January 2015

traffic
TECHNOLOGY INTERNATIONAL

WWW.TRAFFICTECHNOLOGYTODAY.COM

The death of VMS?
Live traffic apps that could topple variable message signs

Machine Vision

Computer-assisted analysis is changing the way we see our roads. How far will this new technology take us?

Opinion
Nico Anten talks smart freight, beer and ketchup; Jim Misener bids *TTI* a fond farewell, and much more...

PLUS

Mapping the future
The live-update GIS systems that will guide the autonomous vehicles of tomorrow

Testing LED safety
We scrutinize the latest smart streetlighting setups to discover if they are suitable for any location

Defeating winter weather
Intelligent techniques that direct and control snowplow fleets to clear snow and ice from roads fast

Have you heard about colored licence plate?

NEW Vega COLOR family

- All in one, plate Color detection and Licence plate recognition
- Integrated white light illuminator
- Micro Sd memory card up to 32 GB

www.tattile.com

Tattile
Custom Vision Solutions

COVER PHOTOGRAPH: KISELEV ANDREY VALEREVICH/SHUTTERSTOCK.COM

Cover story

36 Seeing the future

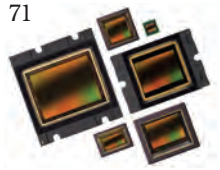
When is artificial intelligence better than the human brain?

Saul Wordsworth investigates the growing possibilities for machine vision in advanced traffic management


58


60


67


71

Editor's letter

There's never been a more exciting time for ITS. Our columnist Larry Yermack puts it best on page 65 where he writes about the industry 'coming of age' in Detroit. There's a lot to be excited about. But there is also a lot of work to be done. Some of the simplest ITS solutions are yet to be implemented in what are seemingly obvious locations, as I discovered when driving home from visiting friends in nearby Brighton earlier this month.

I was surprised to be diverted off the main road (the A23), which was closed for night-time maintenance – something I had never experienced in my 20 years of driving on it. Travel alerts on my car radio were off and, despite the capability of my smartphone to check travel updates, I perceived no need to use this function late at night.

Nevertheless, there it was: A wall of traffic cones cordoning off the entire road; red signs reading 'Road Closed'; and yellow signs bearing the simple message 'Diversion' and an arrow. These yellow signs continued for several miles, tantalizingly directing motorists back onto the main road, briefly, before taking the fuming snake of traffic off on another cross-country trek.

When I finally reached home, half an hour later than expected, I realized one piece of technology could have saved me from the detour – a variable message sign (VMS). Or possibly even two of them. Ideally I would have liked, primarily, a sign to tell me several miles in advance that the road was closed, so I could pick an alternative route. And then, just in case I had missed such a sign, or came onto the road via a route where I did not pass one (I think this second possibility probably was the case), then a portable sign that explained the nature and length of the detour would have eased stress levels and allowed for last-minute rerouting. As it was, the yellow 'Diversion' signs were more akin to a children's treasure hunt than a modern road information system, with no indication of where they were taking us or how long it would be… It turned out to be a 35-mile 'scenic route'.

The whole frustrating incident brought to mind the debate that rages from page 10 of this issue. Are new traveler information systems heralding the death of the trusty VMS? My recent experience would suggest that while the technology certainly exists to replace them, it's the delivery method of such systems that will need to be refined before that happens. Until my phone (or car) is smart enough to 'wake up', realize where I'm heading, and issue an audio warning of what's up ahead and until such technology is in the hands of 99% of road users, VMS will carry the day.

That's why you'll find plenty in the feature on the new technology that's pushing VMS forward, and elsewhere in these pages you'll find the march of ITS – from machine vision (p36) to weather management (p18) – continuing in its mission to make driving a more reliable and sustainable way of getting around, wherever you are in the world.

Tom Stone
Editor

Editor
Tom Stone
tom.stone@ukipme.com

Deputy editor
Lauren Ansell
lauren.ansell@ukipme.com

Production editor
Alex Bradley
Chief sub-editor
Andrew Pickering
Deputy chief sub-editor
Nick Shepherd
Proofreaders
Aubrey Jacobs-Tyson,
Christine Velarde, Lynn Wright

Art director
James Sutcliffe
Art editor
Ben White
Design team
Louise Adams, Andy Bass, Anna Davie,
Andrew Locke, Craig Marshall,
Nicola Turner, Julie Welby

Head of production and logistics
Ian Donovan
Deputy production manager
Lewis Hopkins
Production team
Carole Doran, Cassie Inns,
Frank Millard, Robyn Skalsky
Circulation
Adam Frost

Publication director
Mike Robinson
mike.robinson@ukipme.com
Sales manager
Godfrey Hooper
godfrey.hooper@ukipme.com
Sales manager
Jaspreet Rayat
jaspreet.rayat@ukipme.com
Australasia business manager
Chris Richardson
chris.richardson@ukipme.com

CEO
Tony Robinson
Managing director
Graham Johnson
Editorial director
Anthony James

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

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

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

Air Business is acting as our mailing agent.

published by UKiP

Member of the Audit Bureau of Circulations

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

ISSN 1356-9252
Traffic Technology International

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

Ahead of traffic

In the ITS camera race, AVT's low-light optimized CCD and CMOS sensors, high-speed shuttering, and wide field of view are unbeatable. And with remotely adjustable settings, such as white balance, gain, exposure, and triggering, our cameras are also the easiest to drive. Select from several customizable models with up to 29 megapixels of resolution. They're road tested and ready to take on your traffic applications today. In fact, the toughest challenge wins at **www.AlliedVisionTec.com/AheadofTraffic**.

SEEING IS BELIEVING

Damage limitation

2015 will see major improvements in the way that road authorities across the USA manage congestion and safety after major roadway incidents

Lives will be saved and congestion will be reduced as a result of a collaborative effort between the Arizona Department of Transportation (ADOT), Arizona Department of Public Safety (DPS), the US Federal Highway Administration (FHWA), and the Maricopa Association of Governments (MAG). A three-

Training and techniques

A new facility in Tennessee will offer incident management training

The Tennessee Department of Safety and Homeland Security and the Tennessee Department of Transportation (TDOT) recently opened a training facility, which will be used to teach best practices for safe, quick clearance of major highway incidents. The Tennessee Traffic Incident Management Training Facility, which is the first of its kind in the USA, is situated next to the Tennessee Highway Patrol Training Center in Nashville.

TDOT had received federal Highway Safety Improvement Project funds, which have covered 90% of the US$912,000 cost to build the facility. The site features a section of interstate-like roadway, ranging from two to six lanes, guard rails, a two-way interchange, and cable and steel barrier rails, as well as a section of two-lane highway and a full four-way intersection.

The facility will be used to simulate a variety of crashes, and allow emergency responders to train on safe and efficient clearance techniques.

"This new track will not only help law enforcement, but also enhance the skills of other first responders in the safe and quick clearances of highway incidents," said TDOT commissioner John Schroer at the opening of the facility. "We know that the longer roadways remain closed due to major traffic incidents, the danger of secondary crashes increases dramatically. Improving emergency response will decrease the risk of secondary crashes, overall congestion, and keep our highways safer for all motorists."

Danger zone

Secondary collisions are a major safety concern at accident sites

According to Arizona DPS director Robert Halliday, it is important to clear the scenes of accidents as soon as possible in order to reduce the risk of secondary crashes. "Secondary collisions account for about 6% of crashes on state highways, and one first responder is injured or killed almost monthly on Arizona roadways," he says. "An officer housed in the TOC has the authority to immediately notify the DPS dispatch center and mobilize field officers, fire trucks or ambulances, without waiting for ADOT operators to relay the information to DPS."

year pilot project will see DPS officers co-located at the ADOT Traffic Operations Center (TOC) in an effort to clear freeway crashes more quickly.

To monitor traffic flow, the TOC, located in the city of Phoenix, Arizona, gathers information from a variety of sources, including more than 200 traffic cameras along the freeway network. Operators are then able to monitor and display video from up to 160 cameras simultaneously.

Under the initial co-location program, a DPS officer is on duty during the high peak traffic periods, joining the ADOT operators that provide 24-hour coverage in the TOC.

"Using the cameras available in the TOC, the on-duty DPS officer can monitor and quickly locate or verify traffic incidents, and determine the specific resources needed," explains ADOT director John Halikowski. "Early notification and precise resource allocation will help clear crash scenes more quickly, potentially saving lives and reducing the time motorists are stuck in traffic."

A MAG analysis found that having a DPS officer in the TOC could result in a 33% reduction in overall traffic delay caused by major crashes. "We found that if you applied that reduction to a 36-mile segment of Interstate 10 over a one-year period, it would equate to savings of US$6.6m in lost productivity," says MAG's chairman, Michael LeVault.

The three-year pilot project is being funded by the Regional Council. The US$1.3m of funds will be equally shared by MAG and ADOT, with the program paying for three DPS officers and a DPS supervisor.

Mobile management

Cloud-based communications optimize response efficiency

In Virginia, the counties of Rockbridge and Montgomery have invested in a technological solution that is helping them reduce the wider impact of traffic collisions that often occur on a very busy 82-mile section of Highway 81.

In a collaborative effort, the Rockbridge County Office of Emergency Management, the Lexington Fire Department and the Montgomery County Office of Emergency Management are using a mobile, cloud-based communications platform to optimize the flow of information from the scene of an incident to agencies and communities up and down stream. Using tablet devices, first responders are able to easily complete initial documentation about the nature of the traffic incident and specific requirements to reopen the road. This information can then be accessed by local emergency management offices, who dispatch the closest county and contractor assets to facilitate clean-up.

In 2013, traffic congestion cost the US economy US$124bn

> "Having a DPS officer in the TOC could result in a 33% reduction in overall traffic delay caused by major crashes
>
> *Michael LeVault, chairman, Maricopa Association of Governments*

Autonomous Vehicle TEST & DEVELOPMENT Symposium 2015


© Bosch

17-18 JUNE 2015 STUTTGART, GERMANY

The world's first conference dedicated to the **testing** of autonomous vehicles and advanced driver assistance systems

The Autonomous Vehicle Test & Development Symposium 2015 will bring together the world's leading engineers in the field of autonomous vehicle research, testing, validation and development. The conference will be held in Stuttgart alongside Automotive Testing Expo 2015, the world's largest exhibition dedicated to new vehicle development and testing, and in conjunction with *Traffic Technology International* magazine, the world's leading magazine for advanced highway and traffic management technologies.

Held at:

automotive testing expo 2015 europe

Over 60 of the world's **leading experts** in driverless vehicle testing will be presenting papers!

Book your delegate pass now!
www.autonomousvehiclesymposium.com

Brought to you by the publisher of:

traffic technology international | automotive testing technology international | crashtest technology international | VISION ZERO INTERNATIONAL

Book your delegate pass now!

www.autonomousvehiclesymposium.com


© Rinspeed


© Continental

Topics under discussion:

Public road testing
Virtual testing
Simulation
Traffic scenario testing
Embedded software testing
Safety and crash testing
Fail-safe testing
Cyber threat testing
Validation and verification
Autonomy software
VeHIL
V2V and V2X testing
Robotics
Testing legislation
Safety standards and legislation
Case studies
Possibilities
Best practices
Reliability testing of software and hardware systems

For more information about the Autonomous Vehicle Test & Development Symposium 2015, **please contact Mike Robinson,** conference director: mike.robinson@ukipme.com
Tel: +44 1306 743744 | www.autonomousvehiclesymposium.com

Natural selection

Transportation is currently responsible for about 25% of energy-related global greenhouse gas emissions and 20% of energy use. **Lloyd Fuller** looks at worldwide initiatives to make our industry more sustainable

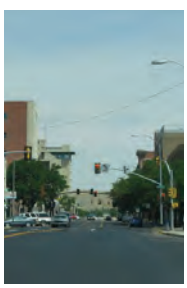
Greener in Greece

European pilot project will reduce emissions using cooperative ITS

The European Compass4D pilot project has begun operation in Thessaloniki, Greece. Coordinated by ERTICO – ITS Europe, the project incorporates cooperative ITS services at two locations – the Energy Efficient Intersection (EEI) service has been implemented in the city center, while the Road Hazard Warning (RHW) service is provided on a beltway. The EEI service will reduce energy use and vehicle emissions at signalized intersections. Selected vehicles, such as heavy goods vehicles, emergency vehicles, public transportation and taxis, will be granted a green light when approaching the intersection, thereby avoiding stops and delays.

Economy drive

Roadway LED lighting will save energy in Wyoming



Work has begun on a statewide project to convert all Wyoming Department of Transportation's (WYDOT) roadway lighting to LED technology, an upgrade that is expected to save the agency about US$690,000 a year in energy costs. The project will upgrade 5,267 light fixtures, including high-mast tower lighting at interchanges and rest areas, roadside and area lighting, parking area fixtures and lighting at road closure gates. The LED lights are expected to cut WYDOT's costs for lighting highways by nearly 40%, and the longer-lasting LED bulbs will also substantially reduce maintenance costs. Work on the LED upgrades will be staggered across WYDOT's five operations districts to minimize traffic disruptions, with the retrofit process expected to take four to six weeks to complete in each district.

Lead by example

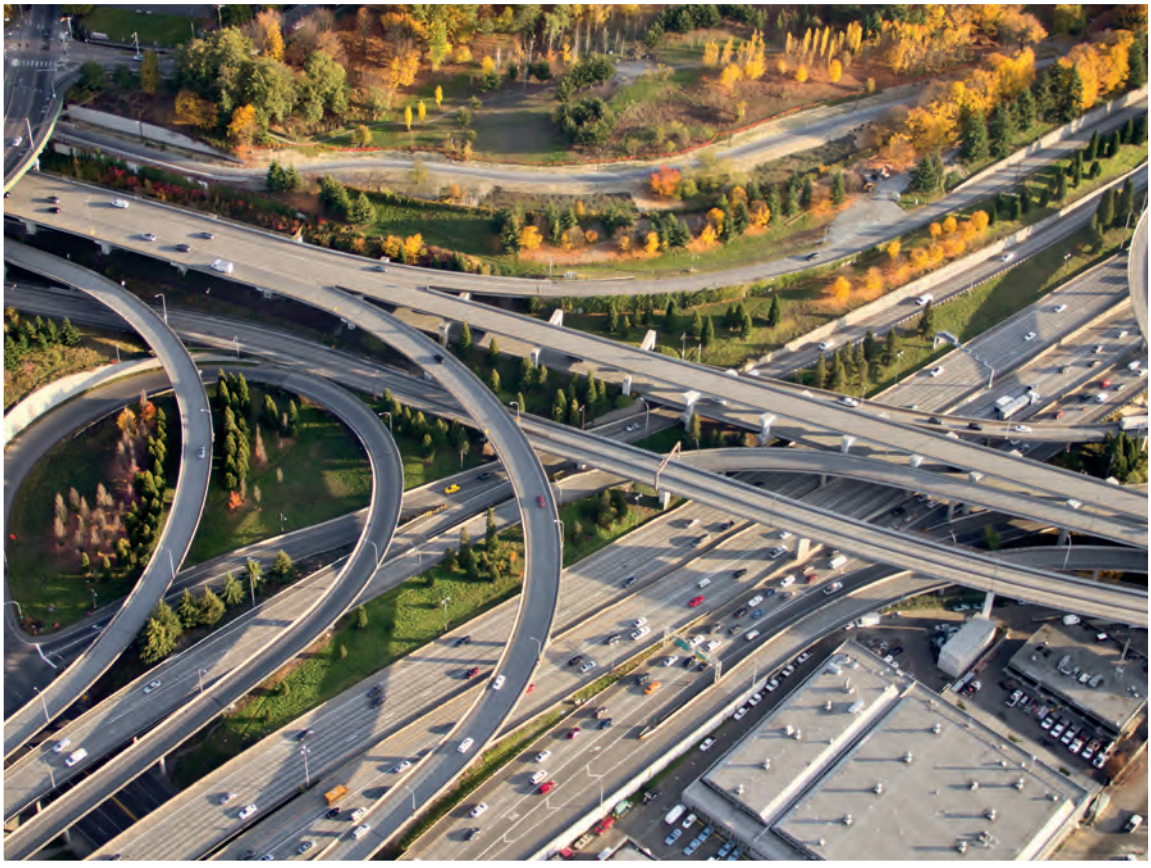
London could lead the world by implementing the first ultra-low emission zone by 2020

The Mayor and Transport for London (TfL) have put forward proposals to introduce the world's first ultra-low emission zone (ULEZ) in the capital in September 2020. The proposals would require all vehicles traveling within the existing Congestion Charge Zone to meet new emission standards and would be in operation 24 hours a day, seven days a week. The plans are projected to halve emissions of nitrogen oxides (NOx) and particulate matter (PM10) from vehicle exhausts, which means more than 80% of central London is expected to meet the nitrogen dioxide (NO_2) annual legal limits in 2020. It will make the city a more pleasant place in which to live and work, and encourage the use of more sustainable forms of transportation.

Joined forces

UN Climate Summit pushes for a greener future

Transportation initiatives announced at the United Nations Climate Summit aim to give the sector a low-carbon future and save trillions of dollars in fuel costs in the process. With transportation energy use and GHG emissions projected to rise by nearly 50% by 2030, the schemes strive to reduce GHG emissions through a host of measures, from increasing the number of new bus and metro lines to increasing the number of electric vehicles and introducing car and bike sharing. The Urban Electric Mobility Initiative (UEMI), which was launched at the Summit, wants to increase the number of electric vehicles (EVs) in cities to least 30% of all new vehicles sold annually by 2030 and make cities worldwide more friendly to their use.



COMPLEX PATTERNS? MEET **SIMPLE ANSWER.**

DISCOVER BASLER'S OUTSTANDING PORTFOLIO OF CAMERAS FOR TRAFFIC APPLICATIONS.

Red light, speed limit and toll enforcement. Traffic volume and road and rail condition monitoring. Automatic license plate recognition. Contemporary traffic control systems rely on high quality images for an ever-increasing range of functions. And each system and geographic locale represents its own unique technical mandates. That's why ITS integrators increasingly rely on Basler. Since the inception of ITS, we've led the industry in the development of easy-to-integrate cameras that provide the high sensitivity, image quality and dynamic range that effective traffic management demands. And we've made high performance increasingly affordable too, bringing machine vision image quality within reach of more municipalities than ever before.

