August/September 2015

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Oregon ditches gas tax!
The inside story of the US state adopting a new road user charge

The Bluetooth takeover
Why wireless technologies are the new essential in traffic data

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Power out!

How long can a city's critical infrastructure keep functioning in a blackout? We investigate the latest battery backup systems

22 MUST-SEE HIGHLIGHTS OF THE ITS WORLD CONGRESS!

EXCLUSIVE INTERVIEW

PLUS

Regina Hopper
ITS America's new president and CEO prepares to lead the industry into a new era of communication

Multimillion-dollar ideas
Five tolling innovations that will boost workforce efficiency, improve traffic flows and increase revenue

Mcity uncovered
As it opens, we take a look inside the world's first dedicated autonomous vehicle test facility

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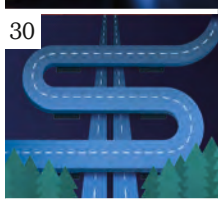
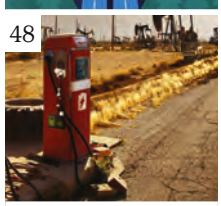
Cover story

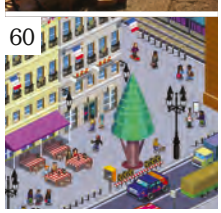
14 What if your power is cut?

Find out how new battery backup systems would fare in a catastrophic blackout

Saul Wordsworth imagines a doomsday scenario on the streets of London







Technology Profiles

Editor's letter

The rate of change in the world is accelerating and this is particularly apparent in the dynamic and growing ITS industry. It's something that is often noticed quickly by newcomers, such as ITS America's new president and CEO, Regina Hopper, who, when I met her, confessed to being thrilled by the almost daily technological developments in transportation, and feeling like "a kid in a candy store". Having a hard day? Get a full dose of her infectious enthusiasm from page 57.

Of course, anyone who visits Bordeaux for the 22nd ITS World Congress next month (October 5-9) will find it hard not to be swept along by the thrilling energy in the industry. However, events of such magnitude aren't without their downsides. The primary one, with so much going on, is how to ensure you don't miss something important. Of course, as a *Traffic Technology International* reader you can turn to page 60 for an exclusive preview of the highlights. But, not only that, this year for the first time we will be updating our website traffictechnologytoday.com live from the event. And – for subscribers to our email newsletter – there will be ITS World Congress Updates. So whether you're planning to visit Bordeaux (or actually there right now as you read this) and want to get the big stories of the event direct to your inbox – or you can't make it but need to be kept informed – simply log on to our home page and click the new link to sign up for our email newsletter. It's free!

Back on the other side of the Atlantic, the recent opening of the University of Michigan's autonomous vehicle test facility, Mcity, has us all very excited (read more on page 7), as does the fact that Oregon has just started the USA's first-ever mileage-based road user charging scheme, a groundbreaking project that could well be the beginning of the end for gas tax (see page 30). Just two more choice picks of 'ITS confectionery' in a packed issue. Enjoy!

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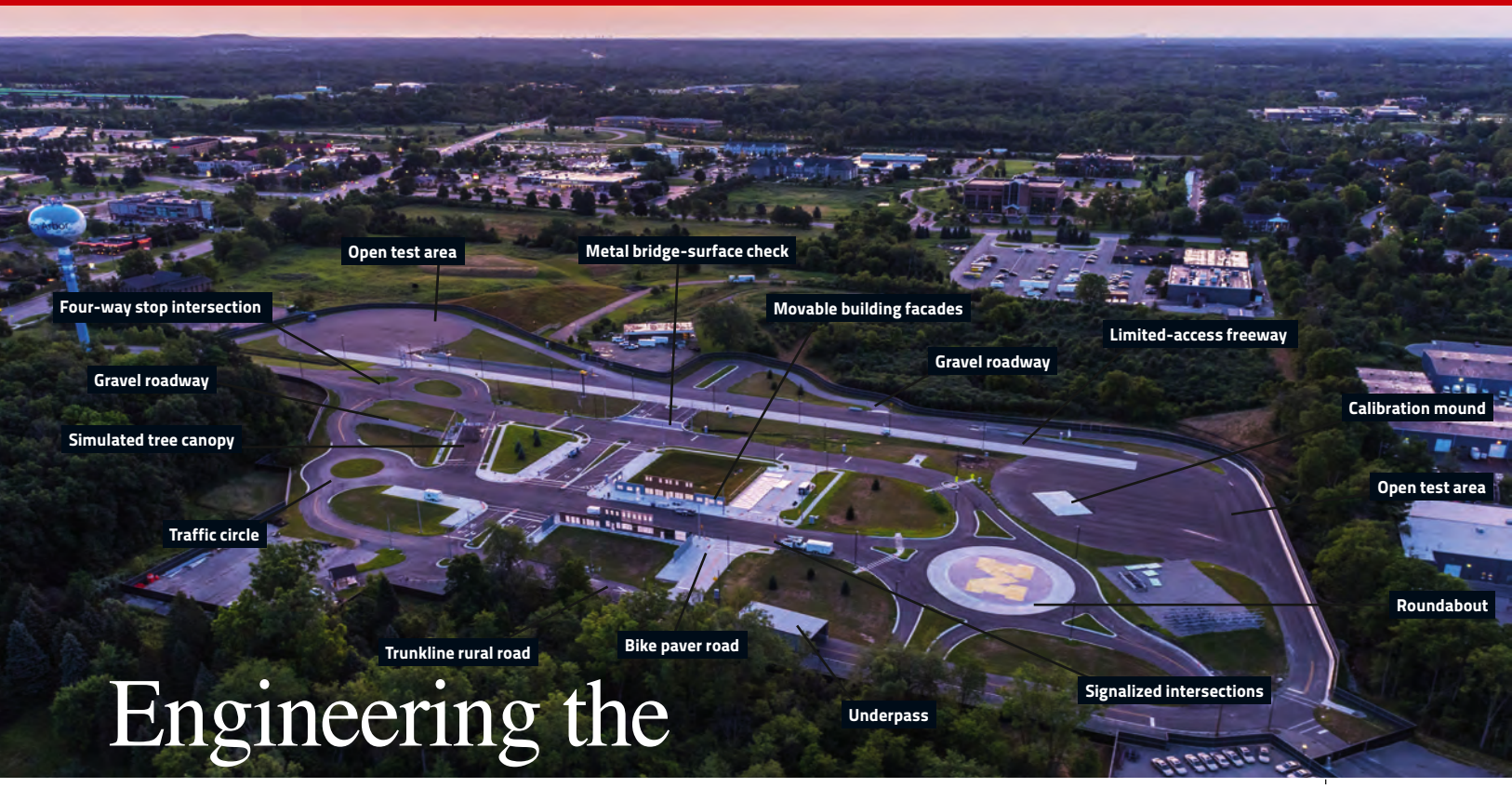

Engineering the future

The newly opened Mcity , Michigan, is the first ever test facility totally dedicated to autonomous and connected vehicles. **Mark Hall** takes a look inside

The University of Michigan's (U-M's) 32-acre autonomous-vehicle test facility, Mcity, has barely been open a month and it is already showing itself to be a vital proving ground for automotive development. It is the world's first controlled environment specifically designed to test the potential of connected and automated vehicle technologies and as such has features that cannot be found anywhere else. For an overview, see our aerial shot above.

As this issue goes to press, to ensure that progress with testing is made as quickly as possible, U-M's Mobility Transformation Center (MTC), which designed the facility in partnership with Michigan DOT (MDOT), has gained its own dedicated director. Dr Peter Sweatman was already heading up the department, but he also had to find time to direct U-M's Transportation Research Institute (UMTRI). Now, the connected and autonomous vehicle expert has been promoted to working full time directing the MTC.

"Launched in 2013, the MTC now has partnerships with nearly 50 companies, as well as federal, state and local government," says S Jack Hu, interim vice president for research. "With Mcity now fully operational, it requires Dr Sweatman's full attention as it moves forward on its ambitious plans for further growth and development." A new director is now being sought for UMTRI, with associate research scientist Carol Flannagan appointed interim director. Both new positions are now effective.

"There are many challenges ahead as automated vehicles are increasingly deployed on real roadways," says Sweatman. "Mcity is a safe, controlled and realistic environment, where we are going to figure out how the incredible potential of connected and automated vehicles can be realized quickly, efficiently and safely."

So far, approximately **US$10m** has been invested in the Mcity test facility

Want to check out Mcity at street level? Hop into a car for a driving tour of the facility with MTC's development director Jim Sayer at **trafficTechnologytoday.com/mcitydrive**

Joined-up thinking

Lloyd Fuller takes a look at how authorities in the USA are optimizing the financing, construction and maintenance of the country's critical bridge infrastructure

Cross-border connection

LED fixtures improve visibility and safety

The bridge linking the USA and Canada between twin cities both named Sault Ste. Marie, in Michigan and Ontario, is getting a major lighting upgrade that will provide a 20% increase in illumination, improving safety for the 7,000-10,000 drivers that use it daily. The International Bridge Administration (IBA) will replace the existing 96 white high-pressure sodium bulbs that run along the top of the twin US and single Canadian arch spans, with colorful and more energy-efficient LED units.

As well as the increase in illumination, the IBA expects a 55% reduction in energy use, which will result in savings of at least US$44,310 in energy costs and US$30,330 in maintenance costs over the lifetime of the fixtures.

Live wires

Authority uses additional revenue streams to keep tolls down

A leading US toll bridge operator is using an additional revenue stream to keep down its tolling fees. The New York State Bridge Authority (NYSBA) will lease 'dark fiber-optic' services over two of its bridges for the next 10 years, generating more than US$900,000 and providing a substantial supplement to its tolling revenue.

Since 2011, NYSBA has executed fiber-optic leases totaling US$3.2m. In addition to the Bear Mountain and Rip Van Winkle bridges, there are also dark fiber crossings on the Newburgh-Beacon and Mid-Hudson bridges. A dark fiber crossing at the Kingston-Rhinecliff Bridge, the authority's fifth vehicular bridge, is in the planning stages. The US$1.25 passenger vehicle toll for E-ZPass customers on NYSBA bridges is among the lowest in the USA for self-supporting transportation agencies. The authority says that its tolls are actually lower today, in real terms, than they were when it began operations in 1933.

Fast-forward

Bridge project recognized for innovative financing

The East End Crossing of the Ohio River Bridges Project (ORBP) has received the Global Road Achievement Award for Project Finance and Economics from the International Road Federation. The award recognizes achievements in cost savings and accelerated project delivery, which the East End Crossing accomplished through a P3 procurement process. The ORBP will save US$228m in construction costs over the original estimate and will be completed eight years sooner than it would have been with a traditional design-bid-build method. One of the largest ever projects of its kind in the USA, the ORBP involves the design and construction of two bridges over the Ohio River to connect Kentucky and Indiana in the Louisville-Southern Indiana metropolitan area.

Asset protection

Autonomous technology to aid bridge inspections

A team at Florida Atlantic University's College of Engineering and Computer Science has received a US$187,000 grant from the Florida Department of Transportation (FDOT) to develop autonomous waterborne vehicles that can assist in bridge inspections. The unmanned surface vehicles could be used to make bridge inspection safer and more efficient. FDOT uses a variety of methods to inspect sections of the state's 11,451 bridges that are above water level. However, the only method to check the sub-surface areas is with divers, who search for cracks, erosion, damage and defects. Many of the state's bridges are in corrosive saltwater, and divers experience low visibility from silt, debris and algae.

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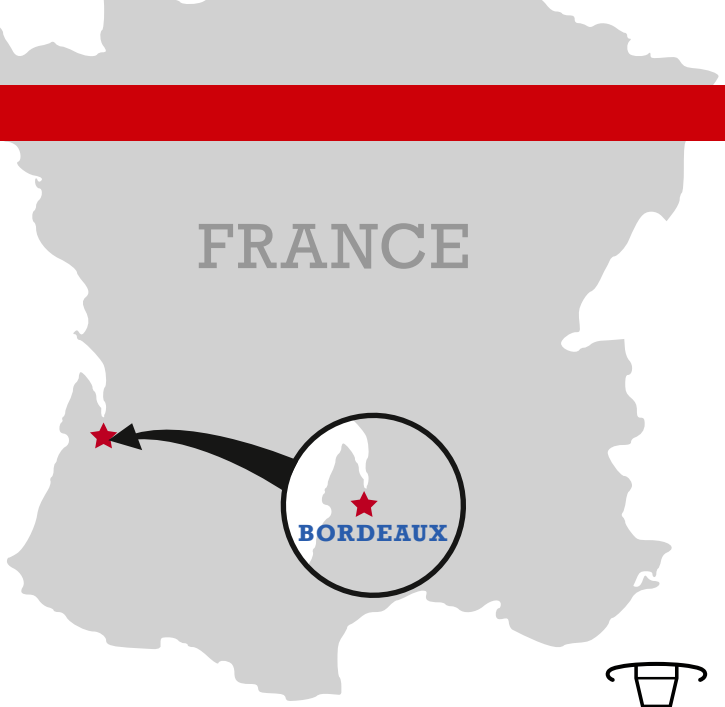
Culture and networking

The 22nd ITS World Congress will take place in the beautiful, historic and very busy city of **Bordeaux**, France, October 5-9, 2015

Infographics: Louise Adams



Traffic in the Bordeaux metropolis area is monitored and managed by the Gertrude real-time system in the city's ITS traffic management center

Bordeaux's road network comprises approximately

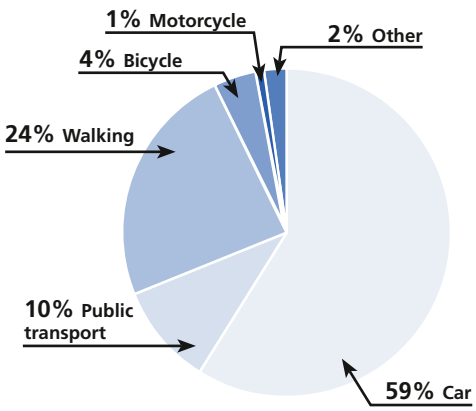
4,000 miles

of asphalt

The population of Bordeaux is estimated to be approximately

2.5 million

JOURNEYS IN BORDEAUX



Approximately

3.2 million

trips are made in the city each weekday

Bordeaux's roads are most congested on

MONDAY MORNINGS and **FRIDAY EVENINGS**

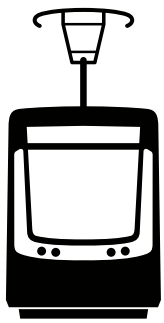
DID YOU KNOW?

In 2007, Bordeaux's historic city center became the largest urban complex to be listed as a UNESCO World Heritage site, following a major regeneration project led by the Mayor of Bordeaux, Alain Juppé

The Bordeaux metropolitan area has

345 miles

(700km) of dedicated cycle paths



BORDEAUX HAS THREE TRAM LINES THAT COVER A DISTANCE OF 36 MILES (58KM) AND IT HAS A FLEET OF 100 TRAMS (THE LARGEST FLEET IN FRANCE)

The cumulative delay for an average commuter with a daily 30-minute trip is an extra

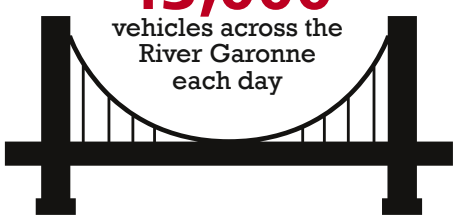
85 hours

each year

Bordeaux's Pont Jacques Chaban-Delmas – Europe's largest lift bridge – transports

43,000

vehicles across the River Garonne each day



Bordeaux runs **401 buses**, of which 30 are hybrid and six are electric

There are 78 bus routes

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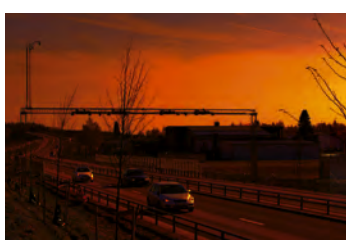

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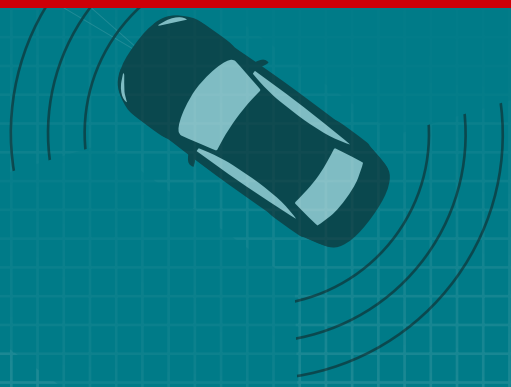
LEADING THE WAY

AV blueprint

Each and every month new research and technology adds to the picture of what our future world of connected and autonomous vehicles will look like. **Mark Hall** has the latest



Steering stuff

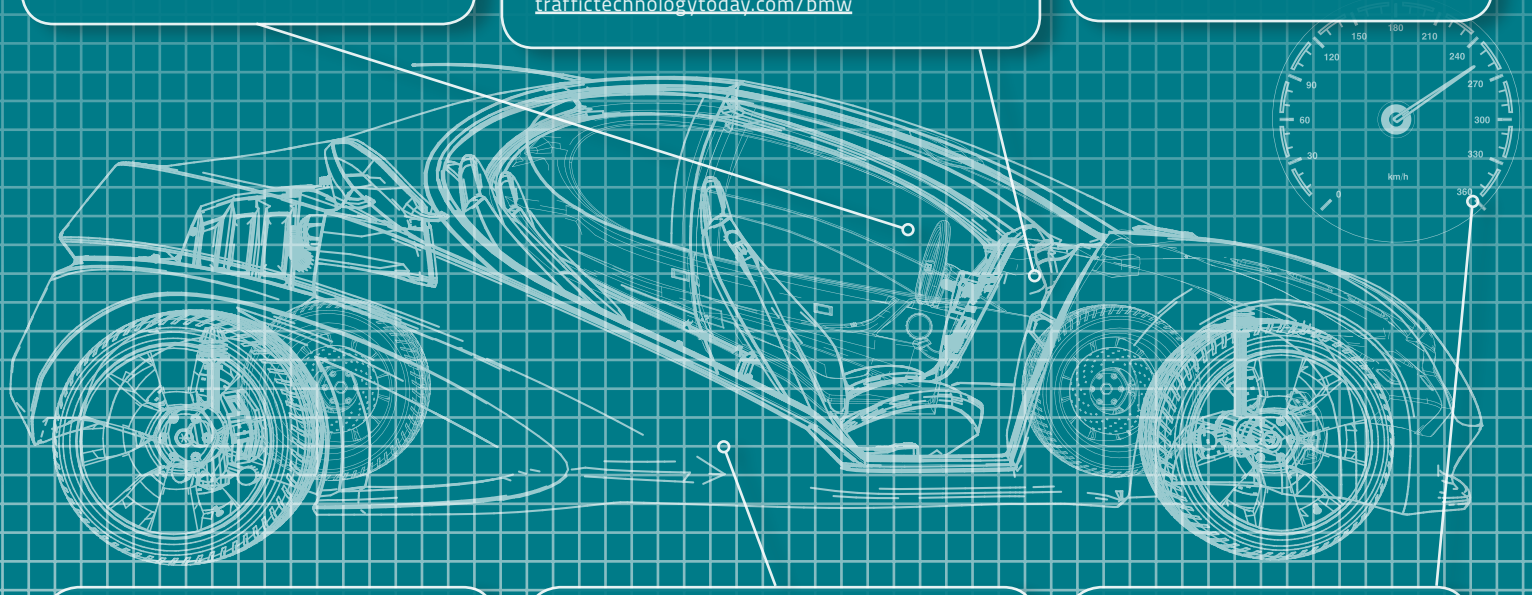
The Aerospace Controls Lab at MIT has turned its attention to self-driving vehicle development and released an excellent instructional video, which forms an introduction to the system known as PID-control – the basis for autonomous vehicle steering.
Watch the video here
trafficTechnologyToday.com/steer

BMWs get V2I comms

BMW drivers are among the first in the world to get vehicle-to-infrastructure connectivity as the automaker is introducing a direct dashboard interface with the EnLighten V2I smartphone application. The app provides drivers with traffic-signal countdown information in real time, making driving in cities easier by helping with anticipation of signal changes.
Find out more at
trafficTechnologyToday.com/bmw

Remote parking

As a precursor to fully autonomous parking, new Mercedes E-class models, available in January 2016, will feature the option of remote parking via a smartphone app. You can log on to our website to see the system in action.
Watch the video here
trafficTechnologyToday.com/merc



Funding boost in the UK

The UK government has launched a £20m (US$31m) competitive fund for collaborative research and development into driverless vehicles, along with a Code of Practice for testing. The measures, announced by business secretary Sajid Javid and transport minister Andrew Jones, aim to put the UK at the forefront of the intelligent mobility market.
Find out more at
trafficTechnologyToday.com/uk

Australia to begin testing

According to Australia's national independent road research agency, ARRB Group, driverless vehicles will be tested on the country's roads for the first time in November 2015. The trials will coincide with the Driverless Vehicle Conference on November 5-6. The trials will take place on Adelaide's Southern Expressway, with multiple vehicles conducting maneuvers such as overtaking, lane changing, emergency braking, and using on- and off-ramps.
Find out more at
trafficTechnologyToday.com/oz

High-speed autonomy

Having already demonstrated its high-speed performance capabilities at a German circuit last year, Audi has now taken its latest race-ready autonomous vehicle across the Atlantic, with a display of 'piloted driving' on one of the world's most challenging race tracks, the Sonoma Raceway in California.
Find out more at
trafficTechnologyToday.com/audi

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Power out!

What would London be like without power? **Saul Wordsworth** looks at the worst-case traffic scenarios, and then discovers the new technology that, as it becomes more widespread, is making such risks more remote

Photography: Alphaspirit

Britain. Winter. 2016. Freezing fog blankets the Southeast. The National Grid has warned that the risk of blackouts is at its highest for years. The closure of power stations leaves spare capacity on the system at just 1.2%, the lowest in over a decade. One morning the capital is hit by a power failure the likes of which it hasn't suffered since the 1970s. All power is lost, including overhead lighting and traffic signals. The roads are plunged into total chaos.

"The result would be instant gridlock," says Nick Hounsell, professor of highways and traffic, the University of Southampton. "Drivers would be hesitant at every junction, where previously they weren't. The queuing would be horrendous."

