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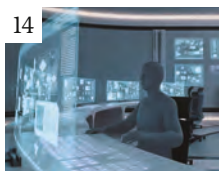
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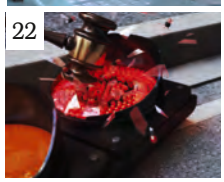
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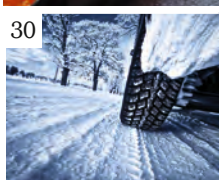
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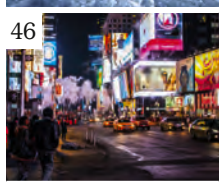
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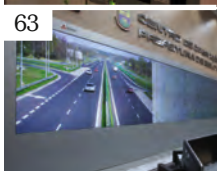

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Editor's letter

How will future generations look back at today's transportation? Certain ways of doing things have changed so much that the history of them seems almost unbelievable.

I remember my father telling me about how he used to go on shopping trips to London with his aunt and uncle in the 1950s. These trips would involve driving to the capital's main shopping thoroughfare – Oxford Street – where they would park right outside the shop they wanted to visit, for free. They'd then pop inside to browse and perhaps jump back in the car half an hour later to drive a quarter of a mile down the street to the next shop they wanted to visit, where they would also be able to park right outside. Even when I was first told this story, back in the 1990s, it seemed fantastic that such a state of affairs could ever have existed. The intervening four decades had seen such an explosion in car ownership that Oxford Street had long since become a no-parking zone, leaving car-bound shoppers to rely on expensive parking garages, or overcrowded side-streets. More likely they'd leave their cars at home and take the bus or Underground instead.

Since the 1990s, this situation has only become worse. However, now, at last, it feels like we may have reached a turning point. The UK's Transport Systems Catapult innovation center recently organized its first Mobility as a Service conference. During the day, it was pointed out that the coming revolution in transportation, which could see most of us paying a monthly subscription for all our transport needs, could make owning and driving a car for personal use socially unacceptable (you can read more at traffictechnologytoday.com/maas). Indeed, if everyone is sharing their rides, perhaps we will return once again to the convenience of always being dropped exactly where we want to go.

As change accelerates, we will also look back on 'unconnected' vehicles as hopelessly outdated. In this issue we look at a host of ways in which connected vehicle technology is already being used, with big benefits. From helping road authorities to make more accurate decisions about weather conditions and maintenance (*When every car is a sensor,* p30), to enabling motorists to reduce waiting times at intersections (*Talking to traffic signals,* p52) and making the crowded streets of The Big Apple safer for everyone (*The future of New York,* p46) – now we can finally envisage a future where getting around by road will be easier.

Of course, some 'early adopters' have been pushing boundaries for years. My great aunt and uncle were already experimenting with semi-autonomous technology in the 1950s – Dad also recounted the slightly unnerving experience of one steering the car, while the other worked the manual gears from the passenger seat.

Tom Stone
Editor

traffic TECHNOLOGY INTERNATIONAL
comtrans

Editor
Tom Stone
tom.stone@ukipme.com

Acting deputy editor
Rachelle Harry
rachelle.harry@ukipme.com

Production editor
Alex Bradley

Chief sub editor
Andrew Pickering

Deputy production editor
Nick Shepherd

Senior sub editor
Christine Velarde

Sub editors
Tara Craig, Alasdair Morton

Art director
James Sutcliffe

Art editor
Ben White

Design team
Louise Green, Andy Bass, Anna Davie, Andrew Locke, Craig Marshall, Nicola Turner, Julie Welby

Head of production and logistics
Ian Donovan

Deputy production manager
Cassie Inns

Production team
Carole Doran, Bethany Gill, Frank Millard

Circulation
Adam Frost

Publication manager
Godfrey Hooper
godfrey.hooper@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

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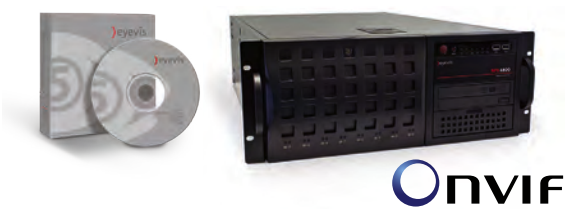

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eyevis GmbH | Hundsschleestrasse 23 | 72766 Reutlingen | Germany
Tel.: + 49 (0) 71 21 - 4 33 03-0 | Fax: + 49 (0) 71 21 - 4 33 03-22 | www.eyevis.com | info@eyevis.de

Driving ahead

As self-driving taxis begin testing on public roads, **Rachelle Harry** rounds up the latest headlines and video reports in the field of autonomous and connected vehicles

Fed rules issued

The USDOT has issued its eagerly awaited Federal Automated Vehicles Policy, laying a path for the safe testing and deployment of new automotive technologies that have enormous potential for improving safety and mobility for Americans on the road. Part of the document sets clear expectations for manufacturers, developers and other organizations, and includes a 15-point 'Safety Assessment' for the safe design, development, testing and deployment of automated vehicles.

Find out more at
trafficTechnologyToday.com/fedpolicy

Autonomous Ford

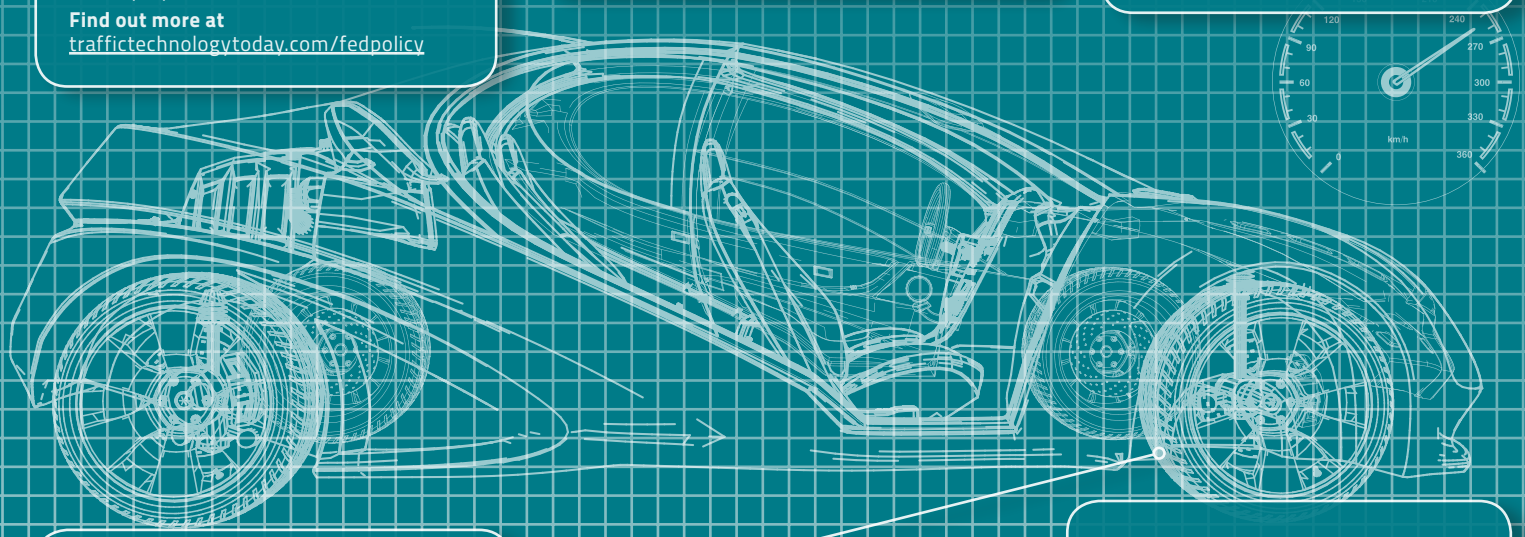
In this interview, Ford CEO Mark Fields surprises the industry by stating that the vehicles that will make up his company's autonomous ride-sharing service, planned for launch in 2021, will have no steering wheel or pedals. He also highlights the growing need for clear legal and regulatory policies surrounding the testing and deployment of autonomous vehicles.

Watch the video
trafficTechnologyToday.com/markfields

Special delivery

Autonomous vehicle delivery pods are being trialled in the UK, Switzerland and Germany, delivering goods to customers from Just Eat, Hermes, Metro Group and start-up company Pronto. The scheme, led by Starship Technologies, is part of a program to test the vehicles' suitability for local deliveries.

Find out more at
trafficTechnologyToday.com/starship



Shuttle power

Switzerland is one step closer to achieving effective smart mobility systems and improved traffic conditions, thanks to a partnership between the Federal Institute of Technology in Lausanne, Mobility Lab Sion-Valais, and the Swiss bus operator PostBus. The companies are trialling electric autonomous buses on public roads in Sion, Valais, Switzerland, until October 2017, to improve mobility and connect areas that were not previously serviced by public transportation.

Find out more at
trafficTechnologyToday.com/postbus

Robo-taxis

In a world-first, Massachusetts Institute of Technology (MIT) spin-off nuTonomy, launched the first ever public trial of a 'robo-taxi' service – beating Uber's Pittsburgh deployment by two weeks. Select residents were invited to take free taxi rides in Singapore's One-North business district in the autonomous vehicles that could help to improve road safety. Human drivers are present in the car, ready to take control if necessary.

Watch the video
trafficTechnologyToday.com/nuton

Policy pioneer

Adrian Flux, a leading UK insurance company, has launched the country's first insurance policy for autonomous cars. It is designed for consumers who already have driverless features, such as self-parking, in their existing cars, or who may be thinking of buying a new car with driverless or autopilot functions. Adrian Flux hopes that its new policy will encourage debate and discussion around the issue of liability for both drivers and manufacturers of autonomous vehicles.

Find out more at
trafficTechnologyToday.com/adrianflux

PREVIEW

16.17.18 NOV

2016 Intertraffic MEXICO

Unprecedented potential for traffic technology growth in Latin America has implications for vendors and operators all around the world. Keep up-to-date with the latest developments, as we preview what promises to be the region's biggest-ever industry event

Above and right: **Increasing car ownership in Mexico City is putting pressure on its streets**

For the first time ever, a large-scale international traffic show is heading to Mexico City. Intertraffic, famed for its biennial Amsterdam event, and more recently for shows in Turkey and China, is bringing its successful brand to the Centro Banamex exhibition center in the Mexican capital, from November 16-18. And not a moment too soon…

Mexico City is growing at an astonishing rate, and transportation infrastructure is struggling to keep up. Now road authorities are turning to technology to attempt to increase capacity on the city's road network.

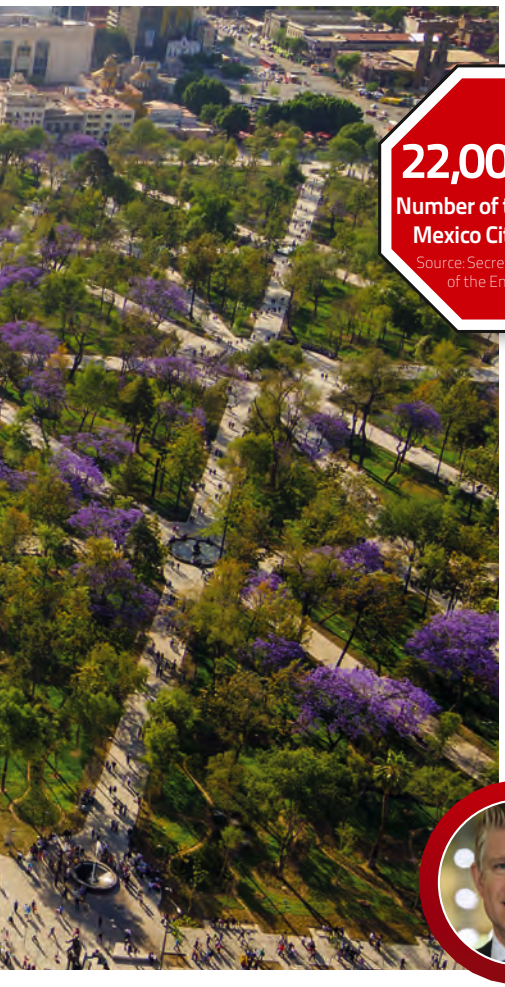
"The biggest problem in Mexico City is the huge number of people traveling through the city," says Richard Butter, manager of worldwide events for Intertraffic. "There are so many cars on the streets that, often, every major and peripheral street is blocked. So they really need technological solutions within infrastructure." Which is where Intertraffic steps in.

A new market

Intertraffic Mexico 2016 is the first edition in what is planned to be an annual event in Mexico City. It will open up new lines of communication between transportation professionals and accelerate the deployment of new infrastructure, safety and parking systems, traffic management technology and smart mobility solutions. It is just what the region has been crying out for.

"We've done our research and we've listened to our existing exhibitors at our other international shows… there are a lot of things that made us decide on Mexico," says Carola Jansen-Young, who is senior marketing communications manager for Intertraffic.

"The Mexican government has a huge stimulation plan for improving its infrastructure,"



22,000,000
Number of trips made in Mexico City each day
Source: Secretary of Defense of the Environment

Above: **Mexico City's Centro Banamex exhibition center**

> Mexico is predicted to be one of the top-five world economies by 2050, so that means there is a lot of potential and shows us there's a need for an Intertraffic event
>
> *Richard Butter, manager of worldwide events, Intertraffic*

continues Butter. "They need international companies to take care of it. So that's one reason why we chose Mexico City. Another more general one is that you can see all the big banks saying how well the economy is developing in Latin America. Mexico is predicted to be one of the top-five world economies by 2050, so that means there is a lot of potential and shows us there's a need for an Intertraffic event."

Huge popularity

Clearly the Intertraffic team's homework has paid off. All exhibitor space was sold out for the show back in January. At that point, the decision was made to upgrade to a larger hall in Centro Banamex, and within just a few more months, that was completely sold out, too.

"To make this event a real success we also have to have good content," says Butter. "Which is why, alongside the exhibition, there is also a full conference program."

"Communication of new responsibilities is a problem in the region," adds Jansen-Young. "That's why the conference program has a strong focus on regulation. It is being lead by the Mexican ministry of communication and transportation."

Registration rush

Of course, it's all very well filling a hall with exhibitors, but if there aren't also a large number of visitors, such events can never hope to be a success. On this front Intertraffic has also got it covered.

"We have registrations from 75 different countries already. The largest number of visitors are, of course, coming from Mexico. But second is Columbia and third is the United States."

The stage is set for what looks certain to be the key transportation event for the region this year – and for many years to come.

Intertraffic Mexico is jointly organized by RAI Amsterdam and EJ Krause

Mexico highlights

Integrated solutions

Czech ITS company Camea will be showcasing its Unicam, a state-of-the-art and field-proven platform for creation of multifunctional and scalable ITS.

One particular new development concerns weigh-in-motion and speed enforcement. One of Camea's cameras can now be used for both functions, thanks to the ability of its applications to share components. For example, a camera for license plate reading can be used for vehicle documentation and identification purposes for speed measurement, as well as for weigh-in-motion. This can considerably reduce both installation and maintenance costs. The applications can also be integrated. It is possible, for instance, to combine weigh-in-motion with spot/section speed enforcement and high-quality traffic counting and classification.

Booth 6, Hall C

Traffic management as a service

As transportation systems become more and more complex, the demand for 360° traffic management solutions is growing. In this session, which forms part of the conference program running alongside the Intertraffic Mexico show, Richard Neumann, head of corporate communication and marketing for Swarco, describes how such services can now be delivered and can encompass everything from basic network monitoring to strategic control of complex urban traffic environments.

Thursday, November 17, 9:30-10:00am, Room 1

Energy Efficiency Act explained

Keeping up-to-date with the rules and regulations surrounding transportation is increasingly difficult in Mexico, which is why an entire day's worth of sessions is being dedicated to 'Regulation and law', in Room 2 on the last day of the event.

This not-to-be-missed session is being delivered by Francisco Javier García, director of mobility and transport at CONUEE (National Commission for Efficient Use of Energy – *Comisión Nacional para el Uso Eficiente de la Energía*), who is also part of the Intertraffic Mexico advisory board. He has over 20 years of experience in the field of efficient use of energy and has created and operated programs and strategies for energy efficiency in transportation for both private firms and governments.

Friday, November 18, 9:30-10:00am, Room 2

Register for FREE at
www.intertraffic.com/en/mexico

Interstate spotlight

As congestion on US roads continues to increase, **Rachelle Harry** looks at the steps authorities are taking to ensure traffic flows freely along the nation's interstates

Public-private success

Colorado Express Lanes wins ARTBA Award

The US 36 Express Lanes project in Colorado has won the American Road & Transportation Builders Association's (ARTBA) Project of the Year Award for demonstrating the high value and innovation that public-private partnerships bring to transportation development in the USA.

A multimodal public-private partnership, the project is led by Colorado Department of Transportation (CDOT), the High Performance Transportation Enterprise, the Regional Transportation District and Plenary Roads Denver.

It was carried out on the busy US 36 corridor between Denver and Boulder, and consisted of the successful building of two free general-purpose lanes in each direction, one tolled Express Lane in each direction, and a bikeway along the US 36 corridor. The project offers road users the choice to ride the bus, carpool, bike, use the two free reconstructed general-purpose lanes, or pay a toll in the Express Lanes, which accommodate high-occupancy vehicles (HOV), bus rapid transit(BRT), and tolled vehicles.

Simulating the future

San Diego's enhanced integrated corridor management system wins again

The San Diego Association of Governments' integrated corridor management system on I-15, which aims to organize individual transportation systems as a unified corridor, has won the California Transportation Foundation Award for Operational Efficiency Program, for the second time in three years.

The project focuses on a 20-mile (32km) stretch of the I-15 between San Diego and Escondido. Its pioneering decision support system uses strategies such as network traffic prediction, online microsimulation analysis and real-time response strategy assessment to give system managers an awareness of the current and predicted performance of the corridor.

The system has been running in an automated stage since March 2014, using simulated evaluations to control signals and ramps. The most recent update is the introduction of 40 alternate route signs to guide drivers to the highway during diversions. This, in addition to enhanced local street detection coverage, continues to improve mobility through the corridor.

Real-time signs

Michigan DOT uses dynamic message signs in its I-75 corridor project

Michigan Department of Transportation has deployed the first phase of a network of dynamic 'Trailblazer' signs, by SES America, as part of its integrated corridor management program along I-75.

The signs are intended to keep drivers on the road informed in real time about highway conditions, and provide alternative routes at times of congestion or incidents.

The signs will help to manage the influx of traffic, and reduce traffic queues and congestion on freeways, benefiting both Macomb and Oakland counties.

USA's most advanced road?

