon system, or the incident management system that they're using. We don't do the detection itself. So if someone says, 'Hey, I've got a problem with my video detection, I'm looking at going back to inductive loops or changing technologies', we can tell them, 'Well, you should actually try using the thermal camera and your problems will go away'. That's how we've grown this market, by inserting thermal cameras where optical technologies were struggling."

> **"Today we have several hundred agencies using our technology, and we're actively deployed in 45 of the 50 states**

Solar cell technology for road studs

Solar powered products have become increasingly popular in the ITS market over the past few years. As the industry has started to prioritize sustainable, environmentally friendly solutions, it is logical that it looks to harnessing the sun's power to achieve these aims.

There is currently a new application for solar power that is causing a surge of interest in the ITS market: solar powered road studs.

One company is driving forward innovation in this field and has already launched the second generation of its solar powered road stud products. Global Solar Vision is a Dutch company that develops and manufactures its entire range in the Netherlands. It recently launched two new models: the GSV 2 Snow Plow and the GSV 4 solar road stud.

The GSV 2 Snow Plow has been developed specifically for heavy-duty roads that have snowplow trucks driving over them. It has an anodized aluminum housing, which protects the surface of the road stud against snowplow blades.

Managing director, Anne Osinga, reports a wide-ranging interest in this product. He explains: "We have customers and installations in the USA, Belgium, the Netherlands, Italy and France. Projects consist of anywhere from 25 to 60 units per installation."

Meanwhile, the GSV 4 has been developed for heavy-duty roads. It has a smoother top cover and is tested with a pressure comparable with trucks of 60 tonnes weight. The GSV 4 has been created as the answer to market demands for road studs that are able to resist heavier load traffic. Its close relation, the aesthetically

(Top) **The GSV 2 Snow Plow**
(Above) **The GSV 4**

Different views of the GSV 4

pleasing GSV 3, is now positioned in the product range as the 'designer' solar road light, which can be installed on vertical surfaces as well. No wonder then, that architects in France have discovered this solar light and used it in walls by the side of the Seine.

Osinga outlines why the industry has been crying out for such a solution: "Our GSV 3 product has a top lens, and is not developed for driving over. We learned that at some installations (roundabouts) cars and trucks are driving over these products, which are often placed under an angle of 45°. For those installations, it is better to have a smooth surface and not a dome-shaped top lens, so that's why we developed the GSV 4. The GSV 3 is perfect for pontoons in harbors, bicycle

pads, roundabouts, and walls. Whereas the GSV 4 is perfect for public squares, roundabouts (with their associated heavy traffic), and pedestrianized areas (with a smooth surface)."

Patented technology

Both new models rely on Global Solar Vision's patented solar cell technology. The competitive edge of this solar technology is that the cells are not serially switched, like conventional solar cells. In the conventional set-up, the battery only gets charged if all the components contribute and if the sum of their efforts is enough. A big problem with the professional application of this technique is partial shading. Leaves, sand, dirt or tire tracks can cover up one or more solar cell segments. This results in a total output that is too low to charge the battery. The same will happen on a cloudy day, when there is too little light to charge the battery. The battery will then be empty after a few days.

Global Solar Vision's innovative technique centers around a single solar cell. This

ⓘ **Need to know?**

Why solar road studs are offering unprecedented opportunities in ITS

> The trend for solar powered solutions is creating new business in the traffic market
> Pioneering efforts from a Dutch company that is an expert in the field of solar cell technology
> Two new products have hit the market: one designed for roads that have snowplows regularly driving over them; the other for heavy-duty roads

means partial shading is no longer a problem. The efficient converter ensures that even small currents are transformed into energy for the battery. This means that even with low light conditions – when the weather is overcast or the solar cell is partially covered – the battery will still be charged. These road studs are designed to maintain light outputs throughout a full annual cycle. And they have a good lifetime too, as Osinga explains: "Based on our experience, the lifetime of the battery in our products is around five years, if the product is correctly installed and not used in conditions for which it is not designed – such as extreme traffic (military tanks, stones on the road, damage caused by vandalism, etc)."

The GSV 4 can be delivered with a wide range of color and intelligence options. The company also produces different materials for the installation, such as metal, hard plastic or alloy housings, depending on the required installation, the material of the surface or the desired design.

But for Osinga, this is only the beginning. "Our R&D team is working on a number of new developments. These include: different housings; higher output from the solar panel to get a higher autonomy; a product for snow/ice detection; and integration of new battery types with higher capacities to get a longer autonomy of the products and/or a higher light output. The future is bright." ○

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I was meeting with the CEO of a major hospital in New York City and discussing a different kind of transportation problem from what I normally deal with. His hospital campus was an amalgam of buildings built over a century and linked by corridors, pedestrian bridges, underground passageways and street-level links. Patients, depending on need, would be transported to operating rooms, radiology units, ICUs and their own rooms. That day we were talking about visitors to patients. How can patients' families find them in this labyrinth? What if the patient's ID bracelet was a GPS device, too? That got me thinking about the concept of person-to-person transport.

In the domain of personal navigation, directions from Point A to B have always been divided by mode of transportation. A street map would only help you drive from one street address to another. A bus map only shows you the bus routes closest to your origin and destination. And while there have been some advances by online trip planners in combining both vehicular and walking aspects to provide a more unified set of directions, they are still restricted to the outdoor street network.

But what if you wanted to find a specific room in a large hospital, the correct platform at a train depot, or a particular store in a shopping mall? Existing navigational technology would be of no help. You would have to hope to find a map of the building or someone to point you in the right direction.

The next logical step in the evolution of personal navigation is the ability to obtain an inclusive set of directions that would take you from where you are standing at any moment to the exact location of your destination, all in real-time on your mobile device. It is a concept I like to call 'complete transportation'. Imagine having navigational directions that not only show you what trains to take and streets to walk down, but also which hallways to turn into, stairways to go up, and doors to knock on.

Two key obstacles need to be addressed before our mobile devices can support complete transportation. The first is accurately finding the position of an individual. At best, today's consumer-grade cell phone GPS technology can pinpoint a device to within 20-30ft of the actual location. Although this may be sufficient for vehicles on a street network, it is far too inaccurate for pedestrian-level navigation. By 2014, however, a new generation of GPS satellites, known as Block III, will come online as part of a US$5.5 billion upgrade by Lockheed Martin. These will increase the accuracy of GPS devices by several times, allowing them to track positions to within 3ft.

The second issue is the ability to provide accurate indoor directions. Even with the impending upgrade to the GPS satellite system, GPS technology is insufficient for precise indoor tracking, especially along the vertical axis. So instead, researchers at MIT are investigating the viability of a concept known as magnetic positioning.

All buildings have a unique magnetic thumbprint created by their steel infrastructure. By using a magnetic sensor array, a person's location can be pinpointed within the building's magnetic field. Once a building has been 'magnetically mapped', navigational directions anywhere within the building can be generated. This technology combined with superior GPS tracking can make complete transportation possible.

There is still a bit of work needed, however, before complete transportation can truly be realized. Magnetic positioning needs to be refined and integrated into mobile devices. Also, cell phone applications need to be developed that can use both GPS satellites and magnetic positioning to generate directions. But as cities expand and buildings are built bigger, the need and demand for more precise directions will grow as well. Complete transportation can fill in the void in existing navigation tools by providing directions not only for the outside street network but indoors as well. Soon, being lost may really become a thing of the past.

What if the patient's ID bracelet was a GPS device, too?

Sam Schwartz, Sam Schwartz Engineering, USA

County benefits from new traffic management system

Montgomery County, Maryland, covers an area of approximately 500 square miles and has a population of about one million people, including many dignitaries who work on Capitol Hill. The county is also home to some of the leading biotechnology companies, corporations and federal agencies in the USA. It has 4,500 center lane miles, more than 1,000 miles of emergency roads, 50 miles of interstate, and 4,000 neighborhood roads. The Montgomery County Department of Transportation (MCDOT) is responsible for ensuring that traffic flows smoothly along all these roadways. To achieve this, the MCDOT must ensure that 800 traffic signals, sensors and surveillance cameras function in harmony, all managed from the county's centralized Traffic Operation Center (TOC).