The myth that traffic lights somehow cause congestion would quickly be dispelled, particularly in a city where SCOOT (Split Cycle Offset Optimisation Technique) is widely in operation. With cars bumper-to-bumper, emotions would

WORLD'S WORST BLACKOUTS

India, 2012

At the end of July 2012, more than 620 million people – 9% of the world's population – are affected by the two worst blackouts in history, covering most of north and east India. Traffic lights stop working, leading to multiple jams. All medical operations are canceled. Mining work is halted.

(Above) **As night falls, London without power could be a disturbing prospect**

be heightened and tempers would inevitably fray.

"Traffic signals are a safety net for pedestrians as well as vehicles," says Hounsell. "With no movement at all, pedestrians would likely be OK, but in a slightly freer flowing environment the risk suddenly escalates enormously." A woman trying to cross the road is knocked down. How will the emergency services reach her? Very quickly the city takes on the sheen of anarchy.

The worst conditions would be reserved for complex junctions. Under normal circumstances they provide a safety function as well as synchronizing traffic. Large junctions could prove extremely hazardous, particularly for those drivers attempting to negotiate them for the first time. Without traffic signals to assist, two drivers trying to complete the same maneuver in conflict could easily collide.

Opinion is divided on exactly how a city like London would react to a total collapse of its traffic signal system. Perhaps the doomsday scenario is overly dramatic and there may be a more harmonious outcome.

"We might actually be pleasantly surprised at how well some junctions perform when all the drivers approach knowing they have to give way," says John Parkin, professor of Transport Engineering at the University of the West of England, who suggests a social spirit may prevail. "Spontaneous collaboration may ensue and the capacity may not be as severely limited as we think."

"Operations might revert back to major-minor type junctions, in which case the major roads will keep going and the massive queues will be on the minor roads," ventures Hounsell. "If lights were down for a long period it would be interesting to see how drivers would react. I imagine everyone would slow right down and be cautious at junctions, and that would cause delays. People would quickly realize they couldn't get from A to B by car in a reasonable time. The outcome would be that business people would work from home."

Backing up

It is only in the past 50 years that we have seen the growth of the major signalized junction, and only in the past 15 that anyone has considered protecting them. Some of the first backup systems were installed at the turn of the millennium as California reacted to power shortages and rolling blackouts. Soon after, agencies across the USA began installing backups in response to power outages and line disturbances such as sags and swells. Other reasons for signal breakdown include power failure at substations, cable failure and miscreants deliberately cutting through cables. It was only as a result of the Northeast Blackout of 2003 (see *World's worst blackouts*) that New York first considered signal backup.

> If all power were lost the result would be instant gridlock. People would be hesitant at every junction
>
> **Nick Hounsell, professor of highways and traffic at the University of Southampton, UK**

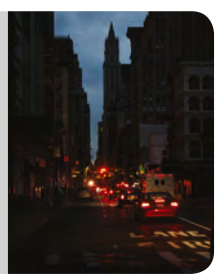
"After 2003 we installed battery backup systems (BBS) for the traffic signals at over 600 locations," says Mohamad Talas, deputy director, system engineering, NYCDOT Traffic Operation and Planning. "We continue to add extra BBS as we go along. The BBS kick in the instant there is power loss and run for up to eight hours, or until a traffic agent is present or the problem is fixed. You can't assume that all intersections are going to have backup. That's a challenge and a problem."

Even where BBS systems are in place, batteries can sometimes fail prematurely. Agencies need to check them periodically to make sure the

WORLD'S WORST BLACKOUTS

N. America, 2003

Northeast USA and Canada, August 2003, 50 million people affected. Lasts two days. Damages total US$6bn. Police direct traffic on Manhattan to prevent gridlock. Worst blackout in US history.



systems are fully functional. What helps greatly is to have a BBS with a self-test feature. Such setups automatically run a system in backup-mode once a month and the agency will be automatically notified of any issues.

Meanwhile, because of storms and there being some areas susceptible to power loss, intermittent problems remain in New York. "These things happen," says Talas.

New developments

With junctions growing in size and complexity, the risk to motorists if signals fail remains greater than ever, particularly at high-speed intersections. As such, there is a worldwide move toward BBSs, particularly at hamburger junctions, where a main road passes through a roundabout.

Virtually all uninterruptible power supplies (UPSs) rely on a battery or bank of batteries to provide power. When customers invest in a UPS, more often than not they are purchasing an office-based solution originally designed for indoor, computer power backup.

> We might be pleasantly surprised at how well some junctions perform when all drivers approach knowing they have to give way
>
> **John Parkin, professor of transport engineering at the University of the West of England, UK**

WORLD'S WORST BLACKOUTS

Brazil, 1999

In March 1999, 97 million people – most southern Brazilian cities – are affected when lighting strikes an electricity substation in São Paolo. More than 60,000 people are stranded in the Rio subway. 1,200 police deployed to prevent looting.

WORLD'S WORST BLACKOUTS

Itaipu Dam, 2009

In November 2009, Itaipu hydroelectric dam, bordering Brazil and Paraguay, grinds to a halt. Suggestions it was the work of hackers are never proved. But, as a result, the power system is now voice-activated.

PHOTOGRAPH: ANGELO LEITHOLD

These generally use lead-acid batteries, which have limited temperature tolerance, which means they're not optimally suited for static outdoor use. In addition, most solutions are 'online', whereby the UPS provides constant power to the load. This isn't necessary since all traffic control systems are able to tolerate short breaks in the mains power. What's more, an online UPS solution that operates all the time overheats and wears out more quickly.

"At Junction 11 of the M4 into Reading we have eight controllers," says Lyndon George, traffic signal engineer for Reading Borough Council. "Originally we had a set of very large containers for air flow to cool the batteries. I referred to them as bicycle sheds because they were that kind of size. That isn't really practical in an urban environment. One day an accident took out one of the cabinets. That gave us the chance to look at what was on market."

What Reading Council plumped for was a new UPS solution from Siemens designed specifically for traffic signal applications. Instead of lead acid, the new system employed lead crystal batteries for a longer life (six to 12 years versus two to four) and for a much wider operating temperature range. The latter meant the housing units no longer needed to act like air-conditioning cabinets, and could be smaller.

"Whereas the older system gave us five to seven hours of continued use after power loss, the newer one is closer to 10 hours," says George.

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The innovative view

(Right and below) **Modern UPS systems use lead-crystal battery technology, which can tolerate larger temperature changes, dispensing with the need for large cabinets**

"This allows us time to get traffic management into place or an engineer to investigate. Unlike online solutions, it is only when the mains power fails or falls outside certain defined limits that the UPS switches on. This helps prolong the life of components that make up the controller itself. Spiked voltages tend to make things heat up, cool and heat up again, causing components to break. The newer units improve the life of the controller."

The solution is not there to provide ongoing power, merely to provide backup power for long enough for a local authority to decide what steps it wishes to take. In the event that the power failure is long-lasting, there is a 'combat' socket built in for a generator. So, if the batteries run out, the site can be kept running for weeks if necessary.

"We have our UPS configured so that it generates output into urban traffic control and in turn our fault-management system automatically signals a fault to an engineer," says George. "There have been cases where the power has failed for a few minutes but we have seen no indication and the lights continue working safely."

> Spiked voltages tend to make things heat up, cool and heat up again, causing components to break. Newer units improve the life of the controller
>
> **Lyndon George, traffic signal engineer, Reading Borough Council, UK**

Backup to the future

It is clear that purpose-built solutions are already proving valuable to the market. At intersections where the cost of signal and enforcement hardware may rise above US$500,000, further investment to keep that technology running makes economic sense. George for one believes that backup, whatever form it takes, is essential, because, however polite we think we might be to other road users, if there was a massive power outage and all signals suddenly stopped functioning – as in the doomsday London scenario imagined earlier – safety would be compromised.

"You need to look at everything from a safety perspective," he says. "Technically you're only supposed to proceed through a junction if it is clear to do so, and only then with extreme caution. You must give way to others unless you can see them giving way to you. Sadly, in my experience, people don't do that."

PHOTOGRAPHY: ALPHASPIRIT/SHUTTERTOCK.COM

WORLD'S WORST BLACKOUTS

Chenzhou, 2008

China, January 2008, five million people in the city of Chenzhou are without power for an agonising two weeks. The population has to endure freezing temperatures during the depth of winter. Eleven electricians die trying to restore power.

The numbers game

Traffic data, at is simplest, is counting the number of vehicles on a road. While there are well-established ways to do this, **Max Glaskin** discovers that, with the growing proliferation of Bluetooth, wi-fi and smart devices, new, more efficient solutions are finally becoming available

175,000
The approximate number of vehicles that pneumatic tubes can count before they start to degrade

Traffic counts provide the most basic of data – and the most important. Highways would be in a complete mess without them because they're used to assess capacity, flow, travel time, maintenance, safety and network expansion. That's why everyone from national governments down to local authorities always keeps an eye on the numbers.

Greg Slater is one of the thousands on the ground around the world charged with collecting those all-important numbers. As a senior planner at Michiana Area Council of Governments, he gathers the data for Indiana DOT, and other local government bodies, from 4,500 locations, across a three-year cycle.

"Each station is counted for 48 hours with pneumatic tubes," he says. "We get a count and, from the axle spacing, ball-park figures for the types of vehicles. The technology we've been using has been around for 40 or 50 years." So, it works, is reliable and durable – Slater estimates a tube can withstand 175,000 vehicles driving over it before it gets "a soft, mushy feel like an old radiator hose from a car".

Then why is there a growing number of increasingly sophisticated alternatives? It's down to advances in solid state electronics and computing power. More information can be extracted and used more effectively

when traffic is counted in smarter ways. Data from induction loop detectors, for example, is monitored remotely in near real time to give 'live' feeds to traffic management centers and for deeper analysis. On the A69 highway in the UK, they're used to calculate how much the national roads agency, Highways England, should pay the road operator each year.

The trouble with raw numbers, though, is that they quickly become the focus of attention and obscure the real world they are supposed to reflect, making it easier for inaccuracies to slip past. The consequences can be a problem when the errors are fed back to traffic management control. Such an issue was identified as recently as December 2014, among some data from induction loop detectors in Switzerland.

"Loop coil detectors are re-calibrated automatically and continuously to compensate for external influences, like changes in humidity, temperature and vehicle mix," explains Dr Thomas Riedel of Adaptive Traffic Control, Switzerland.

"They may re-calibrate to a very sensitive mode and start detecting metal when there is no vehicle to count. Or they may think a vehicle is stationary when traffic is flowing. These events, fed back to the TMC [traffic management center], can trigger control algorithms. It wasn't a problem when control was more localized, but now it's done more centrally and these events aren't always identified," says Dr Riedel. He's developed software to check the data for these erroneous blips before they can affect traffic control and to reveal which loops need to be corrected by manual re-calibrations.

28 million
The number of Bluetooth signals recorded in London in a 10-day traffic-counting study

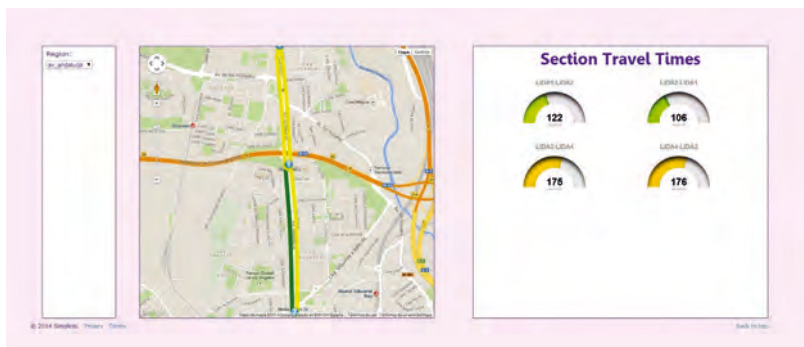
Counting in the digital age

Since the explosion in the use of mobile devices, from satnavs, cell phones, hands-free audible kits, tablets and now smart watches, road operators have had access to other signals that can be detected remotely at the roadside and used to help count traffic – wi-fi and Bluetooth.

These wireless signals can be uniquely identified and are ripe for harvesting, although the data has to be threshed carefully to screen out grains of untruths. They are most commonly used for acquiring travel time data – identifying a vehicle at one point on its journey and re-identifying it at another. Yet count information can also be extrapolated.

> Bluetooth is not meant to be for counting, but it is representative of the traffic volume because we are able to estimate the penetration of Bluetooth devices
>
> **Bahar Namaki Araghi, ITS project manager, City of Copenhagen, Denmark**

"Bluetooth is not meant to be for counting, but it is representative of the traffic volume because we can estimate the penetration rate of Bluetooth devices. In Denmark it's about 25%, in the best scenario," says Bahar Namaki Araghi, ITS project manager for the City of Copenhagen, Denmark, and whose PhD at Aalborg University assessed the feasibility of using Bluetooth for travel time measurement with a particular focus on accuracy and reliability.



(Right) **In Madrid Bluetooth sampling is being used to predict travel times**

"There are some issues if you use Bluetooth. For example, there could be over-counting. Say there are 20 people on a bus, each with a smartphone, you could get 20 signals and over-count," says Araghi. Equally, it could undercount, even in places where there is higher device penetration, such as the 30% level in the UK. Nevertheless, it's an increasingly attractive technology – one detector can cover a multi-lane highway, with a range of 200m, it's not disrupted by weather conditions, has low maintenance, low security concerns, and is relatively cheap to install and maintain.

Bluetooth sampling is also being used in three Spanish cities – Madrid,

Kind of blue

A study by Transport for London has revealed that Bluetooth counting technology can provide an important and cost-effective new data stream

Transport for London (TfL) commissioned Sky High Technology to install 129 Bluetooth detectors for 10 days, to validate the city's extensive traffic model, which included, at the time, 1,673 signal junctions, 1,349 other junctions, 56,480 links and 2,805 zones. The detectors collected a massive volume of data – 28 million Bluetooth signals were recorded from 740,000 unique devices. The priority was to survey journeys, of which 13 million were observed between detectors, with 1.8 million unique routes captured within the survey area.[6]

Inevitably, this meant counting happened as an integral part of the TfL project and it was found that Bluetooth detectors recorded fast-moving cyclists and motorcyclists that ALPR cameras missed. However, ALPR captures a bigger sample of the traffic as not all vehicles emit Bluetooth signals. Siting is also important as Bluetooth detectors can pick up signals over a long distance and, at junctions, may collect data from the wrong roads. Despite shortcomings, the project revealed that the Bluetooth survey has considerable practical and cost advantages over ALPR and roadside interviews, and that it correlated well with vehicle movement in central London.

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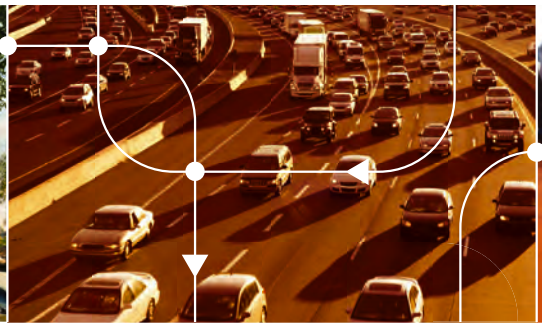


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Seville and Granada – by researchers at the Technical University of Madrid and the University of Granada. "We've been able to monitor traffic density and movement on an individual basis, as vehicle users move between nodes," says Prof. Pedro Castillo, who's been working with technology company Ciudad 2020 to gather low-cost autonomous predictive information using distributed devices.

Although some say that a wireless device penetration level as low as 3% can be good enough to return a quantity of data that's useful for traffic analysis, even this low threshold may not be reached in developing countries. So a team from Japan that wanted to estimate traffic conditions in Dhaka, Bangladesh, analyzed, instead, the log of cell phone call signals received at different masts. Although the city has 6.85 million users, they each average fewer than six calls per day. Nevertheless, their analysis of an entire month of records correlated strongly with an actual road traffic count. So now they have a new tool that enables them to produce historical counts easily.[1]

Another new tool that has the potential to help refine traffic counts is social media, according to Dr Hoang Nguyen, research engineer in machine learning at National ICT Australia. He's been collaborating with New South Wales TMC to leverage Twitter as a channel for network monitoring, incident and event management.

In some instances, social media has alerted TMC to events almost two hours sooner than other methods, but is it also possible to extrapolate count data from the volume of Tweet reports from a specific area? "Yes, that's possible," Hoang tells *TTI*, "But we'd need to combine that with data from other sources such as SCAT [Sydney Coordinated Adaptive Traffic]. That could be a future project."

There's an app for that...

We are moving to a world in which road authorities will be able to cut investment in new hardware for collecting data, because they can instead buy much cheaper smart devices that are launched almost monthly for everyday consumers – devices that can be used to make traffic counting easier. As ever, researchers at Georgia Institute of Technology in Atlanta, USA, have their eye on repurposing off-the-peg equipment for some sophisticated traffic functions.

They've developed a video detection system – an application that runs on an Android tablet for when data from automatic traffic recorders isn't available.[2] It builds on earlier work that assessed whether a video recording on an Android tablet could help manual counters improve their accuracy when using a counting app.

The app displays a live image of the traffic and the human counter taps a vehicle shown on the screen to add it to the cumulative tally. To improve the accuracy, the app includes a supervisory mode. It's a playback facility that toggles through the video, revealing when vehicles were counted and helping to make it clear when others were missed on the first pass so that corrections can be applied. The researchers concluded that the app has the potential to minimize human errors and provide more accurate counts.[3]

The concept of using existing traffic cameras to generate counts via video analytics has been cautioned against in a report published by the Enterprise Transportation Pooled

> [It's possible to count traffic from Tweets] but we'd need to combine that with data from other sources such as SCAT [Sydney Coordinated Adaptive Traffic]
>
> **Dr Hoang Nguyen, research engineer, National ICT Australia**

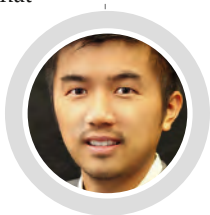
30
The percentage of Bluetooth device penetration in the UK

(Right) **A simple roadside Bluetooth sensor can be used to record traffic volume**

Fund Study in the USA in 2014.[4] Athey Creek Consultants, the report's author, looked at video systems being used in Iowa and Missouri and in Ontario, Canada. It points out that, for FHWA purposes, vehicles must be classified into 13 standard categories and that this is currently beyond the capability of commercially available video analytics.

Even when dedicated cameras are used to capture and record images from which traffic counts might be obtained, state-of-the-art video analytics systems have only an accuracy of 91% during the day and 83% at night with respect to vehicle volume. The report also reveals that vehicle classifications are just 76% accurate for motorbikes in hours of darkness, 87% for cars in the day, 56% for small trucks in daylight, and 77% for large trucks.

The conclusion? "Video analytics is not ready to support this [long-term planning and FHWA reporting] scenario with the current state of practice," the report says, but that nevertheless "the additional classification data from video analytics-equipped cameras would be a valuable asset and improve overall understanding of vehicular movements."



91
Average percentage accuracy for state-of-the-art video analytics in recording traffic volumes in daylight

Future counts

Whichever method is used for counting, there's no point doing more than necessary.

An algorithm developed by Dr ManWo Ng of Old Dominion University, Virginia, USA, could help cut costs.[5] "It has the potential to count traffic on the desired road segments with fewer sensors, or alternatively, it can count traffic on more segments, with the same amount of sensors," Ng tells *TTI*. While yet to be implemented by state DOTs, a small-scale test on local roads in the cities of Suffolk and Virginia Beach in Virginia has produced promising results.

> The new algorithm offers the potential to count traffic on road segments with fewer sensors, or on more segments, with the same amount of sensors
>
> **Dr ManWo Ng, Department of Information Technology and Decision Sciences, Old Dominion University, Virginia, USA**

Counting will always be at the heart of traffic management and provision planning. It's a simple task and the introduction of approaches to make it cheaper and more accurate has been slower than for other tasks. Now change is gathering pace.

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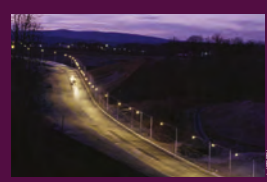
A trio less ordinary

Three traffic counting projects that prove innovation is growing in the field

1 An extraordinarily low-cost, credit card-sized computer has been harnessed for traffic counting. The US$47 Raspberry Pi, invented to encourage kids to take up computing, has been fitted with a US$31 camera to analyze video of traffic on a four-lane highway in Slovakia for 23 days. It produced a count with an accuracy of 92.7%. Matús Jurecka of Zilina University, Slovakia, plans to continue the budget experiment.[7]

2 A sophisticated system is being used to count cyclists in London with a view to triggering traffic signals. A Clearview M100BR below-ground radar unit and a Flir Thermicam are being trialed. "We need to ensure data is 'good' before using it to adjust signal timings in a live environment," says Glynn Barton, head of outcomes delivery for Surface Transport at TfL. If the data is reliable, three more sites will host more trials this year.



VTTI

3 Unusual vulnerable road users – deer, bears, coyotes, foxes and turkeys – are being counted in Virginia on VDOT's Smart Road test track (above), which it built in partnership with Virginia Tech Transportation Institute. The aim is to see if the OmniTrax buried cable is effective at detecting animal hazards. By the end of the 10-month trial, during which 2,850 animals had used the road, detection reliability had reached 99.5%.[8]

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If you run an electric vehicle you pay no fuel tax. Moreover, as all types of engine become more efficient, revenues are falling of a cliff. It's clear a funding crisis is looming, but Oregon's new distance-based charging scheme could be the solution. **Lauren Dyson** looks at the technology that makes it possible and asks if it's soon to be the new world order

Illustration: Ben White

It is no secret that transportation funding in the USA is at crisis point. The Highway Trust Fund, which is the source of more than 50% of highway, bridge and roadway infrastructure investments made by state governments, is reliant on receiving a fuel tax of 18.4 cents/gallon of gasoline and 24.4 cents/gallon of diesel, plus related excise taxes. However, with greater fuel efficiency from internal combustion engines, as well as the growing popularity of hybrid and electric vehicles and green incentives changing traveling behavior, revenues from tax are falling. Furthermore, the gas tax hasn't been increased since 1993, despite rising infrastructure costs. The result is that a lack of substantial long-term federal funding has left many state authorities with no choice but to cancel or delay critical construction and road infrastructure projects.