California Department of Transportation (Caltrans) activates SMART Corridor on I-80

Caltrans has started phasing-in elements of its I-80 SMART (safety, mobility and automated real-time traffic management) Corridor, which will be the most sophisticated network of its kind in the state when it becomes fully operational this autumn.

The SMART Corridor will use a network of integrated electronic signs, ramp meters and other technologies on a 20-mile (32km) stretch of westbound I-80 between the Carquinez Bridge and the Bay Bridge.

The project was developed through a partnership between Caltrans, the Alameda County Transportation Commission, the Contra Costa Transportation Authority and the West Contra Costa County Transportation Advisory Committee.

As delegates prepare for Gulf Traffic, the Middle East's leading transportation expo, the event's conference chair **Akin Adamson** gives his insight into the region

Interviewed by Max Glaskin

Expo 2020 Dubai and the World Cup 2022 in Qatar are two overwhelming reasons why traffic technologies are on the up in the Gulf states. These fast-approaching global events, combined with the continuing development of infrastructure, means many are eyeing up the possibilities to offer systems and services to the region. Akin Adamson is well aware of the potential; as the regional director in the Middle East for Transport Research Laboratory (TRL) for four years, he'll be chairing the first two days of the Gulf Traffic conference at the Dubai International Convention and Exhibition Centre this November 13-15.

"I'm looking forward to the conference tremendously and expect some advanced ideas to raise a lot of interest," says Adamson, talking to *TTI* during his annual vacation back in the relatively cooler Kent, UK. "There will be active discussions about autonomous and connected surface transport applications that are already having an impact on how we see transportation evolving across the Gulf."

Building trust

"It is a competitive market where some traditional considerations still ring true," says Adamson, "If you're in the Gulf for the long term and are prepared to weather the lean times, then that's a recipe for success. But if you think you're going to enter the

> There will be active discussions about autonomous applications that are already having an impact on how we see transportation across the Gulf

Above: **The bright lights of Dubai are attracting some of the finest minds in traffic technology**

market and make a quick buck and not commit yourself to the region, then that's when companies find it challenging. People in the Gulf like to spend time getting to know you and to build up a level of trust."

Adamson himself has been in the Middle East for more than seven years, having arrived initially to develop a telecoms consultancy, a sector in which he'd worked in Australia. "I was doing a lot of the machine-to-machine and connected work – the building blocks of smart cities. Now that I'm at TRL, it's interesting to see the congruence of communications and traffic and transportation, because the two are coming much closer together," says Adamson.

Forward thinking

He believes that, of all the Gulf cities in which TRL is active, Dubai is the most ambitious. "It is forging ahead, trying to understand which technologies it should be implementing for smart traffic and transportation, and smart cities in general," says Adamson.

"You can break down the smart transportation ecosystem into four broad chunks," he says, and does so. The first is the traditional area of traffic control including signal phasing. "Most of the Gulf states have systems that can do it, so they're a fair way down the technology pathway. What they could get better at doing is optimizing those systems; there's scope to use it more effectively," says Adamson.

The second area contains systems that are relatively well-established elsewhere, but which have not been widely implemented in the Gulf. "Some Gulf states are moving in the direction of road-user charging schemes or low-emissions zones," says Adamson. Dubai's open-road tolling system, Salik, has helped to reduce congestion on some routes and it has potential to be used to improve air quality, too, Adamson believes.

"The third area is the emerging technologies, including connected vehicles, autonomous vehicles, ultra-low emissions, smart cities and smart highways," says Adamson, getting into his stride. "There's scope for all of the Gulf states to do a lot more work in these areas and, again, Dubai is probably leading the way, but countries such as Qatar and Kuwait, which are relatively well funded, are currently putting in place their plans to develop transport infrastructure. They have an opportunity to build in a way that is smart and connected. If I was to give any sort of advice to clients it would be to be building infrastructure 'as new' rather than trying to retrofit, because obviously it's much easier at the early stage."

The fourth area is a broad group of convenience and safety technologies. "From better wayfinding, directions and parking availability guidance, to journey planning, or safety systems such as E-call, which has been developed already in Europe," says Adamson, before highlighting an element where Gulf states have some catching up to do. "It's the use of data," he says. "In many cities, transportation providers are making data available to application developers to create a much richer set that's of use to services. But, probably for historic reasons, the Gulf states have been less keen to share information, but I think there would be big opportunities if they were to move in that direction."

The call of the Gulf

After his UK holiday, Adamson was set to return to his job in the Gulf, traveling between TRL's three offices in Qatar, Abu Dhabi and Dubai. The highways there certainly differ from those in Kent, so which of the region's many roads gives him the greatest pleasure? Is it the several grand, wide boulevards, the free-flowing highways, or the twists and turns of the oldest settlements? For a man whose work is committed to improving the technology of the Gulf's traffic technology, Adamson's answer is a healthy contrast. "Personally, I like to be up in the mountains of Oman."

Gulf Traffic highlights

1 **The Gulf Traffic Awards** will honor those companies and persons who have shown their commitment to developing and improving projects, initiatives or products for the benefit of the public and the region. The Awards are attended by key industry players, who are driving and shaping the future of the road, parking and public transportation sectors in the Middle East.

2 **Haenni Instruments** will be showcasing its unique, patented mobile weigh-in-motion systems at Gulf Traffic. Haenni's scales are among the thinnest on the market and are light and robust, and able to withstand virtually unlimited loads because of their special flat oval tube sensing elements. They are used in more than 115 countries worldwide. **Stand Z2.H29**

3 **Middle East Smart Mobility Summit** has provided a yearly platform for the most innovative thought-leaders to convene in a high-level discussion on the future of traffic in the region. With a strong presence from senior government, industry professionals and academics, Gulf Traffic has established a reputation for providing original discussions that have helped shape the regional market's development.

4 **TRL Student Award** is once again taking place at this year's Gulf Traffic. Created by the UK's Transport Research Laboratory (TRL), the Awards aim to tap into the creative skills of today's younger generation in order to help solve practical, real-life problems while also encouraging growth and development in transportation. UAE's top student minds will be rewarded for their proposals of innovative and sustainable transport solutions.

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The f

...ture of TMCs

The best traffic management centers are constantly being upgraded to take advantage of the latest technology. **David W Smith** visits two former Olympic cities, London and Atlanta, to discover how their systems have evolved, and where they are heading

Illustration: i3d

3 billion

The annual investment TfL makes, in pounds sterling (US$3.8 billion), in improving transportation infrastructure

For many cities, hosting the Olympic Games has left behind negative legacies of abandoned, rusting white elephants. But for both London and the US state of Georgia, planning for the Olympics has had a positive impact on the evolution of infrastructure and traffic management centers (TMC). The role of the TMCs in both cities, however, continues to develop to take advantage of modern technologies and confront new challenges.

Atlanta's population of half a million is much smaller than London's, but making preparations for the 1996 Olympics made the Georgia Department of Transportation (GDOT) an innovator in the development of TMCs. Expecting two million visitors, GDOT developed the NaviGAtor 511 program and a TMC to handle them. Both programs have operated continuously ever since, although recent times have seen a major expansion in operations.

Meanwhile, London's traffic operations are vast. A city of 8.6 million, it receives 30 million visitors every year. Each day there are 26 million personal journeys by road, a further 6.5 million personal trips by bus and 645,000 cycle journeys. "These are staggering numbers and London's population is forecast to grow to 10 million within a decade," says Jason Diffenthal, manager of the London Streets Traffic Control Centre (LSTCC) at Transport for London (TfL). "It's a real challenge as the city is hundreds of years old and built for horse and cart, and we're trying to run a 21st century transport network."

> We had a great lesson in the value of shared situational awareness during the Olympic opening ceremony when demonstrators tried to prevent the Queen getting to the park
>
> **Jason Diffenthal, manager, London Streets Traffic Control Centre, Transport for London**

Below: **London's Olympic Stadium in Stratford**

TfL's TMC is born

Although the Olympics was an important part of its evolution, the LSTCC was formed in 2003. After a couple of years building technology and support networks, the bid for the 2005 Olympics proved a turning point. TfL realized that to cope with such an event, it needed greater 'shared situational awareness'. That meant closer cooperation between teams, so the LSTCC co-located with CentreComm – the central bus command center – and the Metropolitan Police into one facility.

"We had a great lesson in the value of shared situational awareness during the Olympic opening ceremony when demonstrators tried to prevent the Queen getting to the park," says Diffenthal. "It was all hands to the pump. We worked with police and a special escort group to make sure she arrived. We watched on cameras and fed live information to Metropolitan Police officers. The lessons about communication are still used today for major incidents, such as the 1-in-40-year storm we had city-wide two years ago."

The principle of shared situational awareness has been taken even further since the 2012 Olympics, he says. Currently, the TfL Surface Transport and Traffic Operations Centre (STTOC) is made up of six main entities: LSTCC, which coordinates responses to incidents; CentreComm, which controls buses; the Roads and Transport Policing

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Command (RTPC); Enforcement and On-Street Operations (EOS), which manages relationships with the police; London Streets Tunnels Operations Centre (LSTOC), which recently moved from its base at the Blackwall Tunnel; and the Strategic Coordination Unit (SCU), which supplies information to senior management.

TfL has an international reputation for innovation in strategy and for embracing new technology. For example, TfL has already installed Split Cycle Offset Optimisation Technique (SCOOT) technology at 4,000 of London's 6,000 junctions. Studies show SCOOT reduces delays by up to 12% at each junction. In addition, new digital road signs will provide the public with real-time information, initially on the A12, A13 and A40, and TfL is trialling an operating system of temporary traffic lights that can be remotely controlled from the LSTCC. Meanwhile, a London 2012 Games-style 24/7 communication campaign means that each day the center feeds information to almost one million Twitter followers.

33,828

The average number of traffic incidents in London each year

"You'd be hard-pressed to find another city in the world with as much remote coverage of controllable traffic signals," says Michael Bloomfield, principal traffic engineer at TfL. "My team of engineers work in the background, then sit hand in glove in the control room helping to deliver solutions."

London is becoming a truly multimodal city. With no more capacity on the roads, TfL continues to build its new east-west and north-south Cycle Superhighways, as well as a series of Quietways that follow back streets, working toward a mayoral pledge to triple the length of the mainly segregated Superhighway cycle route network. The 645,000 cycling trips made daily is now equivalent to 20% of Tube journeys. "We're also rolling out new technology such as pedestrian SCOOT and cycle SCOOT, looking at optimizing signals for people on foot and on bikes," says Bloomfield. "You won't see such initiatives anywhere else in the world. It's a constant evolution – how can we get more out of a network nearing capacity?"

> We're looking at optimizing signals for people on foot and on bikes… It's a constant evolution – how can we get more out of a network nearing capacity?
>
> **Michael Bloomfield, principal traffic engineer, Transport for London**

Working toward prediction

From a strategy perspective, however, the operations center currently remains better at reacting than predicting, says Irfan Shaffi, TfL's intelligent transport systems manager. Shaffi says the Holy Grail for TfL is predictive modeling – having an online real-time model of the network. "Our plan would be for it to analyze everything happening at that time, using data streams to predict what might happen in half an hour. It could provide, say, three possible strategies to follow. We've had decades of human decision making, so once created, there will be a long way to go before we would gain confidence in any machine taking on those responsibilities."

Clockwise from top left: **TfL's Traffic Control Centre; signals are controlled with SCOOT; VMSs relay information to London drivers**

TfL uses a crowd-sourcing approach to data research. All information is put out free on TfL data feeds and other parties are encouraged to do the work. "There are in excess of 8,500 applicants signed up to our open data service, having delivered over 500 apps," says Shaffi. "It's a no-brainer. Why would we become a software house? We do what we do best and let others do what they do best."

The development of new software is a critical means of increasing the LSTCC's incident-detection speeds. New hardware helps, of course, but it's more expensive. For example, TfL has installed 40 traffic cameras using image recognition incident detection

Managing the future

In Virginia a new TMC is being planned that will ensure the state is ready to integrate connected vehicle data into its planning

Virginia DOT (VDOT) is creating an Advanced Traffic Management System that will integrate communication between the state's five traffic management centers. TransCore will be responsible for upgrading the system, which will allow digital signs to send live messages about weather, road traffic accidents, or roadworks.

The new center will cost US$13.9m to build and US$11.9m to operate over a four-year contract. It will share its data with Virginia State Police and 911 centers. VDOT says it will allow for the integration of automated, real-time traffic management technology, as well as connected vehicle technology when it finally arrives.

The system will be completed in phases over two years. The first involves traffic centers in Staunton, Salem and Richmond. The second phase is planned for Hampton Roads in September 2017 and the third phase will integrate the Northern Virginia TMC in March 2018. The final phase will incorporate the traffic and lane closure part in October 2018.

(IRID) technology, but they are costly and coverage is restricted. "We've got video analytics and computers doing clever stuff on video footage," says Shaffi. "But that requires specific types of expensive cameras at specific locations. We've realized from running 'hackathons' that software can detect incidents instead."

A hackathon involves gathering together a room full of computer 'geeks' and letting them loose on high-powered computers analyzing terabytes of traffic data. "They compete to answer questions and win prizes and kudos and they love every minute," Shaffi says. "Their work should help speed up incident detection rates. It can take an inordinate amount of time right now, while every second causes minutes of delay in clearing up the congestion afterward," he says.

TfL wants more LSTCC processes to become automatic. At the moment it is still mainly a human-driven affair involving monitoring CCTV. "We are heading in the right direction, but we are not exactly where we want to be," admits Diffenthal, who is honest about where he wants to go. "We split London into five areas – north, south, center, outer and east. We have dedicated teams monitoring these areas, but the south, for instance, is a large area to be covered and monitored. We use cameras to spot certain things and we discern patterns, but sometimes we're behind the curve and the whole point is to get ahead of the curve and start flagging issues before they escalate. Technology is driving change in the way we monitor the network, supply information, and how we respond to incidents. Our recruitment and also our training of staff is evolving as we embrace not only current technology, but also what is in the future."

Atlanta legacy

In Atlanta, the NaviGAtor 511 program, which is housed in the TMC, covered 37 interstate miles in 1996, but now covers more than 300. It provides real-time speed, volume and travel-time data using field devices such as CCTV and video detection cameras, ramp meters and variable message signs. Georgia's TMC is also home to the Highway Emergency Response Operators (HERO) program.

> We've gone from around 20 operatives to close to 40. We've had to find space for toll operatives and extra personnel to manage getting emergency vehicles into separated lanes
>
> **John Hibbard, operations division director, Georgia DOT**

The center recently went through a major expansion in order to cope with the demands from additional lanes that will change direction morning and night, located in central Atlanta. One lane will open early next year and one the year after. "They demand far more operational attention because we have to close them to make certain the cars have left before we can change the direction of travel," says John Hibbard, operations division director, Georgia DOT. "We've gone from around 20 operatives to close to 40 on the operations floor. We've had to find space for toll operatives and extra personnel to manage getting emergency vehicles to separated lanes. We've taken out offices and small comfort rooms to make room."

Like TfL, Georgia emphasizes the importance of software development. Last autumn it initiated a state-wide project that converted traffic lights to a traffic signal controller technology that provides automatic real-time feedback to the TMC. In the past few months, 1,000 of the state's 9,500 signalized junctions have been converted and the rest will be complete by autumn 2017.

Images: TfL, shutterstock.com

Above: **Olympic Park, Atlanta, Georgia**

"The data allows operatives to better focus on what's happening on the road and to minimize the number of discreet decisions they need to make," says Hibbard.

The next decade, he says, will see enormous changes as autonomous and semi-autonomous vehicle technology brings massive advantages for drivers, passengers and operators. "The operators will be able to send out information about road conditions, especially on the interstates or freeways, but they can also potentially receive real-time information from drivers, speeding up response times. It's an exciting time for the industry." ○

9

US states have laws prohibiting the use of red light enforcement cameras

20

US states have no specific laws on whether red light enforcement cameras can be used or not

21

US states have laws governing the use of red light enforcement cameras

Justice at the lights

Red light enforcement projects are being smashed in the US courts. **Saul Wordsworth** unpicks the increasingly complex patchwork of state regulations, and asks if such systems can survive the legal onslaught

Land of the Free. Not just a line from the national anthem, but enshrined within the US constitution. The Founding Fathers wished their citizens to live in a country underpinned by freedom, of speech, choice and the right to bear arms.

How then do the rules of the road fit with these notions of freedom? Uncomfortably, is the answer. Since the introduction of red light cameras in the USA 25 years ago, there have been uprisings and protests: these anonymous boxes are seen as a challenge to the very notion of what it means to be a free citizen.

"There are real divisions of opinion in this area," says Jason Beahm, president of Beahm Law and a criminal defense attorney specializing in traffic law. "It splits opinion. There are those who are anti-government and anti-police, who also tend to be against the red light cameras. They see them as intrusive and not living up to the requirements of the constitution. Then there are those who say, 'People are out there breaking the law and they're putting people's lives in danger. These systems can help protect from that.' My gut is that more people are against than in favor."

At the current count, 21 states have permitted some laws allowing red light cameras, nine states prohibit their use, and 20 states have no specific laws governing whether they can or cannot be used. Twenty-four states currently have at least one red light camera operating.

Precedents

In October 2014 it seemed a precedent had been set in Hollywood, LA. The 4th District Court of Appeal ruled that the district had broken the law when allowing the company running the cameras, and not the local police, to issue tickets. The ticket was duly revoked. The case, known as City of Hollywood vs Arem, led to several municipalities pulling their red light programs for fear of being sued. It was also used as the foundation for a similar appeal made by Luis Torres Jimenez in Aventura, Florida, last year. After he received a penalty for making an illegal right turn at a red light, Mr Jimenez too had his ticket overturned after claiming that Aventura gave American Traffic Solutions "unfettered discretion" to issue tickets. This, though, was not the end of it. In July of this year the district appellate ruled that the Aventura police officer had in fact legally issued the ticket for the red light violation, and the ticket was left to stand.

US$500

Maximum red light violation fine for a first offense in California

"I would hope the decision would encourage local governments in other jurisdictions not to simply abandon their red light camera programs in the face of litigation challenges," says attorney Edward Guedes, who represented Aventura. "However, unless another state's red light camera legislation is substantially similar to Florida's, the legal effect of the Jimenez decision should be limited to Florida."

"I know Oakland recently dismantled their system," says Beahm. "And I'm told unofficially that in LA you can ignore any red light camera tickets you receive. I don't advise people to do this, although I know some attorneys do. The problem is that there is good data suggesting that red light cameras lead to an increase in rear-end auto accidents, and that most of the tickets are given to people turning right on red without coming to a complete stop, which, while illegal, is a very common offense that nearly everyone could be accused of and rarely results in a major accident."