Challenges

"We've been using a real-time centralized traffic management system since the 1980s," says Michael Kinney, senior engineer at MCDOT. "However, the network was nearing the end of its useful life and the old system lacked the required resiliency. If a single component failed, for example, some or all traffic signals lost coordination, disrupting the flow of traffic."

In November 2009, things came to a head, when there was a system-wide outage, which lasted two days and made national news headlines.

"Commuting in rush hours was significantly impacted and congestion was much worse than normal during all hours of the day," explains Kinney. "In addition to the inconvenience to commuters, ensuing traffic jams wasted gas, resulting in unnecessary CO_2 emissions. It was time to replace the county's traffic management system."

However, upgrading to a modern system had to be achieved within the available budget. Fortunately, the county already had a communications infrastructure of twisted-copper covering hundreds of miles. The MCDOT had also made an ongoing investment in building a fiber ring, so any upgrade to the system had to make use of available resources and re-use this existing copper and fiber.

Montgomery County's traffic cameras, intersection controls and other elements of the traffic management system are operated by just 17 employees. Since 1980, the MCDOT has doubled the number of intersections and added 200 cameras. The number of personnel, however, remained constant, resulting in a high workload. A key specification for the new system was a reduction of the number of trips that employees had to make to manually adjust signal controller timings.

The MCDOT undertook a thorough analysis of the current traffic management system and available solutions. It developed a two-year and a six-year plan, and set a deadline for retiring the old system by 2012.

The right solution

After a thorough analysis and evaluation of several systems from a variety of vendors, the MCDOT selected Silicon Valley-based Actelis to build a network that comprised the county's new intelligent traffic system.

The Actelis system met the MCOD's specific technical and operational requirements, including the ability to function and maintain integrity in cold and hot weather, rain and snow,

Need to know?

The MCOD required a modern, robust traffic management system that could meet a number of requirements

> Must eliminate single points of failure
> Must re-use existing copper and fiber infrastructure
> Upgrade could not involve freeways or roadways being closed for extended periods
> Must not require additional staff or resources
> Must be compatible with battery back-up and UPS
> Must be standards compliant and IP capable

and even after lightning strikes, as a result of its environmentally hardened ML624i and ML688 Ethernet Access Devices (EADs).

The EADs had to be able to bond multiple pairs of copper to deliver the necessary bandwidth to communicate with the controller and provide the required redundancy. Unlike other solutions evaluated by the MCDOT, if one pair failed, the network connectivity would not be lost using the Actelis solution.

The equipment is also compatible with Internet Group Management Protocol (IGMP) snooping, meaning it can logically segregate network traffic between the units and the controller, enabling more efficient bandwidth management.

(Left) **The ML2300 Switch** (Below left) **The ML624i Ethernet Access Device**

The EADs and aggregation switches support both GigE fiber and high-speed Ethernet-based copper interfaces, meaning that Montgomery County's fiber ring is connected to Actelis equipment on one unit, while copper is used to connect the equipment to the signal cabinets.

The new equipment supports VLAN tagging, which allows separation of different streams of traffic. This ensures that traffic from signal controllers follows a different virtual path than a stream of traffic for WiFi access. MAC address filtering and IP access control allow Montgomery County to prevent unauthorized access to the network. In addition, support for Secure Shell (SSH) enables strong authentication

and prevents malicious attacks such as IP spoofing, IP source routing and DNS spoofing.

The MetaASSIST EMS is a Carrier-class distributed element management system (EMS), which enables the Actelis product family to integrate smoothly into existing network management systems via standard interfaces. It also enables centralized real-time planning, provisioning, monitoring and management of networks of multiple systems. The MCDOT uses the combination of these systems to collect data, report on SLA performance and troubleshoot hundreds of network elements across a large geographical area.

Results
The final topology of the network leveraged a hybrid communication network using fiber to create a ring and running laterals to the traffic controllers. The centralized command and control system enable the county to build timing plans that can be used

well into the future. They also enable technicians to make signal timing adjustments – up to 60 times a day – to fine-tune the signal timing to account for accidents or roadworks.

"A practical application of this capability is if a traffic incident takes place on I-495, I-370 and I-270 (three major highways running through the county) as well as on any of the surface streets, TOC operators can quickly divert drivers to side roads and enable traffic to continue flowing smoothly," says Kinney.

Montgomery County is well on its way to achieving its goal of retiring the old signal system in 2012. With 850 network elements installed, it has not encountered any significant issues with the equipment and the solution has proven to be very reliable.

Even though the DOT's 17 traffic technicians are still very busy managing traffic across a large county, the new network has not required additional staff. In fact, the MCDOT reports

that the resiliency of the new equipment and its ability to automatically recover from outages has reduced the burden placed on technicians.

Future plans
Montgomery County's TMC has become a model for implementing the right traffic management solutions. It regularly hosts tours for various cities, counties and DOT representatives to demonstrate how it has successfully upgraded legacy systems while making optimal use of the existing network infrastructure and human resources.

The success of this first phase has led to plans to increase safety and reduce public transportation journey times by instituting transit signal priority, giving buses extra green light time. Since the upgraded network can carry much higher volumes of data, the DOT is exploring the potential to replace school flashes currently operating with time-clocked devices that need manual adjustments every time the schedule changes, with ones that can be managed over the network. It is also looking into enhancing the capabilities of the network by installing sampling devices to detect traffic volume and speed.

"The ability to install and auto-manage the network allows the traffic engineers to focus on their core competency: improving the overall efficiency and effectiveness of the county's traffic system," adds Kinney.

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Building camera-optimized license plates

Automatic license plate recognition (ALPR) cameras are a powerful tool to enhance road safety for toll roads, law enforcement, and other critical transportation applications. Due to the value they deliver, ALPR cameras are experiencing extremely high adoption rates and the trend will likely accelerate over the next few years. As camera adoption increases globally, it is important to remember that the camera is only one element of capturing a high-quality, usable license plate image – the other, more critical element, is the license plate itself. 3M is at the forefront of developing highly camera readable technologies that can optimize image quality in the infrared spectrum while maintaining the appearance of the plate under normal lighting conditions. The result is a license plate that meets the needs of plate specifications bodies (DMVs or ministries of transport) while also optimizing violations processing systems for ALPR users.

Plate readability varies between states and countries, which can confuse ALPR cameras. For example, many US states use high graphic content and/or low color contrast between the alphanumeric symbols and the background, making the plates difficult for ALPR systems to decipher. Highly graphic plates are important to license plate specification agencies as specialty license plates are a source of state identity and pride as well as an important revenue generator. European license plates, on the other hand, tend to be fairly readable due to the limited graphic content, size, fonts and high color contrast used on the plates. Yet issues exist as some countries' plates

(Above) **Barcode plate image taken in diffuse room light** (Left) **Image taken in infrared. Visually inconspicuous barcodes appear under infrared**

ⓘ | Need to know?

Accurate ALPR requires license plates that are both recognizable and verifiable

> ALPR relies upon the plate itself as much as the imaging system
> The trend for ALPR is not going to decrease, so efforts must be made now to ensure the LPR has a better chance of reading the plate
> Increasing contrast on the plate is one helpful solution
> The great potential of barcodes to help verify plate readings

(Top) **Standard image taken in diffuse room light** (Middle) **Non-optimized plate taken in infrared** (Left) **Optimized plate in infrared. Increasing alphanumeric contrast in the infrared increases readability**

are functionally identical, which makes it difficult to properly identify out-of-country vehicles. Asian and Middle Eastern characters can be difficult to read for some ALPR systems that were initially developed for Western markets. Knowing that materials have an important impact on license plate cameras, 3M is working closely with leading camera companies to develop solutions that meet the needs of all stakeholder groups.