"Many transportation interests and members of Congress are loath to reduce spending in line with reduced revenue, but any new source of revenue or the idea of raising the gas tax is controversial," says Adrian Moore, vice president of US-based research organization Reason Foundation. "Congress has repeatedly backfilled revenue shortfalls with deficit spending, but it hasn't figured out what to do in the long term.

"Meanwhile, there are several forces at work in the economy and public policy that are encouraging travelers to be more fuel efficient and use less gas while we continue to use the roads just as much – or more," Moore continues. "The need for money will not decrease, but the tax base is shrinking, so even if you raise the tax, revenue will continue to decline. We need a new kind of user fee to replace the gas tax."

Lead by example

Oregon has always had an innovative approach to transportation funding

1919 Oregon Legislature enacts the USA's first fuel tax

1947 Oregon enacts weight-mile tax for commercial vehicles weighing more than 26,000 lb

2001 Oregon Legislature forms the Road User Fee Task Force to explore new ways of funding and improving the state's transportation system

2012 Oregon welcomes volunteers for the Road Usage Charge Pilot Program

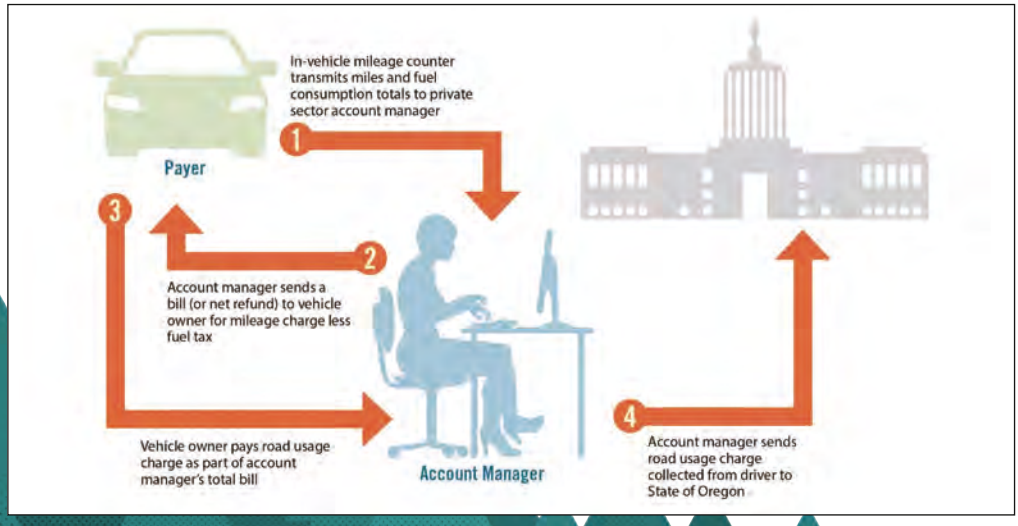
2013 Oregon passes Senate Bill 810, establishing the country's first mileage-based (or road usage) revenue program for light-duty vehicles

2014 ODOT conducts a statewide listening tour to hear Oregonians' thoughts about OReGO

2015 OReGO launches on July 1

> There are several forces at work that are encouraging travelers to be more fuel efficient and use less gas while we continue to use the roads just as much – or more
>
> **Adrian Moore, vice president, Reason Foundation**

(Below) **The OReGO scheme is a simple and fair way to pay for road use**



A new direction

Earlier this year, the state of Oregon made history when it launched the USA's first pay-by-the-mile road usage charge (RUC) program. The program was created by Senate Bill 810 and authorizes the Oregon Department of Transportation (ODOT) to assess a per-mile charge for 5,000 volunteer drivers. Launched on July 1, the OReGO scheme sees participants pay 1.5 cents/mile when driving in Oregon and, in return, receive a credit for the 30 cents/gallon state gas tax paid at the pump. Senate Bill 810 directs ODOT to deposit all net revenue generated from the OReGO program into the State Highway Fund.

"Like every state in our nation, we know that the gas tax no longer generates enough revenue to maintain our roads," says ODOT's public information officer, Michelle Godfrey. "We have known for a while that we need to find an alternative."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In 2001, the Oregon State Legislature created the Road User Fee Task Force to investigate different ways to generate funds to support the state's transportation system. "The taskforce felt that the best alternative would be a distance-based RUC because it is closely related to the user-pays principle, whereby drivers pay for what they use," says Godfrey.

Oregon has always supported the principle of a user-based fee. In fact it was the first state to implement a gas tax, back in 1919. "That was also a user-based fee, just a different type," Godfrey explains. "It worked because at that time all vehicles achieved a similar number of miles to the gallon, but that is not the case anymore. Now, instead of basing the fee on gallons consumed, we are basing it on a driver's actual use of the road."

After examining the potential benefits and challenges associated with a mileage-based RUC system, the taskforce conducted two pilot projects to gather driver feedback and explore different options.

"The first pilot took place between 2006 and 2007," says Godfrey. "It involved a government-installed mileage recording device and people largely rejected it because they felt uncomfortable with the government installing a device in their cars. We redesigned everything for the 2012/2013 pilot, however. This time there were four options that people could choose from in terms of how they managed their account. One of the options didn't use GPS because we had learned that it was not acceptable to some people."

It also helped that in the years that passed between the two pilot projects, the smartphone became popular and attitudes toward GPS begun to change. "People were getting used to using GPS for other user-based services," says Godfrey. "Now, as we approach the age of the connected car, GPS in vehicles is becoming increasingly commonplace and, as such, we are finding that acceptance continues to increase as long as privacy is protected. The bill that created the second pilot program included very specific data-protection rules. For example, data had to be destroyed within 30 days and couldn't be used for any purpose other than to calculate the road charge."

> "Some people definitely pay more, but they are still volunteering to do it. This shows there must be some understanding out there that good roads matter
>
> **Michelle Godfrey, Oregon Department of Transportation**

Resistance and acceptance

Drivers in the OReGO program can choose from three account manager systems. Each offers options and services, using a GPS-based or non-GPS device, which is plugged into the data port of the vehicle. The device calculates the distance traveled, but it also measures fuel consumption, so that a refund of the gas tax paid at the pump can be applied to the road charge.

"The main thing for us at the moment is to test that the system can work," says Godfrey. "This is the largest program of its type ever to take place. It is a fully operational system that could actually be used for a mandated program across the state. It's also a test of whether people will accept the concept and the technology, and would be willing to pay a distance-based charge instead of the fuel tax."

In addition to concerns over privacy, ODOT has been faced with several challenges in implementing the scheme. "It's a tax program, so generally people reject it," says Godfrey. "Nobody wants to pay tax and people feel that a tax is only fair if somebody else has to pay it. There have been a number of objections to the scheme but the concerns we have heard are generally not true, and they can be overcome with education and experience."

One of the main complaints comes from people who live in rural Oregon who have to drive a lot of miles and

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(Above) **OreGO participants can choose to use Azuga Insight – a small plug-in device that tracks vehicle miles while helping drivers save money and drive more safely**

feel that a distance-based charge would be grossly unfair to them. "The truth is that they are already paying a higher user-based fee than some other road users because they are using more fuel," says Godfrey. "This is just a different way of paying that tax."

Another concern is that a distance-based charge would be unfair on people that have invested in fuel-efficient vehicles. "The fact is that these drivers are currently underpaying or not paying at all for their use of the roads," says Godfrey. "Is it really fair that one driver should pay a lot more than another when they use the roads just as much? The user-pays principle means that you pay for what you use, regardless of what car you drive.

"Also, it should be remembered that this program is just the first operational step in the implementation of a full road user charging program," Godfrey continues. "Down the road, legislators may decide to add an additional fee for vehicles that are not fuel-efficient, to provide more of a green incentive, but that would be in addition to the actual road charge."

Despite the concerns, feedback from participants in the program has so far been largely positive. "People have said that the system is easy to use and it's not intrusive at all," says Godfrey. "Users are also enjoying some of the additional services they get with the account managers. One account manager, for example, offers trip logs, measures your fuel efficiency, and offers advice on how to improve your driving habits, reduce fuel consumption and improve your safety on the road.

"In our first month of operation we've had about 850 people sign up. Although that's nowhere near our capacity of 5,000, we're pleased to have such good initial interest and there is no end-date to the program, so we expect the numbers to grow. We just need to continue to raise awareness and encourage people to sign up."

Interestingly, 40-45% of people that have already signed up to the OReGO program drive fuel-efficient vehicles. "These are people that will definitely pay more through the distance-based RUC program, but they are still volunteering to do it," says Godfrey. "This shows that there must be some understanding out there that good roads matter and that this is the best way to ensure that our roads continue to be there for us in the future. That is very encouraging."

Distance learning

In the USA Oregon is certainly leading the way in distance-based RUC research and development, but several other states are also showing interest. Washington, Nevada and Minnesota, for example, have all undertaken pilot projects and California is in the process of creating what is likely to be the largest ever pilot, with a start date next year. Illinois and Florida are also

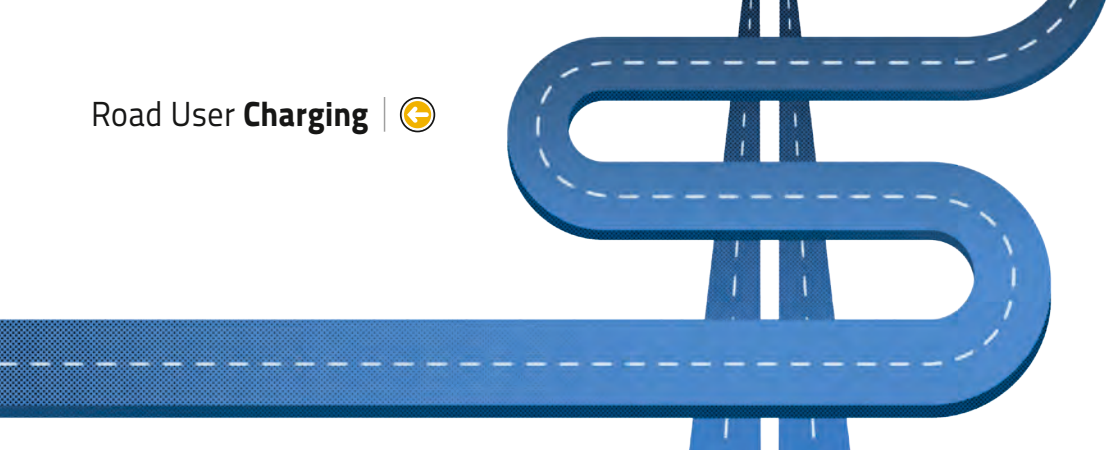
Politics and technology

Across the pond, the UK is also struggling with political hurdles and public acceptance

According to ITS UK's president, Steve Norris, there have been two major barriers to mileage-based RUC in the UK. "The first has been technology and the second political acceptance," he says. "In the past we could get over the political acceptance problem by saying, 'Well you can't do it anyway because it's ridiculously expensive'. But anybody associated with ITS now knows that it's not too expensive anymore. There is a range of methodologies available including Bluetooth, GPS, cellular floating vehicle data, probes, and tag and beacon. The possibilities are endless in terms of how we could create a road charging system. The issue now is political acceptability and that's been impacted by something that nobody saw coming 20 years ago, which is that the next car you buy is likely to be much more fuel efficient than the one you trade in. As a result, we're losing out at the fuel pump. We are paralyzed over how we get to a balanced budget, where the tax revenue pays for what we spend."

ITS UK aims to make alternative funding methods possible by driving down the cost of implementation. "The technologies are available," says Norris. "Developments happening in other areas of ITS are creating the technologies that will make mileage-based RUC possible. Perhaps we need better mobile coverage or faster broadband in rural areas, so we can have a proper all-roads system. The Eddington Transport Study once calculated the cost of installing an RUC system to be between £1bn (US$ 1.6bn) and £30bn (US$ 47bn). That's a bit of a wide estimate. The truth is, he didn't know. If it had been £30bn you'd say what's the point? But if you can get it down to a couple of billion nationally, it has to be worth it."

"I don't welcome road user charging simply because I want to tax people more," Norris clarifies. "However, I do believe in having an efficient road system and I believe that people are sensible enough to realize that the country's roads will need to be paid for more directly. For any government it won't be a popular move, but it has to happen."



starting to investigate how a mileage fee might work for them.

"Several important lessons are being learned from these pilot projects," says Reason Foundation's Moore. "Firstly, that it is really important to involve lots of decision makers and stakeholder groups early on in the testing process so that they can learn and educate others, and also help improve the design of the system. Secondly, it is essential to offer consumers choices about how to have their fee assessed. At a minimum there should be one or two non-technology options that create no data, and there should also be several technology-based options with different benefits and the ability to control any data that is created. This should be combined with new legislation protecting privacy and preventing fraud."

Moore advises that states start small, before they think about growing their programs. "They should also consider incentives or value-added services to get people to switch to mileage-based user fees," he says. "Maybe start with electric and hybrid vehicles that are seriously underpaying for the infrastructure they use. The program also shouldn't be complicated. Transportation geeks like to think about how a mileage-based fee system could be used to add congestion pricing or emission charges, but these are separate policy discussions. The idea here is to simply shift to a new user fee for paying for infrastructure."

"If I were bringing in a scheme like this, I would be very straight with users and abolish fuel duty on the same day that I introduced the new road user charge," says Steve Norris, former UK government transport minister and current president of ITS UK. "So it would be very clear from the outset that we weren't trying to con people. We would be setting out exactly why we were doing this. I think that case is logical and well made."

Like the USA, the UK is also struggling with falling revenues from the gas tax, and transportation authorities are watching Oregon closely. "Oregon has always been at the forefront of this kind of innovation," says Norris. "People simply recognize that if they want decent roads in a state where they are pretty much the only way of getting around, they are going to have to pay for them."

(Left) **Participants in OReGo can now avoid paying the gas tax by choosing instead to pay per mile driven**

Norris recognizes that a similar distance-based road-use charge could bring several advantages to the UK. "Road building could expand as fast as we like, based on how many people want to use the roads," he suggests. "We could also make the road system more efficient by discounting out-of-hours operations so that we avoid the 'rush hour', which is where congestion really hurts. We could even possibly combine a mileage-based charge with our current annual vehicle tax, to encourage people to get more fuel-efficient vehicles."

> People simply recognize that if they want decent roads in a state where they are pretty much the only way of getting around, they are going to have to pay for them
>
> **Steve Norris, president, ITS UK**

Time for change?

Ultimately any new type of road financing initiative will not succeed unless it is accepted by the public. "I'm sure that when the fuel tax was introduced, people were equally upset about it," says Norris. "But now we just accept it as a fact of life."

"A mileage charge could be fairer, but the public won't accept the fees until they have learned a lot more about them," adds Reason Foundation's Moore. "We need to implement large-scale trials and pilot projects, and create more discussion."

In the meantime, gas tax revenue will continue to fall. "All states will eventually have to replace the gas tax," Moore believes. "Given that user fees are much better than general taxes, I think we will continue to see growing interest in mileage-based fees and other states will build on what Oregon has accomplished. The first state to implement a gas tax, Oregon has long had a funding vision that has served its roads well. Why not follow it in a new direction?"

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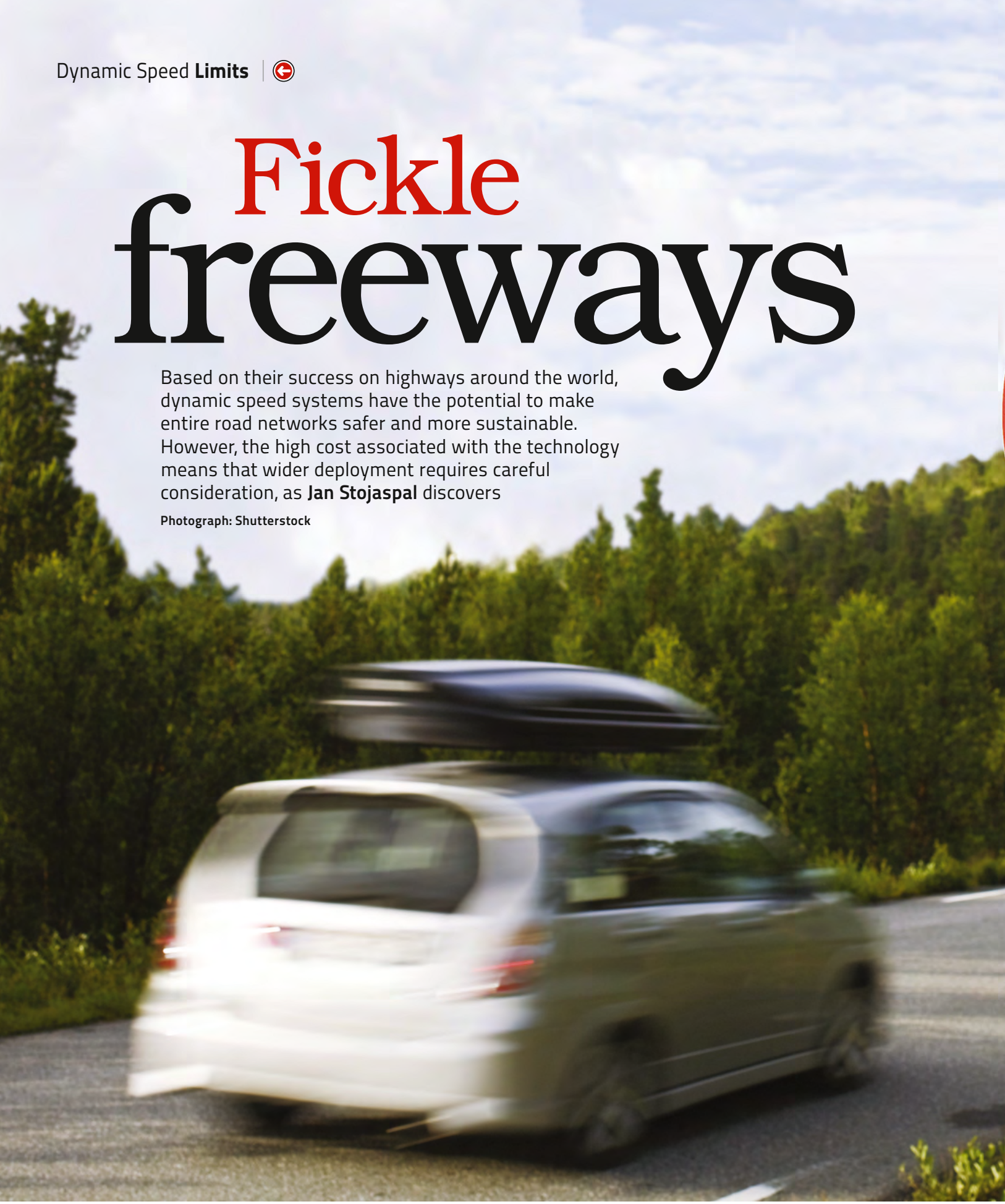
Fickle freeways

Based on their success on highways around the world, dynamic speed systems have the potential to make entire road networks safer and more sustainable. However, the high cost associated with the technology means that wider deployment requires careful consideration, as **Jan Stojaspal** discovers

Photograph: Shutterstock



The case for dynamic speed limits, which change in response to the current traffic, weather or road conditions, is pretty easy to make. It is well documented that they are an effective way to improve traffic flow and increase road safety, and help to manage air pollution resulting from vehicle emissions. In the majority of cases – and some cultural differences apply here – they also improve compliance with posted speeds, as drivers regard them as fairer and more relevant.

However despite rapid advances in algorithms that ensure their accuracy, expanding their use beyond highways remains a challenge both in Europe and the USA. This is despite a number of recent developments, particularly in the Nordics, where dynamic speed limits have been installed at rural intersections, pedestrian crossings and even some bus stops.

The challenge is mostly financial, as dynamic speed limits, also known as variable speed limits, require roadside infrastructure that is expensive to set up and operate. There is also a widespread expectation that intelligent speed adaptation technologies will eventually replace roadside infrastructure by sending speed limits directly to vehicles.

"Our policy is to use [dynamic speed technology] when the cost-benefit ratio is good enough – when we know that [dynamic speed

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controls] can be used to solve the problem in a cost-effective manner," says Risto Kulmala, principal advisor on ITS at the Finnish Transport Agency. "At the same time, we are aware of the developments in vehicle technology and intelligence in vehicles, so we are wary of extending the roadside infrastructure too much."

Data integrity

Given the high cost and complexity of current systems, highways remain the most obvious places for dynamic speed limits, and deployment there continues. In June, ASFiNAG, Austria's motorway and expressway operator, completed an 11-year project that has seen nearly 20% of the country's highway network controlled by more than 730 dynamic speed signs.

Supported by nine traffic management centers, which pull together various types of real-time traffic and weather data, and also liaise with local blue-light organizations for incidents and other information, the signs adjust on a minute-by-minute basis. Most are deployed near cities, where they help to smooth incoming and outgoing traffic.

"You need to have all this information together so that you can provide drivers with accurate information about the road situation," says Martin Gergely, head of traffic engineering at ASFiNAG. "If you don't do that, your information is not accepted by the road user because it doesn't make sense, or they think it unnecessary. You need a lot of money for such traffic management centers."

(Right) **Dynamic speed limit signs in Barcelona**

> We are aware of the developments in vehicle technology and intelligence in vehicles, so we are wary of extending the roadside infrastructure too much
>
> **Risto Kulmala, principal advisor on ITS, Finnish Transport Agency**

In Spain, the government of Catalonia carried out a five-year project from 2008 to 2013 that saw the introduction of dynamic speed limits on five approaches to the B-20 ring road around Barcelona. "There is a dynamic speed sign for every lane and the system kicks in when the traffic flow is near capacity," describes Lluís Serrano Sadurní , head of traffic management at the Catalan Traffic Service.

When it comes to compliance with posted speeds, most European countries, including law-abiding Austria, are reporting better results with dynamic speed limits. "They fit much better to the situation," ASFiNAG's Gergely says. But in places like Spain, compliance is often lower when compared to fixed speed limits, according to Alvaro Garcia-Castro, researcher at Transportation Research Centre, Technical University of Madrid, particularly when drivers don't understand the reasons behind reduced speeds. "The general impression in Spain is that [speed control] is something the government does to raise money through [speeding] tickets," he says. Speed cameras, particularly those that cover entire sections of roads, are a good way of improving compliance. But even this presents an enforcement challenge in cases of police pulling over violators who proceed to claim that the speed limit was higher when they were driving. "We aim to have a solution within the next few years on the issue, relying

Just 10% of drivers would need to adopt smartphone dynamic speed limiting to realize over half the potential benefit to traffic flow

The fast lanes

Will speed limits ever be implemented on Germany's notoriously fast autobahns?