Data on the efficacy of red light enforcement is variable, and different findings can be used to prove a particular point of view. A 2012

1991

The year the first red light camera was installed in the USA

Cycle of red

Motorists often bemoan cyclists jumping red lights. Are they justified?

More than 1,500 red light cameras were triggered by cyclists in the District of Washington DC between January 2015 and April 2016, with no means of identifying the transgressors. The fine for the vehicular equivalent is US$150.

While the police have flagged this up as a safety issue and have promised to prosecute cyclists they catch red-handed, the cycling community has hit back, stressing that there were more than 60,000 red light camera violations in 2015 alone, and that despite any frustrations drivers may feel, 99% of all fatalities on the roads are caused by drivers, some of which involve cyclists innocently following the rules.

Cyclists in Paris are now allowed to run red lights. San Francisco is considering a similar move.

US$300

Maximum red light violation fine for a first offense in New York

report in St Petersburg, Florida, for instance, showed that where red light cameras were in operation the number of side impacts decreased, but rear-end collisions increased. Beyond that, there is anger that solutions pitched as safety devices are there to swell the coffers of local authorities, and operators. In 2013, Florida collected US$52m in red light camera fines, three times the 2011 figure 2011. "If the state needs additional tax revenue, the legislature needs to be fair and honest about how it gets that revenue," said Florida State Senator Jeff Brandes.

Burning the ticket

For many, the issue regarding red light enforcement centers on who generates the ticket: the police or the vendor? In most states, if it is deemed

Above: **The nine US states with laws prohibiting the use of red light enforcement cameras**

to be the latter, this is considered illegal. One man who is making his views heard on the matter is Andy Holt, a right-wing Conservative serving in the Tennessee General Assembly. He is on a mission to outlaw all speed and red light cameras in his state.

"Even though state law mandates that no one other than law enforcement may view the video evidence and determine whether or not a violation has occurred, traffic camera companies view the video footage and determine whether or not a violation has occurred well in advance of law enforcement," he states on his website, which also recommends you throw any tickets that you may be issued with straight in the trash. "Personally, I prefer to burn mine," he says.

"Advocating that people disregard the law is irresponsible," says Guedes. "It's no different than someone posting on a website that gun owners should ignore all laws regulating gun ownership simply because the individual thinks the government has no business regulating guns. People who refuse to pay red light camera citations, but do not invoke the proper remedies that are already available to them under the law, should be prosecuted accordingly."

Points to the reds?

Running a red light is illegal in Missouri but red light camera violations are not technically considered moving violations and no points will be added to your driving record, so long as you plead guilty by paying the fine.

Andrea R Rogers is a traffic ticket lawyer licensed in the state: "Until 2012 when we still had red light cameras in the City of St Louis, most people just paid the tickets, although some fought them in court and others simply ignored them. People were infuriated by the red light cameras. I have heard that the City is trying to rewrite the municipal ordinance regarding red light cameras so they can turn the cameras back on and start issuing tickets again, since it was such a huge money-maker for the

> People who refuse to pay red light camera citations, but do not invoke the proper remedies available to them under the law, should be prosecuted accordingly
>
> **Edward Guedes, partner, WSH Attorneys, Florida**

2014

The year New Jersey abandoned its red light pilot program due to technical issues and lawsuits

City. If they tweak the ordinance slightly, they would probably not have any problems with the constitutionality issues, but red light cameras are very unpopular with citizens, so I don't know if they will actually do it."

Hard line in the UK

Outside the USA there is often bafflement as to how violations may be challenged. Surely a ticket is a ticket. "It needs to be understood that in the UK red light defenses are extremely limited," says Doug Harris, a lawyer with Motor Lawyers. "It is not even an option to suggest that the driver had no alternative but to cross the stop-line to allow an emergency vehicle through."

Yet in the USA it seems much of the law is there to be fought. "In the USA you can fight over the tiniest technical issues," says Beahm. "The law has evolved over individual freedoms and rights, and the government can't just turn these into administrative actions. You're entitled to the full protections of the constitution, for instance the right to confront your accuser, and that's a question: in red light enforcement cases, who is the accuser?"

1991

The year the first red light camera was installed in the USA

Should federal law step in?

The red light camera laws in the USA lack cohesion. Some believe this is what makes the system of government great: each state can adopt its own laws and create a 'laboratory of ideas', while others say it leads to confusion and that a more uniform system would be better.

"The government in the USA is structured as a federalist republic," says Guedes. "This allows for state-by-state laws unless and until the United States Congress issues legislation governing that subject matter and specifically precludes the states from engaging in their own regulation. Is it conceivable that there could be such national legislation? Yes. How likely is it? Not very, at least not with the current political make-up of Congress." [Guedes was speaking to *TTI* prior to the US elections on November 8.]

> The law has evolved over individual freedoms and rights, and the government can't just turn these into administrative actions
>
> **Jason Beahm, president, Beahm Law**

"I think there are enough people who don't like red light enforcement to create a domino effect; but I also think this would already have happened, if it was going to happen," says Beahm. "My prediction is that, for now at least, we'll remain with the current patchwork system."

Legal battles to continue

When appeals are taken to the higher courts, even if they side with the individual, they rarely publish the ruling, meaning no one can copy the argument. This way the courts avoid such decisions being duplicated. "They don't want the whole red light system thrown out," says Beahm. "There are many reasons for this – money being the chief one."

30%

Fatality increase in cities that turn off their red light cameras (Insurance Institute for Highway Safety report 2014)

There is one last twist in Florida: in September 2016, just before we went to press with this issue, a federal appeal court refused to rule in favor of an attempt by local governments in the state to block future refunds of red light fines to motorists. So while Aventura's penalization of Luis Torres Jimenez has been upheld, there is nothing to stop more individuals challenging red light fines in the future in the hope of getting their money back.

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Snow-covered roads, potholes, broken road signs... all can now be mapped accurately in real time using onboard sensors. How can this data be put to good use? **Tom Stone** and **Max Glaskin** report on new software being developed by Michigan DOT to harness the power of connected vehicles

If all the data acquired by all the sensors on all the vehicles on a road network is sent to the state DOT and combined with more information about weather, incidents, safety and events, what have you got? A mountain of data that, processed by the right software, could tell you almost everything about every inch of blacktop, in near real time. Then, if you quickly transmit that wealth of knowledge to DOT teams, you can optimize asset management, design, construction, maintenance and operations. If only…

Now wake up and smell the coffee, because this concept is becoming real in Michigan, home to one of the first connected vehicle (CV) testbeds in the world – the Ann Arbor Connected Vehicle Test Environment, and its associated Smart Corridor. As you read this, Michigan DOT is taking the next leap, to use CVs for the next generation of traveler information systems. Its Data Use Analysis and Processing (DUAP) program combines data gathered directly from vehicles with that from 'traditional' static sources, to generate richer and more pertinent live information on traffic, road conditions, weather and assets.

Sensors on new cars can tell if a road is slippery. If the car is also connected to the cloud, everyone can benefit from this data

"The beauty of DUAP is it takes in everything from all different sources, processes it together, and sends it back out in a form our applications can use," says Matt Smith, MDOT statewide ITS program manager. "It will take in data from onboard devices in CVs, from legacy devices such as roadside weather units or track counters, and from elsewhere. When processed, the information is available for the DOT to use."

To achieve this, many technologies must work in concert. The DUAP system is able to understand different kinds of data received from many sources, synthesize it and pump it out. Robust communications, integrated with CVs, have been developed to gather and transmit this information. Finally, user-friendly interfaces have been developed so the

relevant information is available to DOT teams in easily accessible ways.

"We can take pavement condition information from instrumented vehicles in near real time, combine it with information that's not real time, from other sources, process it together and get a profile for what the pavement looks like," says Smith, "We can do the same for weather: take information in from instrumented vehicles or vehicle systems, pull in more from roadside weather units and even the national weather service, process it all, and then send it back out to the vehicle. The key part is sending this information back out to vehicles."

Technological evolution

Currently DUAP is evolving in Southeast Michigan with a plethora of data sources, including the Ann Arbor CV test environment, where there are around 30 connected roadside units collecting 'true' connected vehicle data. More real-time data about location, speed and heading is gathered from the basic safety messages of CVs, 300 instrumented snowplows and cellular signals.

Yet that's only part of the network. "We have another fleet of 15 light-duty vehicles that's instrumented with Vehicle-based Information Data Acquisition System (VIDAS)," says Collin Castle, connected vehicle specialist for MDOT and project manager for DUAP. "VIDAS is a small field computer that enables us to use whatever sensors are on the vehicle to collect pretty much any information

Road weather and asset conditions can be monitored in real time using connected vehicle technology

about our freeway network, such as defects, surface condition and real-time weather. They also have DSRC connectivity. The idea there is that these are high-mileage vehicles that cover the system on a regular basis. So, now we're not relying on some guy in a maintenance truck who's out there doing something very specific. This could just be people doing their day job and they're out there collecting data without even having to think about it."

When DUAP matures, the number of data sources could grow exponentially. "Right now, the basic safety message is valuable to a certain extent for mobility applications, knowing how fast the roadway is moving, things like that," says Castle, looking to the future. "But these vehicles are just rolling computers that have tons of sensors on them that could eventually be really valuable to us. We know, for example, that a number of OEMs have a wealth of data from their diagnostic fleet and we've been trying to figure out a way we can create a relationship where we can access some of that data.

"The thought is that in the future there will be tons of probes out there collecting tons of information that will give us an unbelievable amount of data to enable us to do our job more effectively," says Castle. It could also provide highly detailed information for travelers.

Partnering is going to be important for the full potential of DUAP to be realized. One example is when a company testing automated vehicles was using video analytics for lane keeping, and contacted Castle. "They said, 'You know what, we have a better idea of the condition of your pavement than you do because our vehicles are out there collecting data all the time'," Castle recalls. "We could partner with people like that or just be a consumer of data we purchase. There are a lot of great opportunities for us out there and we have to figure them out."

> We can take pavement condition information from instrumented vehicles in near real time
>
> **Matt Smith, statewide ITS program manager, MDOT**

Making data useful

However the data is acquired and processed, it has to then be made easily available to DOT operatives in a useful format. The chosen interface is web based and protected by passwords. The data is displayed on

maps with associated reports that can be either real-time or historic. "We have a handful of applications built today, but the real concept is that we have the foundation built, so we can continue to build and mine the data in different ways, which we've never done in the past," says Castle.

Currently DUAP is seen as a decision-support tool for DOT operators. "For example, we can use weather data to identify an affected area and say there's something occurring," says Castle. "Then our operations center can use that information to get more accurate messages out to the public and then our maintenance staff can use it to make better decisions about winter maintenance activity. That's a real-time application.

"Another application that's more historically driven is for pavement defects," continues Castle. "Our design folks can look at two pavement segments side by side, for example, and ask why they are acting differently, even though they were designed and laid in the same way."

Integrating data from so many sources has its risks but, to minimize those, an external consultancy was brought in to engage with all of the many stakeholders. Mixon Hill of Overland Park, Kansas, has been involved with ITS since the early days of the USDOT's VII and IntelliDrive programs. For MDOT, it has listened to all the parties to understand how they would use DUAP, and then designed and built the system accordingly. "Mixon Hill has done all the development, housed all the servers, operated and maintained it for us," says Castle. "We have a long-term contract relationship with them. It allows for them to take advantage of their intellectual property, but also allows MDOT to receive benefit in return for all the time and energy that we've put in."

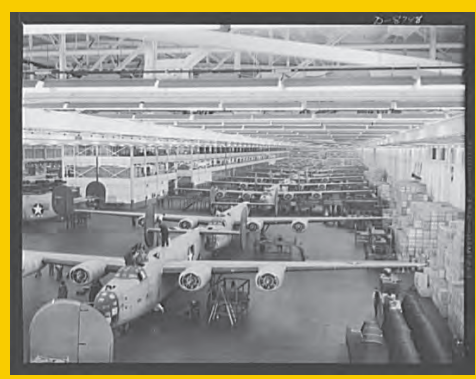
The rebirth of Willow Run

How a World War II bomber factory is getting a new lease of life as a center for testing and certification of connected and autonomous vehicles

When R&D facilities run out of capacity, two things are evident. The first is that the programs underway have momentum. The second is that bigger facilities are needed. So now that the Mcity proving ground for autonomous cars at Ann Arbor has become oversubscribed, MDOT is involved in planning a resource 10 times bigger – using the 311 acre Willow Run site in Southeast Michigan.

The facility being constructed is known as the American Center for Mobility (ACM). "This new site will be able to move forward with testing and certifications of connected and automated vehicles," says Kevin Kerrigan, senior automotive adviser to the State of Michigan, with the Michigan Economic Development Corporation (MEDC). "We've been speaking to NHTSA about it."

The site has a distinguished history. Ford constructed a plant at Willow Run to build B24 Liberator bombers in World War II. At the time it was the biggest in the world and produced one airplane every 55 minutes. Later, GM turned it into a powertrain plant. Now MEDC has bought the property for US$1.2m to test and certify next-generation vehicles. Users will include private industry, academia and government.



> We can use the information to get more accurate messages out to the public… and make better decisions about winter maintenance
>
> **Collin Castle, connected vehicle specialist, MDOT**

Right: **Michigan's Smart Corridor is growing**
Below: **DUAP's graphical user interface**

Bringing in other DOTs

Although the future of DUAP is by no means certain, the plan is that it will spread in two ways – in its capability to use data and in its geographical coverage. "The concept is that it's only ever going to get better," says Castle. "What often happens in DOTs is that you have a specific problem and a specific amount of money, so a specific solution is developed, which is very rigid and doesn't allow you to make other connections between data. With this program you can start to make interactions and ingest data and analyze it in ways that haven't been done before. Our goal is to make it scalable for other DOTs. It's great we built something of value to MDOT, but if others could contribute to it, develop it and build its functionality, it would be worth so much more."

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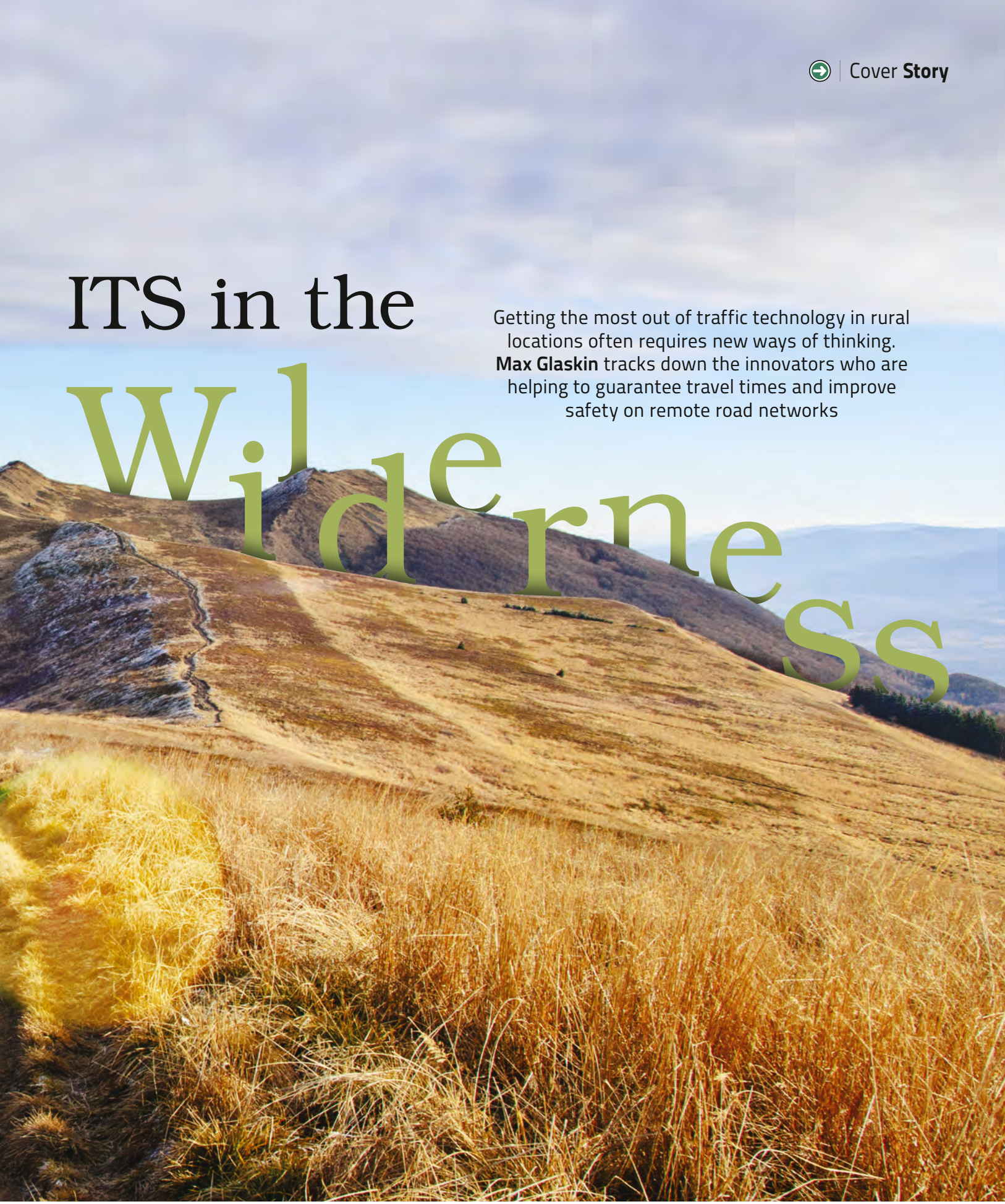
ITS in the Wilderness

Getting the most out of traffic technology in rural locations often requires new ways of thinking. **Max Glaskin** tracks down the innovators who are helping to guarantee travel times and improve safety on remote road networks



More traffic means more pressure to get the most from rural roads. Yet applying ITS can be tricky because power supplies, data cabling and equipment security can be difficult to provide on remote highways. So these installations inspire solutions that city slickers could never imagine.

The presence of a military base close to the rural southern edge of Puget Sound posed unusual challenges for Washington State DOT (WSDOT) when it wanted to reduce congestion on the adjacent I-5. The average daily traffic flow of 130,000 included vehicles whose journeys could conceivably be rerouted away from the freeway, onto rural roads.

> During a period when we're experiencing population growth of 8% annually, four times the normal rate, we're getting double-digit travel time reduction on the freeway
>
> **Tony Leingang, freeway operations engineer, WSDOT**

"The local roads are all within the base and there were two issues. First, the military personnel on the base tend not to stay for long, so they don't have time to get to know the local roads. For them the freeway is the easiest choice. Second, members of the local community who work at the base tend to use the freeway to make short hops from one part of the base to another," says Tony Leingang, freeway operations engineer at WSDOT.