Meeting the challenges
3M researchers are tackling the readability problem in two parts. First, they are experimenting with increasing contrast between the alphanumerics and the background graphics used on license plates. This helps the infrared cameras better distinguish plate numbers from background images, eliminating one of the major causes of low quality reads.

However, simply making the plates more recognizable does not fix the entire problem. Results still need to be checked for accuracy, so the team is developing visually inconspicuous barcodes that can be added to plates, which are extremely visible in the infrared wavelength. These codes improve accuracy by leveraging the 'self-check' attribute of barcodes, which dramatically increases confidence levels associated with the read, minimizing the need for manual review. To address motorists' privacy concerns, only data that is already visible on the plate (alphanumerics, state and plate type) will be embedded in the barcode.

ALPR camera accuracy is improving and is emerging as a viable vehicle identification technology, which makes plate readability increasingly important. Standardizing barcodes across geographies will theoretically make all plates equally readable, regardless of design or jurisdiction of issue, and will dramatically increase plate read accuracy to reduce crime and/or increase revenue generation, depending upon application.

To handle all the data generated by the new barcodes, 3M has drawn upon its experience developing motor vehicle systems enterprise level software implemented by numerous DMVs in the USA. Being well versed in modernizing DMV records management applications, 3M can enable the automated records look-up necessary for efficient enforcement operations. Together, these technologies will vastly improve ALPR systems, leading to fewer errors and increased efficiency.

Security, visibility, safety

As the trend in automated camera enforcement accelerates, it will be imperative to design licenses plates with ALPR reading in mind. 3M technologies will enhance the ALPR process to increase public safety, improve the violations process, and increase revenues, all while maintaining the visual appearance and high graphic content prized by DMVs and global vehicle authorities. ○

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A few months ago, I got an email from the editor asking me to write this column in *Traffic Technology International*. I was flattered and humbled but it was not clear to me that I had enough of value to say (and surely not every few months), so I consider this an experiment. If I can make a contribution to this industry and you all can benefit in some way from my thoughts, we're good. But if you would rather golf, then I'll just join you! So here goes...

In the 1970s and well into the 1980s, we had a few mainframe computer-operated signal systems and landline telephones. When, in the 1980s, an LNG tanker truck sprung a leak on the George Washington Bridge, the New York area went into gridlock because all the agencies had were landlines and they were not quick enough to get ahead of the unfolding traffic nightmare. As the computers got smaller and easier to program and wireless service began, the traffic engineers started to dream about how the new technology could be applied to transportation.

They dreamed of desktop computers running signal systems. They dreamed of traffic control centers with incident detection and video coverage. They dreamed of providing real-time traffic information to drivers; of seamless payment for transit and tolls; of a safer, seamless surface transportation system. They created the technology and institutions to support the dreams. ITS America was born. And they talked to each other endlessly at meetings and conferences. They bewailed the fact that their local policymakers did not get 'it' and they struggled to achieve some modest level of funding for early deployments.

There were heroes in the early days who risked their careers for these high-tech solutions, and I hope to write about some of them in future columns (assuming there are future columns!), but in this edition I want to talk about our biggest failure then… and even now.

It is fair to say that at the beginning, ITS technology was a set of solutions looking for a problem. Engineers with PCs and wireless services developed some marvellous, innovative solutions – but the leadership of the local transportation departments, their engineers and planners had not connected their problems with our solutions. That was the hallway conversation at all of the early meetings. How can we get management to use our stuff? How can we get police, fire and emergency services to see the value of this technology?

The people defining the problem and the folks designing the solution were not one and the same. Since then, a generation of leadership has grown up with instant wireless data communication. The local transportation leadership and their planners and engineers are more familiar with what we do but we have yet to fully bridge the gap.

Transportation planning departments are where the problems are defined and where solutions are explored. Engineering departments are where the big projects are developed. The early planning and design phase is where ITS must be included. Indeed there are some federal requirements and some agencies that accomplish this, but we need to be clear that the problem drives the solution and not the other way around. We need to be the vital force in the transportation community and not expect the community to join with us.

❝ As the computers got smaller and easier to program, the traffic engineers started to dream about how the new technology could be applied to transportation

Larry Yermack, Wendover Consult, USA

Greener technology for VMS solutions

With highway authorities working to reduce greenhouse gas emissions and some even considering carbon neutrality, it's important that traffic solution suppliers develop products that contribute to these goals. Ultra Low Power (ULP) is one technology that's designed to help reduce environmental impact on the world's highways.

Developed by Aesys as an energy-efficient VMS solution, ULP reduces total energy usage by over 80% when compared with standard solutions. This substantial energy reduction allows ULP-powered VMS to either reduce the amount of electricity needed from a traditional conduit or use a battery and photovoltaic panel for complete energy autonomy.

ULP has been less of a sudden 'green revolution' and more of an evolution of technologies. Back in 2005, Aesys began using more energy-efficient LEDs and was able to implement a driver sleep mode to cut off power to unused LED boards. This solution, called Low Power, delivered about 40-50% energy savings compared with earlier solutions.

By 2010, LED technology had increased further in energy efficiency and the R&D team was working to enhance the display's internal power management. Project leader Stefano Ivaldi says: "We knew that power supplies were using a lot of energy in the VMS, so we were able to cut them out by devising an innovative driving method. That gave us an efficiency of over 80% and a strong reduction of dissipation."

Even with reduced internal power consumption, the brightness is as high as ever. ULP-powered VMS have an optical performance that is in

Need to know?

The role of ITS suppliers in developing sustainable VMS solutions

> In the VMS sector, green technology has evolved over the years – today it is more impressive than ever
> Ultra Low Power (ULP) is a method that has been designed to achieve significant energy savings when compared with traditional solutions
> Energy autonomy opens up a further range of applications for VMS: power supplies are no longer a hindrance to VMS deployment

complete compliance with the EN 12966 standard. Also, by adding a battery and photovoltaic panel to the standard electrical line, the VMS is immune to the risk of an electrical blackout. In addition, the improved efficiency of the electronics management allows for fanless cooling and regular maintenance to clean or replace the fan filters can be avoided.

With energy autonomy, it is even possible for ULP-powered VMS to be installed in places where it was previously not possible to run a power line. Delivering important information to drivers does not have to be compromised because of a lack of power.

While higher energy efficiency does come at a higher cost than standard VMS solutions, depending on the installation conditions, the added cost can be immediately eliminated. For deciding if
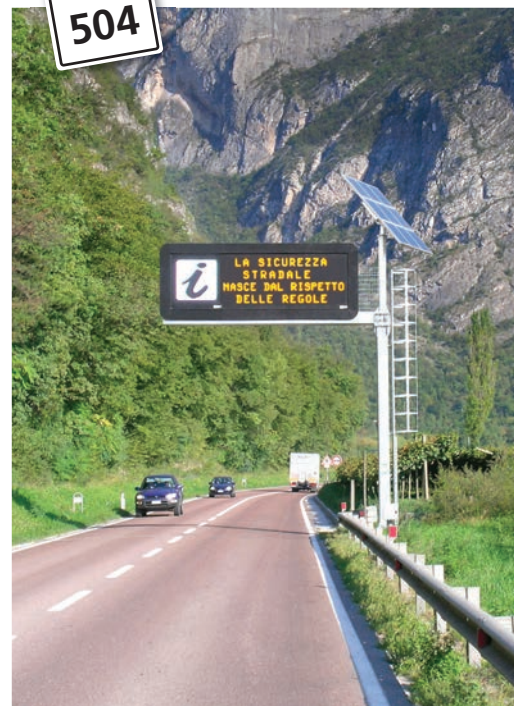
Aesys offers a range of green VMS solutions

ULP-powered VMS are the right choice, Aesys can calculate the meters of power line excavations that must be avoided for the cost to be in line with a standard solution. After the calculated excavations have been avoided, the client is left with the future energy cost savings and the goodwill that comes from an environmental initiative.

Reducing emissions

Beyond reducing greenhouse gases created by powering VMS, dynamic LED toll gate signs can be used to reduce congestion and queuing at toll plazas – where idling engines create excessive emissions.