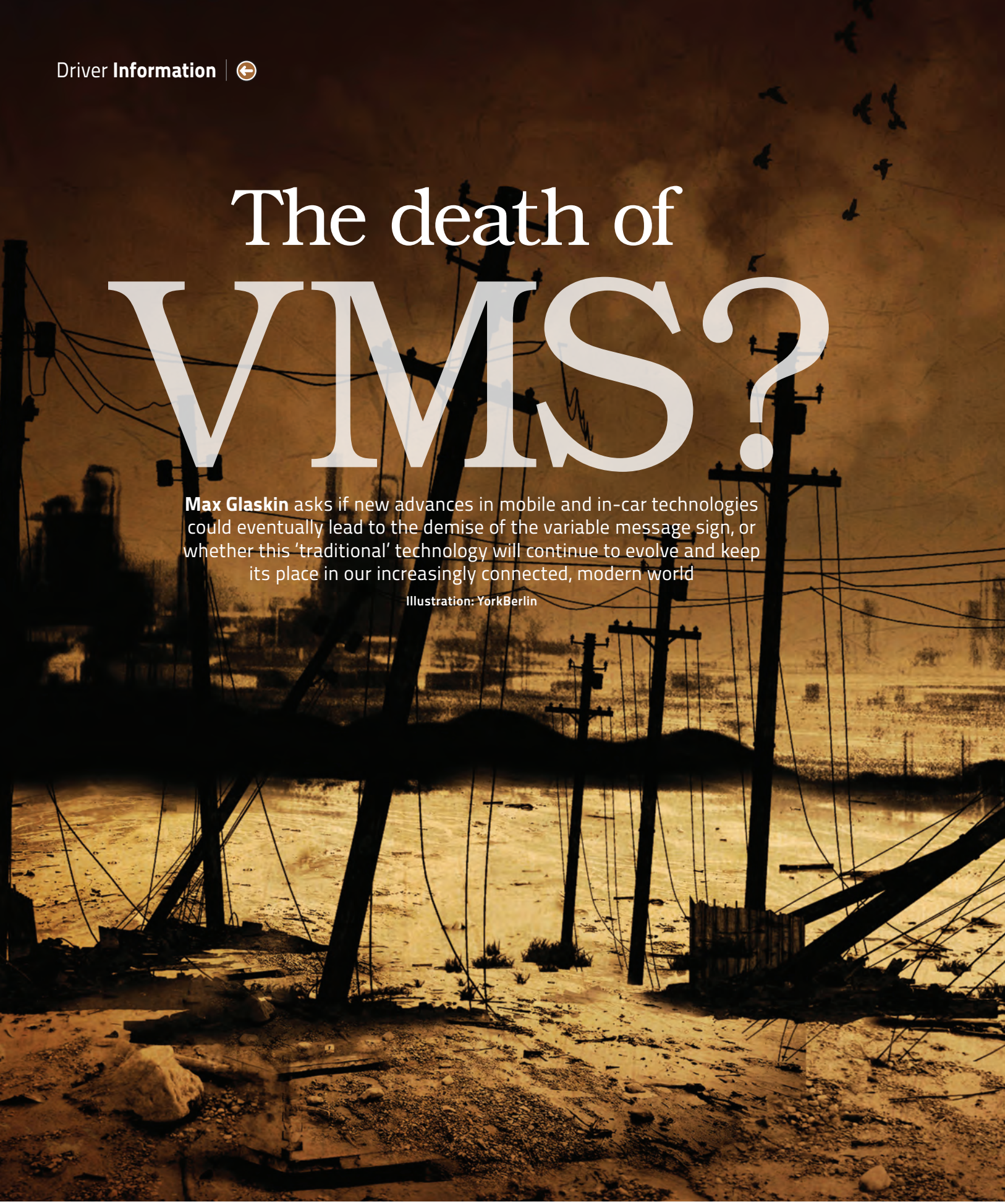
No matter how diverse the functional capabilities or how exacting the performance metrics your system requires, Basler has just the ticket for your solution. Learn more at **baslerweb.com/traffic**.

BASLER
the power of sight

The death of VMS?

Max Glaskin asks if new advances in mobile and in-car technologies could eventually lead to the demise of the variable message sign, or whether this 'traditional' technology will continue to evolve and keep its place in our increasingly connected, modern world

Illustration: YorkBerlin



Could it be the end of the road for the variable message sign (VMS)? For nearly three decades, drivers have glanced at the electronic signs, which provide up-to-date information about local traffic conditions ahead. The message itself may be bad news, but people are happier and less frustrated if they are informed. The signs even played a key role in the Hollywood blockbuster *L.A. Story*. Could these faithful oversized text messengers be preparing for their final missive?

"It's a million dollar question," says Ananth Prasad, secretary of Florida Department of Transportation (FDOT). "Ten years ago, VMS made sense because the space was empty and there was a need for traveler information. State DOTs were the only ones providing this. Now there's so much information out there, we are starting to question whether we, as a DOT, still need to provide traveler information."

> They probably make sense for the next few years, but long term, we need to seriously think about whether this is something we should be investing in
>
> **Ananth Prasad, secretary, Florida Department of Transportation, USA**

Giving taxpayers value for money is one reason to reconsider the viability of continuing to use this technology. "Variable message signs are expensive – they costs millions of dollars to install and millions of

dollars to operate," says Prasad. "They probably make sense for the next few years, but long term, we need to seriously think about whether this is something we should to be investing in."

Intelligent connections

The rise of mobile communications is one of the main reasons the days of the VMS may be numbered. The smartphone, the in-dash screen unit, the head-up display and the plug-in route planner can provide not only visual alerts, but also audible warnings directly to drivers. "A lot of people have smartphones these days," Prasad notes. "They manage their journeys with Google Maps, Waze, Inrix or TomTom. There are a lot of map-based apps out there." But such technologies are far from being perfected, and concerns over accuracy and safety could see VMS fight back.

One of the main selling points of the VMS is that it's specific to a certain location and can impart information pertinent to that zone of the highway, whereas smartphones and in-car devices float around the network. Furthermore, getting in-car information to drivers safely is not easy. Anything that disrupts a driver's concentration increases the risk of collision. In the 100-car naturalistic driving study by NHTSA and Virginia Tech in 2005, merely interacting with passengers was found to be the second most likely cause of crashes. The most likely cause, though, was wireless devices – part of the raft of technologies predicted to usurp the VMS.

(Above left) **If VMS were to develop intelligence of the kind seen in the 1991 hit movie *L.A. Story* their future would surely be secure**

Money matters

Despite safety concerns having yet to be fully addressed, Prasad is already envisaging workable business models for a world without VMS. "DOTs will collect more data from roadside units," he predicts. "Then they'll enter into public-private partnerships (PPP), to share all the data. In return, whoever is the collator or aggregator has the app that provides that information to the taxpayers – for free. It could even be customized to meet the specific needs of a particular state or DOT."

In fact, the FDOT is already collecting the data and disseminating it in forms that others are aggregating, without payment. These organizations redistribute it through their own channels to suit their own business models. "We provide a lot of our camera feeds to TV stations," says Prasad. "They get sponsorship, so they're making money out of it." So why would such redistributors enter into a formal, probably commercial, PPP if they're already getting what they want for free? "There could be an opportunity to collaborate with the private disseminators of information to create a win-win situation," says Prasad. "We have the infrastructure. We can invest in that on a much broader scale. Distributors can rely on that information and create a synergy. I think there's potential there."

So the result of a PPP would be that the DOT collects the data and is helped with the cost of doing so by the redistributor. "That would give the road user access to the information without the government having to spend its tax dollars," Prasad explains. Indeed, some such partnerships are already in place. "The FDOT

> The most likely cause of crashes is wireless devices – part of the raft of technologies predicted to usurp the variable message sign
>
> **National Highway Traffic Safety Administration (NHTSA) and Virginia Tech study**

has entered into a partnership with Waze," says Prasad. "We share our data with Waze and, in return, we can use Waze data to get reports of incidents, to meet our needs. Waze is owned by Google now, so we're working with them, and also with Here (Nokia). TomTom has also expressed an interest."

It could already be the beginning of the end for VMS if it wasn't for the fact that not everybody has a modern car with in-built information displays, nor a smartphone. What price do we place on universal access to safety information?

Adding up the costs

The RITA database shows that a single VMS with cables and cabinet can cost up to US$100,000, although figures three times that may be reached when the support structures and linked cameras are included. Although they have got more robust and reliable, annual operation and maintenance of a VMS can range from US$2,000 to US$6,000. In contrast, the cost of developing a basic traveler information app for smartphones can be as little as US$3,000. A fully featured sophisticated version could cost up to US$150,000, excluding marketing and distribution costs.

The cost of VMS may be high, but it gets information to all road users, not just the wealthy who have the latest phones and vehicles. The VMS guarantees universal access in a way that apps and in-car technology simply can't at the moment. What's more, there is hope that the VMS may get a lifeline if cheaper technology comes on line soon. Perovskite, a material that's cheap to make and can be fabricated into bright, colored LEDs, suitable for a matrix display,

An augmented reality

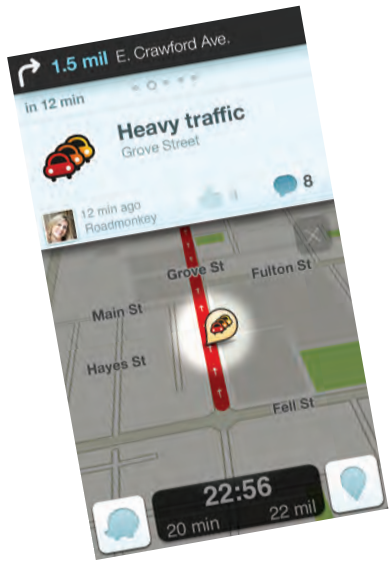
In addition to smartphones and dash displays, the VMS is also threatened by more futuristic technologies

Continental plans for its augmented reality HUDs to be in vehicles by 2017, creating graphics apparently 130 x 60cm and 7.5m distant. The Tier 1 supplier says the projected, dynamic images will marry with the scene beyond the windshield. A variant will do the same for motorcyclists, using the helmet visor as the screen.

A simple red light on the dash, triggered wirelessly when approaching traffic signals, has been shown in experiments to cut red light running by 84%. The study just published by the School of Traffic and Transportation, Beijing Jiaotong University, China, also found that an audio warning message could substantially reduce red light violations.

BMW and GEWI used the ITS World Congress 2014 in Detroit to demonstrate the VMS2DASH. Working with the Michigan DOT, the information unit showed traffic messages that were otherwise displayed on the changeable roadway signs. The same solution was shown at the ITS New Jersey annual meeting in October.

(Above right) **Could travel apps like Waze one day take over from VMS?**



and also into solar cells, which could power the VMS, is predicted to be available in 2019.

Elsewhere, the e-signage project, partly funded by the European Union, aims to produce large area, high-contrast and low-cost traveler information signs, with very low power demands. Instead of LEDs, which need constant power, the characters and symbols are formed from by 'electronic paper'. It only needs power to change the message. When that's happened, the power shuts down until the next change.

Eyes on the alternatives

While the VMS clearly has some challenges ahead, it could be quite some time before we say goodbye to them for good. Prof. Andrew Parkes, chief scientist at the UK's Transport Research Laboratory (TRL), and vice president of the Forum of European Road Safety Research Institutes, has concerns about the various in-car alternatives, including head-up displays (HUDs), in-car display screens, and cell phones. "The problem they create is distraction," he says.

> It seems there's a need to keep checking [in-car screens], even though the information has been fully comprehended
>
> **Professor Andrew Parkes, chief scientist, TRL, UK**

He points to a surprising lack of research into the distraction caused by HUDs, and the fact that what little is known isn't comforting. "Problems of where to present the HUD have been identified, in terms of how it affects the normal eye-scanning patterns and at what focal length the image is displayed," Parkes says. "Brightness,

Reaching for the cloud

Phil Perut, president of VMS manufacturer SES America, sees solar and low-power VMS becoming part of an integrated cloud-based travel information system

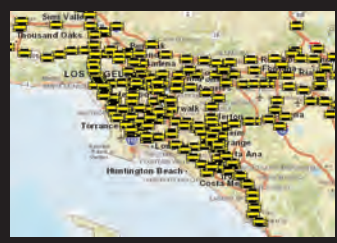
The end was predicted for VMS almost as soon as they were first deployed. "We were thinking about whether signs would start to disappear 15 years ago," says SESA's Phil Perut. "What we see is the opposite... there is more demand. Old signs are being replaced by the newer generation, or being retrofitted. Most of the DOTs are not planning to remove signs. Drivers are used to them. They don't want to see them disappearing."

The constant demand doesn't mean that VMS technology is remaining unchanged, however. Perut reveals that the latest push is to connect VMS to the cloud. "This is something new," he says. "We are working on a prototype that can receive information from the cloud through a wireless connection. Then data providers, such as Google, TomTom, Garmin or others, could provide travel time or other information like local weather or road conditions directly to the sign."

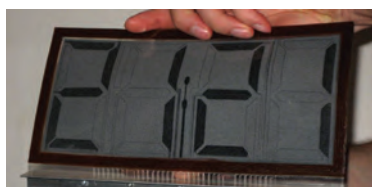
The influx of data would then be manageable with different types of message given varying priority levels. "An emergency message about an accident from the DOT would take precedence over travel-time information provided by a third party," explains Perut. "So if the DOT needed to take over, travel times would no longer be displayed."

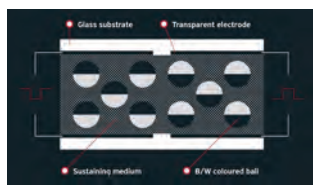
Cloud connections may be a fair few months off yet, but new technology that is already being rolled out includes design changes that reduce energy consumption and enable large VMS to run off solar panels, meaning they can be deployed in more remote locations: the march of the signs looks set to continue.

"The only way a DOT can reach each and every driver and ensure that the driver gets the message is through VMS," says Perut. "You can't oblige them to be connected to the app or smartphone – they can switch them off. The only way to convey the message is through something that is permanently installed on the road – and that's why we see increased demand."



(Left) **A graph showing the increasing deployment of VMS from 1997 to 2010**
(Below) **A map showing all the VMS deployed in the Los Angeles area**





(Above) **The latest research into VMS, partly funded by the EU, is looking at creating signs using 'electronic paper' techniques – so that power is required only when the message changes**

contrast and color are also factors to be resolved. None of those decisions are trivial."

He's cautious, too, about in-car screens. "You'd expect they'd offer some benefit because the information is no longer transient to the driver, as it is on a VMS," he says. "But the research we've done shows the in-car screen is distracting."

Furthermore, the distraction seems to persist. Even when a driver reads information and understands it, they refer to it frequently while it is still displayed. "It's a strange phenomenon you get it a lot in navigation systems and you'd expect it to be the same with any message system," says Parkes. "It seems as though there's a need to keep checking, even though the information has been fully comprehended."

There's one more potential black mark against the in-car alternative to the VMS. Experiments have also shown that drivers use their mirrors less when there is an in-car display screen, yet how much of a hazard this is hasn't been quantified.

Time will tell

FDOT's Prasad still fervently believes that in-car and mobile technologies will eventually be able to provide all of the benefits associated with VMS, even providing location-specific information. "I have been talking with Google, and others, about geofencing," he says. "If a driver using a navigation app gets into an accident, the technology can create a geofence around that vehicle. Other drivers that enter the area will then be notified there's an incident ahead."

When geofencing works, it can be more versatile than an anchored VMS. This could be another axe that could chop away at the pillars and posts of the thousands of VMS around the world.

There remains much debate among traffic technology providers, safety organizations and road authorities about the best way forward for driver information. Ultimately, safety must always come first. While there are viable alternatives to VMS emerging, which are often extremely cost-effective, until they can be proven to be just as safe as 'traditional' signs, their use will be limited. Rumors of the demise of VMS could prove to be greatly exaggerated.

ortana

ORTANA is Offering a New Line of Weather Station Solutions

WEATHER STATION
METEOS 101

Meteos is a new line of meteorological sensors within the ORTANA family which can be integrated ITS systems to detect and measure functional microclimate conditions on roads.

VISIBILITY SENSOR
METEOS 151

ROAD SENSOR
METEOS 201

www.ortana.com info@ortana.com

Cold comfort

Ensuring roads are safe to use is top priority for highways agencies during the winter months. **Tom Stone** finds out how Michigan DOT is staying ahead of the game in the face of record snowfalls

Photographs: Benoit Daoust

Winter began early in Michigan. Just as in 2013, mid-November 2014 saw the northern state blanketed in the kind of deep snow residents are more used to seeing in January. In fact, on November 20, 2014, the Grand Rapids region officially announced its snowiest November on record with still 10 days of the month left to go (28.4in had fallen by 7:00pm that day; the previous record of 28.2in was set in 1895). But at least Michigan residents can take comfort from the fact that state snowplows are operating at maximum efficiency – controlled using an advanced system implemented by the DOT just in time for the early whiteouts.

The new efficiency began with the paperwork. In an innovative agreement, MDOT contracted Delcan Technologies (DTI), a Parsons Company, to provide both web-based Automatic Vehicle Location (AVL) and a Maintenance Decision Support System (MDSS). "Most states and agencies have two separate contracts," says Tim Croze, engineer manager for the MDOT region support unit. "We've combined them into one. That way, we don't have to get in between two vendors and tell them what kind of protocol to use for data and stuff like that. They work it out between themselves. DTI provides AVL GPS for our snowplow trucks. We get data from temperature sensors on our trucks and we know when the blades are down or up and the application rate of the deicing material."

Plowing ahead: the seemingly low-tech endeavor of clearing snow is now alive with intelligent technology

DTI is also contracted to provide the MDSS and weather forecasting components – even though the company itself does not offer this type of service. "They've subcontracted it to Iteris," explains Croze. "We knew there wasn't one vendor that provided both services, but we wanted our AVL data to feed right into the MDSS, since we are collecting weather data from snowplows."

Road-level forecasting

Critically, the kind of weather forecasting needed to direct snowplows not only on the correct routes, but also in the application of the correct type and amounts of deicing chemicals in real time, is highly detailed. A regular weather forecast can tell you what is

about to fall from the sky and what the air temperature will be. However, what it can't predict is the exact effects of this weather on pavement condition. This is due to the variable nature of many influencing factors, including pavement characteristics, environmental influences and atmospheric conditions, as well as previous maintenance activities and traffic levels.

This is where HiCAPS (Highway Condition Analysis and Prediction System), developed by Iteris, comes into play. The MDOT report *AVL/GPS Use For Winter Maintenance* states, "HiCAPS forecasts pavement and bridge deck temperatures using complex models to represent heat and moisture exchanges between the road, the atmosphere and pavement substrate. A key distinction setting HiCAPS apart from other models in the industry is the coupling between the mass and energy balances in the model. In simple terms, this means that when moisture (as snow, rain, frost, dew) is deposited onto the road, it also transfers energy to or from the road, and that evaporation or sublimation of moisture from the road requires the road to have an adequate amount of energy available to support those processes."

This kind of super-accurate forecast meant that recently an MDOT supervisor was able to call in more operators several hours before the TV news predicted snow. "If you are planning to do something outside, you turn on the local news for a weather forecast," says Croze. "But the forecast we get is weather, plus it's forecasting what that weather is going to do to our roadways. It provides us with treatment recommendations based on science. So we know if we should treat our road with salt or some other chemical. And it gives us an application rate because we know the temperature of the roadway and how much snow is falling. So there's a formula that tells us how much salt to apply to be just enough to melt the snow and ice." This means precious resources are conserved, without compromising safety.

The USDOT's assistant secretary for research and technology, Gregory Winfree, agrees efficiency in winter maintenance is paramount: "Forecasting and planning is a key consideration," he says. "Salt and equipment repair and maintenance have very real budgetary impacts on the state."

"Iteris updates its forecast every hour, or as necessary," adds Croze. "Treatment recommendations are updated almost immediately. They are sent to the driver via a monitor in the cab. And they are posted online so supervisors can monitor the situation." It's this monitoring that initially created more problems than it solved…

Winning hearts and minds

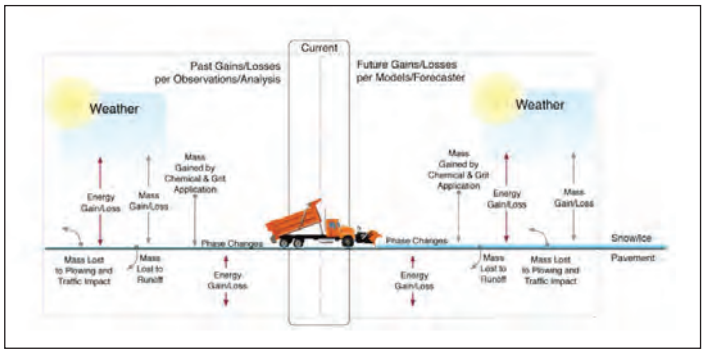
While MDOT and its contractors concentrated on the technical side of the system, they failed to anticipate there would be problems of a more human nature. Many snowplow operators initially regarded the new system with suspicion. Some viewed it not as a helpful aid to more efficient working, but as unnecessary interference – an unwelcome eye over the shoulder.

A key lesson learned, outlined in the MDOT report, was that, "A great deal of effort is needed to promote buy-in for these technologies. To gain buy-in, it is necessary to focus more on how these tools can help with current tasks and reduce manual reporting of labor, equipment and material usage by the operator so they can focus on their maintenance activities. If buy-in, or at least tolerance, of these technologies cannot be accomplished at all levels, it will be difficult to maintain a successful program."