Eighteen ramp meters were installed to deter all drivers from joining the freeway but, to win support from both the military and civilian communities, an information service was planned. It would encourage drivers to avoid the freeway by showing them all reasonable alternative routes and their traffic flow. The project was awarded a TIGER grant by the USDOT, but although this undoubtedly eased the way financially, it also included an unusual constraint.

"The rule is none of the grant can go back to any federal organization, so we couldn't spend any money or give anything of value that would pass to the Department of Defense, which owns the base on which all the local roads are located," says Leingang. So the fiber backbone WSDOT needed between the ramp meters had to be laid just outside the fence of the base. And there was no way that in-pavement vehicle counters could be installed in the local roads because they would add value to the DoD-owned base. How, then, to get near-real-time information from the local roads?

Solar-powered Bluetooth sensors from BlueToad by TrafficCast were

Below: **A VMS weather warning message in Wyoming, USA**

Remote weather warnings

Speed cameras prove VMS weather warning messages on I-80 make traffic slow down

Until V2I is fully developed, highway operators must rely on variable message signs (VMS) to get location-specific information to rural drivers, particularly to tell them to slow down because the weather is making driving hazardous. They've been used for many years in urban areas where the density of traffic means that slowing just one vehicle can check many of those behind. On rural roads, though, vehicles are fewer and the signs need to trigger the right reaction in each and every driver.

So the Mountain-Plains Consortium wanted evidence that the VMS on rural highways across Wyoming, Utah, Colorado and the Dakotas do the job effectively. The 41-mile long I-80 corridor in southeastern Wyoming between Laramie and Cheyenne was the focus, with about 11,000 vehicles daily in the winter, about half being trucks. Drivers face rain, ice, high winds and blowing snow and subsequent crashes can lead to road closures that can end up costing local economies millions of dollars.

The data from speed sensors on the I-80 was analyzed in relation to the information displayed on the 12 VMS along the corridor, and to the weather conditions. Put simply, it was found that drivers slowed down more as the weather warnings on the VMS got more severe, exactly as intended. The gentlest warnings prompted slowing by 5mph and the most severe prompted drivers to scrub 20mph from their speeds. In other words, used carefully by traffic management centers, VMS can be very effective at improving road safety on rural highways.

the answer, attached to existing poles within the base but installed, maintained and owned by WSDOT. The data is sent via the cell phone network to TrafficCast's server for processing. Then it's forwarded to WSDOT, which shares the travel information and flowmaps with the civilian and military communities through its own website and app. "Being a military base meant that we couldn't let TrafficCast display them, it has to be a public service," says Leingang.

The project went live in July 2015. One unusual snag during its implementation was a delay caused by Tesla buying the available stock of components that go into BlueToad units. The WSDOT website for travelers to and from the base currently gets an average of 14,000 hits a month and traveler behavior seems to have changed, reducing problems on the I-5. "During a period when we're experiencing population growth of 8% annually, four times the normal rate, we're getting double-digit travel time reduction on the freeway," says Leingang.

Bluetooth can be used to gather travel times with roadside units detecting the wireless signals of 2.4 to 2.485GHz that connect mobile and fixed digital devices like cell phones, tablets and in-car units over short distances. However, it's not the only wireless signal that can reveal when a vehicle is passing. The rapid growth in the use of transponders for electronic tolling is paving the way for an alternative to Bluetooth detection – transponder tolling tags.

> Our solution is to improve mobility in rural areas by connecting various types of public transportation with a rural version of Uber
>
> **Valerie Lefler, president and CEO, Liberty**

Counting on tolling tech

In South Korea more than half of all cars have the discreet onboard tolling units, which operate at 5.8GHz. Like Bluetooth devices, they can be scanned and identified remotely to acquire travel time information, using dedicated short-range communication (DSRC) roadside units that are cheaper to install and maintain than traditional loops and ALPR cameras.

Yet there's a problem in doing so on rural highways, partly because the DSRC scanners aren't directional – they can't tell which way each vehicle is traveling. This is in contrast with Bluetooth detectors where more sophisticated antennas on the

Right and below:
VMS in Wyoming ensure drivers are well informed even in remote locations

On-demand goes rural

Liberty, a USDOT-grant-winning startup, is aiming to connect disparate rural transportation options to create a new, seamless network

Uber has shaken up personal transport in cities worldwide with a smartphone app connecting travelers with drivers. But it doesn't always meet the needs of those in the less densely populated rural regions of the USA, where only 14% of households can access transit.

A new service called Liberty aims to fill the gap, by means of an app that integrates drivers with existing public transportation providers.

"Our solution is to improve mobility in rural areas by connecting various types of public transportation with a rural version of Uber," says Valerie Lefler, president and CEO of Liberty. "We will integrate the transportation options of rural demand response transit agencies from multiple counties, non-profits, volunteers and non-urgent medical transportation providers, to create opportunities for new rural personal vehicle transportation services."

Liberty is already working with a center in Texas that supports independent living for disabled people and with a transit provider in Nebraska. It's won a Small Business Innovation Research grant from the USDOT. "Now we're moving forward and working on scaling the model," says Lefler.

5G for rural ITS

Can the next generation of cellular comms help road authorities in rural areas implement ITS?

Although it'll be at least 2020 before consumers get access to 5G, trials of its application for rural transport could start as early as 2017 in the northern region of Groningen in the Netherlands.

It's the only rural area in Europe where 5G tests are to take place. They will be run by members of a 10-strong partnership that includes government agencies, researchers and telecoms firms. The focus will be on increasing bandwidth to 1Gbps, boosting network response speed to 1ms and supporting more communications per cell – up to 100,000 connections in each.

"One of the use cases that has been prepared is about ITS and relates to an initiative of the regional authorities to experiment with autonomous minibuses, as part of the future public transport services," says Peter Rake, manager of the region's 5G program.

It would be enabled by a significant reduction in the data transmission delay that besets the current 4G networks. This real-time connection potential of 5G makes it viable for self-driving cars. In addition, 5G would be decentralized, so data would need to travel shorter distances, further reducing latency.

roadside units can spot the direction. So a car can be scanned as it passes a DSRC roadside unit, make a U-turn and pass it again. Anomalies like these disrupt the reliability of travel time information from the rural network. This is where the clever math comes in.

Algorithms that spot the unusual data and exclude them from travel time information are being perfected by Jinhwan Jang, senior researcher at the Highways and Transportation Research Institute of South Korea's Institute of Civil Engineering and Building Technology. In some preliminary trials, his formula gave average errors of less than 5%, which meets the standards expected by the USDOT for travel time information reliability. "I've now verified the method with a wide variety of probe data and have developed a robust estimation technique to provide reliable travel time information," Jang tells *TTI*.

Correctly spaced out

Even when Jang's algorithm is shown to collect travel times reliably, there's still the question of where to place the roadside units (RSUs). If they are not located optimally, there will be gaps where useful data isn't collected or, equally frustrating, more units than necessary will be installed.

This conundrum is also faced by V2I projects in rural areas where RSUs will be needed and here too it is being addressed by clever use of math. It starts with freely available data, by scanning OpenStreetMap or Google Maps to identify potential locations. Then every possible site is scored according to traffic volume, the highways operator's requirements and likely wireless connectivity to other RSUs.

> I have developed a robust estimation technique to provide reliable travel time information [from detecting tolling tags]
>
> **Jinhwan Jang, senior researcher, Institute of Civil Engineering and Building Technology, South Korea**

So far, the method has been tested in the Spiringen area of Switzerland, where the mountainous terrain makes it more difficult to connect RSUs wirelessly with each other to form a robust network. The tests have been carried out by researchers from the German University in Cairo, Egypt, who say that their method will significantly reduce the number of RSU locations that are needed. Although refinements may improve the method by considering curves, road topology and the directionality of the antenna on RSUs, the method already appears to give more accurate results for connectivity between the units than other RSU location decision processes.

The remoteness of some rural roads can, at first sight, make ITS projects appear unfeasible and appropriate only for urban highways. The examples detailed above show that's nonsense. Clever thinking, sound research and careful implementation can spur innovation that wins by a country mile.

Above: **A solar-powered Bluetooth detection unit attached to a telegraph pole in Washington**

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5G ready?

In anticipation of 5G, telecoms companies are joining forces with auto makers to aggressively corner the V2X market

At the end of September it was announced that some of the biggest names in auto manufacturing and telecommunications are joining forces to create the 5G Automotive Association. The founding partners are Audi, BMW, Daimler, Ericsson, Huawei, Intel, Nokia and Qualcomm, with a stated goal of addressing society's connected mobility and road safety needs.

"Intel's leadership work in 5G technology development, long-term commitment to open standards, and collaboration with leaders in the automotive industry, will drive an accelerated path to adoption of 5G in automotive and transportation," says Doug Davis, senior vice president and general manager of the Internet of Things Group, Intel.

"Partnering with other industry leaders will ensure that 5G can support the use cases that will help to deliver on breakthroughs in safety and services for automated driving, smart cities and intelligent transportation solutions around the world," Davis concludes.

46 – The future of New York
A new series looks at progress being made in the USDOT's three Connected Vehicle Pilot Program test beds. First, we report from the Big Apple

52 – Talking to traffic lights
A groundbreaking new V2X concept has vehicles not only receiving data from traffic signals but broadcasting back to them as well

USDOT Connected Vehicle Pilot Program (Phase 2) Update

Part 1

NYC

The future of

New York

Welcome to the first of our comprehensive updates on the world's most ambitious connected vehicle technology roll-out: the USDOT's Connected Vehicle Pilot Program. The project, which is taking place in three locations across the USA, is now entering its practical phase. First up, James Gordon gets the latest from the streets (and vehicles) of Manhattan and Brooklyn

2,820

The approximate number of signalized intersections in the borough of Manhattan, NYC

It's perhaps the world's most recognizable man-made horizon. So iconic that American novelist F Scott Fitzgerald wrote about it, 1980s pop band A-ha sang about it, and Georgia O'Keeffe painted it. But while New York's Manhattan skyline is often seen as a monument to progress, the gridlock viewed from the back seat of one of the city's 13,500 yellow taxis in rush hour traffic provides a different outlook.

According to travel analytics company Inrix, for example, New York ranks as one of the worst US cities for congestion, with drivers spending an average of 73 hours in traffic jams every year.

In an attempt to improve safety and mobility, NYC DOT was selected to participate in the USDOT's Connected Vehicle Pilot Program in September 2015. The chief aim of the initiative, which will take more than four years to fully deploy, is to use vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) comms at intersections to enhance vehicle flow and pedestrian safety in some of the city's busiest districts.

At the heart of the US$20m project is DSRC (dedicated short-range communications) infrastructure, which will marry V2V and V2I to support safety applications for over 8,000 vehicles initially, and nearly 400 of the city's 12,800 signalized intersections.

Hardware deployment

Each vehicle will be fitted with an aftermarket safety device (ASD), which will enable equipped vehicles to communicate with each other and with the surrounding infrastructure through DSRC (at 5.9GHz).

With safety being the primary focus, drivers will receive audio warnings and not visual ones when they are about to encounter a hazard,

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which are generated by V2V or V2I devices using standardized DSRC; the project is not using 3G or 4G LTE.

The ASDs, which will be fitted into 6,000 taxis, 1,250 Metropolitan Transport Authority buses, 500 sanitation trucks, about 400 United Parcel Service vans and some private vehicles, will transmit data to the city's traffic management center (TMC) using the citywide wireless network, NYCWiN, which is the project's communication backbone. At the TMC, real-time information from each of the traffic light controllers equipped with connected-vehicle roadside units (RSUs) will be analyzed and used to optimize traffic signal operation. Information will also be periodically exported into the USDOT Research Data Exchange, where it can be used by researchers and application developers to enhance safety and alleviate congestion in the future.

> We chose the two locations after careful research. Both are prone to heavy congestion with immense, related vehicular and pedestrian conflict
>
> **Dr Mohamad Talas, ITS program manager, NYC DOT**

Six specially designed V2V safety applications issue drivers with active safety advice, including forward collision alerts, blind spot warnings, intersection cross-traffic warnings, and emergency brake light alerts.

A further seven V2I audio warnings are available, ranging from red light and speed-compliance broadcasts to information cautioning motorists if their vehicle is too large or too tall to negotiate the city's bridges, tunnels and underpasses.

Location, location, location

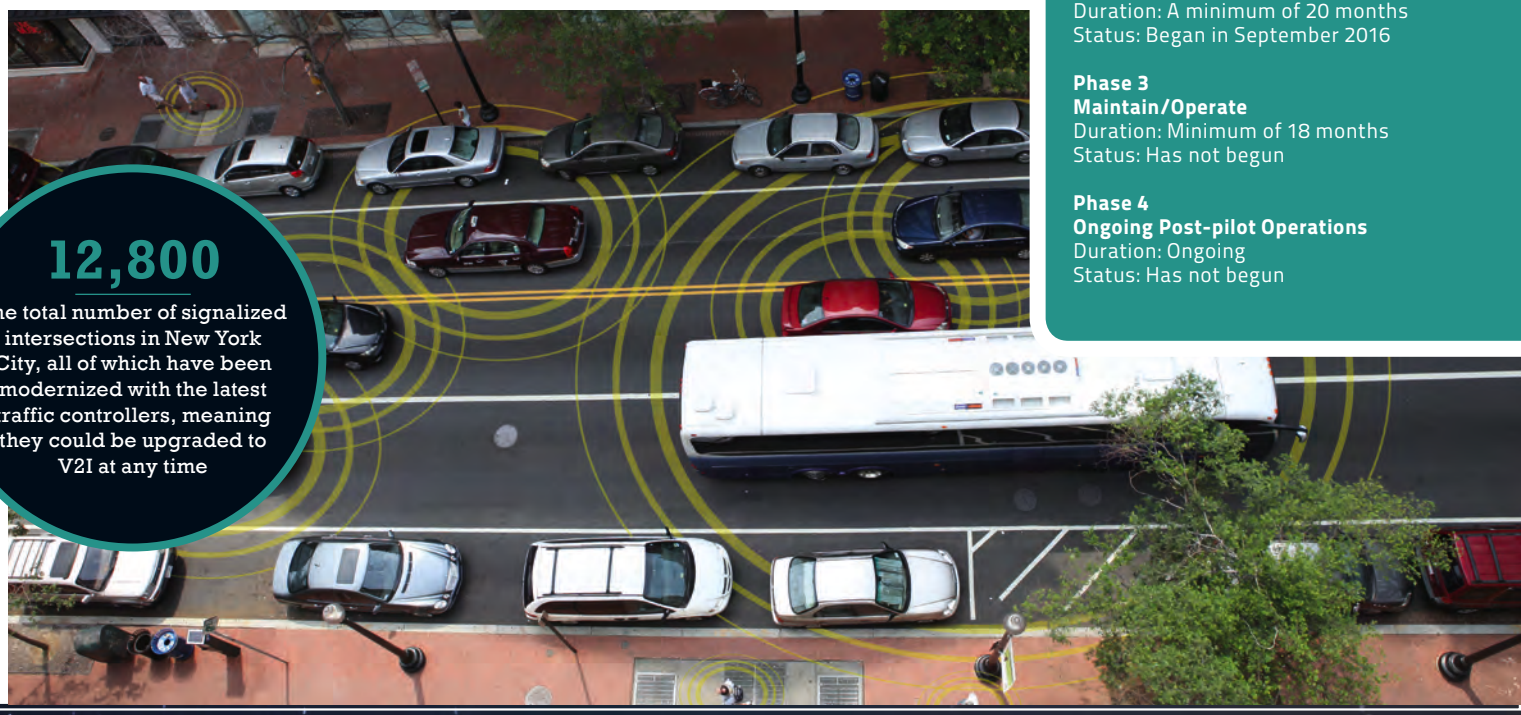
The first phase of the project, which was completed in September, identified two areas – Flatbush Avenue, Brooklyn and 14th to 67th Streets, Manhattan – as prime locations to trial the technology.

Dr Mohamad Talas is NYC DOT's ITS program manager, with 28 years' experience at the department. He is now responsible for leading the Connected Vehicle Pilot.

"We chose the two locations after careful research," he says. "Both are prone to heavy congestion with immense related vehicular and pedestrian conflict at intersections, and widely variable demand during the day and night. One is a grid in the central business district, while the second is a roadway arterial leading to the East River bridges; both have been equipped with the latest ITS, which allows us to measure flow, occupancy and congestion.

"Most importantly, we discovered that around a quarter of New York's

Left and below: **The aim is that, one day, all vehicles will be connected**



12,800

The total number of signalized intersections in New York City, all of which have been modernized with the latest traffic controllers, meaning they could be upgraded to V2I at any time

USDOT CV Pilot phases

All three locations in the Pilot Program are organized in four phases

Phase 1
Concept Development
Duration: 12 months
Status: Complete

Phase 2
Design, Deploy, Test
Duration: A minimum of 20 months
Status: Began in September 2016

Phase 3
Maintain/Operate
Duration: Minimum of 18 months
Status: Has not begun

Phase 4
Ongoing Post-pilot Operations
Duration: Ongoing
Status: Has not begun

Above: **Instrumented vehicles in NYC will get onboard alerts via DSRC**

buses, 40% of New York's 13,500 taxis and a large proportion of the UPS delivery fleet uses these two routes.

"Over the next two phases, our chief objectives are to distribute 100 mobile units to visually impaired pedestrians. We'll install 28 roadside units on Flatbush Avenue and 297 in midtown Manhattan. Finally, we've identified an additional 36 support locations to ensure access to the in-vehicle data from all of the vehicles.

"While we currently plan to use only 371 RSUs, it is important to note that all 12,800 intersections in New York City have been modernized with state-of-the-art traffic controllers, so we can expand our RSU and V2I locations in the future."

Finding the right vendors

But there's some way to go before this fully connected transport environment becomes reality. While the project team has designed and built prototypes, NYC DOT will devote the next eight months to "procurement, delivery and installation" of the ASDs and RSUs, according to Bob Rausch, vice president of TransCore and a senior member of the project team.

"The request for quotes process for 8,000 ASDs and 400 RSUs will begin in November. We expect to select one or more vendors by the end of the first quarter 2017," says Rausch. "We plan to move forward with two ASD vendors and a single RSU vendor – initially deploying 10 RSUs and 100 ASDs. This way, we not only have the opportunity to work closely with vendors, but more importantly, this strategic approach irons out any remaining interoperability obstacles and location issues."