Aesys has been involved in many types of toll gate sign implementations. LED pictogram signs are used to show the method of payment available in a given lane. In Greece, a display above each lane can show one- or two-color

pictograms. An arrow-cross display below shows whether the lane is open or closed.

In Ireland, there is a sign solution using an LED panel with five unique sections, each one designated for a different payment pictogram. There is also an LED matrix for showing if the lane is manual, automatic or closed. In addition, a set of displays is used to differentiate the lane reserved for ETC.

Finally, a Costa Rican project uses a solution that combines two lines of text to show the type of vehicle and payment types accepted, along with an arrow-cross sign to show if the lane is open or closed. ○

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505

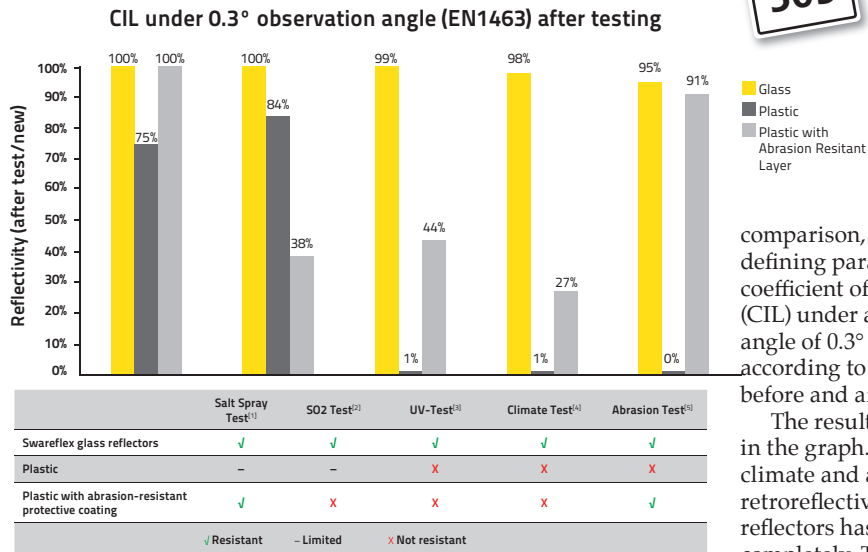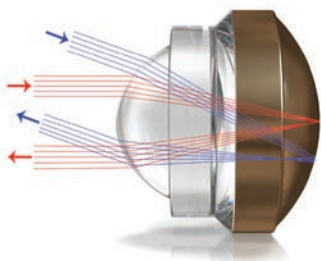The continuous expansion of the road network and the associated growth in maintenance increases the need for highly durable reflectors. The currently available types of horizontal and vertical markings are based on two different types of retroreflection, the corner cube principle and biconvex lenses. The former is used for most of plastic reflectors and the new generations of reflective sheeting.

Swareflex reflectors are based on biconvex glass elements made of very robust, highly transparent Swarovski glass. Thereby, the incoming light is focused on an almost spherical mirror surface. On this highly reflective mirror the light is reflected back to the entrance surface, where an additional refraction guides the light into the direction of the source. To ensure that this retroreflecting property is working for a wide range of entrance angles (from -40° to 40°) the geometry of the glass body is precisely designed by ray tracing programs.

Along its path through the glass the incoming light is colored with color particles inside the glass volume. These particles are part of the glass structure and conserved in a way that the color of the retroreflected light is fully retained over decades.

Among all the reflector products, road studs used as lane dividers have to withstand the worst conditions and

CIL under 0.3° observation angle (EN1463) after testing

Legend:
- Glass
- Plastic
- Plastic with Abrasion Resitant Layer

	Salt Spray Test[1]	SO2 Test[2]	UV-Test[3]	Climate Test[4]	Abrasion Test[5]
Swareflex glass reflectors	√	√	√	√	√
Plastic	–	–	X	X	X
Plastic with abrasion-resistant protective coating	√	X	X	X	√

√ Resistant   – Limited   X Not resistant

ℹ | **Need to know?**

Glass reflectors have proved popular for more than 60 years and this is set to continue

> Retroreflectivity is achieved by biconvex glass lenses
> Along its path through the glass the incoming light is colored by absorption inside the glass volume
> The color particles are part of the glass structure, therefore the color of the retroreflected light does not degrade for decades
> Glass reflectors withstand extreme environmental impacts over decades

(Top) **Graph showing reflector durability test** (Left) **Principle of retroreflection: beam projection in biconvex glass element**

therefore have the highest requirements for durability. Beside the abrasion caused by several thousands of run-overs per day, these products are exposed to aggressive chemicals such as SO_2 and salt spray, face a large UV impact and have to work in a temperature range of -30°C up to 80°C on the asphalt.

In addition to the material resistance, the long-term stability of the photometric performance is essential. The photometric requirements of road studs are defined in the European standard EN 1463-1. This distinguishes between three different types of studs due to their reflector material: plastic; plastic with abrasion-resistant layer; and glass.

For an objective durability comparison, samples of all three types were tested for resistance against salt spray [1], SO_2 [2] and UV impact[3]. Swareflex also defined a climate[4] and an abrasion[4] test according to real environmental[5] conditions.

To ensure a reliable evaluation, a standardized parameter is used. For this comparison, the quality defining parameter is the coefficient of luminous intensity (CIL) under an observation angle of 0.3° measured according to EN 1463-1:2009-03 before and after the tests.

The results are summarized in the graph. After the UV, climate and abrasion test, the retroreflectivity of the plastic reflectors has vanished completely. The plastic studs with abrasion-resistant layer performed well after the salt spray and the abrasion test, but suffer a lack of retroreflectivity after the remaining tests. None of the test conditions have a significant impact on the photometric performance of Swareflex glass reflectors. ○

References

[1] *Salt Spray Test acc to DIN EN ISO 9227:2006-10*

[2] *Kesternich Test acc to DIN EN ISO 6988*

[3] *UV-Test acc to DIN EN ISO 9022-9*

[4] *Climate test: 72hrs – 92% humidity/60°C; 24hrs – 80% humidity/80°C; 72hrs – 92% humidity/60°C*

[5] *Abrasion test: specimen fortified on the inner surface of the test vessel – abrasion medium: 1 liter of loose gravel, size 4-8 – 1 cycle: 30rpm (5hrs), after 2.5hrs change of the rotation direction – tested for 1 cycle*

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Test drive on Vienna's busiest highway

Although road traffic produces more than 18% of the greenhouse gases in the EU, only 0.5% of the CO_2 emissions come from European rail. Across Europe, traffic jams cost about 1.5% of the GDP every year. These figures emphasize the necessity for adaptive and modern traffic management in urban environments. In the past 10 years, the Austrian Ministry of Transport, Technology and Innovation (BMVIT) has invested around €100 million in developing modern mobility technologies. "After 15 years of research and development, the task now is to bring ITS into the real world – to bring it to transport users and the transport business," says transport minister Doris Bures.

When well-known companies work together rather than competing, there is usually something big on the way. Together with Austrian road operator ASFINAG and the federal ITS agency, AustriaTech, illustrious names such as Kapsch, Siemens, Swarco and Efkon are working together on the implementation of

(Above) **Real-world traffic conditions can be delivered in-vehicle** (Right)
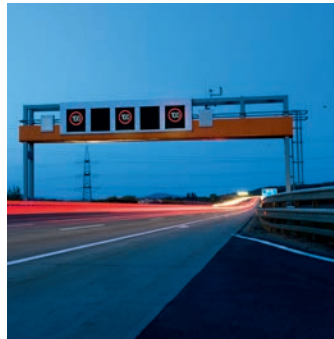
Existing on-road ITS information services will be fed to mobile devices

At ASFINAG's HQ data from both mobile and roadside sources will be collated

ⓘ | Need to know?