At a time when growing concerns over road congestion and traffic safety are forcing speed reductions in many parts of Europe, large sections of the German Autobahn remain without any speed limits. Could it be that the Germans are onto something?

"Definitely not," says Ferdinand Dudenhöffer, director of the University of Duisburg-Essen's CAR (Center Automotive Research). "The insistence on the right to speed at will makes little sense to me."

But until the government loosens its ties to the German car industry, change is unlikely, at least not on chancellor Angela Merkel's watch.

"They call it freedom," Dudenhöffer says, "and there is a strong lobby that is fighting for it. The car manufacturers want it, because then they can tell customers that their cars have been tested on real autobahns, without speed limits. And I am pretty sure that many customers around the world are not interested in more speed restrictions, otherwise they would not buy Ferraris."

However, change will be inevitable, Dudenhöffer predicts. Currently only about a quarter of Germany's highways are without speed limits, and many others lift them under certain conditions. Public opinion shows signs of shifting too, with cars less of a status symbol, and congestion and pollution gaining importance.

on automated information exchange so that the police would have real-time status of the dynamic speed limit values at their disposal," Kulmala says.

In the UK, dynamic speed limits are an integral part of the country's so-called smart motorways, which use technological enhancements to add capacity and improve road safety on existing highways.

According to Highways England's Daniel Wood, smart motorways currently account for a total of 195 miles of England's 1,891-mile highway network, and the plan is to bring the total to 481 miles by 2020.

"Enforcement systems are in place using cameras," says Wood. "Some of the older ones have a fixed camera over a lane looking down. With new cameras they'll be at the side of the road, looking across multiple lanes."

> There is a dynamic speed sign for every lane and the system kicks in when traffic flows near full capacity
>
> **Lluís Serrano Sadurní, head of traffic management, Catalan Traffic Service, Spain**

A question of cost effectiveness

With other types of roads, adding dynamic speed controls requires careful consideration. "There is still potential, but it's rather costly," says Bjarne Holmgren, operations manager for traffic management at the Swedish Transport Administration. "You need a substantial traffic volume to make it worthwhile."

Over the past decade, Sweden, a pioneer in this respect, has deployed dynamic speed limits at more than 15 rural intersections, where they help drivers merge with main-road traffic. But at a cost of roughly €150,000 (US$170,000) per location, conditions must be just right. There must be a traffic flow on the primary road of between 6,000 and 15,000 vehicles per day and a traffic flow on the secondary road of between 15% and 35% of the flow on the primary road.

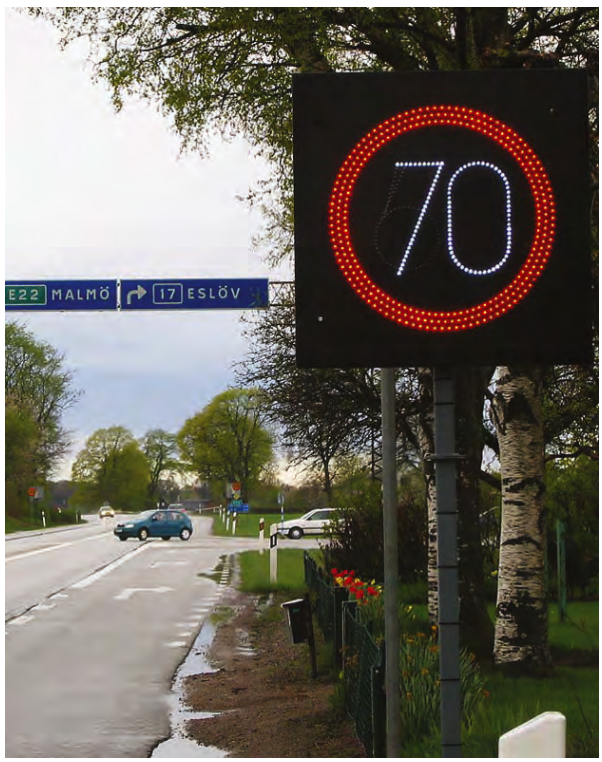
"When you have a higher percentage of traffic flow on the secondary road, the advantages over fixed speed signposting are not that evident, and fixed signposting may be a better and cheaper option," Holmgren says. "When there is a smaller percentage of traffic on the secondary road, dynamic speed limits cannot be justified due to profitability reasons."

As there are only a certain number of locations in Sweden that meet the criteria, dynamic speed signs are planned for only one more intersection at the moment, at Ekerum, on the island of Öland.

In addition to intersections, Sweden has also installed dynamic speed limits at two rural pedestrian crossings (Bäckaskog outside Kristianstad and Domsten outside Helsingborg, both in the Skåne region) and one bus stop, on a busy trunk road at Kyrkheddinge, also in the Skåne region.

While the pedestrian crossings use radar beams to detect pedestrians and reduce the speed limit to 60km/h (37mph) when they are present, the bus stop relies on loop detection to limit vehicle speeds to 50km/h (31mph) on the main road when a bus is present and 70km/h (44mph) for vehicles at an adjacent traffic interchange.

(Below) **In Sweden dynamic speed limits have been introduced as some relatively minor intersections**

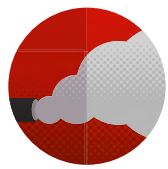


On-road intelligence

Finland, another pioneer in dynamic speed limits, has introduced the approach to some rural intersections and bridges, but its biggest contribution to the sector is in weather-driven speed-management systems.

Since the mid-1990s, Finland has been working on improving weather sensors for dynamic speed management. Today these sensors, which cover about 250 miles of the country's highways, include laser-based camera technology that uses spectroscopic measuring techniques to determine the presence of water, ice, slush, snow and frost. Recently Finland has also been experimenting with integrating vehicle probe data, such as anti-lock braking systems (ABS) and electronic stability control (ESC) readings, into its algorithms. Last winter it piloted this approach with several hundred vehicles but ran into the difficulty of not getting enough data for straight sections of roads, where ABS and ESC are largely inactive.

"We found that we could collect good data close to junctions and on-ramps," Kulmala explains. "But we have much less data on the straight sections, where people usually just run at constant speeds."



Vehicle emissions on London's M25 have been reduced by 8% as a result of dynamic speed limits

According to Kulmala there is, at this point, enough knowledge about how to undertake weather-related dynamic speed management, but more work needs to be done in the areas of traffic flow optimization and emissions management.

"In traffic flow optimization, attention is shifting from reactive systems that only respond when traffic conditions start deteriorating at a particular hotspot, to proactive systems that build their intelligence around desired flow rates and so do not wait for system breakdowns before they start regulating," says Hesham Rakha, director of the Center for Sustainable Mobility at Virginia Tech Transportation Institute (VTTI).

Focus on sustainability

The ability of dynamic speed limits to reduce vehicle emissions, particularly through reductions in stop-and-go driving, is becoming better understood. For example, emissions on the M25 around London have been reduced by up to 8% as a result of increased traffic flow. And the introduction of dynamic speed limits at Austria's Inn Valley in 2007 reduced NO_2 emissions by 3.6% in one year.

What's more, pollution-sensitive dynamic speed control need not be very complicated, as Spain has learned. In 2007-2008 the Catalan Traffic Service implemented a complex algorithm to minimize NOx and PM10 in and around Barcelona. Among other criteria, this algorithm took account of what percentage of vehicles were running on diesel and how many vehicles in the overall traffic flow were trucks. The Catalan Traffic Service later replaced it with a far less complicated system that simply caps, on advice of the local environmental authority, speeds at 80km/h (50mph) during adverse dispersal conditions.

"Although the next big leap in dynamic speed control is expected to come only when speed limits can be communicated directly to vehicles via intelligent speed adaptation technologies, smartphones may actually serve as an important and, at this point, overlooked stepping stone," says Rakha.

In fact Rakha wants to explore this as part of his proposal to the US Department of Energy to study how smartphones could be used to reduce fuel consumption by regulating congestion on highways and arterials in Washington, DC.

In this respect, the smartphone would serve as a substitute for overhead gantries by becoming the channel for recommending speed limits and possibly also providing routing information for maximum fuel efficiency under current road conditions. And all it would take is a small percentage of drivers adopting the solution for it to make an impact.

"We found that if 10% of drivers followed our recommendations, we could get around 60-70% of the benefit, which is very good," Rakha says. "If we could get just 10% of people to use this, we would have done our job." ○

Is twenty plenty?

Trials into the effectiveness of 20mph limits in the UK are ongoing

Speed limits of 20mph are becoming increasingly common in the UK and other parts of Europe, but they have often only produced marginal benefits. In Bristol and the London borough of Islington, 20mph limits have produced average speed reductions of as little as 1mph when not combined with other measures, such as traffic calming and active police enforcement.

And so, while there is no question that vehicles traveling at lower speeds are involved in fewer accidents and that these accidents tend to result in lighter injuries, the search for how to obtain optimum compliance at the lowest possible cost continues. Narrowed roads, speed bumps and other traffic-calming measures are typically costly to implement.

In mid-March 2015, the mayor of London, in conjunction with Transport for London (TfL), outlined plans for eight pilots involving 20mph speed limits on TfL's road network. The first, on Commercial Street in Tower Hamlets, went live in April and the next trial location, along the A10 Kingsland High Street, is scheduled to follow later this year.

But definitive answers may still be two years away, which is when the Department for Transport (DfT) is expected to conclude the most comprehensive study to date, at least in the UK, into the effects of 20mph speed limits on speed, collisions, casualties and encouraging people to walk or cycle more.

> "In traffic flow optimization, attention is shifting... to proactive systems that build their intelligence around desired flow rates"
>
> **Hesham Rakha, director of the Center for Sustainable Mobility, VTTI, USA**

(Right) **Sections of London's M25 have enhanced on-road technologies to manage traffic flow and improve the reliability of journey times**

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Oil shock?

Around the world some electric-vehicle charging posts are falling into disrepair. Does this mean that too many of them have already been installed? And could falling EV sales in an era of cheap fuel make the situation worse? **Tom Stone** investigates

One widely reported frustration for electric vehicle drivers is poor access to charging points. Often users drive to a charging post only to find it isn't functioning. It's a problem that has been growing ever since the EV market first began to expand four years ago. But what is at the root of it? And could the current era of cheap fuel hit EV sales to such an extent that demand for supporting infrastructure will fall further, leading more charging posts to fall into disrepair? Already, it seems, our streets are becoming cluttered with potentially dangerous pillars of metal that no longer function and serve only to remind us of our failed dreams. But is this the real story, or are other factors at play?

Leading the charge

Diego Klabjan, professor of industrial engineering and management sciences at Northwestern University, Illinois, has spent several years modeling the ideal locations for EV charging. The university has recently filed a patent application for the resulting software, which is a web-based, decision-support system that enables users to conduct what-if studies based on investment budget, electrical power grid, and geographic and infrastructure constraints. One of Klabjan's key findings is that such a tool is long overdue, as infrastructure is currently placed somewhat haphazardly, meaning usage isn't anywhere near uniform. "Most charging stations are underused," he says. "A decrease in sales of EVs would make them even less used."

It's a situation that is mirrored in the UK, where government subsidies have led to a massive, uncoordinated roll-out of charging posts. "Most companies putting in charging infrastructure are not necessarily doing it for the right reasons," says Denis Naberezhnykh, head of low-carbon vehicle and ITS technology at the Transport Research Laboratory

(TRL). "It's just, 'Lets do whatever we can to get some infrastructure out there. Let's not worry too much about whether it's the right type or in the right place.'

"What was perceived to be the important thing was to get the numbers high. And we've ended up in a position where we have over 5,000 chargers in the UK and the vast majority are completely underused – and many don't even work. Local authorities don't have a clue about what infrastructure they have. And a lot of the time it's in the most ridiculous places – where whoever was willing to put it in was given the money to do it. We've ended up with lots of charging points in parking garages, or you find them tucked away in a corner in places where you would never expect people to go to charge their vehicle."

Indeed, London's charging network website sourcelondon.net reveals that currently (August 2015) functioning charging posts are not evenly distributed. The ones that work are in paid-for parking spaces, whereas only a handful of free on-street charging facilities are operational, meaning unless users plan carefully they are likely to be left disappointed or worse, stranded.

Predicting the markets

The beginning of 2015 saw a big boost in car sales. Major players GM, Ford, Fiat Chrysler, Honda and Toyota all recorded double-digit sales increases in the USA, with the industry as a whole up by around 13% in the first quarter of the year, compared to 2014. Industry analysts at Edmunds.com expect new auto sales in the USA to top 17.2 million by the end of the year, the second highest total on record (the biggest ever year was 2000 when 17.4 million vehicles were sold in the USA). The new surge is attributed in part to plummeting fuel prices – which have dipped below US$2 per gallon in the USA – feeding the public appetite for 'gas guzzlers'. But what is good for the traditional automobile industry isn't necessarily such good news for the burgeoning EV market. Hybrid and EV sales in the USA have been sluggish in 2015, with those of plug-in hybrid electric vehicles (PHEVs) down 24% in the first half of the year and the EV sector as a whole only just edging forward with growth of 2.1% – disappointing when the auto industry as a whole has grown three times as much in the same period, slowing slightly from its impressive first quarter start.

> We have over 5,000 chargers in the UK and the vast majority of them are completely underused – and many don't even work
>
> **Denis Naberezhnykh, head of low carbon vehicle and ITS technology, Transport Research Laboratory**

Meanwhile, in China, Tesla sold only 120 cars in January, leading CEO Elon Musk to threaten layoffs; shares in the company fell 13%. Edmunds reported that in the first quarter of 2015, 22% of drivers trading in a hybrid or electric car did so in order to buy an SUV. The figure was only 12% three years ago.

Juan Carlos Zuleta is a Bolivian economist who specializes in analyzing lithium resources, lithium batteries and the EV market. Writing on investment website Seeking Alpha, he states that, "Evidence that falling oil prices have already hurt EV sales in the USA is now overwhelming." The signs for the EV market, if not catastrophic, certainly look less positive than they have for a few years, especially as the current era of cheap oil looks likely to last for

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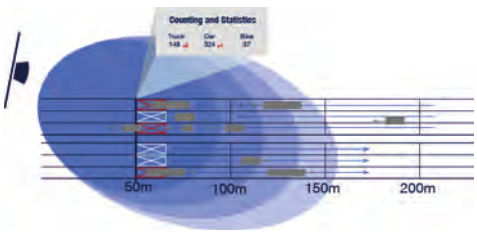

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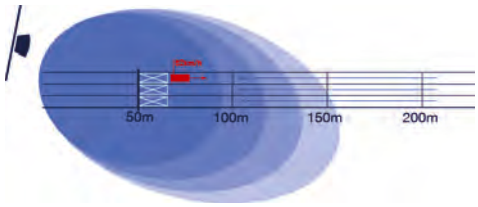

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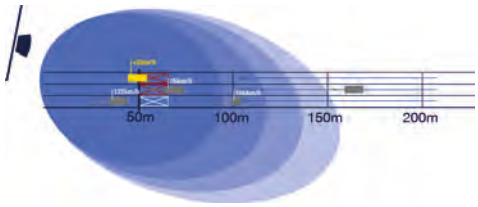

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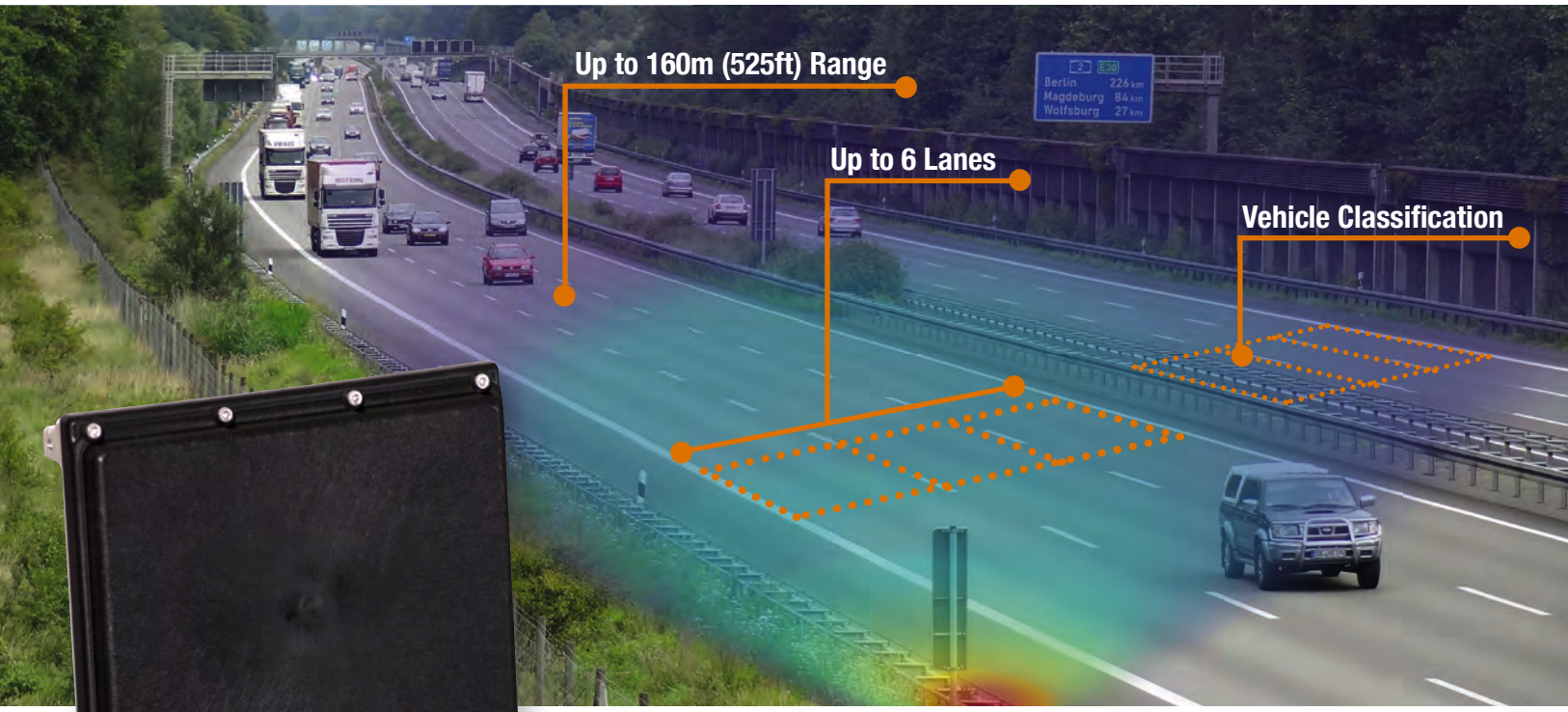

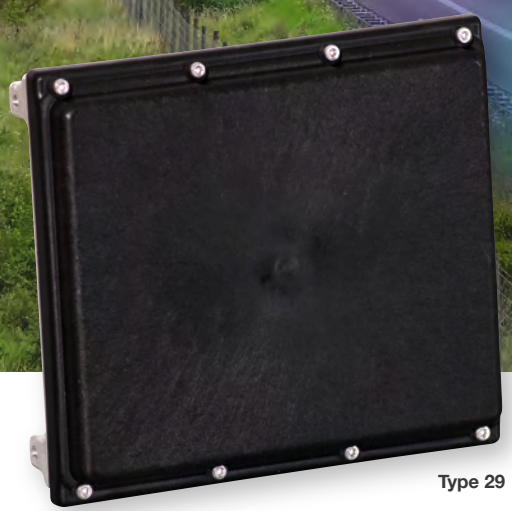

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Together in electric dreams?

The EV takeover may still be many decades away

To try to understand where the EV market is heading in the long term, industry economist Nicholas Chase, from the US Energy Information Administration, has created a detailed reference prediction for US vehicle sales to 2040. His model shows that EVs will struggle to break out of the niche market. "We have a couple of percent of new vehicle sales – plug-in and plug-in hybrid electric – in our forecast to 2040," he says. That's up from 0.5% today, but hardly the electric takeover of Elon Musk's dreams. "It remains a relatively modest piece of the market," Chase confirms. "Most of the vehicles in our forecast remain conventional gasoline."

So what is going to kibosh the EV Utopia that many would have us believe is just around the corner? "What we have in our model is two dynamics," says Chase. "We have the cost of batteries coming down, so the cost of an EV to consumers is going to fall. That starts to happen about 2020. That's the time it reaches a much lower level, which today would make it relatively more competitive. But around that same 2020 time period, conventional vehicles are becoming much more efficient. They are getting up to 60 or even 70 miles per gallon. That increase in fuel economy means you will save less and less money if you switch to a PHEV or an EV. So, despite the fact that costs for EVs are coming down pretty strongly, it's tough to compete with a vehicle that's already getting 60mpg. We see some increased market penetration for EVs. When it gets into the 2020s they are much cheaper, but in our model they don't reach into the mass market and overcome the conventionals.

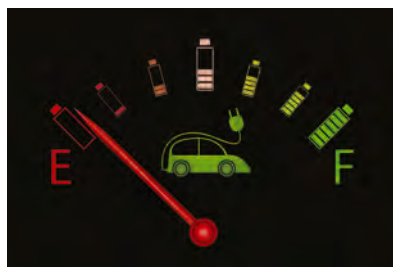
"I think we're getting a sense that about 3% is the early adopter market. But to break out of that 3% into a much larger segment you get into all those questions about fuel economy, infrastructure and ease of refueling."

a while yet. Most industry analysts predict that US$50-60 a barrel will be the norm for many months to come.

So, what does this mean for the roll-out of infrastructure? If EV sales are already plateauing and charging posts are being underused, should private entities and road authorities save funds and curtail installation of yet more expensive hardware that quickly falls out of use?

Long-term forecasts

Industry economist Nicholas Chase, from the US Energy Information Administration, has made detailed forecasts relating to the uptake of alternatively fueled vehicles, right up to 2040. He agrees that oil prices do hinder the decision-making process for car owners – but that's not simply about them staying low. It's about volatility. "The extreme ups and downs impact markets because they create uncertainty in people's minds," says Chase. "If people knew oil was going to stay low, they might not want to buy an expensive EV because they're not going to get their money back as easily. If, on the other hand, it was going to stay high, then people might want to invest. But the fact that it goes up and down can make it very difficult to make an investment decision." If it's difficult for consumers to decide whether to invest, then it appears to be even trickier for DOTs, local authorities and private companies to predict whether the charging posts they are installing will actually be used. Plenty sit idle or fall out of use completely, so it seems that even prior to the current era of cheap oil, plenty of mistakes were made in terms of infrastructure installation.