So exactly what are the key challenges that the team faces?

"GPS location accuracy presented us with problems," says Rausch. "New York City has a multitude of high-rise buildings and hundreds of bridges and underpasses. It is in these 'urban canyons' that we occasionally experience short-term GPS losses. The challenge, therefore, is finding a solution where we can continue V2V and V2I operations without interruption, so we are working with vendors to explore alternative, next-generation technologies."

> New York City has a multitude of high-rise buildings… in these 'urban canyons' we occasionally experience short-term GPS losses
>
> **Bob Rausch, project manager, NYC traffic management systems, TransCore**

And what about range? Did the team experience any significant issues when collecting DSRC antenna installation locations?

"The RSUs will be installed on traffic signal mast arms, which are omnidirectional," says Rausch. "The range may only be 30m in places, but we think that may be adequate for the applications to work."

When all the major glitches have been eliminated, Rausch and his team have set aside a further eight months for the "fine tuning and testing" of the system.

"During this stage, with a solid platform in place, we can download additional application enhancements remotely. We won't have to visit each vehicle. But as an added safety measure, we've allocated a further eight and a half weeks for final product testing," adds Rausch.

As for safety testing, performance evaluation and other deliverables, Rausch thinks it likely that "the NYC DOT, vendors and stakeholders" would carry out some of the testing, rather than contract a third party.

"And the challenges after implementation? There are unknowns, but they are unknowns which excite us," says Rausch. "With a fully working infrastructure in place, for the first time, we will have the ability to gather performance information from taxi garages, the bridge and tunnel entries, and at the airports. We'll be able to manage and monitor the ASDs and adjust system operation using DSRC.

"Ultimately, we hope our project will alleviate congestion and provide a powerful tool to fulfilling Mayor de Blasio's 2013 Vision Zero pledge to eliminate all traffic deaths by 2024."

Wyoming

The second location for the USDOT's Connected Vehicle Pilot Program. Here the focus will be on reducing weather-related incidents. Look out for our update in the next issue

Tampa, FL

The third location in the USDOT's Connected Vehicle Pilot will focus on using the technology to manage reversible express lanes. We'll update you in 2017

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20%

The predicted reduction in intersection waiting times using new app-based V2I technology

Source: University of Calabria

Talking to traffic signals

V2I systems that display traffic signal countdowns on dashboards are already in use, but now a system is being developed that uses an app to broadcast vehicle location, speed and heading to infrastructure, and can therefore change signal phase and timing. **James Gordon** finds out more

He hosts *The Late Late Show* but there's nothing wrong with James Corden's comic timing on set, nor at traffic lights for that matter. In his latest TV ad, driving a classic Mercedes, the larger-than-life presenter demonstrates impeccable timing when each of the seven traffic lights he approaches in central London turns green.

The fantasy driving scenario painted by the insurance company who created the advert could be about to become reality, as a leading-edge telematics project in the University of Calabria, Italy, is harnessing the smartphone data to turn signals green.

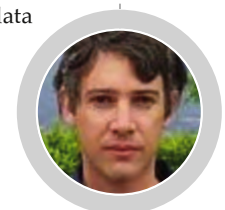
While the first steps in vehicle-to-infrastructure integration have already been taken – Audi will launch the technology in three of its US models early next year – so far the communication is only one way: cars equipped with the technology can receive data from signals, but not send it. So, while drivers can react to dashboard countdowns, the position of their vehicle has no influence on signal phase and timing. That could be about to change, thanks to some new thinking.

€50bn

Estimated annual cost (US$55bn) of traffic congestion in the European Union

Source: European Commission

> In areas where traffic signals are poorly regulated, waiting times at intersections could be reduced by 20%
>
> **Vittorio Astarita, professor of Transportation and Engineering, University of Calabria, Italy**



Spearheading the next-generation project is Professor Vittorio Astarita, who heads the laboratory in the University of Calabria's Transportation and Engineering department. Astarita has been working on this revolutionary technology, in which traffic lights are controlled by cell phones, since 2002. He believes it will transform traffic signal technology because unlike other systems it works in real-time, combining GPS with cellular data networks. Traffic lights can then be controlled according to a vehicle's position and speed, unlike than the majority of current systems, which record traffic volumes only at one or two fixed points.

"The sequencing of most stop signals today is dictated by measuring

How does it work?

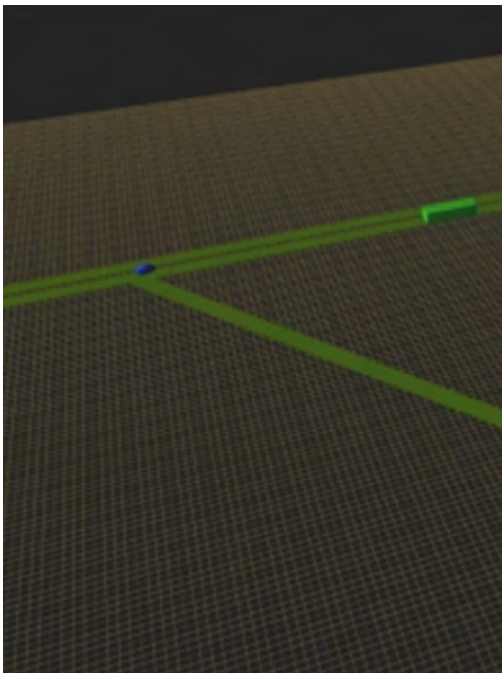
How an app can control signal phase and timing

Drivers download an app onto a smartphone, which connects to the city's central server via the mobile network. The app is programmed to send the vehicle's speed and position to this powerful hub. The server gathers data from every car in the scheme. As each vehicle equipped with the technology approaches a stop signal, the server sends a message to the electronic controller regulating the traffic light. The signal then automatically optimizes the green phase for approaching traffic, so drivers using the system wait less time at lights.

At the heart of the technology is a highly complex algorithm that took Astarita four years to formulate using laboratory testing and a bespoke traffic light controller.

"The algorithm has been designed to measure the number of vehicles using the technology at a given intersection," he explains.

"When assigning a green light to instrumented cars, it has to be able to probabilistically estimate those cars not in the scheme. At each stop signal, the algorithm calculates the distance between each car that is using the system and also takes account of the approaching vehicles that have not yet reached the junction. If none of the cars at the lights is using the technology, the algorithm reverts to a fixed-time control system."



traffic flow," explains Astarita. "At the bottom end of the technology scale there are electromagnetic powered fixed-time control units, with the signal time set anywhere between 35 and 120 seconds. Some stop signals are a little more high-tech, in that they use dynamic control technology, where sensors embedded in the road detect and relay the density of traffic at an intersection, enabling the signal times to change. However, these systems are grossly inefficient and often lead to unnecessary congestion."

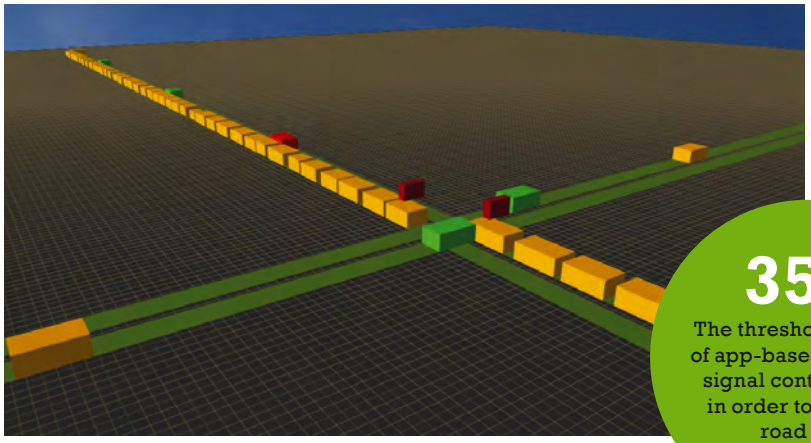
Stuff and nonsense

Astarita, who is in talks with Fiat, Italy's largest car manufacturer, and the European Union (EU), believes that the technology he and his team are pioneering could prove to be "a game changer for traffic managers and motorists".

Years of in-house testing have revealed that for this next-generation technology to have a major impact on a city's traffic infrastructure, it would be necessary for just 35% of motorists to subscribe to the scheme. "Our algorithms show that when the customer base tips over 35%, every driver will benefit from the scheme regardless of whether they are members or not. We think, for example, that in any area where traffic signals are poorly regulated, waiting times at intersections could be reduced by 20%.

"And even when the percentage of subscribed drivers is much lower, there are still huge benefits for those who have actually signed up to the scheme, as they will almost always have priority over cross-traffic at stop signals," he adds.

"We do not have a required minimum percentage of subscribers. The system would fall back on standard pre-established fixed-time cycles when there are no subscribers driving around. In practical terms our system can work with very few vehicles, even though it would better adjust traffic lights to real traffic demand with more subscribers."



Left: **Traffic queues at red lights could be significantly reduced with V2I technology**

35%

The threshold of uptake of app-based V2I traffic-signal control needed in order to benefit all road users

Source: University of Calabria

Into the real world

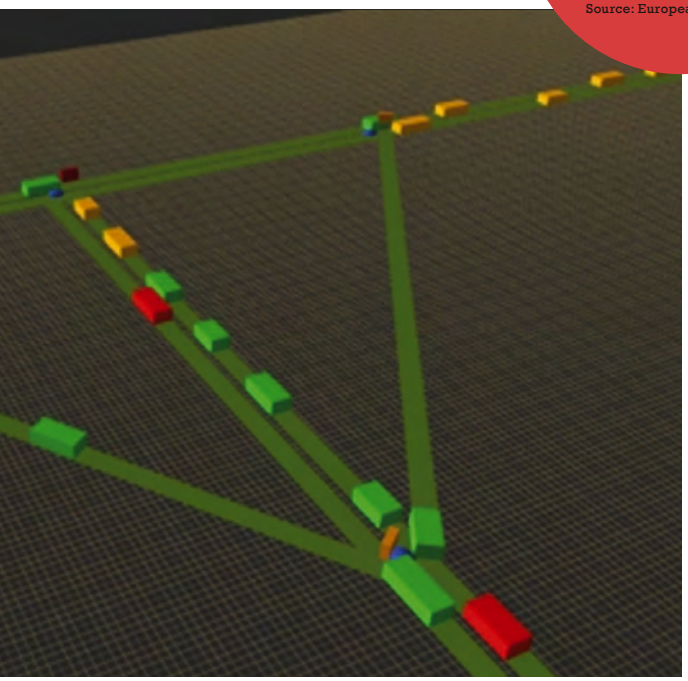
While the technology has been rigorously tested over a two-year period, it has yet to be trialled in the real world. But with concept and feasibility studies completed, a preliminary design project is set to take place in Bari in October or November this year.

"We will start experimenting on a single traffic light," says Astarita. "The plan is to check that the algorithms we have created work at real stop signals. We'll spend six months approaching the intersection on different days, times

10%

The average percentage of roads in the European Union affected by severe gridlock every day

Source: European Commission



Above and left: **Extensive computer simulation has helped to assess the effectiveness of app-based communication with traffic signals**

and seasons to ensure that the algorithm is functioning correctly."

But is this proving ground large enough to carry out comprehensive tests? Take GPS and wi-fi issues, for example. What happens when vehicles lose signal at intersections where coverage is poor?

"We have spent hundreds of hours in the laboratory planning for these eventualities," he says, confidently. "First, in the unlikely event that the technology fails, there is no safety issue as traffic lights will simply revert to a fixed time setup. But, that said, we anticipated early on that motorists would enter 'urban canyons' where the signal is weak or non-existent. We solved this problem by developing Bluetooth ground-based beacons, which are particularly effective in areas where skyscrapers dominate. Secondly, as a last resort, if 2G, GPRS, 3G, UMTS and 4G fail, short-range radio can be used."

Once Astarita and his team have ironed out the final glitches, they expect to launch the system officially in the third or fourth quarter of 2017.

But he admits there are some financial hurdles still to overcome.

"On the positive side, the cost of implementing the system is very low," he says. "Bari's road traffic infrastructure is highly innovative. It is already controlled by the internet, so it doesn't need a radical overhaul. For the system to really be transformative, it needs subscribers.

> [This scheme could save a city] vast amounts of money and man-hours as it would no longer be necessary to individually regulate each stop signal
>
> **Vittorio Astarita, professor of Transportation and Engineering, University of Calabria, Italy**

They're its lifeblood. Therefore, I envisage a considerable pot of money being allocated to marketing."

How much money does Astarita think is needed? And how many drivers need to sign up before launch?

"We have applied for a grant from the EU. I cannot reveal the exact amount we have asked for, but to complete the last leg of testing and to set the project in motion on multiple intersections, I estimate we need around €500,000 [US$556,000]."

However, Astarita isn't too concerned about the financial outlay. "If the scheme reduces travel times by 15-20% then I think it is something that a city government would be willing to fund. In fact, it's a no-brainer. It would save vast amounts of money and man-hours as it would no longer be necessary to individually regulate each stop signal. Second, it would be able to collect the Floating Car Data, which it could use to further improve traffic flow."

Back in Los Angeles, sitting in traffic and on his way to Studio 56 to host another edition of *The Late Late Show*, how James Corden must wish for a repeat of the smooth ride he enjoyed in his new commercial.

Wait a minute, looks like there's an app for that, James. Over to you, Professor Astarita… ○

See James Corden's ad at tinyurl.com/cordentraffic

The future of DSRC technology in electronic toll collection and beyond

As the requirements of the tolling industry continue to evolve, dedicated short-range communications (DSRC) system integrators can benefit from the versatility and choice that the technology provides. With the imminent widespread use of smart digital tachographs, a new purpose for DSRC is on the horizon.

Electronic toll collection (ETC) plays an important role in maintaining good flow as the volume of road traffic increases. DSRC is a well-established technology based on international standards, and there are now many suppliers of both vehicle-mounted onboard units (OBUs) and roadside units (RSUs). One advantage of DSRC standards is that products from different manufacturers are interoperable, enabling customers to purchase products from different providers.

"DSRC standards enable system integrators to concentrate on what they do best – projecting, installing and maintaining tolling and enforcement systems," says Per Jørgen Weisethaunet, group CEO of Norbit. "Furthermore, OBU purchasers can procure the products they find most economically beneficial."

Norbit produces a range of DSRC products, including OBU and RSU solutions. The company's OBUs currently have the functionality and flexibility required by the market, and a new generation of OBUs will be even more flexible. Norbit's OBUs and DSRC modules employ state-of-the-art application-specific integrated circuit (ASIC) technology to ensure a compact size, long lifetime and a high degree of flexibility. Norbit also provides DSRC modules for integration into global navigation satellite system (GNSS) OBUs, for example. RSU solutions are appropriate for both single- and multilane use, in addition to various modes of redundancy.

Right: **Dedicated short-range communications (DSRC) technology is key to many modern free-flow tolling systems**

Need to know

Norbit ITS manufactures and supplies DSRC products to system integrators and tolling operators worldwide

- Norbit produces a range of DSRC products, including OBU and RSU solutions
- Its DSRC products are compliant with applicable EU standards
- Norbit's solution for a smart DSRC tachograph consists of a DSRC module combined with a CANbus interface and wide-range power supply

Trends in DSRC tolling

As DSRC products continue to evolve, OBUs are getting smaller, support more applications and are expected to have longer battery life. GNSS-based OBUs using DSRC technology for enforcement and tolling have been on the rise for a while, requiring more advanced functionality. New European Electronic Toll Service (EETS) providers demand DSRC systems that work seamlessly across Europe. RSUs are required to support multilane systems and redundancy, and must be easy to integrate, install and maintain. Developing, maintaining and supporting successful DSRC products requires substantial resources in addition to a team with a deep understanding of DSRC technology and the practical aspects of its use. This may be why there seem to be fewer active DSRC product suppliers in the market in recent years.

Smart tachograph

The European Union (EU) plans to replace existing digital tachographs with smart ones by 2019. As well as GNSS integration, the new smart tachograph will use DSRC.

Over the course of many years, an interest in truck drivers' speeds and distances traveled has led to the EU trying to increase road safety by improving their working conditions. In 1986, when the EU introduced the Annex 1 regulation, it became compulsory for goods vehicles to be fitted with analog tachographs, made of paper disks, to record vehicle movements. Due to this system's vulnerability to fraud, regulations requiring more secure digital tachographs were introduced in 2006, in Annex 1B (EU-Reg. 1360/2002). In 2011 and 2012, EU regulations were updated to include the requirement for independent motion detectors and new motion sensors. The new Annex 1C regulation requires shifting from digital to smart tachographs, which integrate GNSS to provide geographic positioning, DSRC for remote enforcement, optional ITS integration via Bluetooth, and a cryptography update. The smart tachograph will use DSRC technology with a new design of antenna to provide information about potential misuse or manipulation of the device. This will enable trucks to be checked without them having to stop. Eventually, costly truck checking points on highways will become obsolete.

The DSRC device for use in trucks has to be mounted onto the truck's windshield or dashboard, and it will typically be connected to the vehicle unit

or the onboard network via the CANbus interface.

Norbit already has a solution available for a smart DSRC module that communicates via the CANbus. It consists of a field-proven Norbit DSRC module in combination with a CANbus interface and a wide-range power supply. A prototype for a wide-angle DSRC antenna is also available.

Norbit recently began discussions with different stakeholders to integrate its solutions into products for the smart tachograph.

Recent market success

Norbit ITS has delivered more than 70% of the 1.5 million OBUs in Norway.

In 2013, Norbit ITS and another manufacturer made a four-year framework agreement with the Norwegian Public Roads Administration. The frame agreement was for the delivery of EN15509 compliant OBUs. So far, Norbit ITS has been awarded a large portion of these OBU deliveries. The company has also delivered RSUs for toll systems in Norway and Portugal, and on the Bosphorus Bridge in Turkey, with a local partner, Aselsan. To date, approximately 3 million DSRC OBUs, and nearly 2.5 million DSRC modules based on Norbit's DSRC technology have reached market. Satisfied customers include Siemens, Continental and Via Verde. Thousands of DSRC RSUs have also been supplied to a growing global market.

by **Larry Yermack**

As technological advances accelerate, government must take a step back

In my youth and his, Bob Dylan wrote, "There's something happening here and you don't know what it is, do you Mr Jones?" I doubt that he was talking about the surface transportation system but the question sure resonates for us today. There are some odd things happening and I don't think we know what they fully mean quite yet.

Back in Dylan's day, governments deployed technology they bought from the private sector. Today procurement cycles are so long that the private sector bypasses government altogether. Back in Dylan's day you took a train or a bus or drove and it never occurred to you that those services should be linked. Today customers are demanding that all services be accessed via smartphone. Are these related? You betcha.