Testfeld Telematik's innovative, collaborative approach to cooperative mobility

> Showcasing the progress that occurs when leading names work together instead of competing
> A unique Austrian project that is deploying the latest ITS services to improve the flow of information between vehicles, roads and indeed other modes of transport
> Embracing modern communications tools such as smartphone apps and the use of tablets to disseminate real-time information

cooperative systems in the Testfeld Telematik project. Further project partners are TomTom, Bayrische Medientechnik, Audio Mobil, ITS Vienna Region, HiTech Marketing and Fluidtime. The €5.5 million project is funded by the climate and energy funds –

an important federal initiator for sustainable technologies.

Multimodal approach

The test route in the urban areas of the Austrian capital Vienna includes Austria's busiest road, the A23 motorway. Within this project, numerous ITS services feeding from the live systems working on this route are being tested and displayed on different mobile devices, including accident and traffic jam warnings, information about roadworks, and the display of road signs inside the vehicle. In the context of better road management, another project goal is to encourage people to use public transport more often. Therefore the recommendations also incorporate detailed information about the location and current occupancy of Park & Ride facilities. This allows the stimulation of modal shift.

Once the system is open to the public, there will be several possibilities for users to participate. You can download an app for your smartphone or use a PND. Another 100 test users will receive real-time messages and information on tablets and about 3,000 people

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I sometimes write about autonomous smart cars, and at other times I write about connected smart cars. I've written about smart transit systems, where the smart component is a dynamic transit trip planning aimed at the traveler. However, to this point, I have yet to write in earnest about or extolled the benefits of smart vehicles in the aggregate – across all road types, vehicle classes and transportation system users. That is, I haven't written about the real integration of applications, transcending smart cars, smart roads or even smart travelers. Given ubiquity in connectivity and used correctly, there could be a smart transportation system, communication could enhance and therefore embrace significant safety, mobility and environmental data and information. Not only would real-time information be disseminated, but analytics performed on past information and then fused with real-time information would provide information about the state of the transportation route and indeed the system in the future. This would of course enable travelers to make choices based on optimizing their own travel start times and routes.

But there's much more, and in this case that "more" is the roadway operator. Consider the possibilities in revolutionizing system management, to including routing and pricing strategies – where within the limits of traveler acceptance and understanding, high fidelity spatio-temporal decisions could be made to change (and perhaps by pricing) routes, whether trips are taken and modes the trips may be taken in. The traveler could have the door opened to, or at least a certain door encouraged, for him or her to travel at a certain time, within defined modes and perhaps to even travel at all. The greenhouse gas attainment authorities could be able to regulate travel to manage perhaps regional objectives in meeting targets. And finally, the system operator could truly balance demand to provide the best possible quality of service over time interval(s) of choice.

There have been some interesting but still incipient ideas. These include the idea of congestion or cordon management, where progressive transport into 'bullseyes' or city centers can be regulated; the idea also of integrated speed assistance, where throttle is strictly regulated; and the idea of connected vehicle safety, where short-range car-to-car communication ensures that in the near field there may be a type of virtual bumper, providing warning, then as necessary active braking to keep the driver safe. Now, imagine all the above, combined to give benefit to all entities involved in transportation operations, to of course include individual users but on the aggregate, to consider an optimization of a variety of participants.

Imagine the result: if you traveled, you would be given pre-trip or en route and even lane advisories, some type of dynamic pricing – to even include a metered type of insurance payment – such that the when and the where of your trip could be affected. Governments could effect transportation policies that could be aligned to road use by time of day, class or vehicle, emissions or other primary criteria, and the now-ecumenical connected vehicle world would be multi-modal, transcend operational or agency restrictions but still, overall, would be quite personal and customizable. It would indeed be a smart way.

are planned to use the smartphone app. But the hardware will not only be utilized to provide content to the users, it will also anonymously collect relevant vehicle and environmental data. At ASFINAG's headquarters, the data from both mobile and roadside devices will be used to generate an integrated picture of the traffic situation in the urban area.

Project in context
Austrian scientists and project developers have been researching multimodal traffic information and cooperative systems in national and EU-funded projects for years. Testfeld Telematik builds upon the knowledge acquired so far and incorporates insights from ongoing projects such as Verkehrsauskunft Österreich (VAO), GIP.at and GIP.gv.at. The aim of VAO is to create one inclusive and unified database for transport information services for the whole of Austria, which can also recommend multimodal routes.

The transport infrastructure data platform known as Graphenintegrationsplattform (GIP) will represent the first high-quality intermodal traffic graph of Austria. The first version of VAO is planned to be available for the 19th ITS World Congress, taking place in Vienna from October 22-26. Testfeld Telematik will be open to congress delegates and visitors, and initially tested on October 22. ○

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" The traveler could have the door opened to, or at least a certain door encouraged, for him or her to travel at a certain time, within defined modes and perhaps to even travel at all

Jim Misener, executive advisor, Booz Allen Hamilton, USA

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Modern traffic management

The catchphrase 'It's the economy, stupid!' was made famous during the American Presidential election of 1992. The same phrase applies to the vital role of ITS in keeping people and goods flowing.

Many factors affect the flow of traffic. An accident can cause considerable disruption to traffic flow – as all of us have experienced. Many accidents are caused by speeding, and the role of ALPR-based speed cameras in reducing such accidents is well known.

Damage to the road structure – often caused by overweight vehicles – leads to costly repairs, detours, and extended delays. Overweight vehicles can be identified using road classification loops and gantry scanners, often in conjunction with weigh-in-motion (WIM) sensors.

Unintended obstructions can create short-term delays as drivers move to avoid them. Obstructions such as debris, stationary vehicles, and pedestrians on major roads can be seen by fixed radar systems.

Poor information about hazards ahead can lead to uninformed drivers adding further to the delay. VMS can be used to warn of problems ahead, aiding traffic flow and reducing accidents.

All of these methods of improving roads and road use, including the financing of roads via tolls, would be impossible without the use of ITS.

To manage the data flow, switches and serial device servers that are able to cope with wide variations of temperature (from -40°C to 70°C) and still function flawlessly are needed. Products with a high degree of redundancy are essential, whether it is the ability to

Some of the Satyrn range of smart switches

READER ENQUIRY NO. **507**

ⓘ | Need to know?

The crucial (yet not always acknowledged) role that managed switches play in ITS

> ITS helps keep people and goods flowing smoothly: when obstructions occur, they need to be managed appropriately and fast
> Communications technology is the backbone of ITS operations
> PoEand PoE+ switches are valuable for traffic cameras
> 3G routers are increasingly used to carry data independently of the main network

recover when one path is broken or to send data to multiple hosts. Many peripherals, such as cameras, require power-over-Ethernet (POE) and POE+ options to power them. Other systems must send large volumes of data across long distances and electrically noisy environments, so 10/100 and Gigabit Ethernet fiber is needed.

Intelligent switches
In-road equipment such as road loops, vehicle sensors and WIM sensors are often serial based, so a serial-to-Ethernet unit, such as the Satyrn S2E-042-BR with four serial ports and two Ethernet ports, one that uses POE for power, is ideal for collecting data and sending this to the traffic control center. POE and POE+ switches, such as the Satyrn M082-PC, (eight fully-managed POE ports with two Gigabit uplinks), and the Satyrn L042-PP (four light-managed POE ports with two SFP uplinks) are used for ALPR and general surveillance cameras. If the cameras are non-POE, the switches are intelligent enough to sense it and not provide power from that particular port.

In a number of applications, the data cables will need to be placed in the same cable tray as the power feeds. In this case, fiber feeds need to connect the switch and the roadside cabinet to prevent the problem of data corruption.

3G routers, taking data from systems and transmitting that across the GSM/GPRS network, are increasingly being used to carry data independently of the main network, in remote areas without any Ethernet infrastructure, or where laying cables is prohibitively expensive. The latest 3.5G cellular VPN router in the Satyrn series (Satyrn C-011-EN) is ideal for this role.

The connection between the gantries is often controlled by larger, fully-managed switches with copper and fiber Gigabit capability. Typical examples might be the Satyrn X168-CQ with 16 Gigabit combo ports and eight Gigabit SFP modules, or the Satyrn X244-TQ with its 24 copper gigabit PoE+ ports and four Gigabit SFP ports that make it ideal for large camera clusters of the sort found at toll plazas.