> The fact that oil prices go up and down makes it very difficult to make an [EV] investment decision
>
> **Nicholas Chase, industry economist, US Energy Information Administration**

"The problem still hasn't really been addressed in that we're still not in a position where there is a really intelligent distribution of charging points," says Naberezhnykh. "People aren't saying, 'Let's look at where the demand is and where it's likely to be, and then put some chargers in there." It's more a case of putting the posts in first, then finding out later whether they are used or not.

In Contra Costa county, California, for example, some infrastructure is quickly becoming over subscribed. "We paid for two charging stations and to start with our Leaf was the only car parked there all day long," says Contra Costa Transportation Authority's executive director Randell Iwasaki. "Pretty soon there was a Tesla, then there was another Leaf, then a Volt, then a Civic hybrid. Within a year or so we started getting notes on the back of the Leaf, saying, 'Move your car!'"

Iwasaki's anecdote illustrates well the pressures on electric vehicle infrastructure when it is installed in the right place. "We need two things," he continues. "We need more infrastructure, but we also need to know where it is and what the state of occupancy is. That's where intelligent transportation systems really come into play. You need to know where all the charging stations are, whether they are working or not, and whether there's somebody in that space ahead of you."

Bespoke approach

While many installations are ad hoc, a more organized system for installing charging posts is being overseen by big commercial companies. "We do target areas," says Erin Mellon, director of communications for US-based ChargePoint. "We have both incoming sales and we go out there pounding the pavement, calling folks up and saying, 'Hey, you have 20,000 electric cars in your region, do you want to put an EV charging station in?'"

> The location and number [of our charging stations] depends on what the market wants. Businesses contact us to say they need them
>
> **Erin Mellon, director of communications, ChargePoint, USA**

ChargePoint has also recently partnered with BMW and Volkswagen to install 100 fast-charging points along the east and west coasts of the USA. "A robust network of conveniently located DC fast-charging stations will go a long way toward increasing EV adoption and making ownership even more enjoyable," said Robert Healey, head of EV infrastructure at BMW, when the scheme was launched.

But, targeted strikes like this aside, the placement of stations is left largely to market forces. "We don't give away the stations; we sell them," confirms Mellon. "The location and number depends on what the market wants. Businesses contact us to say that a bunch of electric cars are showing up in their parking lots and they need charging."

Although, of course, with millions in government subsidies sloshing about all around the world, there's always the chance that businesses are installing infrastructure that's not really needed, simply because it's cheap, which serves to skew the perception of demand.

"The big companies have a much more strategic approach," says Naberezhnykh. "But I haven't heard of any local authorities in the UK saying they want to identify the most suitable places to put charging posts. That's what is desperately needed. It was needed two years ago and it's needed even more now."

Furthermore, while one may argue that having too many charging posts is better than not having enough, it seems that the unanswered question of who is responsible for maintaining large swathes of the infrastructure means that much of it is simply falling out of use – ironically often in the places it is most used and needed. This is regardless of whether sales of EVs are increasing in an era of environmental concern, or in free fall on a planet awash with cheap oil. Indeed, in the UK, according to data from the Society of Motor Manufacturers and Traders (SMMT), new EV registrations are keeping pace with the healthy growth of the car market as a whole (albeit bolstered by government subsidies) and yet the problem of out-of-use infrastructure persists.

(Above) **The private business model of ChargePoint in the USA results in a good level of maintenance and high use**

In need of a fix

"When the systems were rolled out, no maintenance schemes were put in place because of the strange public-private partnership arrangements that have existed, where governments subsidized installation costs [through either grants or tax credits]," says Naberezhnykh. "Companies wanted to be seen to be the first to install chargers, and they thought, 'Great this is going to be a fairly cheap installation for us.' But they didn't want to commit to the ongoing cost of maintenance and that was never set up in a contract. So when something goes wrong with a charger, nobody is responsible for maintaining it. It continues to be a really big problem."

Once again, commercial companies, particularly in the USA, are proving that a sensible business plan is often more beneficial for all involved than simply throwing money at a problem. "Our customers pay a subscription," says Mellon. "We put it on the network and we get everything working. We help with installation and service it throughout the life of the station. We provide driver support and station-owner support if there are any issues, and we do the mobile app for free."

So, it seems for the most part, charging posts don't fall out of use because they aren't wanted, but rather because they aren't properly maintained. Whatever happens to EV sales, until all charging points are linked in one smart network, the day when there are enough working, in the right places, still seems a long way off. But it is a problem that ITS could one day solve.

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As she takes the helm of ITS America, president and CEO **Regina Hopper** focuses on a new era of communication and looks toward an exciting future of rapidly evolving technology

Interviewed by Tom Stone

As intelligent transportation systems (ITS) evolve from being an industry only understood by experts within it, to becoming a fully fledged part of public consciousness – with everything from smart parking to self-driving cars regularly grabbing headlines around the world – it is only appropriate that ITS America has appointed its most high-profile president and CEO to date. Regina Hopper is no stranger to the glare of the media spotlight; before her most recent career heading up industry associations (formerly she has represented the energy, telecoms and trucking sectors), she was an Emmy Award-winning reporter for CBS News, where she covered events from the White House and anchored the network's overnight broadcasts. Furthermore, in her youth Hopper won the Miss Arkansas beauty pageant and today is chair of the Miss America Foundation Board of Trustees and first vice-chair of the Miss America Organization Board of Directors.

With such extensive experience of both dealing with the media and actually working within it, Hopper is set to take ITS America into a new era of communication. Indeed, when we sit down to chat, her enthusiasm is infectious.

"Going out and talking more about what ITS is, and what it means, will advance the industry," says Hopper. "In a world of social media, news is not just 24/7 – it's 24/7 on steroids. You've got broadcast, cable, print, blogs, podcasts… you have all of this media wanting attention. Well, let's use it. Let's use the avenues that are out there to talk with people about what this is, how it advances their world, whatever audience they're in. I hope to be able to do all those things. In the end, ITS America belongs to the board and its members. They are the ones with the intellect, capacity and ability to decide what to develop and where it should be deployed. But I certainly hope my experience will help to advance the cause."

Accelerating change

Of course, communication is only one aspect of Hopper's new role. In an industry that is advancing as rapidly as ITS, simply keeping up with exactly what should be communicated can be a full-time job in itself. Advances such as connected vehicles, which just a couple of years ago were thought to be at least a decade away, are now just around the corner. "You wake up every day and you say, 'What's the next new advance going to be?'" says Hopper. "I think the question for the board and the membership now is to look at the organization and say, 'What role do we want it to play?' We can build on the great foundation we already have and then advance that. We are at turning points in both public perception and technological advances."

And Hopper has a sweet tooth for new innovation. "I feel like a kid in a candy

> In a world of social media, news is not just 24/7 – it's 24/7 on steroids… Well, let's use it. Let's talk about how ITS advances our world

ITS America Facts

1991 The year ITS America was founded
450+ The total number of public agencies, private sector companies, and academic and research institutions that are members of ITS America
27 The number of ITS America State Chapters across 40 states
1,200+ The number of ITS America member organizations

store," she says. "I meet all these really smart people and I just want to go, 'Wow! Can I just sit and talk to you?' They're just really great people and the topics are so interesting. And they're right there – right on the cusp. It broadens your world."

The funding problem

While communication and technology are a source of excitement and hope for Hopper, she is also eager to lend her voice to help some of transportation's more intractable problems – notably the ongoing near-insolvency of the Highway Trust Fund in the USA. "Everybody says they want a long-term, sustainable funding plan, but nobody has yet figured out what that is. Everyone can agree that this needs to be done, and yet nothing happens. And part of this is just because it's funding, and how do you get to the right funding mechanisms, and that's where everything starts spooling out," she says. "It will probably end up being a combination of many things because in the USA we've relied on gas taxes in the past and that tax hasn't been raised in 20 years. There are all kind of ideas on the table – such as repatriating US foreign company income and taxing that.

"A new Congress might help to get things moving. With our electoral-politics timing we have windows of opportunity. New members of Congress will come in at the same time as a new president. And you have about 12 to 14 months before the mid-terms kick in, when Congress can change. So you have these limited windows that aren't tied up with electoral politics, so when we get out of this cycle we'll be moving into one of those. But I always hate to say it can't get any worse, because you never know. Our political system in the USA has its challenges!"

Funding or no funding, Hopper is also quick to point out that ITS itself may be an important part of the solution as it can help to make funding dollars go further. "Even with the existing infrastructure, intelligent transportation technologies can be overlaid on the existing infrastructure in a way that can combat at least some of the problems," she says. "Certainly not all of them – ITS isn't going to fix a pothole – but it can help DOTs that are trying to fix crumbling infrastructure to re-route traffic effectively."

Transportation in the blood

Hopper also has previous experience of adapting large organizations to keep pace with rapidly changing technology – certain to be helpful at the helm of ITS America. "I worked with the US Telecom Association," she says. "It too found itself in a place where technology was pushing it out of its current business structures into new business structures. So we rebuilt that organization two or three times to keep up with technology. I went from working from the FCC [Federal Communications Commission] to working with the DOE [Department of Energy]. Then I started with trucking and that was the DOT. Now, here, it's energy, DOT and FCC."

But of these three sectors, it's certainly transportation that is closest to Hopper's heart. "My family comes from a transportation background," she says. "My father was the longest-serving highway commissioner in the state of Arkansas and has a tunnel in Arkansas named after him – the Bobby Hopper Tunnel. To me, it is an honor to be working in this industry as these are folks that my dad worked with for years, so it's like carrying forward the family tradition. It means a lot."

> A new Congress might help to get [funding issues] moving. With our electoral-politics timing we have windows of opportunity

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Eric Sampson CBE, senior advisor, ERTICO – ITS Europe

2) LOCAL FLAVOR

"As Bordeaux is famous for its wine, we will be hosting a wine festival on the evening of October 6"

Rasmus Lindholm, partnership service and communications director, ERTICO – ITS Europe

3) SMART FREIGHT

"We have some new stakeholders coming in; for example, we will be running a mini-symposium on October 9 on freight logistics"

Rasmus Lindholm, partnership service and communications director, ERTICO – ITS Europe

4) INTERNATIONAL MULTIMODALITY

"What we are now focusing on – and there will be sessions about this – is getting journey planners from different countries to talk to each other"

Eric Sampson CBE, senior advisor, ERTICO – ITS Europe

5) AUTOMATED VEHICLES

"A special itinerary on urban and inter-urban roads will enable demonstrations of automated vehicles under real traffic conditions"

Didier Gorteman, CFO, director of congresses and chair of the European Programme Committee, ERTICO – ITS Europe

FIVE WORLD CONGRESS HIGHLIGHTS

The main event

As the great and good of ITS prepare to descend on Bordeaux, **Lauren Dyson** talks to key figures involved in organizing the biggest gathering in the industry's history, and gets insider tips on what to look out for

Illustration: Armyoftrolls.co.uk

From October 5-9, 2015, the 22nd ITS World Congress will take place in the beautiful French city of Bordeaux. It is anticipated that the congress, which is being organized by ERTICO – ITS Europe and hosted by TOPOS Aquitaine, will see more than 3,500 congress delegates, 300 exhibitors and 10,000 visitors, from more than 100 countries, unite to debate ideas, exchange experiences and build new partnerships. The theme of the congress is 'Toward intelligent mobility – better use of space', and the congress will feature more than 200 sessions involving more than 1,000 ITS experts. Furthermore, the 220,660ft² (20,500m²) exhibition hall will be packed with some of the most innovative ITS companies and solutions providers, from all around the world.

This is the first time that the World Congress has returned to France since the inaugural congress took place in Paris in 1994. "For one week, Bordeaux will be in the spotlight – becoming the worldwide capital of ITS," says Didier Gorteman, CFO, director of congresses and chair of the European Programme Committee, ERTICO – ITS Europe.

> "For one week, Bordeaux will be in the spotlight – becoming the worldwide capital of ITS"
>
> **Didier Gorteman, CFO, director of congresses and chair of the European Programme Committee ERTICO – ITS Europe**

The 2015 congress is based around seven prominent ITS themes, with an interesting new addition: space technologies and services for ITS. "The fact that we will have people there from the space industry is very exciting," says ERTICO – ITS Europe's senior advisor Eric Sampson. "Three years ago, we would have said that space industry developments are very interesting in terms of use for land transportation, but they are priced out of reach. However, that has all changed – almost overnight. One of the things we have found out from working with our partners in Bordeaux is that these solutions are affordable. We are going to be demonstrating this in Bordeaux, and also at the ITS European congress in Glasgow next year [June 6-9, 2016]. The technologies that are now affordable are just what is needed for remote places, such as highlands and islands, so Scotland is the perfect testbed."

Other congress themes include cooperative ITS deployment challenges, solutions for sustainable mobility, the urban trends that are driving ITS changes, and the multimodal transport of people and goods.

(Left) **Bordeaux's Pont de Pierre ('Stone Bridge') is an impressive centerpiece for the UNESCO World Heritage Listed city**

(Top) **The Palais des Congrès de Bordeaux, where ITS sessions will take place**

"The multimodal transport sessions are going to be very interesting," says Sampson. "The idea started when the previous EU transport commissioner [Siim Kallas] complained that in order to travel from his house in Estonia to his office in Brussels he had to use five different modes of transportation and he couldn't get a journey planner to join them all up. The industry got very excited about that. What they are now focusing on – and there will be sessions about this – is getting journey planners from different countries to talk to each other. The clever thing is to make it seamless, so that travelers don't realize they are being moved from one information system to another."

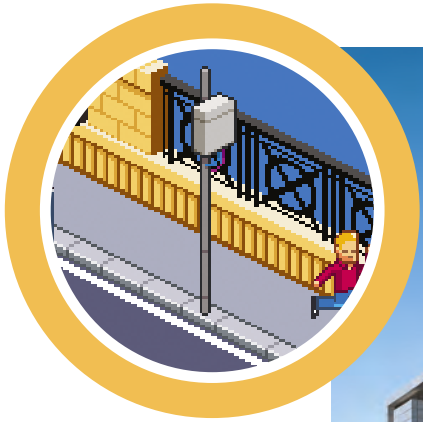
There will also be sessions and demonstrations on automated roads, management and driving, as well as the latest developments in big data and open data. "Open data is a pertinent topic at the moment," says Sampson. "The UK government has a very aggressive policy for making all data open, and now other cities and countries are beginning to take note." There will be several sessions addressing open data at the congress.

"Meanwhile, the most fascinating breakthroughs in big data analytics have come from the retail sector, oceanography and the oil industry," Sampson adds. "I am looking forward to meeting people at the congress who have ideas about how solutions from these other industries can be applied to transportation. This is potentially disruptive to our industry because if these ideas work, it will result in huge changes."

Watch and learn

The live demonstrations are sure to be some of the most exciting elements of this year's program. "More than 30 demonstrations will take place in the areas surrounding the conference and exhibition center," reveals Gorteman. "These are being organized by French companies and organizations such as AKKA, EasyMile, NAVYA Technology, Orange, PSA Peugeot Citroën, Renault, Université de Technologie de Belfort-Montbéliard, Valeo and VEDECOM, as well as international ones such as AISIN (Japan), Cohda Wireless (Australia), Continental, IBEO (Germany), NXP (the Netherlands) and Lindsay (USA). The demonstrations will show autonomous vehicles, cooperative systems, multimodal systems and other special technologies."

"The many different demonstrations will be organized into three main areas," explains Rasmus Lindholm, ERTICO – ITS



(Right and below right) **Plenary sessions will take place in the Palais des Congrès de Bordeaux's Amphitheatre A, which can seat over 1,200 delegates**

Europe's director of partnership services and communications. "There is a parking lot just outside the exhibition where demonstrations will take place and there is a larger area on the other side of the exhibition hall that will focus on autonomous vehicles. Here, delegates will be able to get into an autonomous vehicle and drive around. There is also a road that goes around the exhibition center where autonomous vehicles will be demonstrated. In addition to that, cooperative systems will be demonstrated on selected routes throughout the city."

"The open road demonstration site is pre-equipped with G5 roadside units – 15 in the Bordeaux urban area and seven in the inter-urban ring road of Bordeaux," adds Gorteman. "This is a reliable installation as it is part of a one-year pilot organized by the European CIP [competitiveness in innovation] project, coordinated by ERTICO Compass4D. The project organizers will host their final event and demonstrations in Bordeaux, and will run a demonstration with 10 vehicles for the week of the congress. The open data sources and platforms will give applicants access to a large amount of data and services in order to adapt and show their own applications. Plus, a special itinerary on urban and inter-urban roads will enable demonstrations of automated vehicles under real traffic conditions."

> Bordeaux will be a chance to meet people I wouldn't usually get a chance to talk to… For me, networking in the exhibition area might be the highlight of the entire congress
>
> **Rasmus Lindholm, ERTICO – ITS Europe's partnership services, communications and advocacy director**

Congress highlights

Alongside the live demonstrations, the five days of the congress will be packed with a combination of plenary sessions, executive sessions, high-level technology summits (HLTSs), special interest sessions, interactive sessions, technical/scientific sessions and commercial paper sessions, as well as various competitions and social networking opportunities, which will all take place simultaneously.

"People, in general, tend to prefer to attend events for a short period of time," says Sampson. "As a result, we end up with an event where there are a lot of things going on at once. It has been a challenge to make sure that the various sessions don't interfere with each other. For example, we can't put on sessions about road safety and human factors at the same time because somebody who is interested in one will almost certainly be interested in the other."

"There is certainly a lot going on during the week," agrees Gorteman. "But I would like to highlight two events in particular – the ITS Hackathon and the '24 hours of innovation' student competition. The ITS Hackathon will take place October 6-8, and it's directed at academics from universities and research centers, startups, app developers, and service providers. They will be given the opportunity to develop innovative services and applications, or enhance existing ones, using the MOBiNET project platform, and the data sources and services that the platform provides."

Hackathon teams will have two days to design their services and applications. The winners will receive prize money, and the opportunity to develop their concept into an operational service and demonstrate it at Glasgow 2016.

"The '24 hours of innovation' student competition will involve more than 100 students working together in teams to develop innovative ITS solutions, products and services, new usages, creative marketing or communication plans, non-stop over a 24-hour period," adds Gorteman.

Other highlights of the congress include the two HLTSs on October 6. The first, which will take place 11:00am-12:30pm, is called 'The plug-and-play city'. The session will explain how, in order to solve their mobility problems, cities and industry suppliers needs to find new ways of working together. "People need to understand how public-private cooperation can benefit them, so that they are not afraid of trying something new," says Lindholm.

The second HLTS (1:30-3:00pm) will focus on automated and

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CONVENTION CENTER PHOTOGRAPHY: CEB

Traffic Technology International will be exhibiting at **Booth D7**. *We look forward to seeing you at the show!*

connected driving. Stakeholders at this session will debate the current status of development and discuss the future of these technologies.

"Work on connected vehicles has been going on in Europe for a long time," says Sampson. "In fact, the European Commission [EC] has now set up a Cooperative ITS [C-ITS] platform that is doing a vast amount of work in this area. The driverless vehicle concept, on the other hand, is in a state of flux. Every time there is a user survey, people say that it is all very interesting, but they wouldn't pay for it." Congress delegates can expect an interesting debate about this at the automated and connected driving HLTS.

"It is also worth highlighting the 'New solutions for cities and regions' session that's taking place at 11:00am on October 8," says Lindholm. "At this interactive event, we will have mayors and city authorities discussing the future role of ITS in cities. Business models are changing and so are the ways that public authorities are procuring new technology. I think that this session will be very interesting.

"For me, Bordeaux will be a chance to meet people I wouldn't usually get a chance to talk to," Lindholm continues. "Events like this are an unusual way of doing business. We have some new stakeholders coming in; for example, we are going to be running a mini-symposium on October 9, which is focused on freight logistics. Also, as we are bringing in new sectors, such as the space industry, there will be people at the congress that have technologies and ideas that can benefit the ITS industry and vice versa. Bordeaux is about embracing new stakeholder groups from outside of our industry that could prove to be of huge benefit in terms of cross-cooperation. I am also excited about browsing around the exhibition hall and talking to people to find out what they are doing. It will be interesting to see what developments have taken place since the last congress, as well as what's new. For me, networking in the exhibition area might be the highlight of the congress."

Local connections

The ITS World Congresses in Europe are well known for their emphasis on social events – and Bordeaux will be no different. "We feel that social events are very important in terms of networking and enabling people to get to know each other in an informal setting," says Lindholm. "The World Congresses are also a great way to showcase the local city – you get the demonstrations, the exhibition and the sessions, but all with a local twist. You get a flavor of the local traditions. As Bordeaux is famous for its wine, there will be a wine festival on the evening of October 6." There will also be a gala dinner taking place on October 7, where visitors can experience French cuisine in the grounds of a charming local vineyard.

"We've always taken the view in Europe that you gather round a bottle of wine and some good food, and barriers come down," says Sampson. "We know that a lot of people come to the congress simply to meet and talk to the other people that are going to be there. Indeed, if I were to write a list of 20 people that I would really like to talk to in the industry, I can be pretty certain that 18 of them will be in Bordeaux. But I am also likely to end up having valuable conversations with seven other people that weren't on my list because I didn't know they existed. There is a lot of movement of knowledge between people at these congresses – you know it will happen, but you can't say exactly where or when."

(Above) **Close to the Palais des Congrès de Bordeaux, the Parc des Expositions will feature stands from more than 300 exhibitors**

"Ultimately, we hope that the congress will raise the profile of ITS," Sampson continues. "We want to tell cities in particular, 'We know that you've got problems, we know that you're growing, we know that your citizens are aging, we know that you've got nowhere to expand except up or down, but we can show you solutions that you might not be aware of. These solutions can deliver 10-40% improvements in productivity, they can clean the air and they can reduce congestion. It's a very different way of working to building something. Don't think about building more roads; instead think about how you can make better use of the roads you already have'.

> "We want to tell cities, 'We know that you've got problems, we know that you're growing, we know that your citizens are aging, we know that you've got nowhere to expand except up or down, but we can show you solutions that you might not be aware of'
>
> **Eric Sampson, senior advisor, ERTICO – ITS Europe**

"It would be great if we could look back in five years and track the beginnings of successful initiatives to sessions that took place in Bordeaux."