> If buy-in, or at least tolerance of these technologies, cannot be accomplished at all levels, it will be difficult to maintain a successful program
>
> ***AVL/GPS Use For Winter Maintenance*, T Croze, J Droste, M Neill, B Hershey**

(Above) **Plows become an extremely valuable resource at times of heavy snowfall**

(Left) **A schematic depicting the formula used by HiCAPs to predict the condition of pavement during extreme weather**
(Right) **The location and heading of all snowplows in Michigan is accessible to supervisors via a webpage**



Sensing the road

Complete sensor solutions for winter road maintenance

Assessing the condition of a road surface without the benefit of a human at the roadside is often a pressure point for roadside weather information systems (RWIS). Now a new NIR (near-infrared) camera sensor from MetSense has made a giant leap forward for RWIS. As opposed to the currently available sensors, which can show the condition of only one point of the road, the 2D Road sensor reads more than 4,000 separate points. It offers a full multilane description of the road surface condition in two dimensions: giving a visual image of one or several lanes with a semi-transparent overlay of current condition (dry, wet, icy or snowy).

"This camera sensor can monitor and detect road status and friction on a two-dimensional surface up to 6 x 6m with full resolution," says MetSense's Johan Edblad. "The system has created a lot of interest from winter maintenance authorities and operators as it gives them an overview of the entire road. No other system can do this."

An early adopter of the system is the Norwegian road authority, which uses it to inform its winter maintenance operators and help plan the salting and plowing of roads. "Anyone who sees the camera immediately realizes that this creates totally new opportunities for users in various fields," says Edblad. "The best technology previously available were single-point sensors that can give you one single data point, whereas ours actually gives 2D images with many thousands of measurement points (pixels). We are the only ones in the market with this technology."

Beyond roads, MetSense have started to look at additional applications and to detect ice and snow on any surface, such as the wing of an airplane or on railroads. "On railroads you can heat the track when ice or snow is detected to avoid freezing," says Edblad. "The camera can also be used on racetracks: drivers and teams can get information about where the water is collecting on bends so they can select the best racing line to take."

weather information in the snowplow system for a wider benefit. "We see our snowplows driving around and we know the conditions of the roadway, so we take that knowledge and couple it with other types of weather information such as radar signatures and fixed environmental sensor stations, and advisories and warnings," says Castle. "We take that all into account and determine a location where we can provide traveler information via a roadside sign or the Mi Drive website."

Castle is even looking to a future where it won't be necessary to log on to a website or even look at a sign to obtain such information. He is developing roadside units that will communicate directly with vehicles. "We could be receiving information as to characteristics of the freeway or weather," he says. "We could then take that information and process it, and then return it back to give them some value about current situations, potentially. We're looking at it from a two-way perspective. We can receive information off the vehicles that can give us a better understanding of how the roadway is operating from a mobility/weather/incident perspective. But, in turn, we can provide that information back to the motorist."

The same DSRC technology that is used for V2V and V2I is also being put to use in developing new guidance systems for snowplows. "The state of Michigan is partnering with our Intelligent Transportation Joint Programs Office in using DSRC technology to assist its plows," reveals the USDOT's Winfree. "Part of it is using DSRC so that the plows know what the boundaries of the roads are. I used to live in a very snowy state up north and it wasn't uncommon for a plow to knock your mailbox over – they couldn't see the curb. By extension, they would damage the plow blades so that's an extra cost. DSRC technology will address all that."

> "I used to live in a snowy state and it wasn't uncommon for a plow to knock your mailbox over – DSRC technology will address all that"
>
> **Gregory Winfree, assistant secretary for research and technology, USDOT**

The other side of winter

Once all the snow and ice has finally melted from the roads and spring returns to the Great Lakes, MDOT is planning ways to use its forecasting technology for other purposes.

"We are looking at ways of expanding the use of this tool into other maintenance functions, not just winter maintenance," says Croze. "We do things like herbicide spraying on our roadsides. There are very specific parameters that we need to work at. We can't have a whole lot of wind or rain. So we think we can use this MDSS program to help us in our roadside herbicide spraying applications as well."

As weather forecasting, and more specifically pavement forecasting, become more and more accurate, its potential applications are becoming evermore varied, as are the number of ways such information can be accessed. It seems likely that the connected vehicle of the future could add weathermen to the growing list of professions it may render redundant.

PHOTOGRAPHS: BENOIT DAOUST/SHUTTERSTOCK.COM

Joined-up thinking

Lauren Ansell discovers how an intelligent, hybrid approach to vehicle detection and data collection will improve traffic flow and make waiting in line less frustrating for drivers using the Blue Water Bridge

Photograph: Pictureguy/Shutterstock

A strategic connection between major business and leisure hubs, the twin-span Blue Water Bridge is a critical gateway linking the USA and Canada. The international crossing, which traverses the St Clair River, carries traffic between Port Huron in Michigan, and Point Edward and Sarnia in Ontario. It's estimated that an average of 14,000 vehicles cross the bridge every day. On a particularly busy day, this figure could exceed 20,000, with up to 6,000 trucks.

With the volume of traffic continuously increasing and stringent border controls in place, the bridge has long been a congestion hot spot. While several major modernization projects over the years have already helped to reduce jams, improve safety and enhance traffic flow, another improvement project began last year. The Border Wait Time project is designed to provide travelers approaching the Blue Water Bridge, on

The twin-span Blue Water Bridge is one of the fastest routes from Michigan to Ontario – and back

both sides, with detailed and accurate information about how long they can expect to wait to cross. The details will be displayed on dedicated roadside signs on the highways approaching the US/Canada border and also on the Ministry of Transportation, Ontario (MTO) website. The solution, developed by Parsons/Delcan, incorporates a combination of vehicle loop detectors and Bluetooth sensors.

"This is part of a province-wide initiative by transportation authorities in Canada to improve the efficiency and safety of both people and goods traveling across the border," explains Mike Barnet, senior project engineer for ITS at the MTO. "We feel that it is important to provide travelers using our crossings with an extra layer of information and confidence."

Much of the congestion surrounding the bridge is attributed to the large proportion of trucks transporting goods between the two North American countries. "We do a lot of trade with the USA," Barnet confirms. "There is a particularly large market for the trade of motor vehicle parts, given the nature of businesses in the Detroit area." Ontario is, in fact, responsible for about 65% of Canada's trade with the USA, a business estimated to be worth some C$430bn [US$380bn] a year. "With so much trade moving across our borders, the operational efficiency of our crossings is of vital importance," Barnet confirms. This not only refers to the Blue Water Bridge, but also the Windsor-Detroit tunnel and the four bridge crossings at Niagara Falls.

Critical infrastructure

Previous initiatives to improve traffic management and increase flow at the bridge crossing have included both infrastructure-based solutions and ITS. "Five years ago, we implemented a major expansion of Highway 402's 2.5-mile approach to the Blue Water Bridge," Barnet explains. "This substantially increased capacity, as we expanded the highway from two lanes to five." This section of Highway 402 carries between 15,000 and 25,000 vehicles each day.

The highway approach also operates an intelligent lane management system, using

Intelligent Solutions for Traffic Surveillance

» **PoliScan**^{speed}
Fixed and mobile LIDAR speed enforcement capturing up to 3 times as many incidents as conventional systems

» **PoliScan**^{seco}
Next generation average speed enforcement

» **PoliScan**^{redlight}
Red light enforcement without in-road equipment such as loops and sensors, can also be combined with speed enforcement

» **PoliScan**^{surveillance}
Automatic license plate recognition with highest capture rates

» **TollChecker**^{freeflow}
World´s first nationwide single gantry solution for multi-lane free-flow tolling – now in the fourth generation

www.vitronic.com

VITRONIC
machine vision people

Fast pass

A pre-screening program makes regular travel across the USA-Canada border more efficient and reduces congestion at crossings

The Blue Water Bridge is one of numerous international border crossings that support Nexus – a federal program designed to expedite the border clearance process for individuals that regularly travel between the USA and Canada.

"People who have been pre-screened and pre-approved for frequent travel have their own lane and this helps them to avoid some of the large queues," explains Barnet. "It also enables them to bypass the typical immigration inspection lanes, meaning that these travelers can pass back and forth freely. By incorporating a separate lane for Nexus card holders at our border crossings, we have been able to reduce congestion – and improve journey time for these travelers."

Nexus is a partnership program between the Canada Border Services Agency and US Customs and Border Protection.

dynamic VMS installed above the highway on gantries. "This enables us to organize the traffic into the appropriate lanes well in advance of the crossing," details Barnet. "All heavy goods vehicles are instructed to travel in one lane, passenger vehicles in another, and Nexus card holders in another." (See *Fast pass*, above).

Furthermore, to optimize safety and increase driver awareness in the highly congested area, MTO also operates a roadside queue warning system (QWS) upstream of the bridge. "It enables us to inform approaching traffic that there are long delays at the bridge and slow moving traffic on the highway," says Barnet. "This encourages drivers to slow down well in advance and therefore the risk of collisions is reduced."

The data difference

It is hoped that the border wait-time information project will further enhance the experience for drivers using the crossing. "We wanted to be able to provide travelers with this information because there can sometimes be very long delays at the border," explains Barnet. "This is especially true on holiday weekends, when a lot of Canadians travel over to the USA to shop. When these leisure travelers are combined with the many trucks and the commuters that use the bridge every day, the area can become very congested."

The project team considered several approaches before deciding on the combination of loop detectors and Bluetooth technology. "There are numerous algorithms available that would use only one of these technologies, but we chose to adopt a hybrid approach because we understood that it would be the best way to get accurate and dynamic, real-time information," Barnet explains. "If you use Bluetooth only, there can be lags, because it's always historical data. It can provide detailed information about what happened between a car passing detector A and detector B, but that information can be 10 minutes old before you get hold of it.

"When traffic conditions are consistent, the Bluetooth system would work quite well on its own, but it would struggle when there is a sudden build-up of traffic," Barnet continues. This is where the loop detectors come in. "These detectors pull in information every 20 seconds, so it's a real-time data feed. By combining the data from both sources, you get a better, more accurate picture of what's going on – as it happens."

With such a variety of customers using the Blue Water Bridge, it was also important that the system could distinguish between passenger vehicles and trucks. "We have detectors and Bluetooth sensors positioned upstream of the bridge, which provide us with information about how many vehicles are in the queue," says Barnet. "As our lane management system enables us to direct specific vehicle types to specific lanes, we can furthermore find out how many cars are in the queue, as well as how many trucks. The loops we have installed also help with distinguishing between vehicle types."

The loop detectors situated at the primary inspection lanes provide the real-time service flow rate. "The system knows exactly how fast vehicles are entering and exiting the bridge, in real time," confirms Barnet. "The algorithm then takes all of the information gathered by the Bluetooth sensors and the loop detectors, and provides an accurate picture of the current traffic situation. From this, it can calculate an accurate wait time for drivers approaching the crossing.

> Ontario is responsible for about 65% of Canada's trade with the USA, a business estimated to be worth approximately C$430bn a year

(Top) **The intelligent lane management system on Highway 402 organizes traffic approaching the bridge**

While MTO will not be collecting the data or using it to monitor how much traffic is moving across the bridge, Barnet says the data may be used to improve operational efficiency. "If, for example, we notice long delays reoccurring, we could talk to our partners at the border about how we could improve travel times. If we are constantly seeing long delays, we could think about opening more lanes for inspection."

Instant messaging

The next stage of the project will see the installation of the dynamic LED signs that

PHOTOGRAPH: IVAN LISENKOV

will display the current wait-time information to travelers approaching the bridge. "We're currently finalizing the signs and we hope to install them by the end of the spring," says Barnet. "The design of the sign itself has been quite a challenge, due to the amount of information we want to display. Not only do the signs need to provide information for passenger vehicles, trucks and Nexus card holders, as well as information related to the Blue Water Bridge crossing, we have also had to keep in mind the other border crossings that we might want to use this type of sign for in the future. We have had to be mindful that some of the potential future locations for these signs will also require that we post the information in both English and French – and that could make the sign rather large."

Barnet says it has also been a challenge coordinating the numerous agencies involved in the project. "It always adds a new layer of complexity when there are a number of different agencies involved," he explains. "We have been working closely with our partners at Michigan DOT [which owns and operates the US side of the bridge], who have been developing their own system at the same time, as well as the Blue Water Bridge Authority [which owns and operates the Canadian side of the bridge], Transport Canada, which provided funding for the project, and the border agencies."

Together, the project team also continues to work through some technical challenges to ensure that the results calculated from the data are accurate. "In the early stages, we had a couple of issues with communication failures, so we have had to sort those things out and make sure that the data is reliable and can be trusted," Barnet explains. "We're also hoping to make the data available through open data sources and the web, so that anyone who wants to take the data and disseminate it, can do so."

(Above) **The bridge stretches 6,178ft (westbound) and 6,109ft (eastbound)** (Right) **The crossing plays an essential role in connecting Ontario and Michigan**

> We'd like to see if we could procure data from a third party... and find out if this data could be detailed and accurate enough for us to use
>
> **Mike Barnet, senior project engineer for ITS, Ministry of Transportation, Ontario**

Shared intelligence

If successful, this project could serve as a prototype for other strategic crossings on the USA-Canada border. "We plan to install these types of systems at some of our other major crossings, but we first need to take a step back and see what we've learned here," says Barnet. "While we all agreed initially that a combination of Bluetooth and loop detectors would be the best approach, it will be useful to evaluate the performance of the technology in the real world. We're also interested in investigating alternative solutions that are not based on physical infrastructure. For example, we'd like to see if we could procure data from a third party, such as Inrix or TomTom, and find out if this data could be detailed and accurate enough for us to use.

Looking ahead, Barnet foresees greater collaboration between the international agencies. "It's been great to work with MDOT on this project," he says. "With the economic and social benefits of our border crossings so vitally important to both Ontario and Michigan, we're looking forward to developing our working relationship on future projects that will enhance the prosperity of both regions."

NORBIT

- explore more -

The Independent DSRC Supplier

NORBIT technology at its best – Delivering performance, functionality and compatibility to the world of CEN DSRC.

COVERING THE WORLD – UNCOVERING POSSIBILITIES

Explore more with NORBIT | www.norbit.com

Model behavior

David W Smith speaks to the experts behind the sensor and software developments that will enable fully autonomous vehicles to self-navigate, collect data and share intelligence

Illustration: PILart

(Above) **Obelix, a robot created by the University of Freiburg, Germany, autonomously maps its way through the city's streets**

Although Google's autonomous vehicles often dominate the headlines, the Californian giant has many rivals in the race to create a safe and affordable robot car. Whereas Google has bottomless financial resources, other researchers have restricted budgets, but it's the ideas that count. One of the most innovative ventures is Oxford University's RobotCar UK project, which has a budget in the thousands of pounds rather than the millions of dollars.

The Oxford team, led by Prof. Paul Newman, has built an autonomous car that can map its environment without the aid of GPS, then drive autonomously. While humans drive the modified Nissan LEAF through the test center at Begbroke Science Park near Oxford, it uses cameras and laser sensors to build a 3D model of its environment, including streets and road markings. Later, when the car recognizes a familiar journey, an iPad built into the dashboard informs the driver that the computer housed in the boot can take the wheel. A spin-off company, Oxbotica,

has just been launched to commercialize this and other applications of the robot technology that has been developed.

"The key concept is experiential learning," says Newman. "The car learns from its experiences and becomes more intelligent over time. So let's say you send a car out into an environment and on both the first and second days there is benign weather; it maps that. But on the third day it's pouring with rain. It's seen nothing like that before, but through experience-based navigation, it learns a new memory of what the world looks like in this rain. The car's computer becomes more intelligent over time by learning through statistical means. It counts which things it saw before that are still relevant a day later, or in different weather conditions."

Newman says the vehicle's mapping of the world is 'plastic' because the map is reshaped at every turn. "All the magic is caused by what we call 'plastic mapping'," he explains. "It's different to an elastic map, which would stretch, then spring back to what it was before. Plastic gets deformed by the experiences it goes through, and flows into all the nooks and crannies of difficult and new situations."

There is a widespread belief that the most important advances will be in sensor technology, but Newman says this is a misconception. "Stop thinking about sensors and instead think about software," he says. "That's what changes everything. Software has transformed phones, cinema, entertainment and finance. I'm an information engineer, so I'm interested in taking the sensors and making them perform somersaults because of the way they process data. The printing press was a spectacular invention, but it was nothing compared with the speed of progress of computers – and it's all been driven by software development."

Solid foundations

Although Newman's car achieves good results by mapping from scratch, other experts argue that autonomous cars also benefit greatly from using static maps. Maxime Flament, head of sector for Safe Mobility at ERTICO-ITS Europe, a partnership of more than 100 ITS businesses, says the increasingly accurate static maps of TomTom and Nokia's Here help to facilitate live mapping.

"Static maps are important for sensors as they provide prior information about what a vehicle's sensors should see in the next second, and the car can then tune its sensing platform according to what it expects to see," he says. "An easy example would be if a car is approaching a crossing and it knows from its static maps that the red light is on the right at a height of 2m, it can optimize its sensing and computing power to scan that specific area."

(Above) **Oxford University's RobotCar project navigates using on-board 'plastic' mapping techniques**

Static maps, Flament says, show cars what to expect if there were no cars or pedestrians on the roads. The car can then look for any deviations from the norm. "The live mapping comes in when unpredictable events occur, such as slow vehicles ahead, or incidents in a lane. The smartest way for the car to figure out what's happening is to compute the difference between what it expected based on its static maps and what it has sensed in the moment," he says.

When the static maps become detailed enough, it will facilitate the live mapping, which allows advanced driver assistance systems to take control of the vehicle. "Some of these types of programs already exist in high-end cars, although they are not yet fully autonomous," says Flament. "But when they do become autonomous, they'll first be used for the two extremes of very boring journeys and very demanding ones. A boring journey would be down a long stretch of highway where you turn on auto-cruise. A demanding one could be when roadwork construction forces you to stay in narrow lanes."

> "It's all about software… I'm interested in taking sensors and making them perform somersaults because of the way they process data"
>
> **Paul Newman, professor of information engineering, Oxford University, UK**

However, a lot more research is needed before the capacity of cars to carry out live mapping is accurate enough for cars to drive on the roads, according to one of the world's most distinguished thinkers in the field. Prof. Wolfram Burgard is head of the

Ditching history and going live

Here plans to use autonomous vehicles to eradicate out-of-date data

Nokia's Here team has designed a mapping system to solve the problem of out-of-date information. Up until now, the company has relied on the sensors in its own fleet to gather information about the location of lane markings, traffic lights or the height of curbs. But the data gathering is restricted to the company's own fleet. Meanwhile, car makers are demanding ever greater accuracy for the

maps used in their prototype autonomous vehicles.

To expand the quantity of information available in the future, Here says it plans to gather data from autonomous vehicles that have installed its HD maps.

"As the number of autonomous cars increases, the sensors on the cars build a view of what they see, which we could cross-reference with the HD map," Here's communications manager, Christopher Lawton, told *SlashGear* magazine. "When the two don't match, the car would send us a signal."

Laboratory for Autonomous Intelligent Systems at Freiburg University, Germany. His applications are used by both Google and Daimler in their autonomous car prototypes, and he co-wrote *Probabilistic Robotics* with Sebastian Thrun, a driving force behind the Google driverless car.

"There are many complex problems to solve," Burgard believes. "One example is getting the sensors to accurately read directional lights. I discovered this problem when I was riding in the back of Google's autonomous car this summer and the car in front of us signaled it would turn into a driveway. I could see the car was going to brake or slow down, but the Google car didn't realize because regularly blinking lights are hard to read. As a result, it made a sudden braking maneuver. You need highly accurate technology to overcome such problems."

(Top) **Prof. Wolfram Burgard's Obelix robot creates a stir with its live, laser-assisted mapping techniques**

Another example he gives is that autonomous cars find it difficult to use GPS to navigate on snowy roads. "In one study, the autonomous car was displaced by 1.5m from the line of other cars when snow covered the road markings," he explains. "But by using precise algorithms and live mapping, you could theoretically infer where the lanes are and follow the other cars."