We all rely on ITS for our day-to-day traveling lives and keeping the economy moving. This would not be possible without the high-availability managed switches discussed here. ⚪

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Philosophy defines distinctive cable package

An expert in the cables sector has designed an innovative package for traffic and mobility applications, made using high-performance plastics and providing a high degree of water resistance and mechanical strength.

The Dutch manufacturer, Eldra, is well-known in the Netherlands and has also proven itself internationally by promoting a philosophy characterized by its approach to technical, environmental and practical aspects.

Eldra is part of the TKH Group and specializes in the manufacture and supply of cables for various niche markets, including the infrastructure market. In collaboration with contractors, consultants, and national and regional government bodies, the company continuously develops innovative products in its own R&D center. Using the right cable for the right purpose is no longer as simple as making a choice from a standard catalog. It goes without saying that regulations, standards and system requirements have to be complied with, but budgeting and social interests are just as important: clients work with public money and corporate social responsibility is high on the agenda. Eldra uses this knowledge not only in its own production process, but also in ensuring the recyclability of its products and the use of halogen-free plastics. Each customer has specific requirements for sustainability, reliability, safety and quality, and Eldra is able to meet these varying needs as a result of its versatile Eldtraffic cables. Moreover, the quality norm for Dutch cables is more stringent compared to standards in other countries due to the

Need to know?

A range of cable solutions that have particular benefits for traffic applications

> A well-known Dutch company is also proving a hit in the international cable market
> How stringent requirements in the Netherlands have helped to create a range of cables that can cope with all environments
> Smart solutions such as double-walled cables are popular choices for traffic management tasks

Eldra's cables are used in a variety of traffic management applications

difficulties posed by working in the unique Dutch soil types. Eldra's halogen-free, recyclable cables contribute to this high standard.

Inductive loop cables

The Eldtraffic product range originates from inductive loop cables. A major issue with inductive cables has always been poor durability and high maintenance requirements. To deal with this issue Eldra has developed an inductive loop that is resistant to heat, water drainage and movement in the road. Vibration in the ground will eventually cause copper wire to break. For this reason the company developed a double-walled cable where the outer wall is affixed to the road surface and the interior is free to move, eliminating the likelihood of fractures. Traffic enforcement specialist, Gatso, recommends these cables and has certified their reliability and durability.

Traffic control installations

Eldra's complete cable package is color coded, which means it's also suitable for use in traffic control installations because it's instantly visible which cable serves which function. Outside the Netherlands, it's typical to see a bunch of tangled gray cables snaking along the side of the road. Color coding considerably simplifies maintenance. This system has proven so efficient that it is now the official norm in the Netherlands and it has been certified by testing and certification body KEMA. The certification proves the quality, safety and reliability of this sophisticated halogen-free cable. Eldra also works closely with suppliers to develop their system ideas into new products. For example, the company has developed specific solutions for LEDs in traffic control installations using EMC shielded cables, vastly reducing the number of shortages.

The company has worked together with Traff-ISS (Innovative Sustainable Solutions) to develop a new type of cable: the Saddle, which stands for Sub-asphalt Dynamic Detection Loop by Eldra. The cable is attached by means of a mat to the base layer, upon which the asphalt can be applied directly. The material is heat-resistant and durable. The advantage is that it is no longer necessary to cut into the asphalt. This eliminates weak spots in the asphalt. Furthermore, there is no need to use asphalt cleaner. Less maintenance is required, which saves costs. Working with Saddle cables means that projects are finished faster and on a lower budget. ○

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Cooperative Vehicle Highway Systems (CVHS) focus on sensors, telemetrics, intelligent driver override, roadside computation, telecommunications, emergency technologies, and so on. The stress is on technological solutions that address a problem with a large social and human component – e.g. human safety, congestion, efficiency, and reliable automobility.

CVHS's goals form a virtuous circle: reduce accident counts and severity and improve the performance and efficiency of existing transportation infrastructure while reducing fuel use, emissions, and congestion. These are a lot of wins.

In general, when thinking about CVHS, we see two components: vehicle and roadside infrastructure. Also key are intelligent communications between car and roadside, many-to-many pair-wise communications between proximate cars, and of course communication among all of these and the cloud. But there is another critical and elusive component – the driver. I'll return to this.

CVHS is highly related to the Connected Vehicle, and sometimes the distinction gets blurred. I see them as two adjacent phases on a continuum as we equip vehicles, roadways, and communication networks for the Connected Age of Automobility already underway. The Cooperative Vehicle is focused on safety and driver assistance, while the Connected Vehicle is focused more on driver information and trip assistance, including infotainment and payment services. But, a portion of the enabling fabric can be shared.

A key distinction is that many Cooperative functions involve intrusive control – generally braking and steering – when the driver is perhaps distracted or not responding appropriately. Meanwhile, some Connected functions have the potential to contribute to the distraction problem that is one of the key motivators for the Cooperative functions.

All of this makes the human a mystery component. Will the net benefit make us safer? Will automation make our species' driving skills atrophy? Will anyone be able to parallel park in 30 years?

A well-reported phenomenon called risk compensation tells us that drivers tend to invest a perceived increment in safety by driving a bit faster or a bit more aggressively. Humans seem to have a risk budget they are eager to spend.

Surely, if one begins to trust that their vehicle can handle breaking and steering, the use of infotainment systems and gadgets (Connected or not) will be perceived as safer. And that may not be a problem in most cases – we hope. But how good does Cooperative technology have to be before Connected technology will not make us less safe?

There are liability reasons ensuring that Cooperative technology will likely never be installed as an aftermarket upgrade, unless by the original manufacturer. And there will clearly be resistance to letting the car 'take control' from a driver. Could aftermarket warning systems that beep rather than brake, or whistle rather than steer, be the way to erode that resistance? Could aftermarket Connected Vehicle platforms be the evolutionary link that gets the Cooperative Vehicle onto dry land? I think so.

We also know from experience that mandatory safety equipment requires user acceptance, which in turn implies slow introduction and consumer-led market penetration prior to mandate. This may be the best reason that aftermarket Connected Vehicle technology that has at least some Cooperative-like functions will the best accelerator to Cooperative Vehicle evolution.

> Could aftermarket Connected Vehicle platforms be the evolutionary link that gets the Cooperative Vehicle onto dry land?

Bern Grush, principal, Bern Grush Associates, Canada

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Advanced camera triggering

One of the key demands we ask of traffic-monitoring cameras is that they get coverage exactly when it's needed, while ignoring the vast spans of time when nothing is happening. A number of features can help system developers to ensure that the traffic-monitoring systems they design will – without fail – document violators every time. These features include auto-brightness, image compression, lens control, and wide dynamic range.

As well as the abovementioned features, Teledyne Dalsa has also added a new capability to its Genie TS range of cameras: pre-triggering of image acquisition.

To illustrate how pre-triggering might be used, consider the following scenario: a daily commuter is late for work. Every morning he seems to get caught by a red light at the same intersection, where he sits watching an empty cross street. This morning, however, as he approaches the intersection and sees the light turn from green to yellow to red before he reaches the stop line, he decides not to stop.

He's already slowed down while approaching the stop line under the yellow, but instead of stopping he accelerates in an attempt to reach the intersection before the light turns red.

It is too late, however, and the light turns red before his vehicle crosses the stop line.

An oncoming driver begins resuming speed when she sees her light turn green as she approaches the stop line. Then she is startled by the violator crossing the intersection under full acceleration and has barely enough time to slam her foot on the brake pedal. The whole incident lasts two seconds.

The latest Genie TS cameras now offer pre-triggering of image acquisition

ⓘ | Need to know?