Turn the page for ITS World Congress exhibitor highlights you won't want to miss, from Traffic Technology International supporters

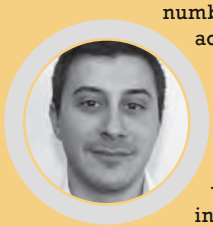
Show highlights

Park smart

Banner Engineering
Booth F24

Banner Engineering will be using the Congress as an opportunity to showcase its latest traffic and parking solutions. The Belgium-based daughter company manufactures and distributes sensors and solutions for the global traffic industry, including: on- and off-street parking guidance systems, vehicle detection and counting solutions, traffic lights, wireless communication and management for dynamic panels, access and exit systems, and vehicle detection for EV charging stations.

"Banner Engineering has recently developed a unique, indoor parking guidance solution using wireless ultrasonic sensors," reveals Mathieu Raffin, business development manager. "Installation and deployment of traditional wired systems is time-consuming and labor-intensive. Our solution is completely wireless, and easy to install and operate. This minimizes facility disruptions, downtime and revenue loss during deployment. Once deployed, our guidance solution directs people to available parking spaces, reducing vehicle congestion and enabling the facility to maximize the number of visitors it can accommodate."



Such parking facilitation tools will soon be required in some parts of the EU, in an effort to reduce vehicle congestion in and around parking areas and to improve traffic management in urban areas. "Banner Engineering has multiple solutions that support these goals," says Raffin.

The company has also recently been selected to participate in automating the toll plaza on a new bridge that is currently being constructed across the Bosphorus in Turkey.

Connected innovation

Neavia
Booth B108

Following more than five years of research, Neavia will introduce a complete set of V2X products at this year's Congress. The company's wide range of devices cover a variety of needs, from vehicles, to roadside infrastructure, to software stacks.

"In addition to showing our roadside unit, Neavia V2I station, in live traffic, we will also demonstrate our novel onboard unit," reveals Jean-Hubert Wilbrod, Neavia's president and CEO. "For example, automatic messages and real-time services can be exchanged between our devices and the cooperative network, to prevent accidents and congestion."

Neavia has become a key player in the V2X sector through its participation in European ITS projects, such as Drive C2X, Compass 4D and Scoop@F. The company is also involved in projects such as the East Corridor project, which incorporates 300 miles of services along the highway between Strasbourg and Paris. It is also installing a new urban cooperative network for the city of Versailles and has been selected for the trans-Alps Syncro project.

"Neavia has also been assisting car manufacturers PSA Peugeot Citroën and Renault Trucks with the management of new urban crossways by adding a GLOSA (green light optimized speed advisory) functionality to traffic lights," says Wilbrod. "This feature transmits the remaining time and status of all signals in the intersection so that vehicles can avoid wasted time and to maximize fuel efficiency. This cutting-edge technology is the next step for vehicles in meeting the challenges of the next few years."

Forward thinking

Egis Projects
Booth E101

"It is clear that our industry is becoming more and more service-oriented and that partnerships between public and private entities are key for the development of ITS in France," says Pascal Lemonnier, business development executive at Egis Projects. "Furthermore it is becoming increasingly important to reduce CO_2 emissions and reduce traffic congestion in cities. Digital applications and machine-to-machine technologies will play a crucial role in achieving this.

"ITS Bordeaux should address these issues in preparation for the COP21 sustainability forum in Paris at the end of the year," Lemonnier continues. "People will need to learn to adapt their driving behaviors."

Visitors looking to find out about Egis Projects' expertise and experience in ITS design and engineering, system integration and operation, should visit the

company's stand at the show. "We have a very high-level performance case study and project profile that should be very interesting for visitors," says Lemonnier. "We will be on hand to explain our approach and provide tailor-made solutions for individual projects."

Recently Egis Projects Inc, the US subsidiary of Egis Projects, signed a five-year contract with the Central Florida Expressway (CFX) for operation of the E-PASS customer service center, two walk-in centers and a violation enforcement system. Furthermore, Egis Traffic Management Solutions (ETMS) recently won the tender for incident response services on the M2 Motorway and Lane Cove Tunnel in Sydney.

Egis Projects has also recently taken part in a tolling project in Rotterdam, where it gained experience in demand management. "Our experience here could benefit other cities that are preparing future mobility plans," says Lemonnier.

360° traffic management

Flow
Booth C59

At the World Congress, Belgium-based traffic solutions provider Flow will be demonstrating FLOWcontrol, the company's intuitive online traffic control center.

"We will be on hand to explain how our system can give road operators hassle-free access to dynamic traffic management," explains Philip Taillieu, CEO. Other notable solutions include traffic monitoring using floating car data or fiberglass sensors, parking guidance, traffic management for roadworks or events, and bicycle or pedestrian counting.

"Since its foundation in 2008, Flow has grown into a trusted traffic service and technology provider for local and regional road administrations, in France, Belgium, the Netherlands and Turkey," says Taillieu.

Show highlights

Virtual ITS

Forum8
Booth E66

Forum8 will be launching several new, innovative products, which are all associated with its award-winning, interactive 3D VR simulation and modeling software, VR-Design Studio.

Firstly, the company will be showcasing the Forum8 SimRex MDS – a compact driving simulator designed to provide a 'real car' feel through the use of real-car components and an active steering wheel.

"One of our key objectives is to enable the simulation of the real world as accurately as possible," says Brendan Hafferty, the company's Western regional manager. "This includes being able to reproduce and control environmental effects such as time of day, geographic location, shadows, street lighting, rain, etc. The VR-Design Studio scenario editor enables almost any conceivable event to be introduced into the driving experience."

Forum8 will also be introducing the Lily Car – a 1/10 scale model of a real car designed to accurately reproduce its driving capabilities. It uses infrared sensors for collision detection, an augmented reality (AR) marker for car tracking, a wireless module to enable communications and control from a remote PC, and a main controller to manage the whole virtual system. Forum8 is using Lily Car in the development an virtual reality (VR) autonomous driving system.

Other products showcased will be the Forum8 software interface to the Oculus Rift VR viewing system; MAPSs – an innovative GIS mapping and 3D modeling product; and UMDC PC – a space saving, low-cost PC for high-speed graphic calculations.

"We have noticed a trend toward using interactive VR in autonomous vehicle research," says Hafferty. "Another trend is the use of point cloud data, from both aerial and ground-based lidar, in the production of interactive 3D street/cityscapes. The VR-Design Studio point cloud plug-in is being used to turn millions of datapoints and RGB values automatically into an interactive 3D VR environment.

"It is highly probable that in the future we will see cloud-based systems dominating all aspects of ITS," Hafferty continues. "Especially in relation to transport planning, through interactive consensus building within stakeholders, as well as in other areas such as V2V and V2I communications."

Automation intelligence for traffic control

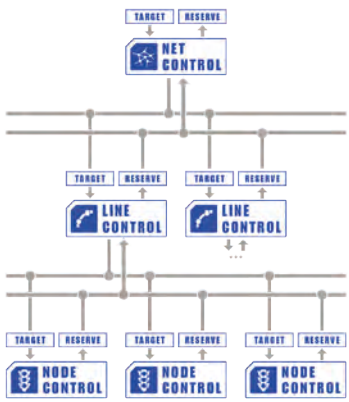
Andata
Booth A19

"Autonomous and connected driving are currently two of the biggest topics in ITS and automotive engineering," says Andreas Kuhn, owner and CTO of Austria-based Andata. "They are expected to deliver breakthrough advantages in terms of driving assistance, comfort and safety, as well as improved traffic flow."

Andata has been involved with connected driving technologies for more than 11 years. The company develops intelligent algorithms and mathematical control models, which are important for overall system performance. Andata has always concentrated on the use of methods and procedures from artificial intelligence (AI), data mining, machine learning and soft computing, building up rich experience – long before 'big data' became fashionable.

Within the automotive safety sector, Andata is working with German car makers Audi and Volkswagen. Together they founded Automotive Safety Technologies in 2009.

Notably Andata has developed Veronet – a framework for highly automated, integrated traffic control and active traffic management. The system is built on distributed data, and can be used for anything from the control of a few conventional or automated vehicles, to optimal control of busy intersections, to the control of complete cities and interurban regions.



"The technological fundaments are based on a subsidiary, hierarchical network of modular, distributed intelligent agents, which intensively use AI and swarm intelligence," Kuhn explains. "That way, the best can be taken out of any kind of floating car or fleet data, as well as static traffic sensors, to achieve improved vehicle safety and more efficiency in traffic control."

Outdoor Solutions

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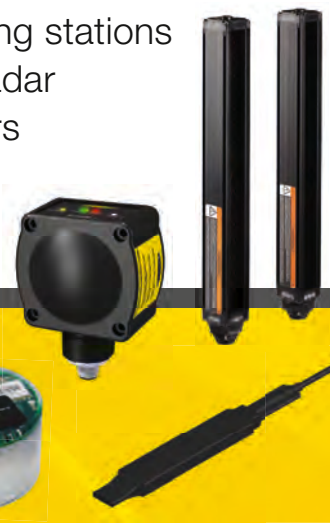

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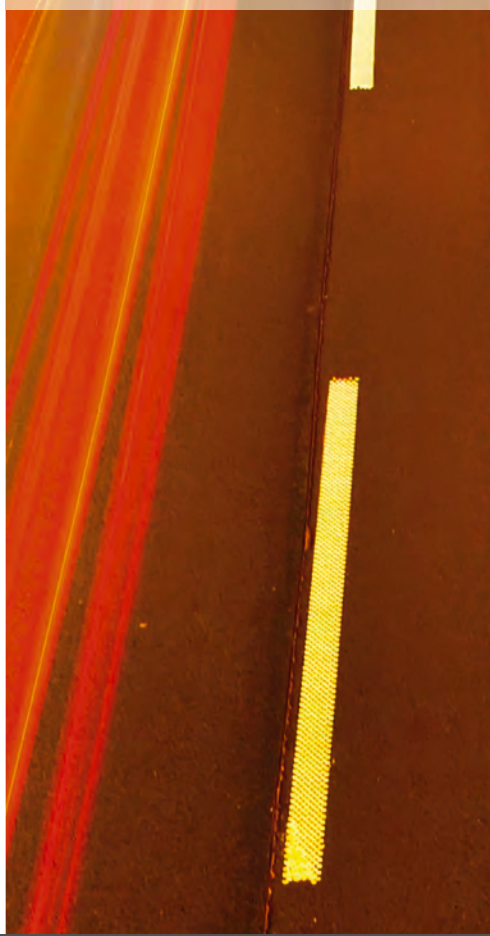

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Show highlights

Mobility focus

DAT.Mobility
Booth D5

Congress visitors who are interested in data-driven mobility should visit the DAT. Mobility stand. "We focus on data collection through different types of technology, as well as data fusion, interpretation and visualization as enabler for the next generation of traffic-modeling and simulation, and crowd management," says Wieland Hendriksen, commercial director.

DAT also recently launched its own app for individual mobility monitoring. Sense.DAT provides organizations with an insight into mobility behavior and the choices that people make.

Notably, the company recently successfully executed mobility monitoring at the 2015 SAIL Amsterdam event, using a real-time crowd management dashboard. In cooperation with Delft University and Amsterdam city authorities, DAT used a combination of different real-time data collection methods to build algorithms to model and simulate 'slow-mode' mobility. This enabled city authorities to, for the first time, see the crowds at SAIL in real time and predict potentially unsafe situations.

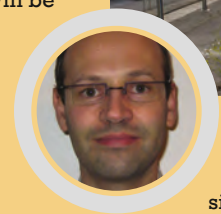
DAT also provided the event organizers with a Smart City Mobility Platform, based on its OmniTRANS traffic model. This provided information about people, cars, bicycles, buses and trains entering and leaving the city and event area.

"DAT.Mobility aims to be a leader in the transformation of mobility planning and simulation based on data collection, fusion, analyses and visualization," says Hendriksen.

ITS innovation

Sterela
Booth B108

France-based Sterela is a manufacturer of advanced ITS solutions. The company is well known within the weigh-in-motion (WIM) sector and has recently become involved in the Smart City market."We will be demonstrating both our advanced vehicle weighing and Smart City solutions at our stand," says Benoit Geroudet, ITS product manager.



Sterela's WIM systems can be used for statistics and weight enforcement (preselection). The company has also complemented its offer with static and low speed weighing devices that facilitate enforcement in accordance with OIML R076 & R134 certification.

"We are noticing a trend toward direct enforcement," says Geroudet. "Indeed, we are currently engaged in three WIM direct enforcement projects – in Brazil, Belgium and France."

In the Smart City arena, Sterela benefits from extensive experience in vehicle detection and ALPR technologies.

"Our solution is designed to improve on-street parking management," Geroudet explains.

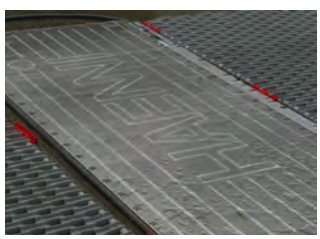
Last spring, Sterela signed an agreement with two Canadian companies, Varitron and EMM Groupe, in the presence of the Prime Minister of Quebec and the French minister for economic affairs and finance. The goal was to promote Sterela's solutions in Canada and North America.

"The next two decades will see groundbreaking innovations in the ITS market, especially in terms of autonomous and connected vehicles," Geroudet believes. "Our challenge is to be part of the upcoming migration to a service economy based on big data and the Internet of Things."

Weight management

Haenni Instruments
Booth B11

"As fully automatic weight measurement is becoming increasingly important in our industry, Haenni will be presenting a new strip sensor at the ITS World Congress," reveals Beat Cotting, sales manager. "Measuring only 11mm thick, the strip sensor is one of the thinnest and lightest of its kind in the world. It is designed for mobile applications, but it can also be set flush in the pavement."



Haenni has been a leading supplier of portable wheel load scales for weighing HGVs for more than 30 years. The company has sold more than 40,000 scales to more than 115 countries. "This year we sold some scales to Cambodia for the first time," says Cotting. "In some countries, our scales have permanently enhanced weight enforcement. Romania, for example, has 56 scales and in Thailand, the Department of Rural Roads equips its mobile teams on a yearly basis." The Qatar police also recently bought 10 portable, dynamic axle weighing systems for weight enforcement.

"Although everybody these days looks for fully automatic weighing systems, the social interaction between drivers and any personnel checking the weight is very important," Cotting believes. "To protect road assets worldwide, official weight controls need to become mandatory in every country. In the future, HGV weighing will be much more comprehensive than it is today. The weight of transported goods will be much better recognized and recorded. Big data will help to plan road assets for better network performance."

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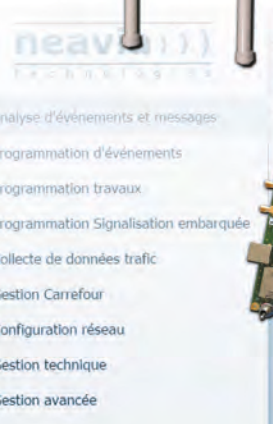

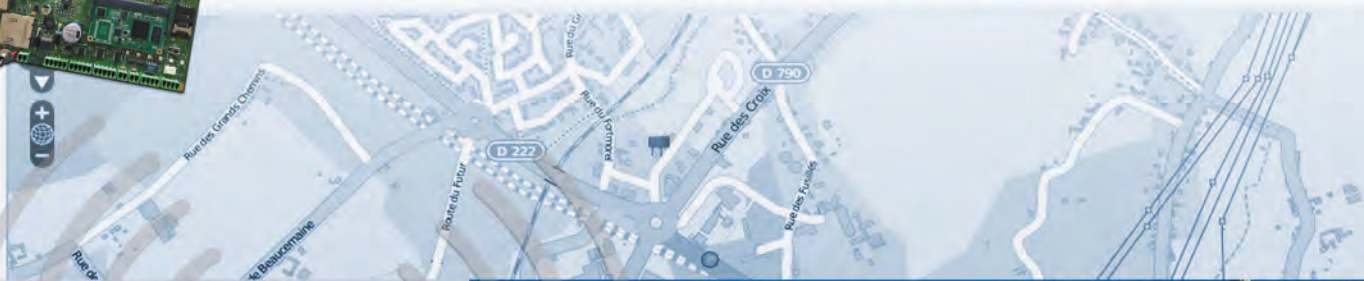

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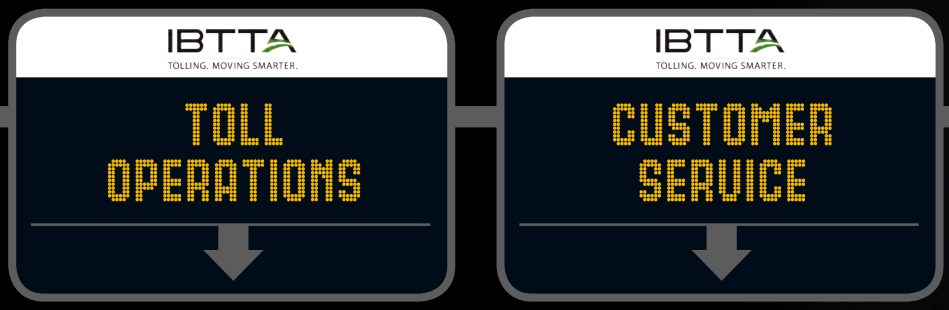

Winning routes

Over the next five pages, **David W Smith** talks to the winners in each of the five categories in this year's International Bridge Tunnel and Turnpike Association (IBTTA) Toll Excellence Awards. Get in lane to discover how the latest tolling innovations will change the way you do business

The International Bridge, Tunnel and Turnpike Association (IBTTA) has announced the winners of its annual Toll Excellence Awards, industry accolades that are sought keenly all over the world.

"This year's submissions were particularly innovative," said Patrick D Jones, executive director and CEO of IBTTA. "There were many great examples of projects highlighting new ideas and emerging practices throughout the international tolling industry. A new category, Private Sector Innovation, was added to recognize the innovative solutions being brought to market by our private sector members."

The 2015 honors were awarded in the following five categories: Toll Operations, Maintenance and Engineering; Customer Service and Marketing Outreach; Social Responsibility; Private Sector Innovation; and Technology. The winners received their awards on Monday, August 31, at IBTTA's Annual Meeting and Exhibition, in Dublin, Ireland. During the awards ceremony, the Taiwan Area National Freeway Bureau (TANFB) received the coveted President's Award for Excellence.

The Dublin meeting is the IBTTA's biggest annual show, with three days of presentations, workshops and roundtable discussions about the industry. The goal is for authorities to come together from all over the world and exchange ideas to the benefit of all. There was also a large exhibition hall featuring private sector companies offering tolling solutions.


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TOLL OPERATIONS

WINNER

New Jersey Turnpike Authority

The New Jersey Turnpike Authority is the only agency in the USA using web-based software designed to manage the construction scheduling of lane closure requests each week. The authority's Traffic Permitting and Lane Closure Application has replaced its paper-based application, which was unable to efficiently process an average of 850 closures a week.

"The paper system didn't work. It consisted of hundreds of emails sent to a designated email address with attached Microsoft Excel spreadsheets," says Christine Bugel, traffic engineer in the Operations Department. "Each email had to be opened and reviewed and the attachments opened and copied to a central Excel table. This manual process became overwhelming as the requests for construction access increased. The time involved to read the daily mass of emails and copy and paste each request became so time-consuming that last-minute changes were commonly missed."

The new application schedules all construction activities on the NJ Turnpike and Garden State Parkway. Authorized users, such as contractors, resident engineers and Turnpike construction personnel, get direct access. There are four categories of user. A contractor would be in the 'contributor' category; a resident engineer, or project manager, would be a 'reviewer'; operations personnel are 'approvers'; and users who require access to disseminate information to the public or police have 'read-only' access.

> "It's vastly more efficient now. There is a single point of access that is automated and self-managed. Users input requests directly into the system, instead of relying on manual cutting and pasting from table to table"
>
> **Christine Bugel, traffic engineer, New Jersey Turnpike Authority, USA**

"It's vastly more efficient now. There is a single point of access that is automated and self-managed. Users input requests directly into the system, instead of relying on manual cutting and pasting from table to table. Users have access to the application 24/7 to add, change, or cancel requests for construction access. Transferring the responsibility to the contractor and resident engineer relieves our operations department of this task, allowing for more time to address conflicts and manage the process of construction scheduling."

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CUSTOMER SERVICE

WINNER

Taiwan Area National Freeway Bureau

The Taiwan Area National Freeway Bureau (TANFB) has introduced a distance-based, electronic toll-collection system, which has streamlined traffic flows and improved the driver's experience.

TANFB director general Yen-Po Chen says, "Before the launch of distance-based electronic toll collection (ETC), we had 21 toll plazas with an average distance of 40km [25 miles]. All vehicles had to reduce their speeds in ETC lanes, or stop altogether in manual lanes, to pay their tolls. As a result, our toll plazas became bottlenecks. With distance-based ETC, there's much less congestion. Vehicles don't need to slow down to pay tolls, so it's much more efficient."

Private company, FETC (Far Eastern Electronic Toll Collection Company), installed 319 gantries at the freeway sections between interchanges. After eight months of work, installation was complete in June 2013. Following a further six months of equipment installations, the new distance-based system went online in December 2013.

"Previously, drivers paid all their tolls at the plazas and the rate was the same at each one. The new system calculates the toll according to the total mileage traveled per day. All drivers receive a 25% toll discount for mileages over 200km each day, and they also get 20km toll-free every day."

TANFB averages 14 million transactions daily, with a tolling accuracy rate of 99.97% and a detection accuracy rate of 99.9%, which is the highest in the world. "The 99.9% detection accuracy is achieved using the most advanced laser detection module. And for those detected vehicles, 99.97% of their eTags can be deduced from license plate images," says Chen.

"With the introduction of distance-based ETC, we have achieved the goal of 'fair tolls'. In 10 to 20 years' time, TANFB will have more applications using the data that ETC collects. For example, we may be able to forecast future traffic conditions and the ETC system will play an important role in transportation management."

> "The 99.9% detection accuracy is achieved using the most advanced laser detection module. And for those detected vehicles, 99.97% of their eTags can be deduced from license plate images"
>
> **Yen-Po Chen, director general, Taiwan Area National Freeway Bureau, Taiwan**

The next challenge was to get the public on board. Chen said the key to encouraging widespread acceptance had been issuing all vehicles with an RFID eTag free of charge. After just 18 months of the new system, there were six million vehicles in Taiwan newly equipped with eTag.