Let's look at technology acquisition. Public procurement cycles are many years long. Suppliers know that they need to be involved with the government customer long before the RFP (request for proposal) is even issued to offer input on scope and specs. When it is, it can be at least a year to a decision and deployment can take years more, with all of the deployment steps reviewed and approved by the government, thus slowing the provider down further still.

Add to the mix the rapid development cycle for apps and what is a tech company with a hot new idea to do? Deploy without the government is the response. That is indeed what we have seen: transportation network companies, ride share, trip planning, traveler information and even in-car safety applications. Transportation has been bifurcated into public and private services, but there is one element that can't be fully privatized, and that is payment. Every day it gets harder to use the US payment system for obvious security reasons and so publicly provided transportation services need a private partner for their payment systems.

Putting additional pressure on the divide between privately delivered and publicly delivered services is the customer. Today's customer has grown up with smartphones and expects to manage his/her life on that device. One of my daughter's friends, in her twenties, told me that she would not consider a bank unless she could deposit checks with her phone. The providers of transportation, both public and private need to be responsive to that demand. If it doesn't have an app, forget about it.

> "Public procurement cycles are years long… what is a tech company with a new idea to do?"

So how do these two ideas come together? Government procurement cycles are too slow for today's technology but governments need privately provided payment systems. The solution lies in a new relationship between government and their technology providers. If the public is to benefit from state-of-the-art technology then the agencies will need to step back from being in charge of the technology and instead be in charge of the level of performance being delivered. If they can let technology companies do what they do best and instead of a focus on the specifications of the system, concentrate on the requirements of the customer experience, they can get the best of both worlds: satisfied customers as well as rapid uptake on technology.

Larry Yermack is strategic advisor to Cubic Transportation Systems, USA. lyermack@gmail.com

Improving communities with traffic technology solutions worldwide

With more than 30,000 traffic cameras operational in more than 80 countries, Jenoptik has extensive expertise in handling traffic safety around the world: every day, more than 50 million license plates are read, leading to 2.2 million traffic offenses being processed every month. The figures prove their worldwide concern for countering traffic congestion and improving safety.

But to build an effective traffic technology solution, it is necessary to do more than just install a speed or red light monitoring system. First there must be a survey of current infrastructure, evaluating needs. This should specify the mix of systems and services that will be required. Only then can the delivery and installation of systems be undertaken. Once this is in place, incident-processing solutions should be considered that will guarantee system operation. In addition, there should be provision for training and maintenance, service and support.

An individual solution for a given traffic safety project has to be able to utilize different technologies and services. Deterring drivers from illegal behaviors and capturing evidence that allows authorities to secure prosecutions is a challenge across the globe.

Different traffic solution trends can be observed in different regions. Here we investigate how problems are being tackled in Canada, the UK and Australia.

Red light enforcement

The Canadian province of Ontario is continuing and expanding its traffic safety program with Jenoptik, focusing on digital camera systems for red light monitoring. It is already one of the largest and most successful traffic safety programs in North America.

A new contract between Jenoptik subsidiary Traffipax and the city of Toronto, Ontario, will continue 10 years of successful cooperation for another five years from January 1, 2017. Negotiations will be started soon with seven other municipalities in Ontario.

In Toronto, Jenoptik will install 79 new digital camera systems for red light monitoring by the end of 2016. Under the new series of agreements, the scope of supply is expected to increase to about 250 systems with the other municipalities participating. These systems will be used to replace existing sites as well as for establishing new ones.

Jenoptik is operating more than 200 red light systems in the Greater Toronto Area, which are now being modernized. This extensive program runs until the end of December 2016, and is operated out of the Traffipax location in Toronto.

Need to know

Jenoptik provides a variety of traffic safety and monitoring solutions worldwide

- In Canada, Jenoptik cameras make up one of the most successful traffic safety programs in North America
- A quarter of police forces in the UK use Jenoptik ALPR technology for surveillance
- In Australia, Jenoptik is delivering an entire suite of traffic safety services, including red light and surveillance cameras

"Our combination of optical technologies, software, operation and service allows us to offer customers complete solutions for traffic safety," says Jenoptik president and CEO Michael Mertin. "This new order reflects the level of confidence of our Canadian partners in Jenoptik."

The new systems will start operation on January 1, 2017. The camera systems will be manufactured at the main location of Jenoptik's Traffic Solutions division in Monheim on the Rhine, Germany. Traffipax will again take care of installation, operation and service. Jenoptik will also provide the software for a modern, centralized back office, which will enable employees to evaluate the incidents captured.

They will use an Ontario-specific variant of the latest TraffiStar SR520 digital red light monitoring systems, allowing a combination of speed and red light monitoring at intersections. The systems work on the basis of proven induction loops, which are embedded in the roadway and allow up to four traffic lanes to be monitored simultaneously. All systems will be equipped with smart cameras designed and manufactured by Jenoptik, which can take high-

resolution images and capture at least two pictures in order to document incidents occurring at an intersection.

ALPR and security

Jenoptik's Vector automatic license plate recognition (ALPR) cameras are able to rapidly identify and report on vehicles of interest, wherever and whenever they are seen. Working as standalone units or as part of a wide ALPR network, Vector cameras provide 24/7 monitoring, with each unit capable of capturing thousands of plates a day. Combined with powerful back-office analysis software, police can locate wanted vehicles quickly, or identify criminal activity with analysis of driving patterns.

A quarter of all police forces in the UK use Jenoptik ALPR equipment. It is used for security cordons or surveillance of the road network. The capture of ALPR data alone is useful, but the intelligent use of data helps to observe patterns and analyze trends that otherwise wouldn't be apparent.

A security cordon allows police to monitor and record every car that enters an area, and can provide solid barriers that prevent unauthorized entry. This intelligent use of technology is probably the most radical shift in decades in free-flow protection.

ALPR technology is used to help detect, deter and disrupt criminality at a regional and national level, including tackling traveling criminals, organized crime and terrorists.

As a vehicle passes an ALPR camera, its registration number is read and instantly checked against a database. Police officers can intercept and stop a vehicle, check it for evidence and, where necessary, make arrests. A record for all vehicles passing by a camera is stored, including those for vehicles that are not known to be of interest at the time of the read, and may in appropriate circumstances be accessed for investigative purposes. The use of ALPR in this way has proved to be important in the detection of many offenses, including locating stolen vehicles, tackling uninsured vehicle use and solving cases of terrorism and major and organized crime.

Traffic safety services

Automated traffic enforcement is a central part of Western Australia's Towards Zero Road Safety Strategy 2008-2020. Most recently, the Australian state's strategy called for the replacement of existing equipment and an expansion of the number of systems.

Clockwise from bottom left: **Canadian control room; speed enforcement in Western Australia; Jenoptik ALPR camera in the UK**

Western Australia has long focused on a smart approach to traffic safety challenges, with the aim of using the best technology for every situation. Solutions need to be both mobile and stationary, and both laser and radar sensors need to be at the disposal of the authorities. Whatever the most suitable technology is for a specific road, Western Australia uses it.

Jenoptik is ready to deliver on all Western Australia's needs after it was awarded the contract to deliver traffic safety services, which will include intersection (red light and speed) cameras and infrastructure; fixed-speed cameras and infrastructure; and location surveillance solutions, which will include remote camera monitoring.

The operational service model features fixed-camera operations and monitoring; site management; data management; security and safety; transfer, extraction and transformation; documentation; and training services.

Jenoptik will also provide full support and maintenance services, including system calibration, certifications and associated record keeping; asset and warranty management; and release management.

Knowing the market

From these three case studies, it is clear not all traffic officials have the same requirements. But from standalone cameras, to full end-to-end solutions, including back office operation – whatever the requirement, Jenoptik can deliver. ○

How highly accurate road weather data enhances traffic management

The acquisition of The Weather Company by IBM earlier this year has revolutionized how industries – including transportation – approach decision making in the face of weather.

The Weather Company, an IBM Business, is the largest private weather enterprise in the world. It processes more location- and weather-based information than any other company in the world. The US government's National Weather Service is the only entity with more meteorologists.

Recently, The Weather Company announced a new global forecast model called Deep Thunder, which advances the accuracy of forecasting by combining hyper-local, short-term custom forecasts developed by IBM Research with The Weather Company's global forecast model. The merger of that enormous volume and variety of data with advances in atmospheric and computational sciences enables The Weather Company to produce one of the most reliable global forecasts available today.

"It's a major shift for the transport industry to be able to have access to such accurate weather forecasts and this change has happened over the past 18 months," says Eric-Mark Huitema, IBM's global smarter transportation leader and the ground transportation global director for The Weather Company. "DOTs used to use data from public authorities, which wasn't very precise because it wasn't closely linked to the local road network. Now, we can provide precise local weather forecasts that are updated every 15 minutes, and because the forecasts include hyper-local data from Weather Underground's [one of The Weather Company's consumer brands] crowdsourced global network of 200,000 personal weather stations and uses the most advanced prediction models, it's accurate to 500m."

Above: **Eric-Mark Huitema, IBM's global smarter transportation leader and the ground transportation global director for The Weather Company**

Olaf Naami/ shutterstock.com

Vital road weather info

Predicting the weather with confidence is a vital element of keeping roads safe. About 28% of highway crashes and 19% of all fatalities on the roads are weather-related, according to the US Department of Safety.

"We provide weather data to transport agencies, storm warning and emergency centers, police stations and road authorities, which can help predict what will happen on their networks, so they can be prepared and use that data to proactively anticipate problems and help make decisions on sending out safety alerts," says Huitema.

One example of an important traffic application is predicting congestion on roads. The Weather Company takes the DOTs' congestion data and fuses it with its highly precise and accurate weather data. "You can have congestion based on bad weather and accidents," says Huitema. "But also when it's a bright day or there are drivers watching a beautiful sunset. The weather data allows authorities to inform drivers that routes will be slow and suggest alternatives," he says.

The Weather Company is also working with leading automotive brands to leverage predictive weather alerts that could coordinate automatically with the car. For example, an upcoming storm might cause the convertible roof to close, and a warning about black ice could cause a sports car to shift from race mode to safe four-wheel-drive mode.

Need to know

The Weather Company has smart forecast solutions

- Crowdsourced data from more than 200,000 personal weather stations
- Accurate to 500m
- 26 billion individual forecasts a day
- 2.2 billion locations every 15 minutes

Beyond traffic

These forecasts are not just relevant to the transportation industry. The Weather Company offers data-driven solutions and services to more than 5,000 clients in media, aviation, energy, insurance and government. In the insurance industry, companies can

leverage the weather data to warn policyholders about moving their vehicles out of the path of imminent severe weather. Weather is an invisible layer that connects people and companies more deeply – it is the secret to understanding how consumers feel, and predicting how they'll behave.

"We advise retailers on what products to stock based on the forecast: soda sales increase during wet winters and liquid detergent sales increase during periods of above average precipitation and below average temperatures," Huitema says.

The Weather Company will play an important role in the future world of autonomous vehicles, too. Normally, drivers react to heavy rain, snow, or fog by driving more carefully. But an autonomous vehicle will require external sources of weather information so it can adapt to road conditions.

IBM has just helped to launch an autonomous 3D-printed transport pod called Olli, in Washington DC, to be the first vehicle to use IBM Watson's cognitive learning. Weather data will be an integral part of Olli's learning experience.

"Olli can interact with the passengers, and if you ask him where to go for dinner, he will take the weather into account. If it's sunny, he will recommend a restaurant with a terrace, and if there's rain and thunder he'll warn you to take an umbrella and eat inside," he says.

by **Neil Hoose**

Will road authorities *and* OEMs back connected highways?

To what extent do automated vehicles need connectivity, and do the advances in automated vehicles reinforce or undermine the case for investment in connected highways?

Currently the communication from the road operator to the vehicle is via the driver. Drivers recognize and interpret road markings, signs and alignments. This transfer of information is subject to some uncertainty as to when the transfer takes place and when any corresponding action, if required, results. For example, a driver may see a speed restriction sign 100m before reaching it and be able to correctly identify what the limit will be. But they may not react until the vehicle is actually passing the sign and then only gradually reduce their speed over tens of meters.

Automated driving systems use sensors to identify, recognize and 'read' the same signs, signals and information on road layout and the vehicle's absolute and relative position direction and speed, combining it with stored onboard data. The variability of the response range to signs and signals may be much smaller because of the deterministic way in which they are programmed.

Real-time connectivity can further reduce uncertainty. Where and when information is transferred can be specified, and in the case of automated vehicles, the variability in nature, time and location of action can also be reduced so that the relationship between instruction or information from the road operator is much more deterministic than at present. In the example above, the exact location where the speed limit applies will be part of the communication and the vehicle will reduce speed in time to meet that requirement. The vehicle can also confirm back to the infrastructure that it has complied.

This greater determinism in terms of reaction to control and information is a potential benefit in terms of safety and emissions. It may also create smoother and more predictable traffic flow. In the longer term there are potential benefits from not having to provide physical infrastructure. This makes the connected-vehicle infrastructure environment attractive for authorities.

For a vehicle supplier there is an issue about loss of control over the performance of their product. At the moment the OEMs spend a lot of time and effort in creating and maintaining customer confidence. In a connected vehicle environment, the effectiveness of the communication and, perhaps more importantly, the quality of the information being communicated becomes a significant factor in the way the vehicle behaves. This is not under the control of the OEM and hence is bound to make them uneasy. If any limitations in quality and timeliness of information affect all suppliers equally then it may be less of an issue, but what if it is not?

"For vehicle suppliers there is an issue about loss of control over product performance"

The case for connected highways looks to be very positive, with a range of potential benefits that includes real cash savings. The case for the vehicle suppliers is much less clear cut. The potential for their products' reputation to be influenced by the action of a highway operator is unattractive and the benefits to them in terms of income stream and competitive position are much harder to articulate.

So the answer to the opening question is different according to whether you supply and operate vehicles, or supply and operate the roads they run on, and the investment in automation does create a clear case for connected highways.

Neil Hoose is an independent ITS consultant and owner/director of Bittern Consulting Limited ***info@bittern-its.com***

Adaptive and responsive control and the need for manpower

Two main types of devices are available to manage signal timings at intersections. Both have the same goal: to optimize traffic flow while minimizing malfunctions. The main difference between the two is in their level of automation.

The first type, known as adaptive control, has been around the longest. Its biggest advantage is that it works independently of human control and adapts its behavior to traffic situations using analysis of previous situations.

The second approach is responsive control. This is a system that reacts to real-time situations by implementing particular algorithms set by a traffic engineer.

Assessing needs

Traffic at any intersection can be defined as being in one of three basic states. The first is when the traffic is light and the crossroad is almost empty. In this case, the setting of signal timing isn't difficult and it is fairly easy to ensure safety and minimize waiting times for individual drivers (subjective functioning).

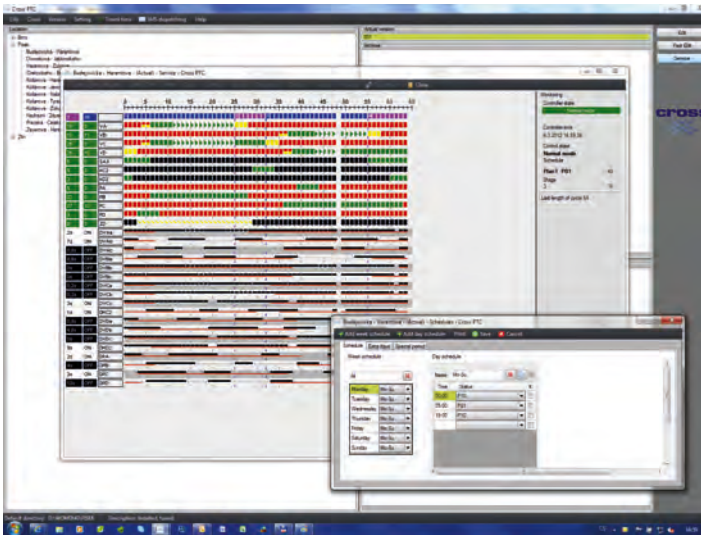
The second state is when the intersection is heavily loaded, which requires the signal planning to be optimized, with the emphasis on objective functioning (evenly distributing waiting times).

In the third state, the intersection is overburdened and therefore the signal planning concentrates on minimizing its negative effects on traffic.

Even though adaptive devices may appear more suitable and less demanding, in reality their usefulness is quite limited. They work better than the human brain in certain situations, but usually only in low traffic levels. When the area is under a heavy load, many intervening factors play a role and the device can create signal planning with heavy bias. That leads to the device setting signal plans tens of percent off the ideal, which can cause significant problems for objective and subjective functioning. By comparison, in responsive control, an experienced traffic engineer can react to the real-time situation on a given crossroad with an inaccuracy of just 1%.

Adaptive limitations

The reason adaptive devices provide such undesirable outcomes lies in the way they process data. They acquire their plans from past experience and calculate an average constant of the traffic, which does not necessarily reflect the current situation. It is true they also use real-time sensors, but these are usually situated a few hundred meters from an intersection.



Above: **Cross PTC, a programming and maintenance software**

Left: **Traffic light controller Cross RS4**

They help to predict the traffic behavior; however, this calculation cannot be precise. What happens in reality also depends on the behavior of each driver. Cars can travel more slowly than predicted, they can stop or turn before reaching the lights, or there can be a stream of other vehicles coming into the intersection from a side road. All these possibilities can lead to a different outcome from that predicted by adaptive control.

On the other hand, these events can easily be perceived by a skilled traffic engineer, who can react to them by implementing a particular algorithm, therefore adjusting signal timing more accurately.

Efficient control

The vast experience that Cross Zlín has gained during its many years of operation shows it that the majority of intersections enter high levels of utilization at some point. That points to the essential role of responsive devices. Adaptive systems can be of only limited usefulness until the technology is able to identify real-world situations with greater accuracy.

Given all these factors, Cross Zlín believes that concentrating on the development of responsive devices will provide the most suitable solutions to satisfy the growing demand for more efficient control of signalized intersections.

Need to know

Signal timings can be set by either adaptive or responsive control

- Adaptive control is automatic but doesn't always achieve the best results in heavy traffic
- Responsive control requires the input of a traffic engineer, but is more effective
- Adaptive control cannot react to unexpected events such as vehicles turning or heavy traffic on a side road
- Responsive control can get within 1% of optimum timings; adaptive control is often significantly off optimum in heavy traffic

Teamwork holds key to success in control room integration project

There can be few bigger challenges for any city authority than delivering the infrastructure to support a major global sporting event. Only a small percentage of cities worldwide have ever faced these challenges; fewer still have faced delivering infrastructure projects to cope with two events happening within two years of each other. But that was the task facing Rio de Janeiro (host of the 2016 Olympics) and the city of Belo Horizonte (host of the 2014 FIFA World Cup), 440km away. Coping with the extra traffic and visitors required major improvements to the traffic management, emergency and municipal services infrastructure.