The latest advanced features are enabling traffic cameras to be truly effective

> When you don't know you need an image until it's too late, you need pre-triggering
> The conflicting demands we ask of traffic cameras: that they document every violation that occurs while ignoring all the time where nothing happens
> How a pre-triggering feature can ensure that every single violation is captured while images in which nothing happens are automatically discarded

Dilemma for traffic system designers

This type of situation poses a dilemma for the designer of automated traffic systems. The intersection may have been quiet for several minutes before the violator's arrival, and nothing might happen again for another several minutes. There may not be another violation for hours. Yet, to document the violation, the system would need to have captured images of the violator's movements both before and after the event. Some traffic cameras are free-running, capturing tens of thousands of worthless images to be sure of capturing the two or three needed to document a violation.

A better configuration would be to install Genie TS cameras overlooking each oncoming traffic lane. Each camera would be programmed to acquire frames continuously, and although most of those frames would show the same, empty stretch of roadway, the camera would be programmed to automatically discard images in which no events occur.

Automatically better

With its pre-/post-trigger capability, the Genie TS camera can monitor a potential violator's lane and automatically select multiple frames taken a fraction of a second apart. The useful images would show the vehicle approaching the stop line at speed, when it should be coming to a stop, and another image would show the vehicle after it has just passed the stop sign. With the license plate clearly visible in all useful frames, along with the timestamps on the images, and the (calibrated) distance the vehicle moved between frames, the system can automatically calculate the speed of the car, document that it did not stop for the red light, identify the vehicle, and even show the driver's face behind the steering wheel. The system can thus capture enough information to issue a citation, while discarding any images that are not needed.

The benefits of this triggering ability

Without the system's pre-/post-trigger feature, it would not have been possible to collect and store enough images to document what really happened in the scenario outlined above. A typical camera might have been able to capture an image of the violator passing through the intersection but would not have captured the near collision. The key element that made this red light violation easy to confirm is the advanced feature set, including pre-/post-triggering, of the Genie TS camera series. ○

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Common interfaces for US tolling

Movement in the tolling industry toward common interfaces is analogous to what happened long ago in the banking and telecommunications industries.

The establishment of a common interface for roadside to back office and between back offices for interoperability has progressed recently, with several initiatives underway. For example, one of the major goals of the Alliance for Toll Interoperability (ATI) is creating a common interface or universal financial message (UFM). Another initiative from the OmniAir Consortium, called Electronic Payment Services National Interoperability Specification (EPSNIS), aims to become the basis for interoperable back office processing of toll payments. The ATI Interoperability Hub is one possible deployment scenario for EPSNIS.

For the Interoperability Network Pilot Phase (INPP), CS implemented a Hub interface that accepted whatever file format agencies preferred. Hub system adaptors transform different agency formats into

ⓘ | Need to know?

Current progress in the ongoing move toward fully interoperable US tolling

> The role of common interfaces in making progress in tolling is similar to what has already happened in the banking and telecommunications industries
> How the ATI Interoperability Hub is encouraging the move to an interoperable network
> Setting the stage for the next step: the move to a common service interface and transaction message format

The Golden Ears Bridge, Vancouver BC, will be fully interoperable with the future Portmann Bridge free-flow system

internal messages and schemas. A mediation server handles all conversions. The formats supported included those from the most popular regional schemes: E-ZPass, SunPass, TxTag, and Colorado. Most agencies used batch mode for data transfer, with the exception of the Florida Turnpike Enterprise (FTE), which sent unmatched transactions and received matched transactions on a real-time basis using web services.
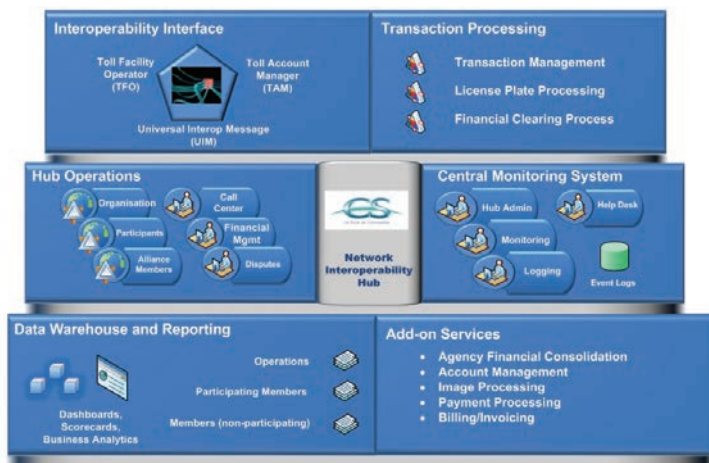
The flexibility of the transport layer (batch or real-time), message, and file formats made it very easy for agencies to participate in the ATI pilot Hub. There was no need for expensive software modifications; they simply extended their current interoperability network to ATI.

Devising a supplementary matching service

Another innovative enhancement of the ATI Hub during the pilot phase was the ability of agencies to participate without having to send plate information due to local legislation. These agencies joined the ATI Hub as a supplementary matching service. The Hub sent all unmatched transactions to these agencies on a daily basis and the agency returned any matches by doing lookups on their local account database.

The next phase of the ATI Hub will initiate a movement to a common service interface and transaction message format. This common format will simplify reconciliation, billing, adjustment, and dispute processing. ○

Functional overview of the Interoperability Hub provided by CS

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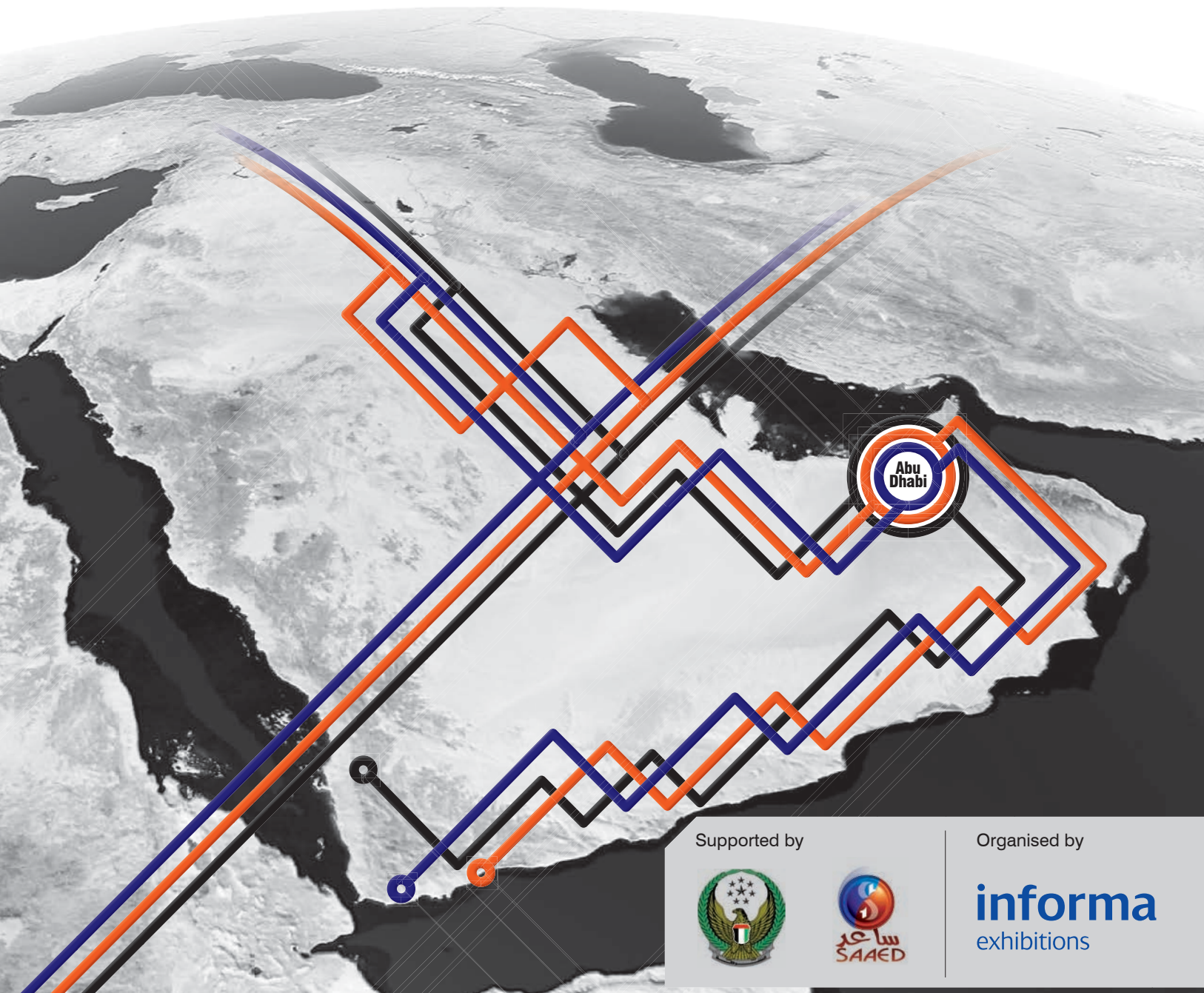
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Further contract wins for enforcement expert