The public, Chen says, quickly realized that it would benefit from the new system:

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SOCIAL RESPONSIBILITY

WINNER

Illinois Tollway

For years, the Illinois Tollway used a monolithic private-sector company to staff its customer service call center. The nationwide provider was not even based in the state. Then, back in 2012, Illinois Tollway entered into a partnership with the non-profit Chicago Lighthouse to provide jobs for two under-employed populations, the disabled and military veterans.

The new Illinois call center opened in October 2013 and now provides jobs for 124 employees, including 66 people with disabilities and 55 military veterans. The center, which has been adapted for wheelchair users and the visually impaired, handles between 8,000 and 11,000 customer calls per day, and processes 27,000 toll and violation payments per month.

At the start of the partnership there were a few teething problems with the scheme. The mission statements of a charity and a public agency that has to justify every cent of its spending were radically different. But compromises were found.

"The Chicago Lighthouse is doing a great job recruiting from under-employed populations, which is something we could not do ourselves and private organizations would not be motivated to do," says Shana Whitehead, Illinois Tollway's chief of business systems. "They employ the same trainers that worked for the private company that had the contract before, and they do a lot of outreach into disability and veteran communities in Illinois."

> "The Chicago Lighthouse is doing a great job recruiting from under-employed populations, which is something we could not do ourselves and private organizations would not be motivated to do
>
> **Shana Whitehead, chief of business systems, Illinois Tollway, USA**

Whitehead says the project works well on many levels. It keeps the work within the State of Illinois and also provides jobs for populations that often struggle to find them. But also The Chicago Lighthouse rates are competitive and the scheme costs no more than the previous contract with the large private company.

For its Chicago Lighthouse partnership Illinois Tollway was named 2015 Agency of the Year by the state's Interagency Committee on Employees with Disabilities.

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PRIVATE SECTOR INNOVATION

WINNER

Etan Industries

Etan Industries has designed a unique financial accountability solution – called FastLane – for Miami-Dade Expressway Authority. The idea of FastLane is to take functions away from Miami-Dade so they are free to manage traffic and run the roadways. Etan works on the principle that customers without a valid toll tag represent 20% of transactions, but consume 80% of resources, including billing, customer service, payment processing and collections.

Although FastLane was designed for Miami-Dade, it is applicable for other authorities and Etan Industries believes it could become a revolutionary tool for the tolling industry. "Most authorities take a piecemeal approach to outsourcing separate services, but FastLane provides a unified database and a common data model, so there's a single point of reference for everyone. Consumers, accountants, operations teams, and customer service teams all see the same information," says Sterling Shepherd, VP at Etan Industries and project manager for FastLane.

From the moment video cameras film cars without tags, or passes, Etan takes charge of all customer services and account reconciliation. "It's a very unusual model because we do all the toll collections for the authority. Our approach is to treat the customers respectfully and give them every opportunity to pay. It's not the same as simply cutting off someone when they don't pay a phone bill.

"They will be customers again and the way tolls are collected reflects on the authority. We never suspend delinquent accounts. One of the unique things in tolling is that authorities can do 'registration holds' so drivers are unable to renew registrations until they pay tolls. Our customer service site makes this process as easy as possible for consumers," says Shepherd.

"It will be interesting to see what the future holds as it relates to RFID technology and video tolling. Whatever happens, financial accountability will be increasingly important for our industry, so we see a secure future on our horizon."

> "Most authorities take a piecemeal approach to outsourcing separate services, but FastLane provides a unified database and a common data model, so there's a single point of reference for everyone"
>
> **Sterling Shepherd, vice president, Etan Industries, USA**

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TECHNOLOGY

WINNER

Transurban

Transurban, the company that operates the 495 Express Lanes in Northern Virginia, claims to have created one of America's most technologically advanced roadways. The 495 Express Lanes are two high-occupancy toll (HOT) lanes designed to reduce congestion and offer drivers more journey and payment choices over a 14-mile stretch of roadway.

Mike McGurk, corporate relations associate at Transurban, says, "This is a much more high-tech approach than you will see on many roads. The 495 Express Lanes was the first roadway of its kind in the region and is one of the most technologically advanced in the USA. Innovative elements include dynamic pricing, all-electronic tolling, dedicated incident response, a state-of-the-art operations center, and interface with VDOT."

All drivers must have an E-ZPass, or E-ZPass Flex, to use the lanes. Carpoolers with an E-ZPass Flex set to HOV mode, as well as motorcycles and buses, travel toll-free. Toll gantries are located at nine points in each direction to track a driver's trip.

One of the high-tech elements has involved placing microwave traffic sensors every third of a mile. These collect real-time traffic flow data and send the information to the Express Lanes Operations Center for use in a dynamic pricing system. Meanwhile, dynamic message signs inform drivers of real-time toll rates so they can decide whether to travel in the Express Lanes, or the regular lanes.

Construction of the 495 Express Lanes marked the most significant package of improvements to the Capital Beltway in a generation. There was a complete reconstruction of 58 interchange bridges and overpasses, many of them including new bicycle lanes and pedestrian walkways, and major upgrades to 12 key interchanges.

> "Innovative elements [on the 495 Express Lanes] include dynamic pricing, all-electronic tolling, dedicated incident response, a state-of-the-art operations center, and interface with VDOT"
>
> **Mike McGurk, corporate relations associate, Transurban, USA**

Irish rovers

As the Toll Excellence Awards comes to Ireland we take a look at the country's free-flow toll technology

There are 11 toll roads in Ireland and 10 of them employ conventional barrier toll plazas. The exception is Dublin's M50 road which is a barrier-free tolling road that uses eFlow's registration plate technology to identify cars.

The eFlow system relies on gantry-mounted cameras that record the details of passing vehicles, or identify tags. There are a number of ways to pay. The cheapest is to register for either a Video or a Tag Account. eFlow Tag saves €1 (US$1.15) on every M50 journey and holders can also use express lanes at all Irish toll plazas. Meanwhile, eFlow Video saves €0.50 (US$0.57) on every M50 journey. If the toll charge is not paid by 8pm the next day, then a fine of €3 (US$3.45) is incurred.

The M50 is Dublin's orbital road. The toll runs between Junction 6 (N3 Blanchardstown) and Junction 7 (N4 Lucan). It has around 115,000 vehicles using it a day and generates annual revenues of €110m.

The eFlow tolling system is operated by Sanef ITS Operations Ireland, a subsidiary of the French company Sanef. It has proved highly profitable for Sanef since it came into operation in 2008. Sanef ITS Operations Ireland recorded pre-tax profits of €2.9m (US$3.33m) in 2012. Sanef's current deal, which includes an option to extend the original contract, is due to expire in March 2018.

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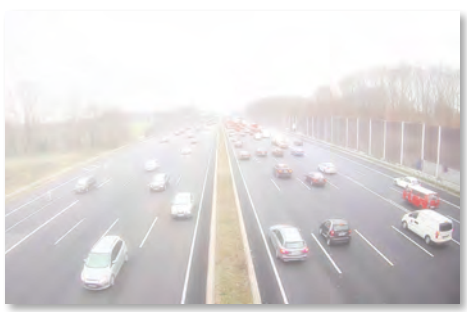

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According to **James Buczkowski**, Ford's director of electrical and electronics systems, research and advanced engineering, the era of connectivity has arrived

Interviewed by Max Glaskin

> As we move into the future, the vehicle will no longer be separated from the Internet of Things. It will be part of it

Connected vehicles are desirable for a host of interrelated reasons, including to reduce congestion, boost road safety, improve fuel economy and protect the environment. The promise is that V2V communication, along with the associated infrastructure and network control, will alleviate a host of problems. Highway operators, emergency services, law enforcers and governments are all keen for this ITS Swiss Army knife to unfold. Yet all these cutting edges hinge on one sector: the auto industry.

One man at the sharp end is Ford Motor Company's director of electrical and electronics systems, research and advanced engineering, James Buczkowski. He's a Henry Ford Fellow, has been with the 'blue oval' for 35 years, and is responsible for the research and design of telematics, driver information and active systems. He prides himself on being an early adopter, so if anyone can say where the auto industry stands on connected vehicles, it's Buczkowski. And he's up for it.

"Connectivity is not the next big thing; it is the big thing right now and will continue to expand," he says. "In the short term, connectivity has primarily been around consumer services and experiences – navigation and communication – but as we move into the future, the vehicle will no longer be separated from the Internet of Things. It will be part of it. It will be able to share information with the cloud and with other vehicles, as well as extract information from the cloud and use it for processing."

Interactive experience

Having been responsible for the launch of Ford's SYNC and MyFord Touch infotainment systems, Buczkowski is aware of the importance of user experience of connectivity. Different functions will require different levels of interaction with occupants. "Some will be transparent or behind-the-scenes and will make for more efficient, safer driving," Buczkowski declares. "They may be assistance features, relating to shift scheduling, knowing where the hills are, or knowing about the weather – conditions that might affect performance of the vehicle itself."

Other functions will be more obvious, offering informed choices. "If you're on your way to a meeting and the connected vehicle calculates that traffic conditions mean you're going to be late, it could ask you if it should alert your colleague about your delay or reschedule the meeting," says Buczkowski.

In his eyes, then, connectivity goes way beyond what's happening between the road and the vehicle. It's all about mobility – not just physical but also temporal. Auto makers, through their products, will be individual pieces in the dynamic jigsaw, the aim of which is to make sure the people who drive their vehicles benefit. "We will target those experiences that have high

> It's hard to add hundreds of dollars to the cost of a vehicle and say, 'Well, it's for the future.' Customers want immediate benefits

(Above and left) **Connected vehicles see way beyond a driver's field of vision**

value for consumers, ones that help them save time or make their journeys better – and it will transcend the whole mobility experience," says Buczkowski.

Better connected

The new paradigm will be reached in stages and the chance of false starts should be minimized by having standards agreed at the outset. "Unfortunately for us, not every connected vehicle is going to be a Ford," says Buczkowski, wryly. "So we're going to have to work with competitive products. Standards do play an important role, not only in V2V communication, but also in sharing information through other sources."

As leader of the electrical systems group of SAE's motor vehicle council Buczkowski has experience – and influence – in recommending and agreeing such standards. He perceives a difference between US and European approaches. "The USDOT is focusing heavily on the safety elements of V2V communication," he says. "In Europe it's much more focused on getting the driver more information."

These different features require different standards. "If it's a dedicated safety-related communication it's going to be highly secure. Other features that are not safety-critical will leverage standards through cellular networks and other consumer-grade technologies," says Buczkowski. "This mix of requirements will affect the timescale by which connectivity features will become available. "Some services can be delivered a bit quicker because we don't have to invent any new standards, and can leverage cost-effective hardware and software that already exists," Buczkowski explains. "On the other hand, when it comes to safety-critical information, it will have to travel using some other standards that are still in development."

Of course, new standards can be voluntary or mandated. What will it be in the connectivity universe? "Regulation-wise, I think this is always going to involve working together in many partnerships because we are crossing the industry now," says Buczkowski. "No OEM can do it alone. We have to work together with government and in some cases there will need to be some regulation so that we're all adopting the same standards."

Political factors

It's clearly vital, but is standards-setting process progressing fast enough? "We're not working in a direction of resistance," says Buczkowski. "We're working cooperatively with government regulators to find what's best for consumers."

That's the nub for the auto industry – the market must be best served by any connected vehicle standards as soon as they come into effect, so vehicles can be competitive. "We have to contain our costs, make sure cars are affordable and ensure that our businesses are successful," says Buczkowski. "It's hard to add hundreds of dollars to the cost of a vehicle and say, 'Well, it's for the future.' Customers want immediate benefits. There may be a role that regulation plays to mandate putting transceivers in vehicles, but nobody likes to regulate if they don't have to."

For the full concept of connectivity to be achieved, infrastructure must also be augmented with hardware. Buczkowski questions whether enough of this is being done. "The difficulty is, governments aren't keen to allocate large amounts of funds to this," he says, understanding at the same time that technology is rapidly changing, so it's challenging to make capital investments in hardware that may turn out to have a short lifespan.

"We are at a crossroads where we need that kick to really incentivize moving forward on this," says Buczkowski. "People are exploring if there are other ways we can give value to consumers to get this thing kick-started. People are being creative; ideas are still coming out about how we could cross that bridge."

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An innovative approach to parking results in barrier-free solutions

Q-Free has supplied an advanced, barrier-less parking solution to the Ericsson Globe, the largest hemispherical building in the world

PHOTOGRAPHY: STOCKHOLM GLOBE ARENA

A natural consequence of the continued convergence of different sectors of the ITS industry is cross-fertilization. This is bringing about some very positive developments, as best practice and the state-of-the-art in various application areas begin to make their presence felt elsewhere. Parking management is a case in point, and solutions provided by Q-Free are facilitating change in a sector that has remained static for several years.

Within the urban arena, the convergence of the advanced traffic management system (ATMS) and smart parking is a fairly recent phenomenon. Town and city managers have realized that these two sectors need to work more closely if congestion and environmental issues such as atmospheric and noise pollution are to be addressed. Business models that saw on-street queues outside parking garages as good practice are obsolete – the emphasis is now on seamless integration of ATMS and parking guidance system (PGS) operations.

Speeding up progress

Successful electronic toll collection (ETC) operation requires the ability to facilitate cashless services of numerous types, including both pre- and post-payment. It requires substantial experience of providing back-office systems capable of handling the transactions generated by large numbers of both account and non-account holders. At the front end, it requires competence in numerous on-board unit (OBU) and sticker tag solutions, whether based on dedicated short-range communications (DSRC), radio frequency identification (RFID), or global navigation satellite system (GNSS) technologies. These, together with automatic license plate recognition (ALPR), are used to carry out the vehicle detection, identification and classification, payment and enforcement tasks.

(Left) **The Ericsson Globe is primarily used for ice hockey matches but also hosts major international music artists**

But the key feature of ETC is the ability to provide uninterrupted – that is, barrier-free – progress. In many respects, tolling is a more challenging application than parking in that systems have to cope with vehicles moving at highway speeds in variable light and environmental conditions.

The parking sector has continued to be dominated by barrier-based solutions, partly because of the predominance of a traditionally minded group of more established (and in some cases, quite large and influential) suppliers and also because of lingering doubts among parking garage and scheme operators over the ability of barrier-less systems to prevent revenue leakage.

And yet the use of ETC-type technologies by the parking sector would confer upon property owners and parking operators notable advantages in terms of capital and operating expenditure, as well as greater operating efficiencies. From the user perspective, there is greater convenience both

Need to know

Developments in the ITS industry are making way for optimized parking operations

- Q-Free's recent acquisitions are in line with a strategic realignment that is turning it into a full-spectrum ITS provider
- The company retains its core expertise in ETC, as well as its long-standing ALPR and optical character reading (OCR) capabilities
- The addition of ATMS specialists to the group has also given it an influence in urban areas
- Q-Free has recently acquired US PGS specialist TCS International and Maltese company Traffiko, which provides parking management applications

in terms of payment methods and in ease of use.

Gaining traction

It is the welcome removal of great amounts of metal, in the form of barrier systems, that characterizes the Q-Free approach. It is an approach that is gaining traction with leading parking providers, including APCOA Parking.

In the Nordic region, Q-Free has provided ALPR-based congestion tax schemes for the cities of Stockholm and Gothenburg. A defining characteristic of any congestion management scheme is that it must be free-flow – that is, it must be barrier-less and must not involve vehicles having to stop to make payments. It must also be relatively watertight in terms of revenue collection – a 'leaky' scheme will lack credibility and very rapidly lose political and public support.

APCOA, which was looking to develop a competitive advantage, expressed an interest in the Q-Free ALPR technology used for the congestion tax scheme in Stockholm. This led to a demonstration at the former's offices in the same city. Installation of ALPR at a small parking facility was used to compare performance with a traditional barrier system and address perceptions that a barrier system is somehow safer.

A successful demonstration has led to the installation of a barrier-less solution from Q-Free at a very high-profile APCOA location – the Ericsson Globe, Sweden's national indoor arena, which is situated in the Johanneshov district of the Swedish capital.

Showcase deployment

The Ericsson Globe has a diameter of 110m (361ft) and an inner height of 85m (279ft). It is predominantly used as a venue for ice hockey matches, but it is also used for other events such as shows and concerts. It has a seating capacity of 13,850 for ice hockey matches, and 16,000 for shows and concerts. A mall with over 60 stores and several hotels and offices shares the same parking facilities.

The Ericsson Globe represents a true cross-company effort for Q-Free, as it brought together specialists from numerous group companies: Q-Free TCS supplied the PGS; Q-Free Elcom supplied the variable message signs (VMS), which provide real-time user information on-site; Q-Free Traffiko provided the car park management system (CPMS); Q-Free Netherlands performed manual correction of low-confidence ALPR reads; Q-Free Sweden carried out the installation work; and Q-Free Norway was responsible for the sales and contractual effort.

The PGS monitors and controls a total of 1,400 single-space sensors. These are mounted overhead and trigger colored LEDs to show occupancy, as well as pushing information to the back office. The Traffiko-supplied CPMS is highly flexible and integrated with various APCOA back-end systems, including those for electronic pricing, accounting and invoicing. It is offered as a cloud-based software solution and priced at a monthly cost per site. At the Ericsson Globe, it integrates with an existing ALPR system from another provider, but there is a plan to replace this with a Q-Free Netherlands Intrada solution at some point in the future.

A total of 18 cameras are used to cover nine entrances and exits. Inside, 21 touchscreen payment kiosks have been provided. To make a payment, a visitor simply has to type in his or her license plate details and, once a picture of the correct vehicle is displayed on the touchscreen, confirm and pay via credit card.

The first two hours of parking are free of charge, but there is also the facility for visitors to simply leave without paying and then do so online within 72 hours. This allows those exiting after large-scale events, such as an ice hockey match or a concert, not to have to stand in line for long periods to pay on-site. It is an example of how intelligence built into a system improves user convenience and satisfaction by helping to reduce waiting times and congestion.

The new PGS at the Ericsson Globe went live on March 18 this year and demonstrates how barrier-less parking could be implemented in the future. Building on the success of the deployment, Q-Free is currently discussing implementing the solution at additional sites with APCOA in Sweden and is also exploring interest from other countries.

Working toward the creation of next-generation smart cities

Globally, more people live in urban areas than in rural areas. Indeed, 54% of the world's population resided in urban areas in 2014. In 1950, 30% of the world's population was urban, and by 2050 that figure is expected to increase to 66%. There is a direct relationship between urbanization, economic growth and development, and contribution from towns and cities to gross domestic product (GDP), which has increased dramatically over the past 50 years and is expected to rise to 75% in 2021. Cities are accordingly referred to as the engines of economic growth.

There is an urgent need for cities to find smarter ways to handle large-scale urbanization and find new ways to adapt to new situations, manage complexity, increase efficiency, reduce their ecological footprint, engage citizens, reduce expenses, and improve quality of life for everybody.

A sustainable environment

'Smartness' in a city means different things to different people. It could be smart design, smart utilities, smart housing, smart mobility or smart technology; thus it is rather difficult to give a definition of a smart city. However, people primarily migrate to cities in search of employment and economic activities in addition to a better quality of life. Therefore, a smart city needs to offer these opportunities to a wide section of residents, regardless of their level of education, skills or income levels. In doing so, a smart city needs to identify its comparative or unique advantage and core competence in specific areas of economic activities and promote such activities by developing the required institutional, physical, social and economic infrastructures for it and attracting investors and professionals to take up such activities.

While there are many definitions of 'smartness', smart cities all seem to have a sustainable environment made of physical, social, institutional and economic infrastructure, while ensuring centrality of citizens and their quality of life.

The road to 'smartness'

Along the path to the 'smart city' goal, three evolutionary steps can be envisaged. In the first place, a city must become sustainable and 'liveable', enabled by the use and constant promotion of innovation in all aspects of city life – administration, mobility, energy, planning and education. It promotes a developmental attitude that is not damaging to the environment, but is economically and financially sustainable and socially balanced. The liveable city is attentive to the needs of everybody, provides efficient, easy-to-access and customized services.

Second, a city must become digital and connected, with information and communication technologies (ITC) playing a pivotal role in making the city more adapted to the contemporary needs of its citizens. These offer relevant benefits to systems and urban services. Moreover, they foster permanent connections and information exchange between people, systems, services and objects. A smart city actively uses innovation in all its administrative services and distribution networks, and it promotes innovation by creating a fertile environment favoring the creation of new services.

Finally, smart cities are enabled by inclusion, which means engaging citizens by promoting their active participation and offering 'open' services to sustain 'bottom-up' initiatives and innovations.

The smart city becomes an extended and heterogeneous mix of systems and services, where mobility represents a supporting pillar. All major smart cities worldwide have a sound traffic and transport management system at their core. The traditional 'silos' layout, where different traffic and transportation operators are working separately, is replaced by an open and distributed architecture, which implements the integration ('open') and cooperation ('distributed') of the smart mobility paradigm.

Need to know

To become 'smart', cities must invest in innovation, technology and sustainability

- Smart City solutions provide the opportunity to harvest an immense amount of information on the state of the road network
- Information can be transferred from vehicles and travelers back to the traffic control center, providing an additional real-time source of data
- Used intelligently, the potential is there to improve real-time network management and to implement much better informed strategic network management decisions

Intelligence optimization

"Swarco is supporting smart city growth by guiding the development of its products and solutions toward a new mobility management concept," says Manuel Milli, Swarco's solution manager for smart mobility. "Mobility management acquires a broader meaning and uses the latest technologies to intelligently combine individual driver objectives (individual user optimization) together with network-wide management strategies (system

optimization and equilibrium) in a win-win scenario."

The future of traffic management is to build upon the deployment of connected vehicles and travelers in order to achieve convergence of mobility services and traffic, while giving value to the legacy and creating new business opportunities.

Multimodality is key to the smart city vision and is supported by the rising priority that cities are giving to cyclists and pedestrians. The Omnia concept exploits Swarco's three decades of experience gained in the fields of traffic control, transport management, mobility information service, and integrated ITS architectures. Omnia is an open platform, which means that any ITS application can be integrated, independent of the supplier or technology. The platform collects real-time data and uses it not only to manage operations, but also to model and forecast mobility demand. This gives all applications access to high-quality data, which is also available to operators and city managers for their strategic planning.