The COP-BH project

For the systems integrators delivering the visualization system for the Belo Horizonte control room, Centro de Operações da Prefeitura (COP-BH), the immovable deadline of the 2014 World Cup start date meant operating under severe time constraints with almost no margin for error. The project itself was a major undertaking, integrating the city's agencies, including traffic, public transit, mobile emergency service and more, into a single working system in just 45 days.

The COP-BH control room has workstations in place for up to 96 operators and 10 supervisors, served by a 7.8ft (2.4m) high x 52.4ft (16m) wide display wall using 20 Mitsubishi SXGA+ rear projection cubes.

Mitsubishi Electric is a leading manufacturer of control room displays. More than 78,000 of its DLP video wall cubes have been installed, in a variety of applications, around the world. The firm's background in major infrastructure projects has given it a unique perspective on how to deliver solutions that are versatile, and can be reliably and rapidly implemented. One manifestation is its modular approach to video wall displays; Mitsubishi Electric manufactures a range of solutions that enables it to cost-effectively match capabilities to requirements. This versatility is also apparent in Mitsubishi Electric's relationship with the vendors of other hardware such as screen controllers.

Left: **Mitsubishi wall cubes in the COP-BH control room**

Need to know

Mitsubishi was involved in a World Cup 2014 project that integrated control-room systems

- The program began in 2013
- The new control center for Belo Horizonte was one of the first serious challenges
- The program involved 14 command and control centers in 12 cities
- It integrated 30 public and private institutions, including highway and traffic management services and the police

Time-saving teamwork

One such partner is Mauell. Its X-Omnium processor has been paired with Mitsubishi Electric displays in numerous successful projects. For the COP-BH project in Brazil, extensive knowledge of each other's products proved an invaluable time saver, ensuring that the chances of an unforeseen incompatibility or unplanned troubleshooting exercise delaying installation, was extremely remote.

The IP-based X-Omnium is universally applicable to systems using video, camera feeds, software applications, graphics and supervisory control and data acquisition (SCADA) data. Its decentralized structure is designed around 'distributed intelligence', in which every display in effect has its own single mini-controller that is interlinked with the other units in the video wall over the IP network. The system is not dependant on any one controller; if one fails, another automatically takes over, making a system failure all but impossible. The system is also scalable; processing power effectively increases when more displays are added to the system. The Mitsubishi Electric DLP cubes themselves have additional failsafe features built in and are designed to give continuous, free from maintenance, operation.

The huge display at COP-BH provides a total resolution of 14000x2100 pixels, on which operators can show any number of video and data windows in a wide range of layouts, providing technicians and public officials with a comprehensive picture of the entire city. Mitsubishi and Mauell's previous collaborations have built up an extensive software library, enabling engineers to develop and adapt solutions for individual projects very quickly and reliably. This played a crucial role in helping the COP-BH project to be delivered on time.

During the event, project handover occurred nine days ahead of schedule, in time for the first match of the FIFA World Cup 2014. The COP-BH project provided a valuable template for subsequent projects ahead of the Olympics in 2016, and proved – if proof were needed – that teamwork is the secret to success.

Blurred lines: managing traffic multi-jurisdictional environments

After two decades of experience in providing integrated traffic management solutions, Telegra has a new offering for integrated corridor management (ICM).

Traditional distinctions between state and city traffic responsibilities are being blurred. In the past, US state DOTs have mostly been responsible for traffic on highways, while cities/counties have taken care of arterials. But traffic spills off ramps into city streets and causes gridlock. The only way to alleviate congestion is to coordinate supervising agencies.

This idea of collaboration is what gave rise to ICM. Although a great idea in theory, it may never be efficient in real life if there is not proper integration of systems. This cannot exist if there isn't an advanced traffic management system (ATMS) capable of operating in a multi-hierarchical and multi-jurisdictional context.

The image (*right*) shows the connection between three fundamental levels of integration for ITS and ATMS subsystems. The main component for building a truly integrated ATMS and achieving all three levels of integration is a versatile and powerful software platform. It is the tool that bridges the gap between successfully designed traffic management system and effective implementation, and brings real, measurable benefits. An integration platform is software that simplifies traffic management by implementing fully automated centralized plans and strategies.

True integration

The biggest obstacle to a truly unified traffic management system are the different ITS data gathering technologies used (e.g. loop, radar and video). Different technology has different data, formats and protocols. So traffic management has required operators in charge of different systems to be in the same room, coordinating verbally.

This approach often leads to confusion and human error. The solution to this is technological integration (TI) – also referred to as true integration. In TI all the subsystems are represented, managed and controlled in a single system, in one easy-to-use graphical user interface.

To have a truly integrated system, there has to be a platform capable of unifying and standardizing different data. Once all data is in the same system, 'speaking the same language', it is possible to implement automated traffic management rules to incidents on a multi-hierarchy and multi-jurisdictional level. These automated or semi-automated reactions ensure the operator is guided through critical situations and always follows the required procedures.

Management support

The main reason for ICM is to implement responses to traffic incidents and irregularities. Automated operational procedures are sets of rules that should be executed in an incident situation. This concept ensures each system operator reacts in the same manner, thus reducing the possibility of human error and providing the fastest response time. This, along with the use of TI through interaction of all deployed subsystems, ensures the best safety and mobility of traffic.

City traffic management is complex as many traffic incidents can happen simultaneously. It is important to focus on this during planning, as this will dictate system architecture. Successfully managing incidents means promptly and effectively reacting to them, and dispatching the information to all involved personnel. It is thus important to support multilevel situation management across multiple workstations and even multiple centers.

The prerequisite for the above is to bring all the data together in one place. This allows the system to interpret the data and initiate alarms if there are irregularities. These alarms can be programmable and easily edited to define different thresholds. They can also be triggered by input from a single subsystem, or a combination of inputs from various subsystems (e.g. lowering speed limit based on both traffic density and weather). Once there are alarms, there can also be predefined reactions to them, using a decision support system.

As the architecture is becoming more complex, the integration platform has to be able to process a lot of data simultaneously, and trigger the alarms that start the operational procedures, based on either raw data or algorithms.

Automatically triggered procedures can result in automated reactions, or could require the operator's decision, depending on the event and user preferences. However, the workload used to need several operators can now be completed by a single person, ensuring uniformity.

Automated system

The role of an ATMS software platform is often neglected

by **J J Eden**

As millennials take to the roads, what can transportation companies do to secure their business?

"It's not uncommon to rent a vehicle, locate and pay for private and public parking and, of course, pay for tolls or order an Uber, all from your cell phone"

According to the USDOT's Federal Highway Administration (FHWA), there are around 50 million drivers in the USA under the age of 35. This new generation of drivers presents new challenges to transportation officials, particularly those of us in the user fee community. Millennials have different buying habits that constantly test traditional marketing efforts, which makes it even more important for those of us in the industry to keep abreast of our customers' preferences.

The majority of millennial drivers are used to 'having things their way', and I am not just speaking about eating at Subway or Burger King. Most important is their increasing online interaction – over 50% of smartphone users reach for their phone when they wake up, but not to make a phone call, to use data services. Today's consumers demand the ability not only to purchase services online, but also to interact with and quickly resolve any issue or question they have. They want that power at their fingertips, whether that be from their smartphone, tablet, or laptop.

And we in tolling and managed lanes are not alone; millennials are causing shifts in other areas of the transportation industry as well. Today it is not uncommon to rent a vehicle, locate and pay for private and public parking and, of course, pay for tolls or order an Uber, all from your cell phone. To keep attracting these new users we must design access to and create management of customer accounts that is straightforward and simple. Along with this simplicity it must be a satisfying experience, visually pleasing, lightning fast and accurate.

Brands have always been important to consumers, but nowadays customer experience is what makes a brand. People want to do business with brands that are well liked by their friends, family and other peers. And it's easier than ever for people to share their thoughts, opinions and experiences and read about those of other people. In the old days, when a reporter 'got it wrong' it could be updated or retracted. Today, once something hits the web it will be around for eternity and can destroy a brand. If customers have favorable experiences we need to encourage them to share those positive notes with others. However, one bad review can spread faster than wildfire. One person's experience can be read by and influence hundreds, thousands or even millions of people within minutes. The power of today's digital world bridges traditional media, social media and word-of-mouth marketing, and reaches across all generations.

Managing a transportation program today takes more than writing a plan and installing high-quality systems. For our industry to remain relevant and continue making progress, we must look more closely at the consumers view, and adapt and design experiences that meet our customers' ever-changing expectations.

J J Eden is director of tolling at Aecom
james.eden@aecom.com

Need to know

Integrated corridor management (ICM) must overcome a number of challenges to be effective

- ICM must be multi-hierarchical and multi-jurisdictional
- ICM must be capable of gathering and unifying data from multiple sources in a single hub
- ICM must enable automated operational procedures (aka resolving scenarios)
- ICM should have an easy to understand graphical user interface to enable quick manual interaction

when considering traffic management, especially in a multi-jurisdictional environment, perhaps because successful implementation is limited without a suitable platform. However, the amount of data is too large for humans to handle efficiently. The need for a capable software platform is obvious for dealing with multiple incidents with different priorities and jurisdictions. That is when a computer is the only tool that can suggest optimal strategies based on predefined rules.

The next generation of advanced traveler information systems

Mother Nature will always impact transportation networks with adverse weather. But there is technology that can help travelers to safely and efficiently reach their destinations: advanced traveler information systems (ATIS).

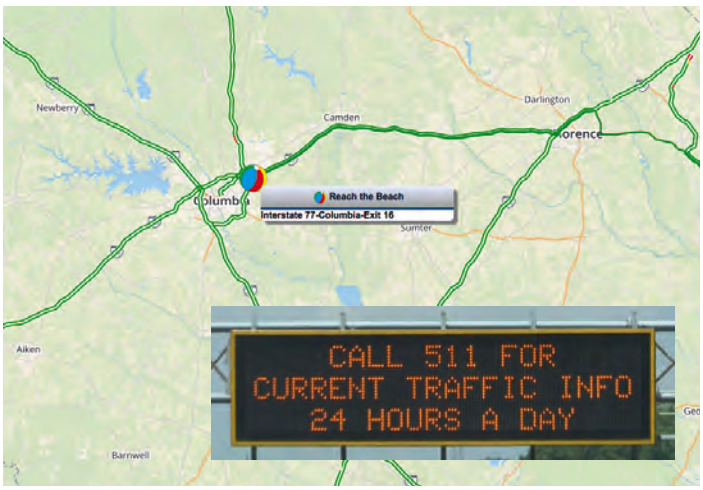
One such ATIS is the USA's national travel information phone number, 511, set up by the Federal Communications Commission (FCC) in 2000. It is available in 42 of the 50 US states and eight of the 13 Canadian provinces and territories. While the number refers directly to the phone service, ATIS have since gone above and beyond that, with technology evolving to include mobile and web services.

Whatever the weather

The USDOT's real-time system management information program (RTSMIP) was established in 2010 and requires basic real-time information by authorities, allowing them to better manage and operate transportation systems. One key component of the RTSMIP is roadway weather observations. By utilizing technology to determine adverse weather conditions, agencies can notify road users of hazards and work to keep their roads as safe as possible, whatever the weather.

In order for weather information to be accurately obtained and shared, state DOTs must commit to precise road-condition reporting and collaborate with meteorologists with knowledge of the local area to specifically tailor forecasts.

ATIS are not only used when severe weather threatens road safety; year-round, dynamic message signs and ATIS services provide estimated travel times across a number of routes – including to the nearest beach in summertime, for example – allowing travelers to choose the best-suited travel options.



Need to know

Iteris advanced traveler information systems (ATIS) help to keep roads in the USA moving

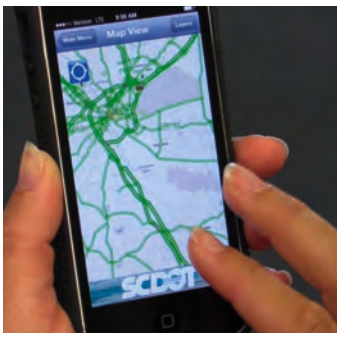
- The 511 travel information service is available in 42 US states and eight Canadian provinces
- Iteris manages 14 ATIS services in the USA
- Iteris ATIS delivered 75 million push notifications to travelers in the two years to July 2015
- Iteris is looking to continue to update ATIS through connected vehicle reference implementation architecture (CVRIA)

Iteris has implemented, and currently manages, 14 ATIS services in the USA. It has long operated a shared infrastructure for ATIS, which initially started with dedicated lines for individual 511 services, as well as additional shared lines across all services required to handle call capacity when it exceeded normal levels. Today, Iteris has expanded the ATIS infrastructure concept to the cloud, enabling seamless data sharing across different state services. So, for example, Georgia travelers can be alerted about major closures in South Carolina, and vice versa.

Service evolution

ATIS alerts started off on the interactive voice response (IVR) system as 'floodgate' messages that could be recorded and heard at various levels of the phone service's menu tree. But with advancements in technology, ATIS services can now 'push' information to travelers when they need it, and to the platform of their choice – be it phone, email or text.

Over a two-year period (August 2014 to July 2016), more than 75 million unique pieces of traveler information were provided for travelers by Iteris, with usage from 'pushed' 511 services (also known as reverse 511) and mobile apps trending up sharply. Should this continue, it is expected that Iteris's ATIS will soon reach travelers over one million times a week, providing information about their journeys when they need it.



Left and above: **Real-time traveler information can be accessed online, via telephone, through a mobile device, or simply via the more traditional roadside variable message sign network**

As the saying goes, "If you can't measure it, you can't manage it." That is why Iteris has created a web-based dashboard to enable agencies to directly monitor their ATIS dissemination tools in real time. Iteris has also provided the reporting of aggregated data over time to inform management, media, the traveling public and other stakeholders of current overall 511 ATIS performance and of the cost per touch.

Iteris continues to explore new dissemination technologies and leverages its foundational work with the connected vehicle reference implementation architecture (CVRIA) website to bring 511 into the connected and automated vehicles era.

A smart, flexible, fully integrated ITS solution

Nowadays there are numerous specialized processes used within ITS applications, such as: VMS, traffic counters and vehicle classifiers, call boxes, weather stations, over-height detectors and automatic incident detectors. But to provide a unified level of control, a single solution that incorporates management systems is needed. Such a flexible, open system can be achieved by simplifying operations, logistics and maintenance in control centers.

Current systems' limitations

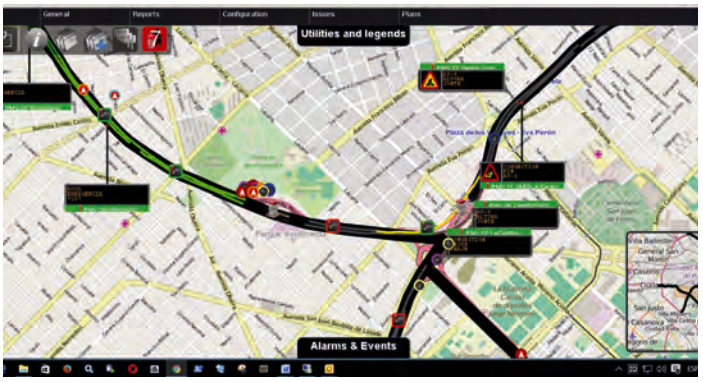
When carrying out surveys, Tecsidel has found that one of concessionaires' biggest complaints is the length of time that they have to wait when integrating new components into a current system – and many of them only have remote access to applications from their workstations. Tecsidel's research and development department realized that most systems are based on heterogeneous applications that coexist separately and offer different features. Therefore, Tecsidel decided to unify all of these applications by creating the new Tecsidel ITS+ solution.

This distinctive system provides management for different devices and allows for an easy integration of system components.

Tecsidel ITS+ can also save its users money, as it is not necessary for them to hire qualified personnel to carry out software updates.

Right: **Tecsidel ITS+ can be accessed remotely via smartphone, laptop or tablet**

Below right: **A screen view of the Tecsidel ITS+ solution**



Need to know

Tecsidel ITS+ enables the monitoring, control and management of traffic in a single system

- It consists of a number of applications and processes that handle the processing of data obtained from the devices of peripheral systems
- It allows ITS operators to see an overview of their roads in real time
- The system has data recording and report-generating capabilities, which can be used in post-incident reviews

A new ITS approach

Tecsidel ITS+ is an innovative technology that challenges the limitations of intelligent transportation management systems. An advantage of this solution is its level of flexibility and ability to unify different locations, such as highways, tunnels and bridges, without wasting time in the integration process. It can integrate unlimited ITS+, can operate according to different rules, in different languages, and offers high scalability – all features that are desired by concessionaires. For example, thanks to Tecsidel ITS+, concessionaires can handle the whole duration of an incident with a single control center platform, no matter where the incident is located. Tecsidel ITS+ will alert control center operators, send all of the information acquired by system component devices, and automatically generate an action plan to address any problems.

Tecsidel ITS+ allows remote access from laptop, smartphone or tablet devices, thanks to its user-friendly interface, HTML5 and Javascript web, which offer compatibility with any browser on computers and cell phones. This state-of-the-art solution is being continuously enhanced and updated.

Tecsidel ITS+ has been successfully used in highway management projects in South America and Asia. The next Tecsidel ITS+ projects are set to take place in Peru and Italy.

Are you ready for the ALPR revolution?

A new range of automatic license plate reading (ALPR) cameras by Tattile features cutting-edge technology and high-performance for access control, red light and speed enforcement, security and traffic monitoring and free-flow applications. The range includes the Vega Basic and Vega Smart.

Targeted at parking and access-control systems, with a maximum input power of 7W, the Vega Basic line features a Power-over-Ethernet (POE) interface for minimizing installation and maintenance times, an onboard multicore processor with Linux operating system, and a new generation of full-HD sensors for reading reflective and non-reflective plates. With its compact size, the Vega Basic is easy to install and does not require external IR lighting.

The high-performance Vega Smart line, allows for easy scalability for high-end, multivehicle-per-second applications. The camera has a multicore processor and Linux operating system. Additional app-like function packages enhance basic features. Apps include: brand and color recognition, optical classification, full-HD video, speed estimation from image analysis, two different onboard optical character recognition (OCR) systems, and sophisticated auto-trigger software.

"The units have a low visual impact and very limited power consumption, in line with the dictates of green engineering – a fundamental standard of Tattile production," says Massimiliano Cominelli, sales manager, Tattile Traffic Division.