Although Burgard agrees with Prof. Newman that software development will solve most problems, he feels the quality of sensors also has to improve. "For one thing, we do not have a 3D sensor that isn't bulky," he says. "The Google car has a large Velodyne sensor on the roof and all other autonomous vehicles have to be densely equipped with heavily modified sensors. Some developers are starting to use radar because it's more compact, but it's less accurate than laser."

Collaborative efforts

The need to tackle so many issues has led map makers and car manufacturers to pool resources. In October, at the Paris Motor

Show, TomTom and Volkswagen announced a partnership to develop Highly Automated Driving systems. The goal, they said, was to combine TomTom's expertise in map making with Volkswagen's technical knowledge of cars and automated driving. Meanwhile, TomTom's major rival, Here, has already teamed up with BMW to provide drivers with more accurate maps.

ERTICO's Flament says there also needs to be greater collaboration between public authorities and map providers. "The commercial map makers are gaining more knowledge of the environment and road networks all the time, but I get the impression public authorities have less and less information about networks," he says. "They are barely controlling the information they have already."

Flament wants to see a digital infrastructure framework between public authorities and map providers that lays out their mutual responsibilities to keep maps up to date. Both sides would benefit. "There would be operational cost savings for the road authorities, and the map makers would get ready access to a lot of data," he says. "They would exchange all their information. Whenever an authority changed a speed limit – to give just one example – all map makers would be immediately notified. Conversely, if an automated car's sensor notices a pothole or unreadable road markings, modern technology would enable the authorities to be notified automatically."

Keeping the static maps updated is crucial for accurate live mapping. "To enable automation, it's essential that the information on the roads is detectable by the sensors," says Flament. "Then, there will be a further step in the future when maps become so accurate that we won't need all these road markings. That might happen when all cars are being driven autonomously, or at least feeding back a lot of information to the driver. Then there would be huge savings on infrastructure costs."

Shared intelligence

Flament believes all vehicles will eventually participate in mapping the roads. The live data they gather could be made available to all cars. Here has a partnership with IMB, with the goal of storing live mapping data in the cloud for everyone to access.

The vehicles will also eventually communicate the live data to each other through vehicle-to-vehicle (V2V) communication. "The cars could exchange information about free parking spaces, or the location of traffic lights, or send warnings about incidents ahead," details Freiburg University's Burgard. "This would substantially enhance navigation. But there's not much research in this area. Most projects are about an individual car's intelligence, rather than using multiple cars to achieve a joint interpretation of the world that is dynamically updated in real time."

Despite the many advances necessary in order to build safe autonomous cars, Burgard predicts that the day will come soon enough. "We will get there gradually," he says. "Right now, we can drive autonomously at 30km/h (19mph) on highways – with the increasing robustness of perception algorithms, that speed will get faster and faster. Autonomous cars will be able to navigate complex urban environments like New York City, although a place like New Delhi, with its rickshaw drivers and elephants crossing the road, might take a little longer!"

Common ground

A partnership between TomTom and Volkswagen is aiming to develop a universal language for mapping and navigation

In their new partnership, TomTom and Volkswagen are attempting to create a new standard for digital maps that provides a universal file format for navigation devices. They call it the Navigation Data Standard (NDS).

The companies argue that one of the biggest problems with emerging technologies is that everyone wants to build their own standard.

Mapping technologies for automated driving are a good example. Rival companies are developing independent solutions, which makes everything more expensive and less efficient.

The expectation is that NDS would help to drive down prices of automated technologies, including live mapping. In addition, a standardized system would make V2V communication much easier between the automated vehicles of rival car makers.

(Right) **Prof. Wolfram Burgard poses with one of his research robots, 'Albert'**

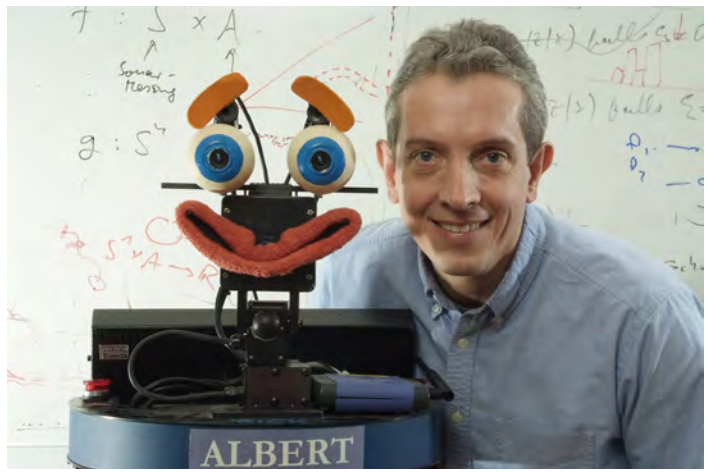


ILLUSTRATION: PILART/SHUTTERSTOCK.COM, HOBBIT/SHUTTERTOCK.COM, PETRAFLER/SHUTTERSTOCK.COM

> There will be a further step in the future, when maps become so accurate that we won't need all these road markings. That might happen when all cars are being driven autonomously
>
> **Maxime Flament, head of Safe Mobility, ERTICO-ITS Europe**

Lumenera corporation

High-Performance IMAGING SOLUTIONS for Your Transportation Needs

USB 3.0, USB 2.0, GigE

LUMENERA TRANSPORTATION CAMERAS

Lumenera offers a wide range of cameras specifically designed for advanced transportation systems. Choose from over 1,250 off the shelf board-level and enclosed cameras. Tailor our flexible products to meet your specific needs, or fully customise your own product to fit your design requirements.

Automated Tolling • Safety • Monitoring • LPR • Speed / Red Light / HOT Enforcement • Parking Access

Contact us today to determine how you can benefit from Lumenera's high-performance cameras.

www.lumenera.com

Lumenera® corporation

Seeing the future

In a figurative sense, machine vision is only just opening its eyes. **Saul Wordsworth** investigates its growing use in advanced traffic management and predicts where these enhanced powers of observation will take us

Photographs: Kiselev Andrey Valerevich

Vision is the sense in humans that provides most of the input and requires by far the highest level of processing in the brain. The human eye, with its 100 million sensors, far outstrips the capabilities of a camera. The human brain, with its 10^{11} neurons, dwarfs the processing power of a PC.

However, since the 1960s, when people started to understand the potential of automatic pattern recognition and machine vision (MV), computers have gradually been able to perform some tasks better than humans can, notably optical character recognition (OCR) and the automated inspection of products during manufacture. The human brain quickly tires of these types of monotonous tasks, whereas a computer can excel by performing a 100% untiring inspection, thereby eliminating the unreliable human component.

"The promise of MV is to perform boring, mindless tasks better than the

human, and in many cases perform them much faster," says Roy Davies, professor of machine vision at Royal Holloway, University of London. "It is only in the past decade that MV has entered the world of traffic technology. Its solutions in this area include vehicle counting, vehicle identification, license plate recognition, vehicle lane adherence and the gathering of all sorts of statistics, usually via cameras placed above or beside highways and roads. All this surveillance can in principle result in the whole road system being controlled – and not merely by placing adjustable speed limits above traffic lanes."

All-seeing London

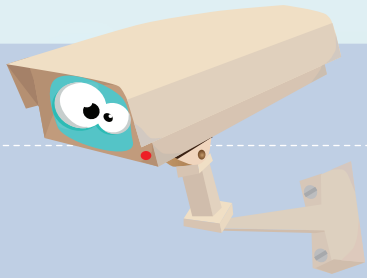
MV was adopted by Transport for London (TfL) eight years ago. Current systems include one that monitors standard traffic cameras and uses MV to detect congestion automatically at pinch points that have been identified around the city.

"We use video analytics and real-time data to alert our control center to congestion," explains Mark Cracknell, technology team leader. "Such systems are widely used around the world. We also have an automatic road network, monitoring roadwork sites to determine activity. When we draw up conditions for when people can deploy roadworks, we need to ensure they work according to their permit. For this we use wireless redeployable MV cameras that clamp to lighting columns. MV is also used widely used in tunnels to detect broken-down vehicles, debris and smoke."

TfL coordinates traffic in London via SCOOT (Split Cycle Offset Optimisation Technique). This monitors traffic and

> We are the first and only people in the world using MV stereoscopic cameras to quantify pedestrian demand and calculate waiting pedestrian numbers
>
> **Mark Cracknell, technology team leader, Transport for London**

How smart is your camera?



The best machine vision gives the user more information and control

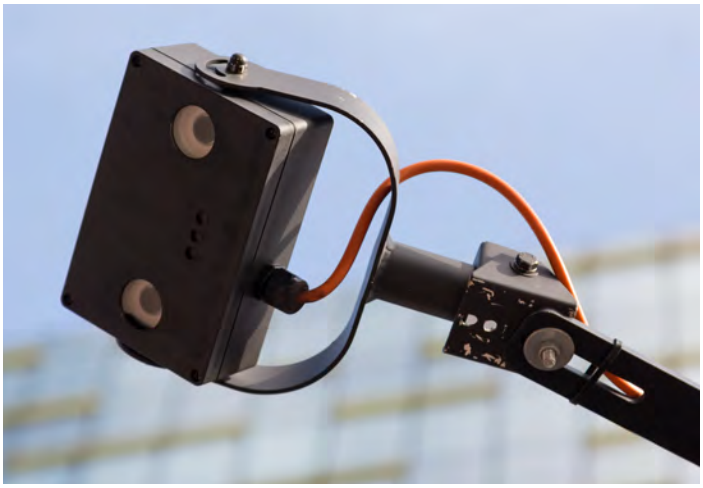
Smart is an often misused term when it comes to taking pictures. "Many camera manufacturers claim their pocket digital cameras are smart because they have automatic focusing, irises and exposure times," says professor Roy Davies. However, such functions don't really fit the true definition. "The term is better defined as including communications systems that can automatically send data to central control locations, as well as being controlled by them," explains Davies. "They can often incorporate specific software for specific applications and can in some cases amount to complete inspection or surveillance systems.

"On the other hand, how much is done in a remote smart camera rather than a much smarter complete computer installation is arguable and smart cameras are bound to be limited. This follows because the controlling computer will usually know more, not least in the case when multiple smart cameras feed it with information."

performs calculations every second to coordinate the traffic signals. Historically this has catered only for vehicles because of the limitations of the detection technologies available.

"To date SCOOT has only been used to detect large lumps of metal," says Cracknell. "When it comes to pedestrians, all we knew before was that someone wanted to cross the road because they had pushed a button. We didn't know whether one or 100 people were waiting. Our latest project is to evaluate technology that can allow us to quantify the number of pedestrians waiting to cross, so we give them the appropriate amount of time to do so. One part of the project is the MV element, in other words the smart cameras to capture that information. The other part is what we do with all that data back in our urban traffic control system."

Two sites in east London currently have smart cameras on traffic signals, which are monitoring the curbside waiting area. They use a technology called stereoscopic vision, which employs two cameras within the detector that enable it to get a sense of depth – in the same way humans judge depth with two eyes (think how much harder it is to catch a ball with one eye closed). Two



(Below) **Transport for London's SCOOT system is now being expanded to include machine vision that detects numbers of pedestrians waiting at crossings**

> The count information shows us the number of cars in a zone. It can trigger a threshold to change the sequence of the lights – to adjust it in real time. This would not be possible without machine vision
>
> **Andrew Maximous, acting principal traffic engineer, City of Santa Monica**

cameras means discounting shadows, puddles and reflections, thereby providing robust detection for solid objects.

"Of the two products we are trialing, one gives us an absolute count of the people, while the other one quantifies the percentage of the waiting area that's full," says Cracknell. "We are hoping to determine how accurate the detectors are, as well as capture the benefits we will get once it's pushed into the SCOOT system and timings are updated. We are the first and only people in the world using MV stereoscopic cameras to quantify pedestrian demand and calculate waiting pedestrian numbers."

California counting

Santa Monica, California, USA operates two types of cameras, CCTV and video detection. According to Andrew Maximous, acting principal traffic engineer for the City of Santa Monica, not only does the latter give another set of eyes at the intersection, but it's a flexible way of detecting vehicles.

"We set up count zones on the video detection screens to allow us to collect extra data," he says. "It's not as accurate as having someone out there, but it gives us a good idea of what is going on. We are in the process of trying to take the camera feed data and integrate it with our traffic management system. The count information shows us the number of cars going through a particular zone; it can trigger a threshold to change the sequence of the lights – to

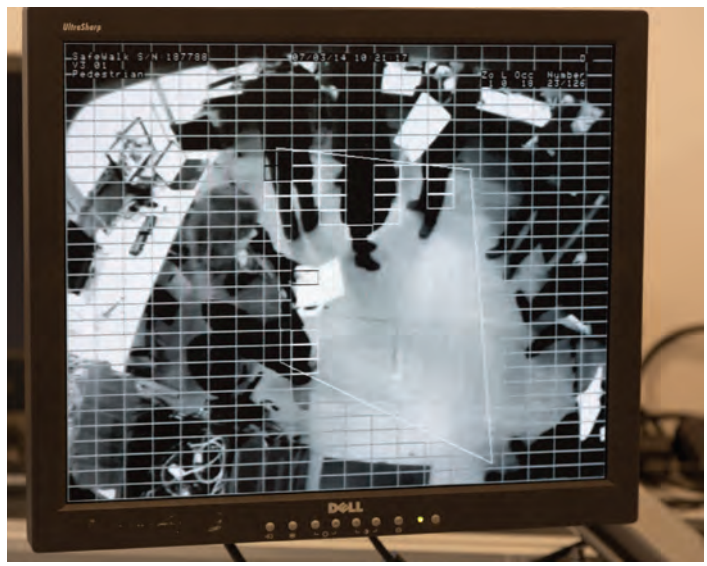
Cameras for cars

What are the limitations of MV when applied to vehicles themselves?

Driver assistance, robot control and examining driver wakefulness and alertness are all possibilities for vehicular machine vision. Driver assistance can include informing the driver of routes, events and hazards to come, spotting pedestrians, and automatic control of steering, brakes and accelerator, some of which may feature in future automated vehicles. Robot control means that the assistance system takes over. Google and others have been carrying out tests and have obtained a lot of capability and credibility. These tasks are all suited to future machine vision systems.

However, who takes the blame if something goes wrong? The driver will say it is not his fault; the car manufacturer the same. The robot control system designer will say it was not designed for such extreme eventualities and that the driver should not have relinquished full control to the robot and gone to sleep. One way out of this quagmire is that the robot should take over only when there would otherwise be an accident, which it can prove afterwards if necessary by supplying the right amount of ambient data from its many cameras and sensors. All this might induce drivers to take excessive risks.

Perhaps the biggest remaining problem is one of visibility, including that made available by combined radar, vision, infrared and ultrasonic sensors. Rain, hail, sleet, snow, mist and other weather conditions, including reflections from wet roads and glare from lights, render the going difficult for humans, let alone robots. Data fusion of a lot of sensor systems doesn't automatically hold the key.



adjust it in real time. This would not be possible without machine vision."

While most cities still use their timing plans and schedule on a time-of-day basis to change the lights, Santa Monica is moving toward a more real-time, reactive system.

"These adaptive, responsive systems are improving," says Maximous. "It's all based on good data. The camera technology has its ups and downs, but is more robust when it comes to getting that data to our systems."

Canada calling

"Machine vision cameras play a large part in our solution," says Darrell J Geiss, crew lead traffic technical operations, Regina, Saskatchewan, Canada. "We have cameras at almost every intersection in the city. In most cases we are detecting side street movements along with the left turns on main street coordinated phases. By using detection for side streets, we give priority to the main coordinated movements."

(Above right) **Through the eyes of a machine: Transport for London tests its pedestrian counting system in an office environment**

According to Geiss, newer technologies are streamlining equipment at all levels. The hardware needed has reduced from numerous bulky components and cabling, which takes up vast amounts of space within roadside control cabinets, to only one or two small boxes operating via Ethernet. Multiple cameras can now operate on just one cable.

"With rapidly changing technologies, it's anyone's guess where it will go or what it will be capable of, but it's a given that it will help to provide more efficient traffic flow and data," he says.

German input

Basler is one of the world's leading providers of MV cameras. According to Enzio Schneider, the company's ITS product line manager, until recently MV solutions have mostly been limited to high-end applications such as enforcement systems or free-flow tolling where the car doesn't have to stop at the barrier and the license plate is read automatically.

"These two applications usually generate revenue and therefore are able to justify a higher investment up-front," he says. "This is changing because MV cameras are becoming more price attractive due to the higher volumes being produced. That makes them more appealing for new traffic solutions with a good pricing in areas that haven't yet been addressed."

OEM – Now in Europe

All stocked and supported directly in Europe

New 3 Mega-Pixel Integrated Zoom Lens

1/1.8" 15-50mm F/1.4-close (model DE005)
designed especially for ITS applications

- Optical Design for Low-Light Conditions
- Ideal Focal Length for Traffic Surveillance
- Precise Remote Control
- Special Coating Technology
- Extra Low Dispersion Glass Elements
- Compact Size

Get in touch with us for more information:
www.tamron.eu

TAMRON
New eyes for industry

Data overload?

Setting up cameras is one challenge; processing their data is quite another. The vast amounts of data machine vision generates is sometimes referred to as 'big data' – a large bulk of information that is difficult to process using traditional means.

"With pedestrian SCOOT we just provide a number but we can also, for instance, determine how long pedestrians have been waiting," says Cracknell. "There is scope for additional data that can be brought into the system. The detection system is built for one use, but there are many possible new applications of MV being researched."

One such application is in vehicles themselves, but this creates even more big data issues. "The amount of data coming from a vehicle-mounted computer in even one week can't be processed in full by any simple means," says Royal Holloway's Roy Davies. "However, it could be analyzed in real time – for instances of pedestrians on the road ahead, for example. You could also use the big data produced by machine vision to train a driver assistance system in all types of bad weather. You could get the controlling computer to analyze and use as much imagery as necessary to train it to become a good all-hours, all-weather driver."

(Left) **Santa Monica's traffic management system where MV helps to make signal timing decisions**

> The amount of data coming from a vehicle-mounted computer in even one week can't be processed in full by any simple means
>
> **Roy Davies, professor of machine vision, Royal Holloway London**

Computers are good at assessing risk, as well as at coping rigorously with complex statistics, so for simple tasks, MV looks set to be a massive growth area in advanced traffic management. However, as cameras become more advanced and detailed in their images, such systems also run the risk of adding to the growing mountain of big data that is never properly processed. In our modern, digital world, the last word on MV is nevertheless over 150 years old: It's as 19th century American author Henry David Thoreau said: "It's not what you look at that matters, it's what you see."

PHOTOGRAPHS: KISELEV ANDREY VALEREVICH/SHUTTERSTOCK.COM

Season of the switch

Mention LED streetlights that automatically dim and the chances are someone will question their safety. **Michael Donlevy** investigates whether the industry has adequately addressed these concerns, and discovers a technology that, through reduced running costs and increased adaptability, is poised to take over the world

Illustrations: Akinina Olena

LED streetlights are big business, with the new fittings rapidly replacing the suddenly outdated HPS (high-pressure sodium) lights that have prevailed for decades. But also increasingly big business is the network technology that can control and monitor the lights.

"We expect networked streetlighting to expand rapidly in the coming years," says Jesse Foote, senior research analyst at Navigant Research, which earlier this year published a report *Smart Street Lighting*. "A great example is China, which set a goal to install 500,000 networked lights by the end of 2014, and, as we speak, appears on track to do so. Many European cities have installed networked streetlight control as well, with Germany and the UK being leaders.

"One big development was the publication of ANSI standard C136.41 in February 2013, which allows a plug-in device to dim a streetlight," says Foote. "Many streetlight manufacturers are already adopting the standard. Those lights can be networked and dimmed, based on real-time conditions."