READER ENQUIRY NO. 511

Traffic enforcement specialist, Redflex, is continuing its growth across the world with the announcement of further contract wins. Off the back of the recent major contract announcement in Malaysia, the company has announced that it has been awarded the contract for the Transurban CityLink tunnel speed camera upgrade project in Melbourne, Australia. The robust tender process saw Redflex emerge as the successful bidder for the commercially complex project that involves removing and upgrading the speed enforcement camera systems in the privately owned and operated Domain and Burnley Tunnels. This contract award cements Redflex's position as the leading provider of speed and red light enforcement systems in Australia, and reflects its strong relationship with the Victorian State Government.

On the other side of the globe, Redflex has also recently been awarded a contract for the Highways Agency Digital Enforcement and Compliance Systems Version 3 (HADECS3). The contract covers design, development, prototyping and approval of both outstation equipment and in station equipment. This work has been allocated under the Highways Agency framework to supply speed enforcement equipment to road schemes.

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New software product line for traffic management

READER ENQUIRY NO. 512

With Vision Online, the German software provider PTV has launched a new product line for traffic-adaptive network control and predictive traffic stats. The new range incorporates PTV Balance, a software solution specifically designed for efficient signal control, and PTV Optima, which provides transportation experts with detailed predictive traffic data.

PTV Optima is a modeling tool that gives planners an accurate picture of the traffic situation and enables them to provide traffic forecasts. The system receives data on traffic volumes and speeds via detectors and signal control systems and processes it. In the event of an accident, it will calculate the impact on traffic in real time and assess several solution scenarios simultaneously.

"We have integrated PTV Optima into our software suite, Vision, and created interfaces to our transportation planning system, Visum. This allows us to use Visum as data hub and develop a dynamic transportation model that can then be used in PTV Optima," explains Peter Möhl, director of products and data, PTV Germany. As a result, the traffic management center can plan traffic up to 30 minutes in advance. "This means that the control team is able to react more quickly and effectively to traffic incidents," says Möhl. Predictive traffic stats can also be transmitted to PTV Balance for traffic control.

PTV Balance enables traffic-adaptive network control and provides a comprehensive view of the entire road network: every five minutes it calculates signal plans for the next five-minute period, which are optimized and tailored to the current traffic situation. The product, which was developed by Gevas software and TU Munich, was acquired by PTV in January as part of a cooperation agreement. "Gevas will continue to serve existing customers and manage the projects in this field. PTV will put a strong focus on global marketing of PTV Balance and its tight interplay with the software suite Vision," says Möhl.

PTV Balance also enables cities to create dynamic green waves. The city of Ingolstadt has already explored the advantages of using PTV Balance. Waiting times at traffic signals have been reduced by 20%, generating fuel savings of 700,000 liters and reducing CO_2 emissions by 1,600 tonnes.
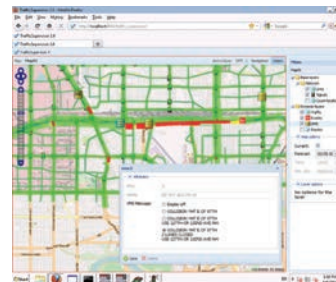
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❓ What impact do you think the Long-Term Evolution wireless communications standard will have on ITS and what benefits do you think you will experience?

A "LTE will most certainly play a role in supporting ITS services, which will be funded by vehicle owners on a fee-for-service basis. Driver requests for service information is periodic and is not continuous as ITS safety information. Current thinking is that ITS safety-related communications as defined in SAE J2735 precludes use of communications resources that required a continued fee for service. Even if the service fee restrictions were not applied, there is a major issue of data loading of SAE J2735 messaging on the LTE network. Communications requirements of 400 vehicles transmitting full basic safety messages would saturate the LTE network. The 'footprint' of the LTE network will define the number of vehicles and intersections that must be supported by high-reliability, low-latency communications. The ASIL of safety applications requires error-free safety messages to be delivered at 99.97% confidence level. As SAE J2735 is broadcast to all vehicles within the 'coverage footprint', discrete addressing would be required, which adds to the communications load and latency. Furthermore, while broadcast capability is in the LTR specifications, it has not been widely implemented by cellular service providers. LTE defines turnaround latency of no greater than 10ms and defines a sleep-to-wake latency of 100ms, it does not define connect time as a vehicle enters the LTE footprint."

Bruce Abernethy
senior principal engineer, Arinc, USA

A "Standard broadband 4G smartphones appear functionally capable of supporting many ITS applications. ITS should benefit from commercial sector successes to achieve interoperability within the public safety ITS sectors. Many ITS organizations have access to right-of-way along streets, roads, highways, and freeways that have value in public-private communication partnerships. Automated highways are ITS goals for the future, and although this will require dedicated communications for many functions, 4G LTE should provide extensive supporting communication. The emerging commercial 4G LTE ecosystem should enable more cost-effective development of tailored ITS 4G LTE terminals, infrastructure and applications."

Jim Gunn
founder, JGunn Research, USA

A "Substantial! Connected cars will increasingly leverage drivers' LTE-based smartphones. This will bring many benefits. LTE signal coverage, for instance, will be far greater than DSRC, WiFi, and WiMax can ever be. Also, smartphone sales made up 31% of all mobile device sales worldwide in 2011 and this will increase. Moreover, data rates are high and support infotainment services, including traveler information services, and some safety features. Car manufacturers will benefit because it downloads the capital cost and operating expense to the car owner. It also allows the driver to change devices every three years or so without having to go back to the car dealer. There are some negatives that need work, including tools to enable the OEMs to manage driver distraction, the cost of data plans, roaming charges, etc. Further evidence of the potential of commercial 4G/LTE systems is the USDOT's announced investigation into whether it can be used for ITS applications, traveler information services, and some of the safety functionality currently envisaged for DSRC."

Barrie Kirk
partner, Globis Consulting, Canada

A "In the shorter term, probably not much. Long Term Evolution (LTE) is now really being rolled out to solve the problem of exploding wireless traffic – most of it video – not to meet per-se the needs of any one application category. In the longer term, however, the next iteration of 4G, 'LTE Advanced', may have some impact on ITS if the carriers fully commit to implementing its most interesting features. LTE Advanced may include 'traffic shaping' and Quality of Service (QoS) modes that ITS applications may invoke to ensure critical data arrives quickly. Furthermore, LTE Advanced may be smart enough to allow handsets or vehicles to establish and manage communication sessions that hop between many of many different wireless networks such as cellular, WiFi, and perhaps even DSRC. This 'vertical' roaming and traffic-shaping technology will allow mobile network operators to introduce flexible tiered services, coverage and pricing incentives that fit particular ITS applications' technical requirements and perhaps even budgets."

Steven H. Bayless
senior director, Telecommunications and Telematics, ITS America, USA

Readers are invited to answer the Burning Question for the June/July 2012 issue:

What still needs to be done – from both an enforcement and an ITS technology perspective – to make road tunnels safer?

email answers to:
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