Traffic management

With embedded ALPR, image analysis software, high-resolution sensors, low power consumption and an onboard web server, the Vega Smart camera is able to perform a range of innovative functions.

The Tattile Vega Smart (left) and Vega Basic (right) traffic cameras

In a speed-enforcement system, for instance, a Vega Smart camera and a 3D multitracking radar enable the control of two lanes from 0 to 250km/h (0-155mph). If there is a speed-limit violation, the radar sends a trigger to the camera. The camera provides speed, plate number, country, date and time for legal evidence. This data is combined with two black-and-white license plate images and two color context-overview images.

In a red light enforcement system, the Vega Smart camera automatically recognizes the color of the lamp. When the lamp is red, the violation mode is enabled. Exploiting its image analysis capabilities, the system creates a virtual trigger and, for a red light violation, the camera provides a picture with plate number, country, date, time, lane number and red time. Red light violation evidence also includes three color context-overview images showing the vehicle approaching the traffic signal; three color context-overview images showing the vehicle passing the stop line; one black-and-white license plate image before the stop line; one black-and-white license plate image after the stop line, along with a five-second video showing the violation.

"The red-light and speed-enforcement systems can be combined," says Cominelli. "The system generates reports and evidence for both."

In a security and traffic-monitoring system, a Vega Smart recognizes plate, country, vehicle brand, vehicle type and color.

Information from Vega Smart can be used for intelligent traffic light management, counting and classifying vehicles, traffic monitoring and congestion prevention, tax and insurance control, police enforcement, vehicle tracking, congestion charging, access control, statistical information, and border control. Police, government agencies, city councils, traffic planners and consultants are among potential recipients of data. Moreover, the system can generate a real-time HD streaming video suitable for security purposes.

In a free-flow application, the camera can monitor one lane, with multivehicle-per-second detection and overlap assured. Speed evaluation is based on image analysis, with auto-trigger up to 250km/h (155mph).

The camera can be integrated with and connected to external devices and can receive vehicle class data from an external classifier (laser scanner, radar, loops, etc), tag identification from RFID antenna and vehicle axle number data from an external device.

Need to know

App-like functionality enables Tattile's Vega cameras to perform a variety of tasks

- Software for vehicle brand, color and model identification aids rich data collection
- Full HD video means the cameras can double as CCTV security
- Two onboard OCR systems ensure data is high quality and ready to use, which is vital for tolling applications

Added-value features

"The main functionality of the cameras is enriched by app-like features, reducing footprint and costs," says Cominelli. For instance, the full-HD video-streaming capability allows the camera to become a passive video security system. "This has been conceived to provide data with real-time integration in the information database, thanks to the single source that manages the information."

The software apps include one that enables the functioning of the two OCR systems. This is important, especially in modern tolling environments, where every transit corresponds to a payment and so requires the highest possible recognition rate.

"Today, even the most advanced cameras use a single

OCR system," says Cominelli. "The data provided by the camera is then processed by another device. This requires additional licenses and dedicated resources. However, Tattile's new cameras have two different OCR systems on board, to ensure data processed by an internal algorithm is always accurate. If you add the vehicle brand, model and color identification capabilities, you can make a digital print of the vehicle that enables a huge improvement in the recognition rate."

Compared with previous ranges, the difference is huge – both technically and due to added value. This is expressed by the additional apps, the scalability and its ability to operate not only as a plate reader, but also as a traffic analyzer and even a CCTV security system.

A new tool

Tattile is now developing a tool that will enable the cameras to be remotely configured by operatives working from the base of a pole. The tool will also be able to automatically check the correct installation of the camera, providing corrective indications if necessary, which will enable a worker to manually set it in the best operating configuration.

Available from November 2016, Vega cameras are fully designed and manufactured in Italy. They ensure a high level of compatibility with previous models, to ensure a continuity of operation for customers.

by **Don Hunt**

Technology can help to reverse recent increases in road fatalities

With a still-expanding job base, lower gas prices and increasing vehicle miles, the big strides in reducing auto fatalities in the US are reversing. After a high of 43,500 fatalities in 2005, the number dropped over the next five years to about 32,500. Then progress in fatality reduction ended, followed by 9% increases in 2015 and the first half of 2016.

Europe has experienced a similar flattening of the progress in reducing vehicle fatalities, and saw a level 26,000 vehicle deaths in 2013-2015. The EU's goal of cutting vehicle-related deaths by half from 31,500 to about 16,000 in this decade looks to be in jeopardy.

While government transport agencies will continue to use design, enforcement and education to reduce fatalities, the trends may indicate that auto safety features and government initiatives have gone about as far as possible in fatality reduction. Enter new vehicle technology.

Connected vehicle technology, whether cellular or dedicated short-range communications, promises in-vehicle warnings to alert drivers to accident situations, such as dangerous traffic slowdowns. While connected vehicle technology will forge ahead, the big safety variable – the human driver – remains the limiting factor in this approach. With human error accounting for up to 90% of all vehicular accidents, the big game changer to reach the goal of zero fatalities is fully automated driving. And not some intermediate level of autonomy that requires re-engagement of the driver at a moment's notice, but full driverless operation on motorways, urban streets, and eventually everywhere.

No technological leap outside of medicine has the potential to improve world safety like automated vehicles. Worldwide, there are currently 1.25 million road deaths a year, the ninth leading cause of death, and the only top 10 cause not related to human health.

Governments should focus initially on 'robo-taxis' rather than driverless private cars – that's where the biggest benefits lie. Autonomous taxis are being tested on public roads with a human monitor: Uber and nuTonomy are doing this on the roads of Pittsburgh and Singapore, respectively. Eventually these companies intend to make the jump to fully driverless taxis, with no human monitor. Governments around the world must be proactive in guiding these advances. As driverless vehicles interact with human-operated vehicles, accidents will occur.

"No technological leap outside of medicine has the potential to improve world safety like automated vehicles"

On September 20, the US National Highway Traffic Safety Administration became the first agency anywhere to issue guidelines for what NHTSA terms Highly Automated Vehicles (HAV). While the guidance is only a voluntary process for vehicle makers to provide systems and operational data, NHTSA has created the first framework anywhere for testing and market introduction of HAVs, including SAE Level 5 driverless vehicles. The debate regarding self-certification versus government certification has yet to begin, but the NHTSA guidance is a big step in getting HAVs on the road to eliminate highway deaths. A positive next step would be for NHTSA to adopt a high level of transparency in data sharing, ensuring that the public can begin to make its own conclusions about the efficacy of HAVs.

Don Hunt is a transportation consultant and former director of Colorado DOT ***dhunt@anteronet.com***

Supporting the control room: the role of KVM technology

The control room forms the heart of operations in a number of industries, from traffic control and rail networks to power management and broadcasting. While the specific applications within those industries differ, the central importance of the control room remains the same.

The decisions hub

Control room operators need to be able to view, retrieve and share the right information at the right time in order to make critical decisions that contribute to the overall success and efficiency of the control room. In traffic management, for example, these decisions and the associated information flow can have a considerable impact upon a very large number of people and services. As a result, the design, operation and management of the control room is almost as important as the area itself. More often than not, it is technology that can help operators and organizations meet their critical objectives.

Typically, it is the highly visible technology – video walls and large LED monitors – that springs to mind when imagining a control room. However, supporting equipment such as keyboard video mouse (KVM) technology, particularly high performance IP-based KVM, has an equally important part to play and can even improve the overall design, room layout and user experience.

Space efficiency

In a nutshell, KVM technology provides switching and extension capabilities that help make the control room more efficient, comfortable and secure. Extension enables operators to work at their desks while their computers are located elsewhere. In addition to freeing up valuable space in the control room, the removal of computers also takes away the excess heat and noise that they generate. The machines can be placed in a different room within the facility, on a different floor, or even in a separate building entirely. More often than not, computers are placed in a centralized location, such as rack-mounted in a secure server room. Here, the temperature is carefully moderated, as are other environmental factors such as dust and humidity. What this means for the machines is increased performance and a longer life, and for the users in the control room, it means a much more comfortable working environment.

Additionally, by moving machines to a controlled environment, such as a server room, security around them increases. Organizations can add a level of security to ensure that the machines can only be accessed by staff with the right credentials – similar to the way in which software access rights can be managed remotely, with operators only able to access the machines and content that they have been granted rights for.

Secure access

AdderLink Infinity provides the ability to switch between any number of machines from one workstation with one mouse and one keyboard. Adder solutions also give operators the ability to move their mouse cursor across screens, seamlessly accessing multiple computers, giving the impression of a single desktop. Again, this frees up space on the desk, improves ergonomics, ensures that shift handovers can be accomplished smoothly, and supervisory functions can easily be undertaken. With trends such as 'hot desking' on the rise, switching has particular benefits as operators can log in from any workstation and access their personalized user interface and perform as they need to.

Making the control room a comfortable environment that supports decision making will continue to be a top priority for organizations that rely on the processing of data and visuals in order to control and manage dynamic, fast-paced and critical applications. And it remains the role of technology to support these environments and ensure that operators are able to meet their objectives and make those decisions quickly, based on the right information.

High performance command and control solutions from Adder Technology

Need to know

Adder Solutions allow multiple users to access multiple host computers from one screen with one keyboard and mouse

- Support for a wide range of devices
- Easy admin
- Flexible, scalable infrastructure
- View, access and switch your computing resources remotely
- Switch to any connected computer via intuitive on screen menu

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Choosing the right license plate recognition system

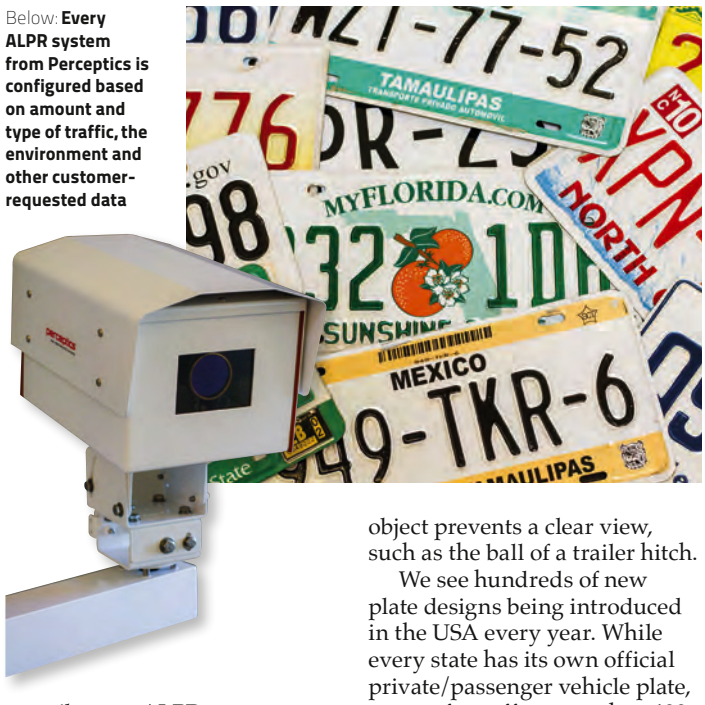
Even in an era where CCTV cameras, RFID chips and biometrics systems are increasingly being used in the identification of people and vehicles, automatic license plate recognition (ALPR) serves an important function in increasing safety and efficiency, while often decreasing costs.

The case for accuracy

When companies and organizations find themselves choosing an ALPR system, accuracy is often a top priority. Road authorities stand to lose millions in uncollected tolls and fines if ALPR systems do not provide a high level of accuracy. Government and security organizations cannot afford to risk public safety by utilizing ALPR systems with low accuracy rates at border crossings. Moreover, the commercial vehicle industry benefits greatly from decreased waiting times at weigh stations when license plate data doesn't have to be input manually.

Because accuracy is critical across so many industries, here we take a look at what factors contribute to ALPR accuracy and how to avoid the mistakes made in selecting a solution.

Below: **Every ALPR system from Perceptics is configured based on amount and type of traffic, the environment and other customer-requested data**



Left: **ALPR cameras at border crossings must be able to read thousands of types of plates**
Below: **Perceptics's 7th generation license plate reader is being installed at more than 165 primary vehicle inspection lanes in Canada and at 43 US Border Patrol checkpoints**

Need to know

Huge benefits result from using the right ALPR technology

- A high vehicle-detection rate and plate-read accuracy reduces manual review time
- Sufficient accuracy improves officer safety at borders and high-risk areas
- Processing of commercial vehicles at weigh stations is more efficient when data doesn't have to be manually entered

Readable vs unreadable

ALPR has been around for more than 30 years. A common misconception is the ability of ALPR systems to read 100% of license plates 100% of the time. Although ideal, it is simply not possible. End users and manufacturers often have different ways of stating claims, which ultimately leads to customer dissatisfaction or mistrust about accuracy.

High-performance ALPR should be able to return optimal license plate data regardless of vehicle speed, plate format or design, weather or lighting. But, a plate can't be read if it is: missing from the vehicle; outside the field of vision; damaged – portions are missing or severely bent; mounted in a manner inconsistent with the local law; or obstructed – an object prevents a clear view, such as the ball of a trailer hitch.

We see hundreds of new plate designs being introduced in the USA every year. While every state has its own official private/passenger vehicle plate, states often offer more than 100 different options of plate designs based on hobbies, clubs or organizations, causes, collegiate alliances, sports teams, military or public service, and more. Some states even let residents create their own designs. Add in official plates for emergency and government vehicles, trailers, antique cars and disabled drivers – each one with different background designs, colors and character placement. Now multiply that again to account for all the different years the plates were issued, and that's a lot of plates to read. ALPR cameras should be able to read all legal license plates, including those well past their prime.

Doing the right math

As has been shown, maintaining a high level of accuracy is not always easy. Additionally, not every camera manufacturer measures accuracy the same way. It is important to have a clear definition of accuracy so you can hold your ALPR provider accountable. Below are two simple equations to help define accuracy:

$$\%\ \textit{Vehicle detection rate} = \frac{\text{Number of vehicles detected} \times 100}{\text{Actual number of vehicles}}$$

$$\%\ \textit{Plate read accuracy} = \frac{\text{Number of plates read} \times 100}{\text{Number of correct reads}}$$

But what constitutes a 'plate read' and what is meant by 'readable plates'? This is where your definition and your supplier's may be worlds apart, which can translate into a bad ALPR purchase experience.

So, when choosing an ALPR system provider, critical to keep in mind the importance of a high level of accuracy and proven experience.

Express lanes

Your shortcuts to some of the big stories in this issue – and beyond!

"Horizons is an advanced asset management solution. It helps us win long-term maintenance contracts by making a compelling asset management case from the outset"

Dave Brown, associate director, Amey

Find out more about Horizons and Amey's ongoing partnership with Yotta at trafficTechnologytoday.com/horizons

"All 12,800 intersections in New York City have been modernized with state-of-the-art traffic controllers, so we can expand our RSU and V2I locations in the future"

Dr Mohamad Talas, ITS program manager, New York City DOT

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"Pittsburgh is home to world-class engineering talent… Uber started ATC 16 months ago with the specific purpose of getting self-driving vehicles onto the roads"

Raffi Krikorian, engineering director, Advanced Technologies Center (ATC), Uber, Pittsburgh

Find out more about the public test of self-driving cars in Pittsburgh in this video report trafficTechnologytoday.com/ubertest

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"We can take weather info from vehicles, pull in more from roadside weather units and process it all, and then send it back out to the vehicle"

Matt Smith, statewide ITS program manager, Michigan DOT

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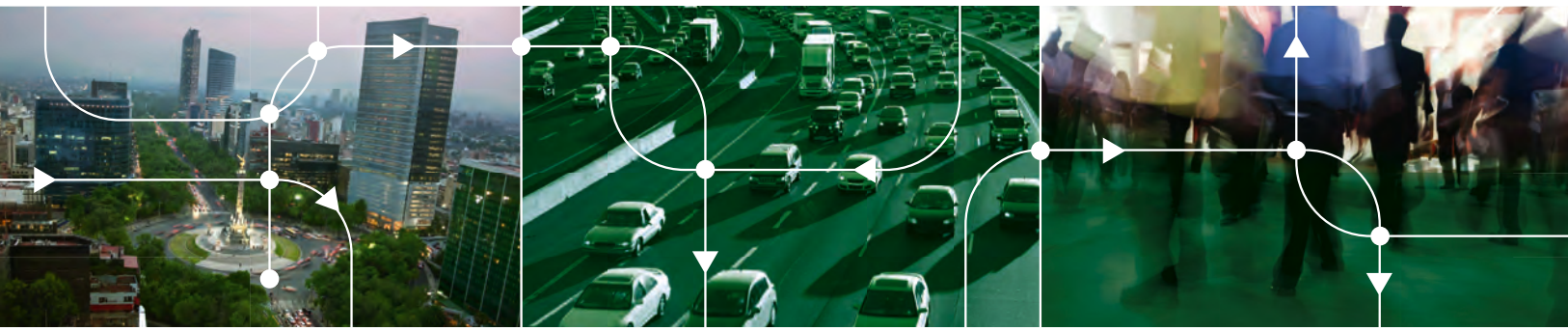
Intertraffic MEXICO

16.17.18 NOV 2016



International trade fair for **infrastructure, traffic management, safety** and **parking**

Centro Banamex
Mexico City

Connecting businesses and traffic professionals worldwide

- Monitor market demands in one of the most lucrative markets in the world
- Access high level decision-makers and a large customer base
- Find a local partner and generate alliances to create business opportunities in Mexico
- Enhance your corporate reputation and brand image

Organized by: rai AMSTERDAM EJK®

Intertraffic® com

See you at
GULF TRAFFIC
in Dubai
13.–15.11.2016
Booth Z2D31

Traffic Law Enforcement | Police & Security ANPR | Traffic Data Management | **Traffic Safety Services**

Improving roads, journeys and communities with Traffic Safety Services.

SHARING EXCELLENCE

The international solution provider for global traffic safety, Jenoptik, knows that roadside equipment alone does not make a highway better.

Jenoptik Traffic Solutions are experts in supporting the whole life operation of a traffic enforcement project.

From initial consultancy and design support, through implementation, project management and training, Jenoptik's global team of enforcement experts are there to bring your enforcement requirement to life. This support doesn't need to stop at handover, with a full finance and back office operation available if required. We have the capability to run an entire end-to-end solution.

Facts & Figures

- 30,000 systems delivered
- Operating in over 80 countries
- 480 staff working on traffic solutions
- 2.2 Mio offences processed every month

JENOPTIK | Traffic Solutions
traffic-solutions@jenoptik.com
www.jenoptik.com/traffic-solutions

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