Advances in technology mean that increasingly the latest smart LED streetlighting is confounding critics by improving safety as well as saving money, in more and more locations around the world.

Brand new and retro

In 2014, San Diego became the first city in the USA to illuminate its downtown district with GE's intelligent lighting system. The installation included LED luminaires – fitted into the city's historic streetlights – and GE's LightGrid technology, which uses a wireless network to monitor and remotely control every light individually to measure emissions and warn of problems.

> We wanted a wireless inventory assessment of each and every light in the system, which engineers can access online at any time
>
> **Lorie Cosio-Azar, project officer, City of San Diego Environmental Services Department**

The motivation for change was simple. "We wanted a wireless inventory assessment of each and every light in the system, which engineers can access online any time of the day or night," says Lorie Cosio-Azar, project officer, City of San Diego Environmental Services Department.

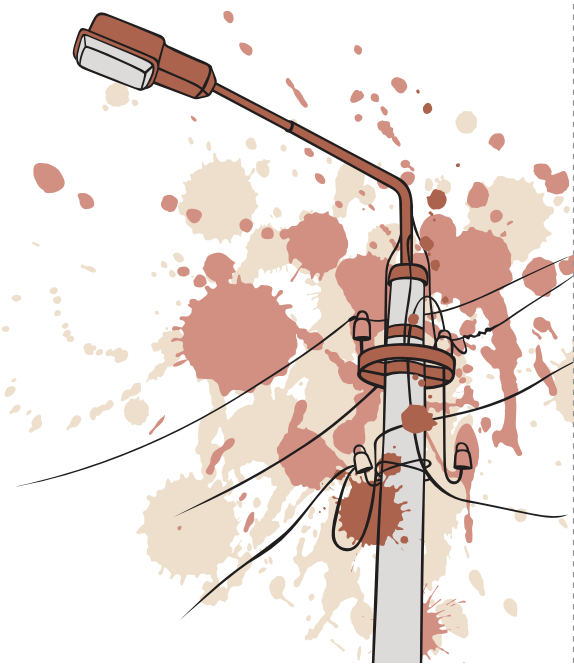
"The maintenance tool enables us to dim the lights to the L70 lumen maintenance rating that the LED fixtures allow," continues Cosio-Azar. "When you buy the fixtures, they're designed to light above the 70% light output rate that you need. Over time the fixture fades to 70% light and is then considered 'diminished'. So when you first buy the fixture you have anywhere from seven to 10 years when you are using 30% more energy than you need to light your area. Adaptive controls provide the opportunity to dim the lights, allowing for extra savings. The system automatically adjusts over time to ramp up the fixtures to make sure the minimum light level is always maintained."

The initial costs aren't low – there are 3,000 streetlights in downtown San Diego – but they will be recouped. "Each roadway fixture installed with adaptive controls costs approximately US$450, including design, traffic control, fixture and labor," says Cosio-Azar. "That added up to US$1.35m. The payback for roadway fixtures with adaptive controls is seven years."

Yet the new system isn't just about saving money – it's safer, too. "LEDs provide a broad-spectrum light source that the human eye sees better in," she says. "It's more directional and clear. There are fewer shadows and there's more uniformity."

Being able to remotely control lights means they can be dimmed or switched off at certain times, but this is not an option in an urban area where traffic and pedestrians move around 24 hours a day. That's not the case everywhere, however.

(Top and above) **Historic lamp posts in San Diego have been refitted with LED lighting systems** (Above right) **The Royal Dock, Grimsby, the UK's largest arrival point for imported cars, has recently upgraded to LED lighting**



Greater control at a lower cost

Kamloops, in the province of British Columbia, has a population of approximately 86,000. The city recently replaced its HPS luminaires (100W and 150W) with LED luminaires (72W and 100W) from LED Roadway Lighting (LRL), equipped with LRL's proprietary Lumen IQTM wireless monitoring and control system.

The lights have been responsible for a total energy saving of 69%, or US$28,316, over the first year. The reduction in greenhouse gases is forecast at 129 tons over 20 years, for a total saving of around US$761,000. Throw in maintenance savings of up to US$805,000 and that's a hefty pot of cash.

"Many cities currently send employees driving around at night to look for outages," says Foote. "In some areas, residents report outages immediately, but in others those outages might not ever be reported. A network-controlled system completely eliminates the need for those patrols. Any networked system will report faulty lights. Most systems also track run times, so that when lights do eventually need to be replaced, the work is well coordinated."

> "I don't believe there's yet a definitive conclusion one way or the other – but there's good reason to think that dimming or turning off lights can be safe
>
> **Jesse Foote, senior research analyst, Navigant Research**

Yet again, safety has to be a key consideration, with contrast almost as important as luminosity. For example, the level of luminosity on the road can be dimmed when just a few cars are driving. The lights at pedestrian crossings, however, are not dimmed and in some systems the luminosity level can be increased if someone is crossing the street. In this way a visible contrast is produced, sometimes called a light band.

Kamloops has a temperate climate but is prone to thunderstorms during the summer, which can reduce visibility during daytime

hours. This is where a manually operated wireless network, which allows a human operator to override preset time controls, can be a valuable safety tool.

This is a key development in the case for intelligent LEDs. "Networked control can be done better than by simply using photosensors," says Foote. "Another example is the ability to bring lights fully on during an emergency, or flash lights to direct emergency responders to a specific address."

In the UK, lights have been turned off in certain areas at night, which has led to criticism from the likes of the Automobile Association (AA). But Foote makes an interesting point. "At the Street and Area Lighting Conference in Nashville, the electrical services manager from Suffolk in the UK presented a good deal of unpublished evidence that turning off lights actually made areas safer," he says. "Criminals like to be able to see inside parked cars without using flashlights that would draw attention to themselves, and his experience showed that vehicle accidents did not increase. More studies are needed. I don't believe there's yet a definitive conclusion one way or the other, but there's good reason to think that dimming or turning off lights can be safe.

"My impression is that town and city residents are used to streetlights being on and having spaces lit, and it's natural to assume that turning those lights off would be unsafe," he adds. "But the example in Suffolk showed that people very quickly became used to having the lights off, and actually complainedwhen they were periodically turned on."

Large-scale lighting

It might not be a city center, but the Associated British Ports (ABP) Royal Dock in Grimsby is a shining example of how LEDs are being used to trial innovations and improve safety in busy areas where there are high volumes of traffic and pedestrians.

The Royal Dock is the UK's largest arrival point for imported cars, and handles around 500,000 vehicles a year from major manufacturers including VW and General Motors. When ABP decided to expand the terminal to increase its capacity, it also took the opportunity to review the lighting.

Initially, ABP planned to install standard lighting for this type of site. But after entering discussions with Philips it became clear that LED lights would improve both visibility and emissions. Philips worked with high-mast specialist Outdoor Highlight to illuminate an area of 646,000ft² (60,000m²) using two 82ft (25m) masts and Philips Luma 3 LEDs. The luminaire's white light is proven to increase visibility, which helps to make the terminal a safer environment for the workers.

"The human eye's perception is such that white light looks much brighter than yellow," says Thomas Novak, research project manager at traffic solutions manufacturer Swarco. "In essence, an LED is an almost point source of light. It's much easier to channel the light output, especially with proper optics. As a result, it's possible to focus most of the light output just onto the road and reduce light pollution."

The fact that LED lights can be focused more accurately on a specific point explains how ABP was able to reduce the number of installations. "About 50% of the light hits the road with LED technology, compared with 20-30% with sodium systems," says Novak. "LED technology delivers on average 140 lumens per watt, whereas sodium lights deliver only 120 lumens per watt."

The installation of LEDs has certainly had an environmental impact, leading to energy savings of 31% and carbon savings of 4.7 tons per year. The number of luminaires was reduced by two per mast and the overall wattage decreased by more than 2,000W, equivalent to 8,672kWh per annum. The original scheme would have involved 16 440W luminaires, but the LED installation enabled this to be reduced to 12 406W luminaires.

(Left) **The new lighting system at the Royal Dock in Grimsby has led to energy savings of 31%**

This has implications for similar sites, such as commercial docks and large parking lots, for example at hospitals and airports. "We're seeing LED lights making headway in all outdoor areas, where lights have high wattages and long run times," says Foote.

Walking into the future

Streetlighting isn't just about illuminating the road for motorists. Pedestrians are important, too, and if they can be better seen there are less likely to be accidents. This is where a new form of bollard-level lighting comes in. A year ago, John D Bullough, senior research scientist at the Lighting Research Center of the Rensselaer Polytechnic Institute, told *TTI* that overhead lighting systems – even LEDs – "tend to illuminate the ground rather than vertical surfaces such as pedestrians". This means that in urban areas traditional streetlights might not be enough to improve road safety.

Bullough has worked on several trial versions of the bollard-level lighting system that he says will increase the contrast between pedestrian crossings and the surrounding areas. Next up is a field test in New York state.

> About 50% of the light generated hits the road with LED technology, compared with just 20-30% with traditional sodium systems
>
> **Thomas Novak, research project manager, Swarco**

"The field test will be a short-term, temporary installation using prototype bollard luminaires, developed by 3M and Intrigue Lighting, along one or more crosswalks in downtown Schenectady, where there are heavy pedestrian volumes at certain times during the night," Bullough says. "The project is being conducted for the University Transportation Research Center [www.utrc2.org] and funded by the Research and Innovative Technology Administration of the US Department of Transportation.

"The fixtures at the edges of the crosswalk provide vertical illumination, which makes the pedestrians appear brighter

Net benefits

Jesse Foote, senior research analyst at Navigant Research, says networked dimmable LED streetlights are increasingly a no-brainer

The case for LED streetlights may have been thin only a couple of years ago, but is now compelling. Prices have fallen dramatically and efficiencies have improved. This has slashed payback periods to a point where, even without incentives or rebates, this type of light is the logical choice. LEDs also provide a better quality of light, giving increased visibility, and longer lifespans reduce maintenance costs. Some manufacturers are already discontinuing HPS product lines, foreseeing dwindling sales in the coming months.

The case for dimmable networked streetlight control is not as solid as the case for LEDs, but is beginning to convince more city managers. Energy and

cost savings can be high if lights can safely be dimmed or turned off when there are few vehicles on the road, or when real-time sensors show that full brightness is unnecessary.

The most compelling part of the case for networked systems, however, is typically not utility or maintenance savings, but rather the host of additional features. Real-time traffic sensing, weather monitoring, modifiable signage, photovoltaic panels, electric vehicle charging stations and a host of other smart city applications become easier once these streetlighting networks are in place.

Considering all the benefits, it seems odd to criticise city managers for trying to cut costs. After all, a city's budget is supplied by the residents of that city. If that budget can be reduced through the use of a product that also provides a superior service, then managers should be advised to quickly consider adopting both LEDs and networked controls to better serve their municipal customers.

Imagine a Traffic Camera Engineered for your Requirements

Genie TS

VERSATILE ITS CAMERA

- Up to 12Mpixels and frame rates as high as 70 fps in HDTV format
- Image-to-Image ROI
- Auto-Iris (Video, DC or Motorized)
- Auto-Brightness Feature
- Extended Dynamic Range Function
- On-board Image compression

Watch the Genie TS 5 features video

http://goo.gl/vazqDN

TELEDYNE DALSA
Everywhereyoulook™

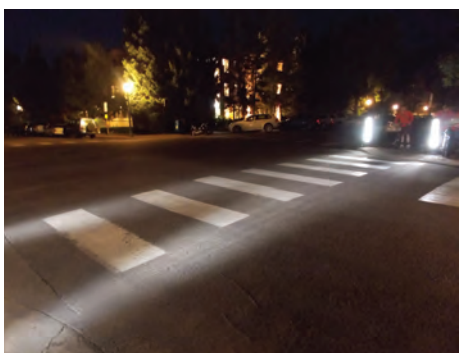
than conventional overhead lighting would," says Bullough.

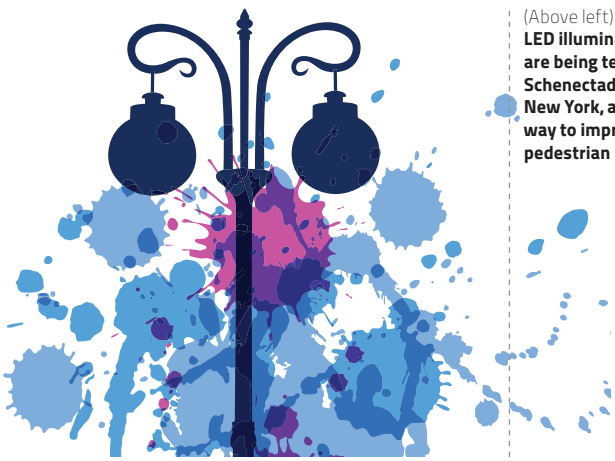
"During the short-term installations we'll measure the light levels and contrast of pedestrians in the crosswalk as viewed by oncoming drivers, and collect feedback from pedestrians about their impressions of the lighting system," he adds. "If it is successful, we hope cities will begin to request this type of lighting in downtown areas, where pedestrian safety is crucial."

Bollard-level lighting is being trialed in the UK, too. In fact, the Giltbrook Retail Park near Nottingham has taken the technology one step further by installing pole-mounted pedestrian detectors that activate LED road studs to highlight pedestrian crossings around the parking lot; this is coupled with LED speed warning signs on approach roads. It's a system that appears to be working to improve safety. Site managers claim that motorists are approaching the crossings at lower speeds.

"The idea is to increase the contrast between the road and pedestrian crossing," says Novak of Swarco, which supplied the system. "Increasing the level of luminosity is demand-driven and raised almost without delay. Since our eye is working ina logarithmic way, it's necessary to double the level of luminosity."

Currently the studs can only be used on privately owned roads in the UK, but campaigners are pushing the Department for Transport to allow the system on public roads.





(Above left) **Bollard LED illuminations are being tested in Schenectady, New York, as a way to improve pedestrian safety**

Foote sounds a note of caution, however. "It will be interesting to see if this project produces research that shows that bollard-level lighting does improve safety," he says. "LED streetlights already substantially improve visibility compared with HPS streetlights. It's possible that bollard lights could improve visibility even more, especially when it comes to spotting pedestrians – but it's also possible that the glare from a light at that level would decrease safety. LED lights especially can have issues with glare, and yes, I would be concerned that bollard lights at eye level could be as bad as or worse than overhead lights that are angled downward."

We are just beginning to get to grips with the possibilities of LED lighting. But the current rate of uptake would suggest that new systems and technologies will quickly be implemented to address current safety concerns and old HPS illuminations could soon look as outdated as gas lamps do today. ○

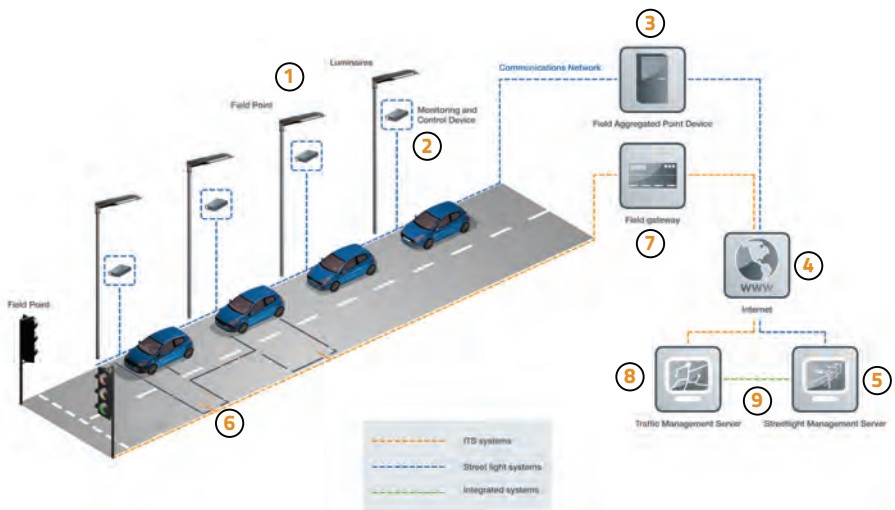
Lighting up the future

Thomas Novak, research project manager at traffic solutions manufacturer Swarco, reveals how its networked streetlighting works

▪ Each luminaire (field point) (1) includes a communication module (2) with dedicated firmware used to exchange data with a field aggregated point device or field gateway (3). In our case it is based on ZigBee technology. ZigBee is used in indoor – and more recently outdoor – communication for lighting applications. It's a standardized and open technology. Communication is realized from the gateway via mobile networks (4) to a streetlight management server (5).

▪ The system is controlled either manually or according to a time schedule. We're also providing the possibility to control the system based on the current traffic situation on the road. Sensors on the road (6) are used to monitor the system, with the data feeding into another field gateway (7). Again, this information is transmitted via mobile networks (4) and depending on the assessment of the situation by the traffic management server (8), a communication is sent (9) to the streetlight management server (5) to adjust the luminosity of the relevant luminaires to the required level.

The streetlight management server software consists of three parts: a module to exchange data with the luminaires via the gateway, a module to process sensor data and derive an adequate level of luminosity, and a module as a user interface for any operator. It can run on any server that provides the required amount of computational power and resources. Operators can access the system from any device capable of accessing a web page. The system is currently in operation in three test sites: Neunkirchen, Waidhofen an der Thaya and Krems an der Donau, all in Austria.



ILLUSTRATIONS: AKININA OLENA/SHUTTERSTOCK.COM

INNOVATION IN IMAGING

See Point Grey's most popular ITS cameras ptgrey.com/its-traffic


RED LIGHT


TOLLING


ANPR/ALPR


PARKING

The best of machine vision technology for ITS solution providers:

- Excellent image quality and sensitivity
- CCD sensors proven for outdoor use
- Reliability: day after day, year after year
- Unbeatable price performance
- Standard digital interfaces: Gigabit Ethernet, USB 3.0, HD-SDI
- Programmable trigger and strobe

POINT GREY
Innovation in Imaging

SMARTER, LEANER, STRONGER, TOGETHER.

TRAFFEX 2015

WWW.TRAFFEX.COM

There's nothing straight forward about the traffic industry.

New legislation, new materials, new technology, new products, new ideas – and new thinking. Constantly changing and evolving but always interesting.

Every two years, Traffex brings together 400 companies, 10,000 traffic industry professionals and limitless ideas – for three days of smarter thinking, creating a stronger industry.

Traffex

21-23 April 2015 | The NEC, Birmingham, UK

Register online now for your FREE ticket at www.traffex.com

Co-located event

Parkex

Content partners

Department for Transport | HIGHWAYS AGENCY | ITS United Kingdom | THE CHARTERED INSTITUTION OF HIGHWAYS & TRANSPORTATION

Event partners

SIEMENS | RedSpeed®

Connekt's managing director, **Nico Anten**, is full of innovative ideas about the potential of ITS, freight logistics and mixing ketchup with beer

Interviewed by Max Glaskin

> Retailers were saying 'ITS can help me'... that's lovely because retailers have more influence on policy than the ITS industry

You've been networking since Monday morning. You've flown 7,800 miles in a week. You've survived 48 hours of meetings and presentations. Now it's Friday afternoon and a weekend break is beckoning. Do you really want to talk to a journalist? Fortunately, Nico Anten does.

He's the managing director of Connekt – the Dutch public-private foundation whose members include companies and the government, and which faces up to the problems of mobility and freight transportation in the Netherlands. "Our main objective is to create trust because you need to collaborate to solve these problems," says Anten. He's talking freely from Connekt's open-plan office in Delft, on the first floor of a newly converted steam engine house, which had previously hosted engineering test facilities, student raves and a *Playboy* photoshoot.

Like many modern nations, the Netherlands wants to make sure its cities are smart and livable. Connekt is commissioned to run programs on these lines, including facilitating the economic development of the freight logistics sector and the introduction of automated road vehicles. ITS should be crucial to the solution, but Anten believes the sector must change course to ensure it is. "The most important challenge for ITS is how to change itself into a demand-driven industry," he says.

"The general public are not very interested in ITS and if they're not then the politicians won't be, either," he explains. "So somehow you have to get the message across to everyone that ITS can reduce congestion and emissions, and improve safety; then they will demand more ITS. I think that if we can involve the end user in the discussion there will be a better chance for us to create a demand-driven approach." To this end, Connekt recently put people from the retail and ITS sectors together. "In the end the retailers were saying 'ITS can help me.' That's lovely because, let's be frank, retailers have much more influence on policy making than the ITS industry."

Anten senses that a lot of Connekt's members expect it to be a difficult transition from a technology-led market to one that's demand driven, but he's committed, even though he admits he doesn't know exactly how the change will be achieved. "I'm sure we can do it," he says. "We don't have a solution in our pocket and it'll take years, of course, but the industry must become driven by demand rather than technology."

Bold movements

When ITS does become regarded as an innate tool for livable cities, it should also be an indispensable component for switching freight from roads to other modes of transportation. This is important for the Netherlands because it is the world's second

> Freight goes by road because it's cheap but this doesn't help if you're trying to build smart, livable cities, so it would be good to switch it to our vast network of waterways

largest exporter of agricultural products, by value. "Freight goes by road because it's cheap but this doesn't help if you're trying to build smart, livable cities, so it would be good to switch it to our vast network of waterways," says Anten.

Surprisingly, the freight industry agrees – because it has a shortage of truck drivers. Also, companies including Heinz, Mars and Unilever want more sustainable logistics. "Heinz makes one million bottles of ketchup every day," says Anten. "That's a lot of trucks, but it's not enough to fill a barge. So Connekt combined ketchup bottles with bottles of beer to fill a barge to capacity. Despite expecting it to be more expensive, the companies agreed to the trial because it reduced their environmental footprint. In fact, it turned out to be cheaper."

Last year, freight that would previously have been carried on roads by 25,000 trucks was shifted to waterways, reducing congestion and emissions and improving safety. It sounds simple but Anten says otherwise. "To do this you need a lot of accurate information about the flow on the roads and the highways," he explains. "To make freight multimodal you need a lot of high-quality information – and that's a job ITS can do. So we are putting a lot of effort into connecting ITS with the logistics industry. They can both benefit. Logistics can run their businesses more cheaply and sustainably, and for ITS it's a new market."

Joined forces

While many goods will still travel in trucks, Anten sees them becoming increasingly automated. "I don't think the need for automation is just for fun," he says. "We need it because of the complexity of our mobility system. Automation of road vehicles is not in itself a policy but it's beautiful in an overall vision of wanting livable and smart cities where we can bring in our goods, our people and information in a smart, sustainable way. The topics on the road to automation, such as platooning, car-to-car tech, the connected car and so on, are all part of that development."

Last year, Connekt was a partner in the Dutch Automated Vehicle Initiative (DAVI).

The child is father of the man

ITS didn't exist when Nico Anten was a schoolboy, so it wasn't on his agenda as a career. "At first I wanted to be a train conductor and then a pilot," he says. "I spent my pocket money on being a member of the Dutch society for environmental issues because I like to be outside, in nature. I have liked mobility and the environment for a long time. At Connekt, we truly believe that we can make mobility smart so that it supports our welfare and that we can make it sustainable so that it supports our well-being. That is the challenge of our generation."

"We put our minister of transport, Melanie Schultz, into a DAVI fully automated car on our highway at 100km/h [62mph]," says Anten, with relish. "We only had a license from our roads authorities for one day, so we weren't able to test it ahead of time, but it worked perfectly and now she's really supportive of more work on automated vehicles. In October we'll have a demo of platooning from Scania trucks and she will be there, too, to show that it's important."

The DAVI drive was a gamble and Anten is very aware that it could have gone wrong. "As one of Connekt's members said, if the test had failed with the minister in the car because someone had hacked the system it would've highlighted that we really should take care of IT system security," he says.

Instead of prompting a withdrawal from vehicle automation, Connekt took this comment as a spur to look into the service security of the infrastructure. "We want to be able to trust the information flow, whether it's V2V, V2I or roadside infrastructure information, but the moment the system is hacked, you really are in trouble," says Anten. "I can tell you that it's easy to hack. There's not a lot of misuse at the moment because there are greater rewards from hacking a financial system, but it's not about criminals – it's about someone who hacks a traffic light for fun and causes disruption. So we really need to discuss how we can protect our data flows in traffic so that they are trusted."

This takes us back to trust. How do Anten and Connekt build and maintain trust among members and in the wider world of ITS and logistics? "There's no simple answer," says Anten. "When I leave home I have to leave my ego behind because we're a connecting organization. It's really important that the members see that they benefit from the collaboration and not that it's Connekt benefiting itself. To do that, you have to make sure that the matters you're working on are in the interest of the members. This is a bit of a fake answer because it's really difficult to describe how we win trust – but I think we do."

Free thinker

Anten feels really privileged to have his job."ITS and logistics are driving forces in creating a new world," he says. "I work in an environment where trust is our main driver. My board gave me their trust, so I have a lot of freedom in the way I act, and I share that freedom. I think that's how you get the best out of people.

"Let me tell you what I don't like to do. I don't like to deliver a PowerPoint presentation and then ask people if it's okay for me to go ahead with that idea. I prefer just to do something and then afterward if my board or members say 'Next time, please take care,' well of course I will listen. Let's just say that I'm still here, 10 years into the role."

expotraffic 2015

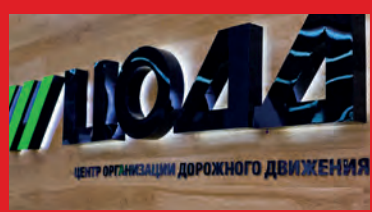
27-29 April 2015

3rd International Exhibition for Traffic Management and Highways Operation

Expotraffic will feature the technologies, equipment and expertise needed to make highways more efficient and safer:

- Road traffic management
- Road safety
- Highways operation and maintenance
- Parking

Book your stand today!



www.expotraffic.com

Supported by:

Ministry of Transport of Russian Federation

The Department for Transport and Infrastructure of the Government of Moscow

International Transport Academy

Media Partners:

World Highways

Mobility

ITS International

Email: expotraffic@mackbrooks.com

Tel: +44 (0)1727 814 400

From basic bare boards to super-sensitive sensors

(Left) **Basler's dart, ace, and IP Box cameras make a powerful team**
(Right) **Advances in sensor technology enable excellent performance in changing light conditions**

Camera systems in modern traffic applications require small, stripped-down cameras on the one hand, and sophisticated sensors on the other. Low-speed applications, such as parking access systems, need neither sophisticated high-end camera equipment, nor a multitude of camera features to fulfill their tasks, but many vision system components provide these, as they are designed to be suitable for the widest possible range of applications. This leaves them over-equipped for systems that work just as well with only the pure basics: low-to-medium sensor resolution, compact size, low weight and a standard interface. Ideally, this combination goes hand-in-hand with a favorable price range.

A simple approach

With its new board-level camera series – the dart – Basler has expanded its camera portfolio for industrial applications, and for traffic systems in particular. Being USB3 Vision Standard compliant, it fully exploits advantages such as secure data transfer and easy integration with convenient plug-and-play functionality, high bandwidth of up to 350MBps and low CPU load, as well as data and power supply via one cable. Three variants – with S-Mount, CS-Mount, or as a bare board – allow for a variety of lenses to be used, including highly affordable ones. This is an easy way to cut system costs.

Equipped with CMOS sensors with resolutions of 1.2MP to 5MP and frame rates of up to 54fps, they are a perfect match for traffic applications such as access control or in-vehicle ALPR systems. Their low power consumption and low heat-generation levels fit well into the mini-PCs that are frequently used in a vehicle, for license plate recognition. For cost reasons, many of these ALPR solutions still work with analog camera systems, which are expected to eventually reach the end of their lifespans or simply become outdated. The small, lightweight Basler dart, for example, would be an ideal replacement for such systems, upgrading them to the latest USB 3.0 interface technology in one transition.

Sophisticated solutions

Technological developments are also heading toward sophisticated sensors that notably improve the performance of ITS camera systems. One such example is Sony's new IMX174 sensor. Based on CMOS technology with a global shutter, it's currently ranked among the top sensors in the market in terms of sensitivity, dynamic range, and noise behavior.

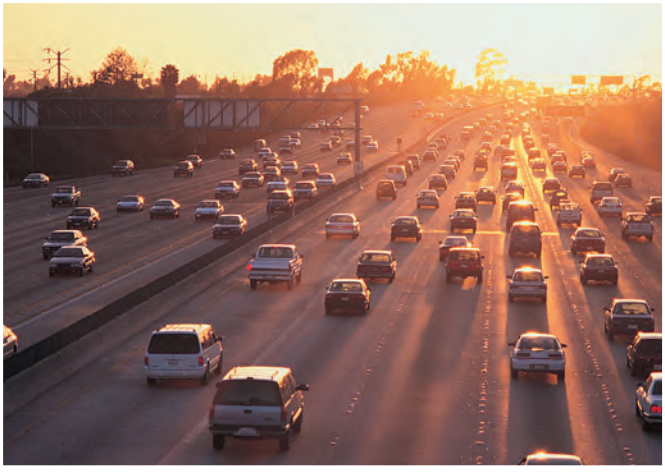
Basler has integrated this sensor model into a selection of its ace series cameras. Two ace GigE and two ace USB 3.0 models each offer 2.3MP resolution with a very high image quality. In combination with its global shutter technology, this sensor addresses two concerns that are common in tolling and red light-enforcement applications: over-exposed license plates or smearing effects.

By balancing the bright and dark areas in an image, it levels

Need to know

ITS camera systems require modern solutions that are optimized for traffic applications

- Basler's dart cameras are designed to meet the smallest space, and the lowest weight and power requirements
- Despite its very small size (29 x 29mm for the S-mount and CS-mount models, or 27 x 27mm without a mount), the dart's low power consumption minimizes heat-dissipation issues



(Below) **Challenging light conditions can be overcome with modern camera technologies**
(Left below) **The Basler dart is ideal for low-speed traffic applications**

out the brightness of the license plate and the darkness around the driver – a major achievement in the light conditions faced by many ITS applications. Double images could thus become a thing of the past – eliminating the need for separate pictures of the driver and the license plate.

For increased flexibility, many vision-based traffic applications combine industrial and network (IP) cameras in a vision box. To use this to full capacity in modular solutions, Basler also equips its IP Box camera models with the new Sony IMX174 sensor.

Exploiting progress

Naturally, camera manufacturers are interested in providing their customers with the latest technologies to leverage the full potential of the vision industry's advancing standards. And progress in sensor technology doesn't stop at 2.3MP resolution; Basler has integrated another powerful sensor into selected models of its ace camera series – the Python 5000 from ON Semiconductor. This high-speed 5MP global-shutter CMOS sensor is ideal for eliminating the unwanted smearing effects usually associated with CCD sensors.

ITS is a demanding market with complex requirements. Outdoor operations, with their ever-changing weather and light conditions, pose a particular set of challenges to cameras and sensors. The wide variety of traffic applications, with its different specifications and tasks, requires solutions that range from basic no-frills concepts that are scalable to operator needs, to modular concepts that allow for ultimate flexibility. With its broad portfolio of cameras, sensors and interface technologies, Basler is well prepared to meet the requirements of the modern ITS industry.

Safety camera success in New South Wales

Roads and Maritime Services (RMS) is the New South Wales (NSW) government agency that provides for safe and efficient traffic throughout NSW, Australia, managing the operations and programs of roads and waterways. According to the organization's website, speeding remains the biggest killer on the state's roads – recognized as a factor in about 40% of road casualties. It's estimated that, on average, 177 people die every year in speed-related accidents in NSW.

The new traffic safety program from the RMS will increase speed monitoring in NSW to approximately 45 mobile vehicles delivering 7,000 enforcement hours every month. Mobile speed cameras produce a sustained change in driver behavior by creating a perception that speeding can be enforced anywhere at any time. These cameras reduce speeding not only at identified enforcement locations, but across the entire road network.

With regard to road safety, Australia's road authorities increasingly draw on the services of private partners. The Jenoptik Traffic Solutions division is one of two providers operating mobile camera systems for speed monitoring in NSW. Jenoptik is processing its share of the order through its Sydney-headquartered Australian subsidiary, which is providing technical equipment and enforcement services for the Hunter Region and the Northern Region.

The Jenoptik program of road monitoring services is called Traffic Service Provision (TSP) and combines all services and processes of comprehensive traffic monitoring without investment by the client or additional personnel requirements. TSP is tailor-made. The spectrum ranges from the complete service delivery model comprising all back-end operations, such as rostering, training, employment, certifications, financing and image quality verification, through to mobile camera car delivery, deployment and data gathering. Importantly, from the public perspective, the delivery of service is not 'fee for ticket' influenced.

Speed camera deployment

Jenoptik delivers a scheduled and allotted 2,400 hours of curbside enforcement a month, delivered by 20 speed camera monitoring vehicles. The timely delivery of services necessitated the establishment of a base office in Newcastle, with three satellite depots in Coffs Harbour, Lismore and Tamworth.

Need to know

Mobile speed monitoring services are supporting traffic safety goals in Australia

- Jenoptik, in conjunction with RMS, conducted a site-by-site risk assessment to check site suitability in relation to safety and operational requirements
- Factors considered included safety of operators and the public, technical requirements of mobile speed camera equipment, operating times and changes to the environment that may have occurred since RMS selection

The mobile speed camera car can be deployed anywhere, providing the flexibility to perform enforcement operations as and when required

The daily enforcement procedure is always performed according to set standards. After a pre-deployment check at the depot, the vehicle departs for its first session and is set up at the measurement site.

The Jenoptik equipment is designed and manufactured to work bidirectionally, monitoring up to six lanes of traffic with lane and vehicle-specific identification. The system provides an accurate trigger position and determines vehicle classification. It uses Jenoptik's latest Robot SmartCamera IV digital camera and tracking radar technology, and also captures rear images, to enable the identification of speeding motorcycles, in all weather conditions, at any time of day.

All measurement sites were initially nominated by the Office of Road Safety and RMS. Every site has been assessed against crash risk and statistical data gathered from previous crashes.

"The 2,400-hour level is an important milestone for this contract, which was awarded to Jenoptik last year, to provide technology and services for mobile traffic monitoring for three years," says Jenoptik sales director, Ralf Schmitz.

Maximizing automation

A wireless tablet PC is used for system control and monitoring of captured incident images. The tablet contains a pre-loaded GPS-coordinated database with all pre-checked site information and is fully populated with site data once the camera vehicle arrives at the prescribed location. This fully automated system ensures the camera operator does not have to second-guess any details, instead confirming them against a preset checklist. After conducting a site risk assessment, the system is ready for enforcement operations.

Once the enforcement shift has been completed, the camera vehicle proceeds to the next site or returns to its depot, where the incidents are uploaded to the back-office server in Newcastle. Incidents are verified with regard to image quality and sent to the State Debt Recovery Office, which is responsible for the processing and issue of penalty notices.

Jenoptik, as operator of the system, receives payment based on the number of hours of enforcement completed in conjunction with prosecutable images delivered. Revenue from the speed infringements will go into the Australian Community Road Safety Fund to bankroll further traffic safety programs.

The NSW government is committed to improving road safety. NSW 2021 sets a target to reduce fatalities on NSW roads to 4.3 per 100,000 of the population by 2016. The government is also a signatory to the National Road Safety Strategy 2011-2020, which sets out targets to adopt best practice enforcement and reduce the national annual number of deaths and serious injuries by 30% by 2020.

Smart technology optimizes winter roadway maintenance operations

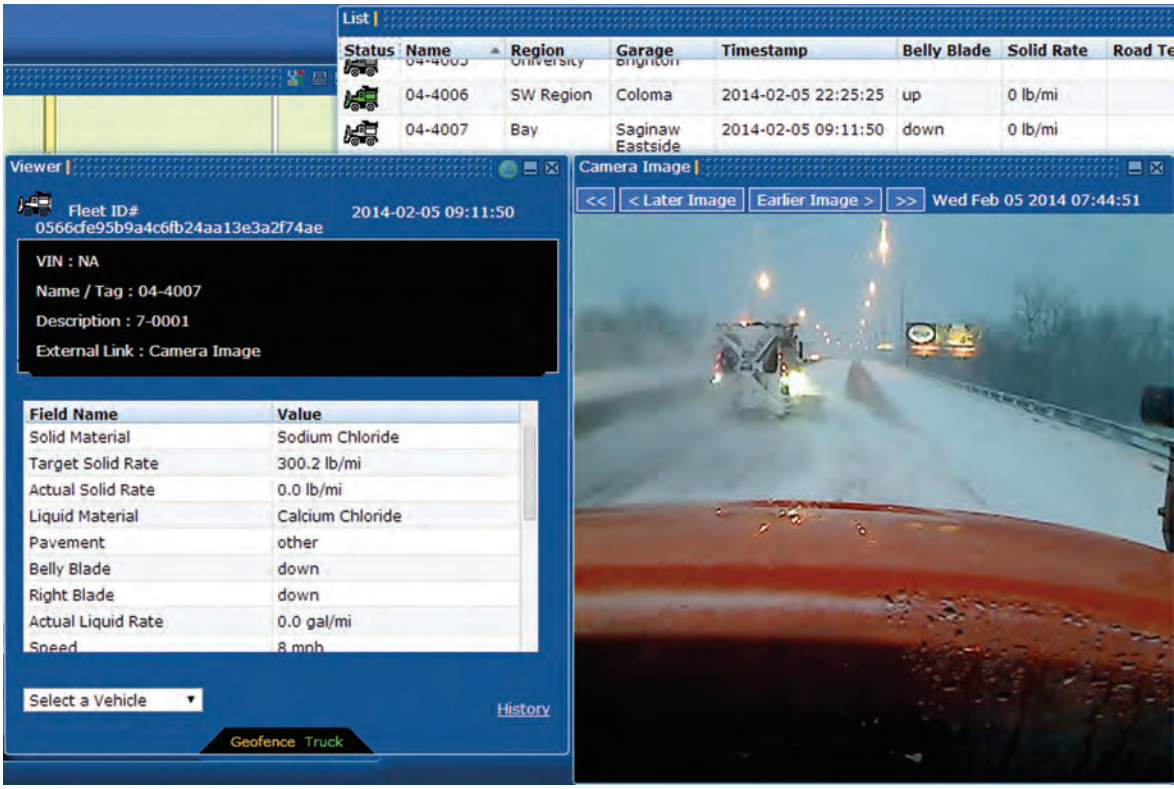
With epic snowstorms hitting eastern parts of the USA in the 2014 fall season, it is predicted to be a wicked winter. In parts of the northeast and mid-Atlantic regions, forecasts indicate that large amounts of snow will define the season. This has put DOTs on alert, to get their winter maintenance equipment ready. It's enough to send shivers up the spines of any good maintenance crew.

But not those at the Michigan Department of Transportation (MDOT). In the fall of 2013, just prior to one of the state's worst winters on record, the MDOT deployed a web-based snowplow Automated Vehicle Location (AVL) and Maintenance Decision Support System (MDSS). Teaming with Parsons (formerly Delcan Technologies) and Iteris, the MDOT equipped 270 vehicles and deployed the system in just four months.

Using a GPS, the AVL technology displays live roadway maintenance operations, produces fleet activity reports, and exports data to the MDSS, which in turn provides roadway treatment recommendations and targeted, precise weather forecasts to the MDOT.

"Not only does this new system enable us to better serve the residents of Michigan, but our operations can become more efficient as we reduce costs," says Tim Croze, MDOT project manager. "In fact we can reduce material use as well as the time spent reporting labor, material and equipment statistics."

In addition to pinpointing a vehicle's location, the robust AVL system is capable of capturing and reporting operational data from a snowplow's onboard systems, such as a DICKEY-john material controller, as well as other data, including material application rates, air and pavement temperatures, and the positions of blades and plows. Data is displayed in near-real time on a website for maintenance garage supervisors and transmitted direct to a plow operator's screen. The data is also stored for future reporting and data analysis, making it a key component for process improvement.



Need to know

A GPS-based system that uses weather and operational data to maximize efficiency

- The MDOT is able to use the information collected by the MDSS to plan for winter weather events and perform preventive maintenance on equipment
- Garage supervisors are able to adapt their operational and resource planning based on forecasting and treatment recommendations from the MDSS

Efficiency for sustainability

Used by at least 15 states across the USA, the MDSS provides location-specific weather forecasts along snowplow routes and predicts how road conditions will change due to forecast weather. The system recommends maintenance locations and treatments, application rates, and suggested times to apply material to maximize its effectiveness.

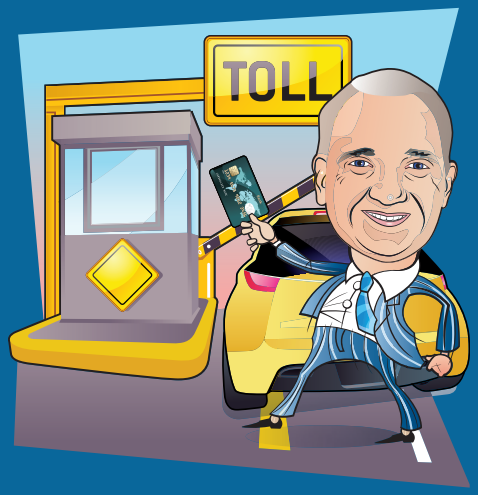
As well as savings in materials, labor overtime, fuel and equipment maintenance, there is a positive effect on the environment through the use of AVL and MDSS technology. Materials used in winter road maintenance operations, including salt and de-icing liquids, can have deleterious effects on the environment, including pollution of streams and damage to crops. Using fewer materials and applying them more accurately can diminish these effects. All these benefits, plus the ability to get ahead of a storm to provide the traveling public with safer

(Left) **The system provides the MDOT with detailed information concerning individual vehicle operations**

roads, makes AVL and MDSS a winning solution for DOTs.

Optimized operations

While the MDOT is not the first agency to use AVL technology and MDSS services to manage its winter operations and fleet, it did employ a unique contracting approach that aided in its large-scale implementation and accelerated rollout. While most agencies have administered separate contracts for AVL equipment, and AVL and MDSS services – and in some cases cellular communications and data storage and management services as well – the MDOT executed an all-encompassing contract, since each component is dependent on the others. This not only ensured a quality outcome, but also enabled agency staff to spend their time managing the overall project, rather than managing vendors and contracts.



james.eden@aecom.com

In the 'good old days', things were a lot simpler. When the government built a road or started a program such as a lottery, the money was allocated to the debt service, maintenance and improvement of that designated program. These days it is not that easy. Money for 'government wants' far exceeds the public's ability or willingness to pay for them. Even the Highway Trust Fund has been raided.

Thousands of special interest groups have formed, protesting that they alone need attention and feel they should pay less or no money for cash-flush programs such as tolling. I am not saying that these are not legitimate groups and projects, but how is funding for these groups prioritized? And what is the impact of these decisions?

You can argue that we should pull more toll revenue out and fund mass transit. Studies show that our youth is moving back into the cities and not driving as much. How about trucking? We really need them to move the goods that we want delivered yesterday with free shipping. Or should the retailer cover that cost, reducing profits in exchange for volume?

We all know that rail infrastructure has deteriorated and needs major funding to continue to drive our economy. Can't you say that about our highway system also? We are not alone in the funding wars.

Look at the lotteries across the country. Most were started with the good intention of funding education, senior citizen programs and other worthwhile causes. Who could argue with that? Now, in many states, lottery programs are fighting for money to maintain the ever-increasing pressure for more profit. But what happened to the intended use of that revenue? Are the lotteries headed for the same fate as tolling? Money is being bled off for other uses of traditional tax revenue and funding for those programs has been cut. Both of these industries are a victim of their success. Is the problem that we don't want or like change? At one point, tolling was a market disrupter in surface transportation, providing superior service and building services that our customers wanted – and we needed to compete with 'free'.

At a recent IBTTA conference in Austin, Texas, the keynote speaker was Doug Stephens, one of the world's foremost retail and consumer futurists. Doug gave a great presentation on how the demographics have changed not only in what we buy, but in how we buy it. Regardless of industry, market disrupters are cropping up daily with bold business models that challenge traditional sales and service methods based on consumer wants and needs. Look at what Uber is doing to the taxi market. Why would anyone ever think that same-day package delivery was needed or even possible 10 years ago? Amazon did.

After Stephens' presentation, someone asked, "What will we do with our existing infrastructure, as it will cost too much to change to fit the new customer base?" I turn this question to you: How do we persist and move forward as a disrupter in transportation? Have we as an industry been bled dry? How can we reclaim funding and financial prioritization so that we meet consumers' wants and needs today, tomorrow, and well into the future? Transportation is key in any economic growth, and we need to find the courage and resources to be a disrupter.

> Market disrupters are cropping up daily with bold business models that challenge traditional sales and service methods based on consumer wants and needs
>
> **James Eden, director of tolling, Aecom, USA**

Advanced radar technology for wrong-way driver detection

Each year in France, dozens of people are killed as a direct result of people driving the wrong way on highways and ramps. Yet to date no solutions to catch offenders or to inform other road users about the potential danger have been widely deployed.

In July 2014, the French newspaper *Est Républicain* published an article entitled "Ghost driver [wrong-way driver] on the A31 near Nancy: one dead, 10 injured," detailing that "11 ambulances, two vans and a command vehicle were required" as a result of the incident. Furthermore, the highway was closed for four hours.

This example is representative. In addition to human casualties, huge resources must be implemented to handle the incident – not only rescue and medical facilities, but also means to rehabilitate the road infrastructure. One misunderstanding can cost several millions of euros, with additional loss to the road operator if the highway is tolled.

French safety officials have not been inactive in this area. Research and studies have been commissioned over the past few years, but in practice they have mainly led only to an increased number of fixed road signs.

Early work on dynamic road signs began 10 years ago, implemented by the General Council of Côtes d'Armor, with the installation of dynamic light panels activated by the police, following a call from a road user. Initial trials showed a lack of system responsiveness, so the General Council asked Neavia Technologies to work on automating this user information.

In the specific context of the RD767 between Guingamp and Lannion, which has multiple lay-bys that enable drivers to make U-turns, Neavia was asked to design a device that could monitor the open road. The company developed a highly accurate, very reliable system that has an extremely low rate of false detections.

Reliability is essential

Neavia Technologies has used the experience gained from the RD767 project to solve the problem of detecting drivers going the wrong way on highway exits.

For detection on the open road, the general principle is to analyze the trajectory of the vehicle from multiple data sources. The radar developed by Neavia is able to analyze numerous points and behaves like several independent data sources. With the ability to rotate up to 110°, it can track a vehicle for several seconds.

The performance of radar can often be compromised by wind, rain and reflections on metal objects. Wind can throw sheets, bags and other objects into the radar's field of view; rain may be responsible for reflecting radar waves on particles; and metal signboards can reflect radar waves. The algorithms that Neavia has developed from precise knowledge of these distractions, makes its filter efficient. Recent tests show that the radar has a false-detection rate of only one event every two months.

Immediate information

As a result of these advances it is now possible to warn users of danger without going through a validation stage. This is crucial because, with the exception of toll roads, most French highways or expressways do not have 24-hour management and staff must therefore validate each event. In addition, the majority of wrong-way driving occurs when the traffic level is low – which generally means outside office hours.

(Above left and right) **FoxVia is installed at the roadside, perpendicular to the detection point**

Another factor to consider is that many drivers use navigation systems, and among these, connected systems are developing quickly. In addition, many drivers use their smartphone as a dedicated traffic or navigation application. So, rather than deploying a large number of VMS along our roads to inform drivers, as we have in the past, we now just need to transfer information to broadcasting platforms.

Neavia has developed a technology platform that receives 'wrong way' alarms, validates them under the rules learned from former experience, and transmits the alarm to traffic information broadcasters through DATEX2 messages. It will then update their information systems, and in less than a minute every road user will be informed about a potential risk associated with a vehicle coming in the opposite direction.

The V2X advantage

Also a specialist in vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications, and a partner in the French Score@F V2X project, Neavia Technologies is now coupling its FoxVia radar with its V2X roadside unit. This enables the roadside unit to deliver an alarm directly to all motorists who pass nearby. The beauty of V2X technology is that each vehicle both transmits and relays information: a vehicle will pass information on to every vehicle it encounters during the lifetime of the alert. Thus, a wrong-way alert can be promptly broadcast to all vehicles within a given area and a given time.

The ability to reliably detect ghost drivers and broadcast alerts through existing traffic platforms can substantially reduce the number of incidents related to wrong-way driving. When all vehicles are equipped with V2X technology, and roads are equipped with FoxVia radars, ghost driver-related incidents will no longer be a concern. ○

Need to know

Developments in radar and V2X technologies are opening up new possibilities for safety

- Neavia's FoxVia is a multitechnology radar designed specifically for event detection
- Designed in the spirit of sustainable development, it only requires 1W of power, enabling it to be powered by solar energy
- FoxVia can integrate with radio communication to enable remote warnings and direct control of illuminated signs

Free reader inquiry service

Neavia Technologies
inquiry no. **504**
To learn more about this advertiser, please visit: www.ukipme.com/info/tfm

New Zealand adopts a sophisticated approach to bicycle safety

Tamaki Drive is one of Auckland's most attractive and high-profile routes. A major access way to and from the city, the road is also a recreational resource for the local community. Here, motorists share the space with cyclists and pedestrians, and this has unfortunately resulted in numerous bicycle-related incidents over the past few years. To address the problem, Auckland Transport has started several traffic safety related projects, including the installation of cycling lanes and a bicycle warning system to reduce vehicle speeds and make drivers more aware of approaching cyclists.

One particular focus was a location where motorists can take a right turn into Ngapipi Road, away from the main road of Tamaki Drive. This had proven to be a spot with a high risk of collisions between motorists and bicyclists. "We needed a way to increase the safety of cyclists and to enhance their visibility to motorists when these drivers are about to turn right," comments Karen Hay, manager of road safety and road corridor operations at Auckland Transport. "FLIR Systems suggested that we implement a system that provides direct visual verification and fast detection of cyclists, and one that can make a distinction between bicycles and vehicles."

Warning lights are very effective in enhancing driver awareness and impacting their behavior in ways that reduce the risk for cyclists. However, traditional, continuously flashing warning signals have a reduced effect, because motorists do not receive a real stimulus to change driving behavior. This is not the case with detection-based warning signals, which can be activated based on the detected presence of cyclists.

Need to know

Thermal imaging sensor technology improves the safety of cyclists on a busy Auckland road

- Thermal sensors detect the heat signatures of everything in their field-of-view, at any time of day
- Because they see heat, not light, thermal sensors don't get confused by sun glare, darkness, headlights, shadows, wet streets and poor weather conditions like video cameras do
- Detection systems using thermal sensors have dramatically fewer false and missed calls than systems based purely on video

(Above main) **Auckland's bicycle warning system**
(Above inset) **FLIR's ThermiCam**
(Left) **Thermal imaging technology enables night-time detection**

Trial and error

Before selecting FLIR, Auckland Transport investigated several detection technologies. The first technology was conventional video detection, which gave good results on bike and car detection. However, differentiation between bikes and vehicles in dark conditions was difficult, because cyclists do not always use their lights.

A second option that was investigated was inductive loops integrated into the bike lane. These loops analyze the electromagnetic signature of a bicycle wheel and, as such, are able to provide bicycle presence information. This technology was not ideal, due to the fact that cyclists do not always conscientiously take the bicycle lane, which makes them miss the inductive loop altogether. Also, inductive loops cannot always collect presence information of carbon fiber bicycles, due to their lack of metallic material that can trigger the loop sensor.

The thermal advantage

At a FLIR training session, Auckland Transport learned about a new solution that could overcome these problems: the FLIR ThermiCam sensor. ThermiCam is an integrated thermal camera and detector for vehicle and bicycle presence detection that can be used to control traffic lights as well as traffic warning signals. ThermiCam detects vehicles and bicycles based on heat information emitted by these road users and will transmit its detection information to the traffic light controller. This makes it possible to control warning signals dynamically, based on real-time information.

Open all hours

One major advantage of the thermal traffic sensor is that it uses the ever-present heat energy of bikes and vehicles to make an accurate distinction between the two. Also, ThermiCam is able to detect bicycles in the darkest of nights and over a long range. As a result, it gives traffic managers uninterrupted, 24-hour detection of cyclists, regardless of the amount of light available.

"The installed ThermiCam sensor on Tamaki Drive has proven to be very effective," says Hay. "The detection of bicycles is very fast and very accurate, regardless of whether we are looking at a carbon fiber bike or not. This is definitely a very useful tool that we will consider within our mix of preferred ITS technologies." ○

Larry Yermack

lyermack@gmail.com

I'll bet that many *TTI* readers were among the more than 9,000 people that attended the ITS World Congress in Detroit. It was impressive in size, but even more so in how far we have come. It brought to mind the old ad for Virginia Slims cigarettes: "You've come a long way baby." Indeed we have.

While the metrics were impressive and not to be disparaged, since ITS America depends financially on the success of the triannual event, what was more impressive was the spirit and technological drive. To understand this, allow me to flash back to both the early as well as middle years of ITSA, because I have been a witness and participant since the very first ITSA meeting, as well as the first World Congress in Paris in 1994. So here are some reflections…

The excitement level was high in the early 1990s; after all, we were creating our generation's interstate system. The ability to combine mini-computers with telecommunication opened up the potential to monitor and control the transportation infrastructure. It was only a generation earlier that traffic signals were electromechanical and traffic control was a police officer. We were creating an entirely new systematic approach to surface transportation. The problem was that we didn't have any customers yet. The DOTs were deep into asphalt and building new capacity or rehabilitating existing facilities. We even had the car companies as charter members of ITSA, although they were to drop away after a few years. This period might be characterized as a solution seeking a problem.

The middle years were even more problematic. It seemed as if the intellectual level was stagnant. After all, a minor improvement to an ATMS was not going to excite us. Architectural diagrams and new communication protocols were not bringing in new people. There was less and less reason to go to the annual meeting, and it was easy enough to go to a state chapters meeting. On a national level, the car companies drifted away. They were here for a 1996 test of the Automated Highway, but when that funding ended, their participation waned.

Then along came the successor to the automated highway: the connected car. It has had lots of names, but at its core is the idea that vehicles can communicate with one another to dramatically increase the power to monitor and manage the infrastructure. Thank you, USDOT, for seeing this and providing ongoing funding and guidance.

Now the car companies are back and we were treated in Detroit to talks from the chief executives of Ford Motor Company and General Motors. We've never had that high level participation before in our more than 20-year history.

It means that the vision of an intelligent approach to surface transportation now encompasses not only public infrastructure, but also the automotive industry – that's an order of magnitude bigger, but it means so much more. We have come of age as an industry, moving from trade publications like this one to the main news sections of the daily press. People are paying attention; now its time to show them our A game.

> The vision of an intelligent approach to surface transportation now encompasses not only public infrastructure, but also the automotive industry
>
> **Larry Yermack, Wendover Consult, USA**

A powerful solar solution for demanding rural ITS

For many years, ITS components such as cameras, sensors and portable dynamic message signs (DMSs) have relied on solar power and wireless communications to overcome the challenges associated with operation in rural environments. These solutions, however, have proved to be an insurmountable obstacle for the permanent, large matrix DMS.

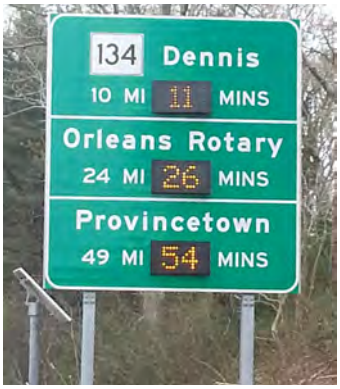
These devices require large amounts of energy and, until recently, powering a traditional DMS with solar-powered systems was unfeasible due to the costs associated with the number of solar panels and batteries needed for these systems. Now, innovation in DMS design has unlocked the potential to tap into solar energy, and is enabling the transportation industry to explore new possibilities.

A new age

Years of developments have seen the elimination of power-draining components, such as the ventilation systems commonly used to help keep DMS housings free of moisture and condensation, and have introduced brighter, higher intensity LEDs that produce more vivid light with no heat dissipation.

SES America (SESA), a USA-based manufacturer of LED dynamic message signs, has embraced innovation and energy efficiency as a driving force behind its business model. SESA was one of the pioneers in eliminating fans, blowers and heaters from its design, using efficient LED display boards that do not require ventilation and require less power.

After years of research and development, SESA introduced the first fully solar-powered, full-size DMS, and in spring 2014, the Massachusetts Department of Transportation (MassDOT) and SESA worked together to roll-out a solar-powered, travel-time DMS pilot in Cape Cod. The project comprised 12 locations with embedded DMSs, full-size DMSs, Bluetooth readers and wireless modems, all powered by solar energy, with full autonomy for 21-30 days.



(Above left) **A solar-powered safety DMS** (Above) **A traffic warning sign on a gantry** (Left) **A travel time DMS in Cape Cod**

Need to know

Years of research and development have culminated in energy-saving DMS designs

- The solar-powered DMS is quick and easy to install, with the solar power chain adapted and calculated for each site
- The installation cost is reduced, as there are no power cables, and the running cost is eliminated
- The solar-powered DMS offers a ROI of 3-5 years
- The DMS incorporates components that: enter sleep-mode when not in use; offer optimized brightness control; have low energy consumption and are highly efficient

The success of the project and the reliability of the DMS later led to the successful launch of the MassDOT 'Go Time' project. When complete, this statewide, solar-powered, travel-time system, which uses a travel-time DMS at more than 130 locations, will comprise the largest travel-time system in the USA.

Sustainable cost-efficiency

As more and more transportation authorities explore options for improving road safety, saving energy and reducing their carbon footprint, solar technology and innovation in ITS technology is providing a path that allows these organizations not only to promote green policies, but also to increase safety on both congested and remote roadways.

With estimated electricity cost savings of about US$4,000 annually for each DMS, solar power offers unique cost efficiency and returns on investment. Along with the elimination of civil works to install power and communication lines, and reduced maintenance costs, the Solar DMS is providing road authorities with technology that benefits the public, while saving money and fostering an atmosphere of environmental responsibility.

A new approach to violation detection

PHOTOGRAPHS: TELEDYNE DALSA

(Left) **Video analytics can optimize red light enforcement** (Above) **Teledyne DALSA's Genie TS camera**

Machine vision technology has automated the management, monitoring and enforcement of traffic laws, including the detection of red light violations, across a range of ITS applications. The goal of these systems is to enable government agencies to identify violators quickly and accurately, and at a lower cost, than is possible with a manual, human-centered approach.

For many municipalities, however, the implementation of a red light violation system can be costly and the results can be inaccurate. Many traditional systems require municipalities to tear up intersections and bury magnetic sensors that complement the video sensors used to detect violators. Video content captured by these sensors is transmitted from the intersection to a centralized facility where it is reviewed in a time-consuming process by operators who work to distinguish violators from the innocent. Construction costs, ticketing overview and data transfer all add up to a system that can create too many false positives.

The perfect view

The integration of video analytics technology originally designed for the short- and mid-wave cameras used in military applications – with high-speed, high-resolution technology – can mean greater flexibility for municipalities that want the benefits of ITS without the added cost or risk.

These integrated solutions gather the same type of images used by more traditional traffic monitoring applications, but parse the data so that only violations are captured. While the camera acquires frames continuously, images in which no violations occur are discarded.

The camera provides the primary video analytics source, monitoring both the traffic light and the traffic itself. Scene analysis is combined with data from radar, and a second, low-resolution video camera provides documentation that can be used in the event of a driver disputing a ticket.

In one such application, Teledyne DALSA's Genie TS camera with Camera Link is combined with Eutecus's Bi-i Smart Cube platform, which runs the company's Multi-core Video Analytics Engine (MVE) on the video stream. The intelligence that operates the system is embedded within the camera, so the entire solution can be installed above ground, providing municipalities with a streamlined solution that is far less costly than traditional traffic monitoring applications.

The solution is also able to capture and process multiple events simultaneously, such as if more than one car runs a red light at the same time.

The next generation

In addition to red light violation, there are many other potential traffic applications in areas that have generally required major roadway construction or operator involvement, such as toll-road enforcement, speeding and wrong-way driver detection.

Similar solutions can also provide traffic analytics to determine if speed limits should be increased or whether roadways should be widened, and can even provide pedestrian warning and safety systems. In all cases, municipalities and law enforcement agencies benefit from simplified installation, reduced time to deployment and lower total cost of ownership. The automated nature of the solution eliminates the potential for human error and increases overall system reliability.

Need to know

Cameras designed for machine vision applications are ideal for cost-effective ITS

- The machine vision camera 'maps' distinct images of the traffic light as well as images of the vehicle in relation to the intersection stop line
- In most cases the system sends an image to the operator only if the images of the traffic light and vehicle/stop line don't align as they should, indicating a violation
- The operator confirms the violation and then generates a ticket. No lengthy or exhaustive video review is required

Improving work zone safety with automated queue warnings

Current statistics from the USA's Transportation Federal Highway Administration (FHWA) show that more than 40% of fatalities and injuries in construction work zones are a result of rear-end collisions in slow or stopped traffic.[1] Automated queue warning (AQW) systems, however, have been shown to reduce incidents and rear-end collisions by 15% to 50%, depending on the application.[2]

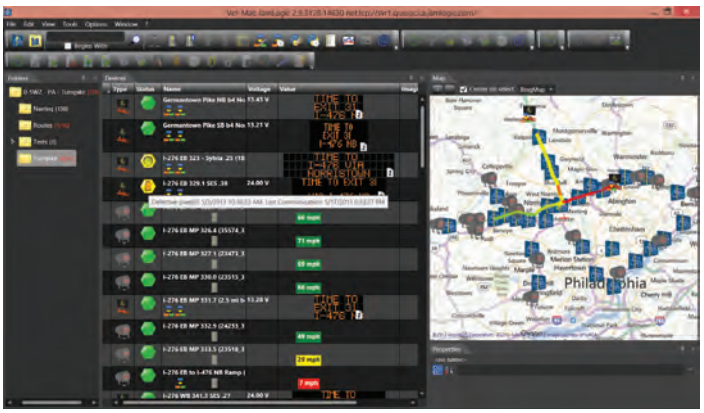
Based on real-time traffic data, AQW systems automatically inform travelers about the presence of downstream stop-and-go traffic, using LED portable changeable message signs (LED-PCMS) positioned upstream. As motorists can anticipate the upcoming situation, the risk of rear-end collisions is reduced.

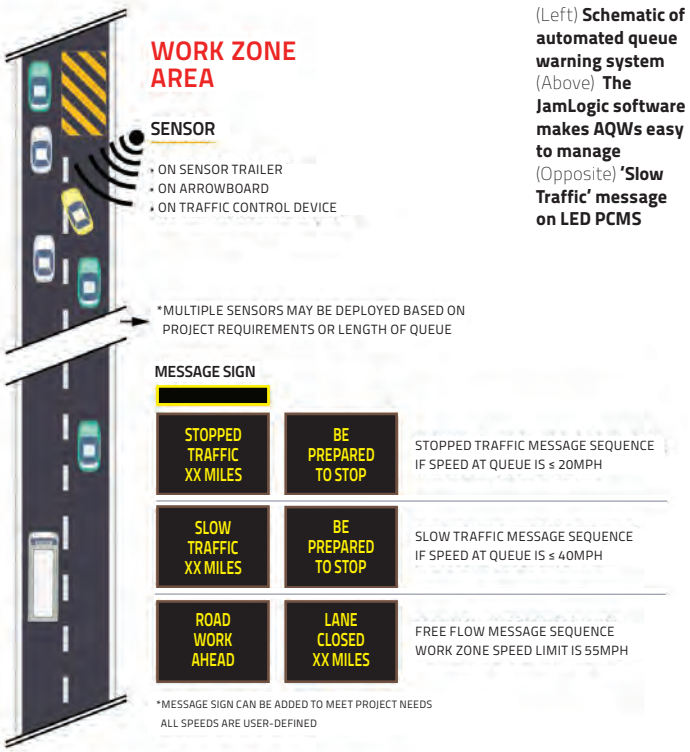
Software solution

Ver-Mac's AQW equipment comprises NTCIP-compliant, battery/solar-powered trailers that can be strategically positioned in construction work zone 'hot spots'. The equipment is designed to operate 24 hours a day, seven days a week. Each device is equipped with a high-speed modem that has GPS. Depending on the application, Doppler radar or side-fire microwave sensor trailers can be used to detect and provide real-time traffic data. All-weather PTZ dome camera trailers are positioned to provide managing agencies with visibility of expected queues. LED-PCMS trailers display the real-time queue warning messages to the public.

Ver-Mac's JamLogic software provides transparent web-based access to all devices and data. The software wirelessly collects data from a variety of field sensing devices via high-speed modems. The JamLogic server analyzes the data based on algorithms. The logic and messages are pre-determined by the project manager or agency.

The JamLogic software automates the messages and provides real-time information to the motoring public, project managers, agency TMC and public websites. Project managers and agency TMCs can be provided with email or text alerts of incidents and have the ability to override messages, if needed. Travel/delay time and alternate route applications can easily be integrated into most AQW systems.





(Left) **Schematic of automated queue warning system** (Above) **The JamLogic software makes AQWs easy to manage** (Opposite) **'Slow Traffic' message on LED PCMS**

Need to know

LED portable changeable message signs inform drivers about dangers ahead

- AQW systems improve safety and mobility, and ultimately save lives, by providing useful driver information, improving traffic flow, and reducing the risk of incidents
- Ver-Mac manufactures AQW equipment and has also developed its own automated software – JamLogic – which provides highway agencies with an integrated, scalable and turnkey AQW solution

AQW applications

Ver-Mac provides two solutions to address both long-term and short-term applications.

Long-term applications require battery/solar-powered trailers that can be deployed and run autonomously for weeks, months or years. Typically they are used by highway contractors or traffic control companies for major road construction projects. The AQW system is designed to detect reoccurring queues due to permanent lane closures and non-reoccurring queues due to work zone activity.

Short-term applications require equipment that can be set up by non-technical workers in less than 30 minutes. Such equipment is typically used by highway contractors performing lane closures due to day- or night-time asphalt paving or striping activities, and by utility and maintenance

crews performing daily lane closures. Here, the AQW system is designed to inform motorists about unexpected queues due to unannounced lane closures. The Speed-Mac Portable Sensor from Ver-Mac has been designed to be a quick and simple solution for short-term AQWs.

The Speed-Mac has a Doppler radar and high-speed modem with GPS packaged into a barricade light. This robust, economical and compact speed data-gathering system can be attached to any traffic control device. The sealed and maintenance-free battery can run continuously for more than 48 hours. The Speed-Mac will also automatically 'auto locate' with other Speed-Macs to sequence speed data. With an algorithm pre-programmed into JamLogic, the system will instantly start automating messages on the LED-PCMS. A system can be designed to be as simple or as complex as required.

1) www.ops.fhwa.dot.gov/wz/resources/facts_stats/injuries_fatalities.htm, United States Department of Transportation Federal Highway Administration
2) Caltrans 'San Diego ramp queue warning system' report; and Illinois DOT 'Madison County project' report

jmisener@gmail.com

I have lost track of how many years I have been writing this column, at least when measured chronologically. It has been perhaps eight or nine years, as time passes between inspiration, procrastination, completion and publication. However, I have not lost track of how long I have been writing this column when measured by the advance of technologies and systems that make the cars we drive so very smart.

At the start of my 'career' as a *Traffic Technology International* columnist, I can palpably recall dearly wanting, and passionately writing about, a futuristic car adorned with what was at that time dubbed 'active safety' – and nowadays are widely referred to as advanced driver assistance systems (ADAS) by those in the know, although not necessarily by marketing departments and the driving public. Regardless of ADAS's sometimes clever or not-so-clever marketing monikers, I can now go to the dealerships of many major makes and find select models adorned with some ADAS features – and increasingly, at affordable price points.

I can recall in those early columnist days that adaptive cruise control (ACC) with perhaps some forward collision warning (FCW) functionality or a totally different lane-keeping assistance (LKA) would be ADAS nirvana, never believing that one day – today – that the 'or' would be replaced with an 'and'. Nowadays, we have more and more combined ADAS functions, portending greater and greater warning, control and automation features.

Indeed, as ruminated in my last column – and the focus of a host of columns from the past year or two – I look forward to a redefinition of this nirvana to be either this ever-progressing march to higher levels of automation, or, if a truly functional and resilient self-driving car comes about, a great leap forward into that brave new road of fully automated driving. Issues such as the limitations of human vigilance and transfer of control would simply (okay, with much complex engineering) be hurdled with this mighty leap. That would indeed be the ultimate nerd heaven for which we ADAS-heads can aspire.

You may wonder why I encapsulate both a retrospective and prospective view of the *Smart Car* column's journey in one fell swoop. I will, with this column, take an exit ramp off this public road. Previous university and consulting employment, followed by a year-and-a-half of working as an independent consultant, has made this column-making possible. Shortly after I submit this version, my work toward a smarter car will be under the employment of a large, well-respected company, and I look forward to that. Therefore, from this point, the purportedly accessible ruminations I pen will disappear. From now on my presence will be felt in conferences, technical meetings, standards and, I hope, in the smart car you will drive.

This is a good journey, and we're only part of the way there. Happy trails.

> I can palpably recall dearly wanting, and passionately writing about, a futuristic car adorned with what was at that time dubbed 'active safety'
>
> **Jim Misener, transportation and technology consultant, USA**

An innovative approach to modern road-safety applications

While road-user safety will always be a priority for DOTs and road authorities, budget cuts and international standards require that modern solutions also be cost effective and environmentally friendly.

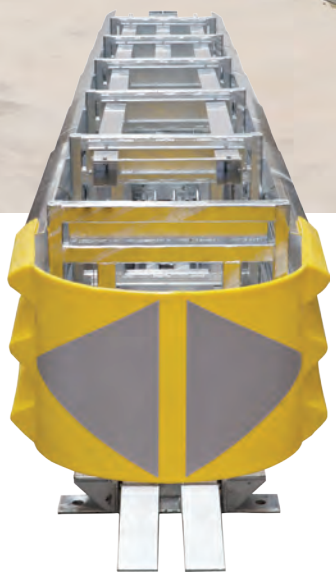
To this end, Lindsay Transportation Solutions (LTS) Snoline has launched an innovative range of parallel redirective crash cushions. The Tau Tube family of products can safely and effectively stop vehicles traveling at speeds of up to 110km/h (68mph).

These crash barriers, which recently received the European CE mark of approval, are composed of aluminum tubes that are able to absorb the large amount of energy that results from vehicle impact.

As the aluminum tubes are so effective at bringing vehicles to a halt, the Tau products are much shorter than most comparable solutions. The 50km/h (31mph) crash absorber is 1.9m (6ft) long, while the 110km/h (68mph) Tau Tube crash cushion measures 5.9m (19ft).

As a result of their compact size, Tau Tube products can be used in locations where it was previously not possible to install a crash cushion, such as road tunnels.

Tau Tube crash cushions are made from an aluminum alloy that provides excellent impact performance



Layers of innovation

This new technology is not only environmentally friendly, but it is also highly resistant to corrosion. Furthermore, as a result of the Tau Tube's innovative design, these crash barriers are much lighter than most similar systems.

As an additional benefit, up to 70% of the system can be reused after an impact and it has also been engineered to offer some interchangeability with Tau (LTS's first line of crash cushions) spare parts, which can result in notable savings in inventory and maintenance. This is particularly important for road authorities that are looking to minimize maintenance costs.

The Tau Tube can be delivered either assembled or unassembled and requires no maintenance after installation.

Ultimately, LTS Snoline has engineered the Tau Tube family of products to be affordable, sustainable and extremely effective. ○

Need to know

A cleverly engineered crash barrier ensures safety, sustainability and cost effectiveness

- The Tau Tube family of products has been tested and approved according to European standard EN 1317-3
- The system can achieve a Class B severity index level for light vehicles traveling at up to 68mph
- LTS Snoline's family of Tau crash cushions has provided protection for drivers on the world's roads for more than 20 years

Free reader inquiry service

Lindsay Transportation Solutions Snoline inquiry no. **509**

To learn more about this advertiser, please visit: www.ukipme.com/info/tfm

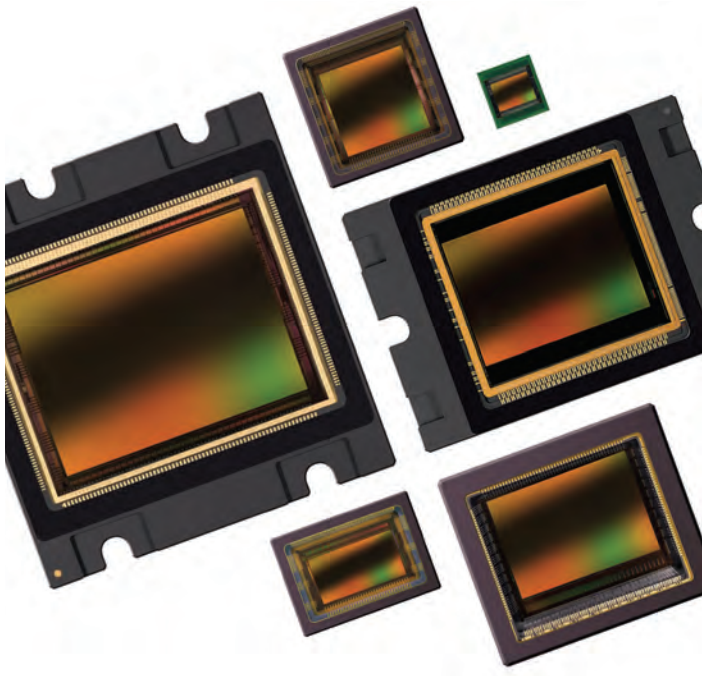
Improving traffic enforcement with machine vision technology

Enforcement is essential if we are to improve the safety of our roads. However, in order to build a court case against an offender, there needs to be unambiguous proof that a speed or red-light violation has taken place. High-resolution traffic cameras are heavily relied on.

ITS applications often resemble industrial vision applications, as the camera grabs images for analysis and outputs only the result. Because of this, many industrial vision camera systems and sensors are used in current ITS systems. The CMV image sensor family from CMOSIS, for example, was originally developed for industrial vision applications, but is an ideal fit for traffic applications as well.

A global shutter is by far the most important requirement if the application involves taking images of cars in motion (up to 180mph). Interline CCD (charge-coupled device) image sensors, which have dominated the industrial vision industry in recent decades, include a global shutter by design. Now, all CMOS sensors incorporate a global shutter as well.

A global shutter exposes all pixels of a sensor at the same time and over the same duration. It is a more complex concept because it requires a local storage element inside each pixel, plus a control function to enable the starting and stopping of the exposure. Even though it requires more complex pixels, it is possible to incorporate a global shutter into a CMOS sensor as a result of the sensor's specific architecture. CMOSIS's global shutter architecture has an eight-transistor (8T) global shutter, as opposed to the traditional 4T rolling shutter or the 5T global shutter.



(Left) **CMV image sensors can be used for numerous traffic applications**

Need to know

Some advanced machine vision imaging solutions are ideal for modern traffic applications

- Blooming (a problem that can occur when using CCDs, where image data becomes corrupted due to overexposure) is avoided in CMOS imagers by using overflow schemes to drain excessive charges in pixels
- This is important in traffic situations with unfavorable lighting conditions that can impair the recognition of license plates, especially if they are partly masked or covered by other parts of the vehicle, or if they have mirror-like surfaces

The CMOSIS 8T architecture provides two storage elements inside the pixel instead of just one, as in the 5T structure. They separately store one image taken at the beginning of the exposure and another at the end. Both of these images are subtracted during readout, lowering the noise associated with correlated double sampling and increasing the shutter efficiency.

In addition to the global shutter, CMOS sensors offer superior frame rates, high dynamic range modes, extended near infrared (NIR) sensitivity, and no blooming artifacts.

Intelligent imaging

It is not always necessary to capture and process an entire scene if just a part of it is required for analysis. To enable partial views, the CMOS sensor array has a flexible 'windowing' function. Up to eight line-wide windows can be programmed and read out at a higher frame rate. Preview modes for low-resolution tracking are also possible.

Traditionally, monochrome image sensors, which achieve a superior quality, have been used for such systems. Nowadays color image sensors are used because they are able to create a better image in terms of context. Additional improvements in sensitivity performance can be achieved by enhanced NIR sensitivity. Traffic systems typically employ NIR LED lighting at night, as it improves image quality without dazzling drivers with a bright light.

Leading the way

Traffic monitoring, in all its forms, is becoming increasingly important. Consequently, the associated industry is expanding and using data processing and imaging solutions that were originally developed for machine vision applications. The CMV image sensor family from CMOSIS provides a range of image sensor solutions that meet most traffic vision system requirements and offer a clear set of advantages compared with many current CCD solutions.

Express lanes

Your shortcuts to finding the greatest minds in advanced traffic management, in this issue... and beyond

"The era of the 'connected car' has already begun, as we equip vehicles with high-speed wireless connectivity. But imagine what is possible when our cars begin talking to each other and the roadways and networks around them"

Bill Ford, executive chairman of the Ford Motor Company, speaking at the 'Future of Mobility' event in Dubai, November 2014

Find out more at TrafficTechnologyToday.com/Ford

"Stop thinking about sensors and instead think about software... that's what changes everything"

Paul Newman, professor of information engineering, Oxford University, UK

Page 30

Page 53

"Somehow you have to get the message across to everyone that ITS can reduce congestion and emissions, and improve safety; then they will demand more ITS"

Nico Anten, MD of Connekt, Netherlands

Page 36

"The promise of MV is to perform boring, mindless tasks better than the human, and in many cases perform them much faster"

Roy Davies, professor of machine vision at Royal Holloway, University of London

Index to **Advertisers**


GLOBAL
REACH
LOCAL
PRESENCE
Q-Free - the single-source ITS expert for all ITS needs
Q-Free offers a complete range of products, solutions and professional services based on the most advanced and cost effective technologies.
• Cooperative ITS
• Electronic Registration Identification
• Enforcement
• Road User Charging
• Traffic Management
Q FREE
LEADING THE WAY
For more information visit us at:
www.q-free.com • Twitter@QFreeASA

Traffic Solutions

Systems and services based on
expertise in enforcement technology

Flexibility for all your traffic safety needs

Jenoptik Traffic Solutions offers technological and service-oriented solutions that efficiently increase traffic safety throughout the world. We place great importance on making our systems as flexible as possible to suit your diverse and changing traffic safety needs.

That is why we have now developed a completely new solution that allows for the flexible use of a laser scanner or radar sensor plus camera system in all stationary and mobile applications. It can easily be applied in a TraffiTower 2.0, in a vehicle or on a tripod or container. This one-system approach provides you with the highest possible flexibility, cost efficiency and handling ease.

Discover our innovative approach, superior technology and extensive expertise in traffic solutions!

JENOPTIK | Traffic Solutions
info.ts@jenoptik.com
www.jenoptik.com/ts

Traffic safety with robot technology

OPTICAL SYSTEMS
LASERS & MATERIAL PROCESSING
INDUSTRIAL METROLOGY
TRAFFIC SOLUTIONS
DEFENSE & CIVIL SYSTEMS

JENOPTIK