(Above) **A smart city relies on intelligent technologies to connect all parts of the transportation system**

The user-friendly Omnia interface offers distributed measurement and supervisory facilities, which provide effective monitoring of the road network and subsystem components, and a simplified way of interacting with the components belonging to the various subsystems. A fundamental part is represented by the performance monitoring and asset management functionalities, which provide a control mechanism that can handle such a complex system. In addition, the organizational environment is complex and requires a deep understanding of local needs and expertise in traffic management and transport. Swarco works daily to facilitate the creation of smart ecosystems, by connecting the worldwide community and creating productive relationships with professional and academic organizations working in linked market segments.

Innovative solutions for optimized tunnel control

The Jack Lynch Tunnel, which transports traffic underneath the River Lee in Cork City, Ireland, is part of a primary national road and forms part of an orbital route around the south side of the city. It provides essential congestion relief to the city center and surrounding roads, enabling easy access to the M8 toward Dublin, as well as to the west and south sides of the city. Completed in May 1999, the tunnel is a 610m-long twin-bore, immersed tube construction. Each bore has two lanes and two footpaths, with a central bore for emergency use. The tunnel transports more than 65,000 vehicles every day.

In 2012, Cork City Council decided it needed to improve the resilience and overall reliability of the control systems through which the operators and maintenance engineers ensure safe operation and management of traffic flow on the roads surrounding the tunnel. The original systems were reaching the end of their serviceable life and improvements were needed to ensure ongoing compliance with the latest EU directive 2004/54/EC and UK Road Tunnel Safety Regulations 2007, which specifies the minimum safety standards for road tunnels.

(Above) **Information about the Jack Lynch Tunnel can be accessed via a smartphone app** (Left and below) **The twin-bore tunnel plays an essential role in Ireland's transportation network**

Need to know

A new monitoring and control system ensures safety at Ireland's Jack Lynch Tunnel

- The tunnel is an integral part of the city's transport infrastructure, and disruption to traffic and the general public had to be kept to a minimum
- This was achieved through thorough factory testing of the system prior to installation and with a carefully sequenced migration procedure to maintain operation of equipment at all times
- The upgrade was so successful that there was virtually no system downtime, and all internal work was done at night

Control and automation

P Ducker Systems (PDS) has been involved with supplying and maintaining the control systems for the Jack Lynch Tunnel since its construction. In 2013, PDS was awarded the contract to supply and install a new system to replace the existing plant monitoring and environmental control system, and to migrate the system communications from a serial communications network to a much higher bandwidth, 1Gb self-healing fiber-optic Ethernet network.

The new system was developed to enable operators and engineers to efficiently control and monitor a variety of control systems from both local and remote locations. It successfully integrates all environmental, plant and traffic management systems into a unified supervisory control and environmental control system, with four operator terminals that each have a user-friendly interface.

The new architecture provides automatic and manual control for the operators, with integrated switching and alarm functions for all subsystems and associated equipment. It is based on a hot standby, redundant configuration, ensuring high

system availability without loss of service. Any potentially life-threatening incidents are quickly identified and safety procedures are efficiently responded to. The new architecture provides much-improved system response times, resulting in high operator confidence to quickly make changes to signs, fans and other critical subsystems.

The Jack Lynch Tunnel is designed for fully automatic operation with remote monitoring and control facilities at the tunnel control room, as well as out-of-hours access to a control room in Dublin. On-call site engineers and PDS system support engineers are able to access the system remotely to help quickly diagnose and address any issues. This ensures that all the required support services can quickly respond to any incidents, and that operational costs are kept to a minimum.

The system is designed to last for more than 15 years. As commercial, off-the-shelf equipment is used and the system is modular, it will be easy to maintain throughout its operational life, minimizing future tunnel closures and disruption to the public.

Commuters are now able to plan their journeys more easily and efficiently, as the control system passes tunnel availability data through to a smartphone app. Planned maintenance closures are also published on websites and through text alerts. ○

by **Mike Schagrin**

The potential 'day one' benefits of DSRC technology must be explored

How can customers get early application benefits from a technology that will (potentially) be mandated for all new vehicles but won't have notable market penetration for several years?

The USDOT's move toward regulation of DSRC technology for new vehicles is a great long-term strategy for safety but does little to address near-term use and benefits. There needs to be a corresponding strategy for accelerating deployment of DSRC technology beyond just new vehicles so that early adopters of the technology can receive near-term value for their investment. Assuming that NHTSA does mandate the technology for new car production, there should be greater emphasis on establishing a more holistic environment for generating 'day one' benefits from DSRC technology. This should include looking more directly at vehicle aftermarket opportunities, mobile devices and infrastructure deployment initiatives, to more rapidly establish a broad-based operating environment for use of the technology.

There are some major initiatives currently underway that are attempting to examine day one applications and deployment scenarios for the connected vehicle (CV) environment, with DSRC in the mix of technologies. In Europe, the V2V Communications Consortium is working with the Amsterdam Group to establish a multicountry V2X corridor (The Cooperative ITS Corridor: Rotterdam – Frankfurt – Vienna) to support both V2V and V2I DSRC/cell-based capability. Initial applications are focused on V2X situational awareness and mobility. Follow-on applications will focus more on cooperative driving, synchronized cooperative driving and automated driving scenarios.

In the USA, pilots will be examining CV applications that improve overall road network performance while also instituting sustainable business models. There is also the newly established V2I Deployment Coalition (comprising ITS America, AASHTO and ITE), which is looking at what more is needed to facilitate an operational CV environment. Its main areas of focus include deployment initiatives; deployment research; infrastructure operator, OEM and supplier partnerships; deployment guidance; and deployment standards. While this group can provide recommendations to the USDOT and the wider industry, there is no funding mechanism for execution of the recommendations or regulation for anything that gets suggested.

"...more should be done to leverage what might otherwise be an underused technology"

So what else can be done to help derive near-term benefits for those that have assumed ownership of the DSRC technology? Since NHTSA is looking to mandate the vehicle technology, should the FHWA take a stronger position than just providing guidance on the infrastructure side?

While cell-based systems will likely lead the V2X application environment initially, more should be done to leverage what might otherwise be an underused technology for several years to come.

Mike Schagrin is former program manager for the ITS Connected Vehicle Safety and Vehicle Automation research programs at the USDOT's ITS Joint Program Office. He has now established Schagrin Consulting International, supporting clients in connected and automated vehicles ***mike@schagrin-consulting.com***

Creating a single, unified and interoperable AET network

For more than 20 years, Via Verde (VV) has stood for success in innovation. The automatic fee collection company's systems enable road users to comfortably pay tolls without stopping, fill-up their cars with fuel, grab a burger and park without worrying about having pocket change, use the ferry or even access restricted areas, such as historical boroughs. Simplicity has been key to its success and, to benefit from these services, users need only to equip their vehicles with a single onboard unit (OBU), associated with a bank card.

Although the most visible aspect of VV is its technology, its concept has much more to it. It is based on finding the right process design and adapting it to user needs. ETC systems are as reliable as the banks' interactions are. The success of VV in Portugal is a result of partnering with the right suppliers for different aspects of the system.

This does not mean that the technology should be dismissed, however. It has proven to be very effective, maximizing cost efficiencies through automated processes. By using non-stop solutions for tolling, such as the VV DSRC-based system, carbon emissions are reduced. This is because they minimize the need for vehicles to queue and eliminate the need for them to stop. Different options are available for customers; they can choose either pre- or post-paid systems that coexist in harmony across more than 10 operators and 40 tolled highways.

Comfort and road safety are perhaps the most important advantages for road users using an integrated ETC system. A single device enables them to use a wide range of vehicle-related services. They cease to be concerned with having enough pocket change for parking meters, or having the appropriate identification for access control. Congestion on highways is reduced, especially in open road solutions. At the end of the month, not only have they improved their fuel economy, they also receive a clear and detailed description of where and when their bank accounts were charged, regardless of the services used.

Operational efficiency

Besides individual road users, there is one type of customer that benefits the most from having ETC systems in place. These are the companies with fleets of vehicles, from buses, and trucks to taxis. Management and expense reports are immediate, using digital billing. Also, commercial advantages can be achieved through discounts negotiated for fleets as a whole, instead of considering individual transactions. This encourages highway usage and fleet owners benefit from reduced costs.

From the road operator perspective, there are several advantages in choosing an ETC system instead of manual tolling. First, one has to consider the extensive use of human labor as one of the largest expenses associated with manual tolling. By not having to deal with cash, ETC systems improve personnel safety and prevent fraudulent behavior.

Traditional toll barriers are, in themselves, obstacles to traffic flow, causing congestion and road accidents. This means

Need to know

Technologies and processes combine to optimize operational and cost efficiency

- DSRC-based OBUs communicate with parking lot and access control antennas, as well as toll plaza antennas
- Free-flow systems can use ALPR to minimize congestion as vehicles are not required to stop
- Audit and monitoring platforms work with the tolling back-office system
- The off-street parking ETC system optimizes payment at these services

(Opposite) **Conventional and free-flow tolling systems coexist at the Tejo river crossing Lisbon, Portugal** (Left) **Brisa's technology has recently been implemented on the Northwest Parkway in Denver, Colorado, USA** (Below) **Payment integration with off-street parking**

that, by introducing free-flow solutions, safety is improved, not to mention the smaller investments needed for funding such infrastructures.

The low cost per transaction has been fundamental to keeping costs controlled for road operators. Dealing with cash creates several problems for operators, even when they rely on automatic pay machines. It means you have to strengthen security and adds cost to transportation services.

Automated access control systems enable operators to minimize the number of personnel responsible for checking credentials and validating access. For the user, the ease-of-use is impressive – there is no need to lower the vehicle window, and as a result time loss is reduced and aggravation is kept to a minimum.

In emergencies, operators can automatically determine the number of cars inside the controlled area. Technology is applied for revenue assurance and fraud control, using automated video processing, while ensuring that regular users don't get penalties when systems fail to correctly identify their OBUs.

Success in Colorado

If success is not just a result of technology, how do these solutions fare when they are applied outside of their initial environment? Will they work? How big an investment is involved in their migration?

This challenge was met when the toll road concessioned in Denver, Colorado, decided to adopt a cashless tolling system, aimed at reducing operational costs and improving efficiency. The adjacent highway – E470 – uses RFID tags and interoperability is expected.

A new all-electronic tolling (AET) solution has increased the business's chances of success, providing room to grow and adapt. The solution from Brisa Innovation enables all road users, without exception, to use the highway without stopping. Also, for each transaction, the road operator does not require any manual intervention.

The road user can choose to install an OBU, associating it with a pre-paid account, or alternatively they can use the GO-PASS online service for a video-tolling account that uses automatic license plate recognition (ALPR). This accommodates the road users that don't want a predefined contract.

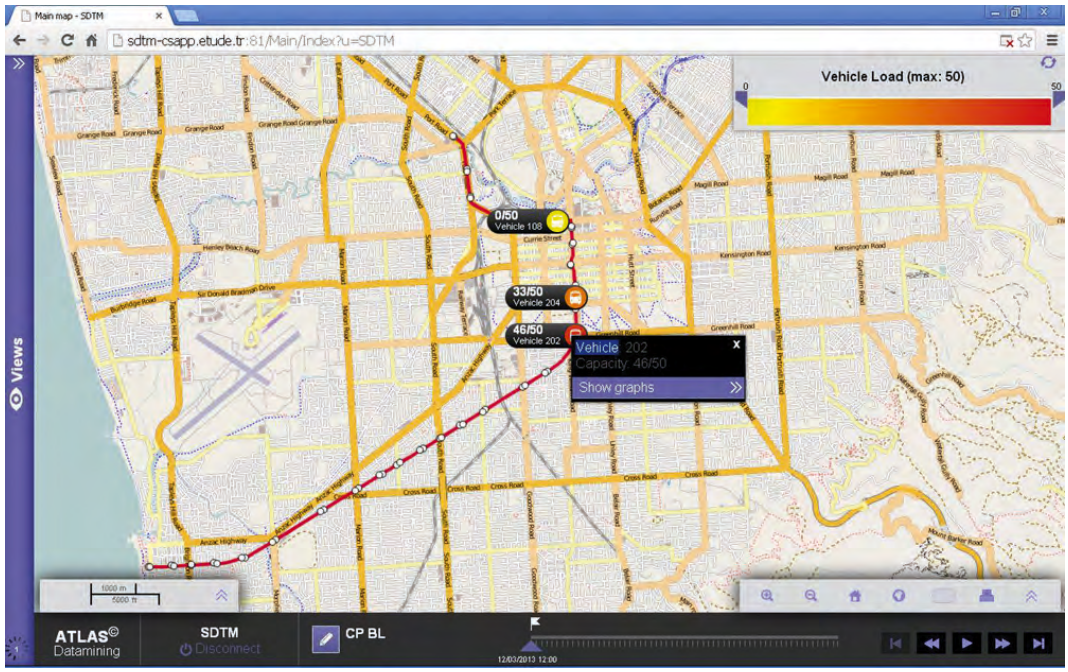
Brisa Innovation's ALPR system identifies the vehicle and a bill is sent to the registered address, with minimal manual intervention. Online payment and account maintenance is easy and secure. This complete and integrated solution eases payment for all tolling points, minimizing transaction costs and simplifying road users' experience. A 35% reduction in operation and maintenance costs has been achieved, due to the low-maintenance design and through optimizing human intervention throughout the entire toll collection process.

On the road toward data-driven mobility

As increasing numbers of people move into metropolitan areas, cities around the globe are seeking better solutions for urban living. City planners and managers want better ways to reduce congestion, and move people and goods more efficiently.

Transportation data can be collected in a number of ways: electronic toll collection can track the number of vehicles entering or exiting the highway; ticketing information from metro lines and bus stations provides valuable information on commuter behaviors; and the emergence of connected vehicles will supply new information on traffic flow, incidents and road use. For transportation agencies, putting this data to use is the key to gaining operational improvements while enhancing the user experience on highways and in metropolitan areas.

Data analytics has been at the core of Xerox's business for more than half a century. Following are three examples of how the company is contributing to data-driven mobility.



Lane enforcement

Transportation agencies have used carpool lanes for many years as a tool to reduce traffic congestion. The theory makes sense – you encourage individuals to share a ride instead of using their own vehicles, thereby reducing the number of vehicles on the road. In addition, carpooling is incentivized by allowing the high-occupancy vehicle (HOV) to ride in a special, designated lane, or in a high-occupancy toll (HOT) lane for a lower fee.

However, until now there hasn't been a way to confirm that the implementation of HOV/HOT lanes actually improves the throughput of people, or if drivers are contravening the regulations and simply using the lane as a way of avoiding traffic congestion. There has not been a way to accurately enforce the rules of HOV/HOT lanes.

The Xerox Vehicle Passenger Detection System (XVPDS) identifies vehicle compliance with HOV-2 and HOV-3 occupancy requirements with 95%+ accuracy, at speeds ranging from stop-and-go to 100mph. It uses video analytics and computer machine vision algorithms that can detect whether a seat is vacant or occupied.

The system was recently piloted by Caltrans, a state agency that manages more than 50,000 miles of Californian highways and freeways. In a three-day rush-hour pilot involving 12,073 vehicles, XVPDS achieved a 95.94% total accuracy rate. Human roadside observers meanwhile delivered 35.7% accuracy over the same period.

When the data was tallied, Caltrans learned that although the majority of drivers complied with HOV/HOT occupancy requirements, approximately 11.65% did not – even when accounting for single-occupant, low-emission vehicles (or hybrids), which totaled 5.75% of the traffic.

Caltrans concluded that XVPDS is a tool worth considering for both data collection and as a way to deter HOV lane violators. This system helps agencies make the best use of their existing infrastructure.

Need to know

Sophisticated data analytics can play a huge role in modern urban mobility projects

- The Mcity test center at the University of Michigan is reflective of a typical city street with sidewalks, construction obstacles, traffic signals, parked cars and pedestrians
- Xerox participated in the grand opening of the facility, along with several automotive heavyweights, and demonstrated solutions that can solve the transportation problems of today and tomorrow

A city-wide picture

Every day, millions of commuters use tickets, creating massive amounts of data about daily transportation habits. Xerox recently introduced an analytics platform that analyzes this anonymous data quickly and accurately, and presents the

(Opposite) **MAP provides a new city-wide picture of transportation operations, including adherence to schedules, passenger-loading levels and parking lot use** (Left) **Demonstration of the Xerox Vehicle Passenger Detection System at Mcity**

information with user-friendly graphics, making it easy for transportation and parking operators to better understand and predict commuter needs.

Xerox's Mobility Analytics Platform (MAP) provides a city-wide picture of transportation operations, including adherence to schedules, passenger-loading levels and parking lot use rates. Using data analytics algorithms and visualization technology, MAP can predict, for example, where passengers will alight and the impact of various factors such as running ahead or behind schedule, and the weather.

The Australian city of Adelaide, which has embarked on a 30-year urban development plan, is piloting MAP to improve its public transportation services by analyzing people flows between different sectors of the city.

Accelerating development

Xerox is involved in the research and testing of vehicles that can sense the environment around them and communicate with each other and infrastructure. Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications will enable safety, mobility and environmental advances that current technologies are unable to provide. The technology is estimated to reduce unimpaired vehicle crashes by approximately 80% (USDOT FactSheet).

July 20 marked the grand opening of Mcity – a 32-acre controlled environment specifically designed to test connected and automated vehicle and infrastructure technologies. Xerox is a founding partner in the University of Michigan's Mobility Transformation Center (MTC), a major public-private R&D initiative that aims to revolutionize the movement of people and goods in society.

Xerox demonstrated smart parking solutions, as well as its vehicle passenger detection system, and connected vehicle concepts. Simplifying the transaction collection process, integrating smart parking and fleet performance monitoring applications, and alerting traffic managers to road infrastructure issues, are a few examples of how Xerox could play a key role in the connected vehicles space.

In recent years, many cities have begun moving toward a multimodal system that enables seamless travel using multiple transportation modes, including bus, train, bicycle and motor vehicle, as part of the same trip. In addition, the use of new transportation modes, such as car and bicycle sharing, is growing steadily. As new, improved payment systems reduce the friction between transportation modes, this adoption will continue to increase. Cities are taking a more connected view of the many ways people get from place to place so that each mode can fill an optimal role in the overall transportation system. Such highly integrated mobility systems require comprehensive data collection.

As more pieces of a transportation system become integrated and unstructured data sources – such as cameras, car sensors and in-vehicle GPS – become readily available, transportation analytics will need to cover this diverse data ecosystem in order to release the potential of multimodal transportation systems.

Improving vehicle data with WIM technology

From strategic decisions for roadway planning, to transactional information for tolling, the quality of results from a decision-making process is dependent on the quality and quantity of the data available. Additional and high-quality data in a decision-making process enables roadway operators to maximize the return on the investment from the systems used to gather the information.

Weigh-in-motion (WIM) technology supplies vehicle and traffic data without causing interruption to traffic. These systems record wheel, axle and gross vehicle weights (GVW), and are able to calculate vehicle speed and classifications for traffic patterns and flow. Planners can incorporate this information into proposals for roadway construction and temporary or permanent enforcement sites.

At the core of these WIM systems are Intercomp's strain gauge strip sensors. Installed in a single day into a 3in-wide channel cut into an asphalt or concrete roadway, these sensors have a minimally invasive installation process, cutting the time needed for lane closures during installation while providing an accurate and durable in-ground means for weight detection.

Application configuration

Intercomp WIM systems are available for applications including data collection, screening for enforcement, pre-selection, bridge protection, tolling and ports of entry.

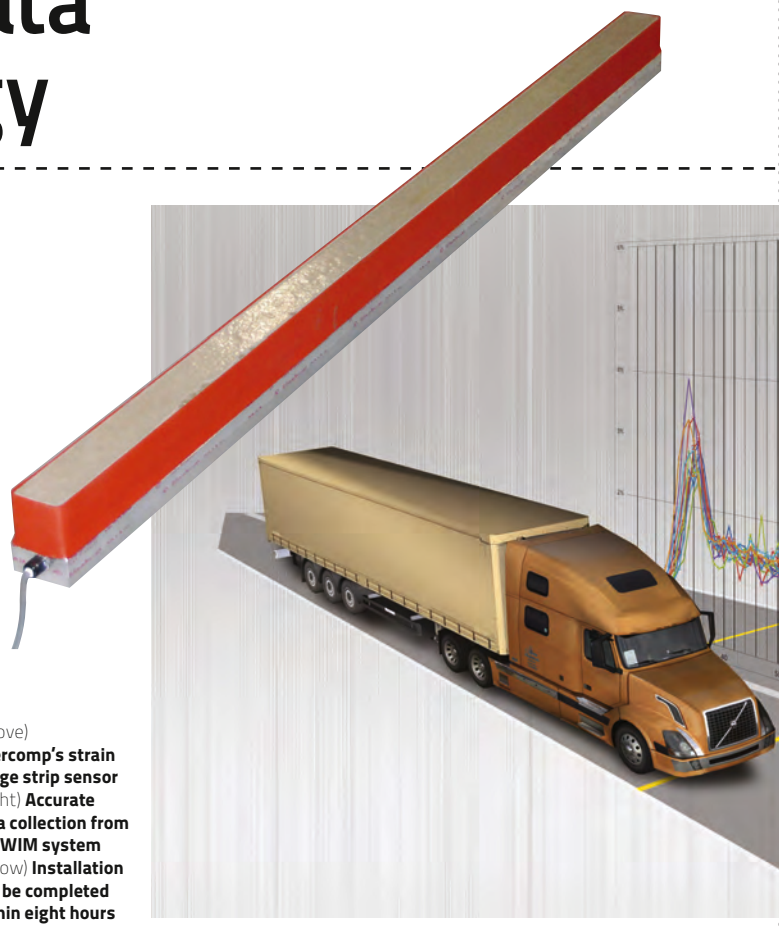
Locale-specific legal requirements demand certain accuracies from WIM systems, which stem from the ASTM (American Society for Testing and Materials) and COST (Cooperation in Science and Technology) standards adopted by many countries. Intercomp's systems and sensors are capable of meeting performance requirements for ASTM E1318-09 Type III and COST 323 A(5) methods, and can be paired with cameras and other equipment specific to the site and application requirements.

WIM applications requiring higher degrees of accuracy, such as enforcement and determination of weight-based fees, use multiple pairs of in-road sensors. WIM tolling, when integrated into automated toll systems, has the added benefit of accuracy without causing interruptions and congestion inherent in the types of processes that stop vehicles for fees.

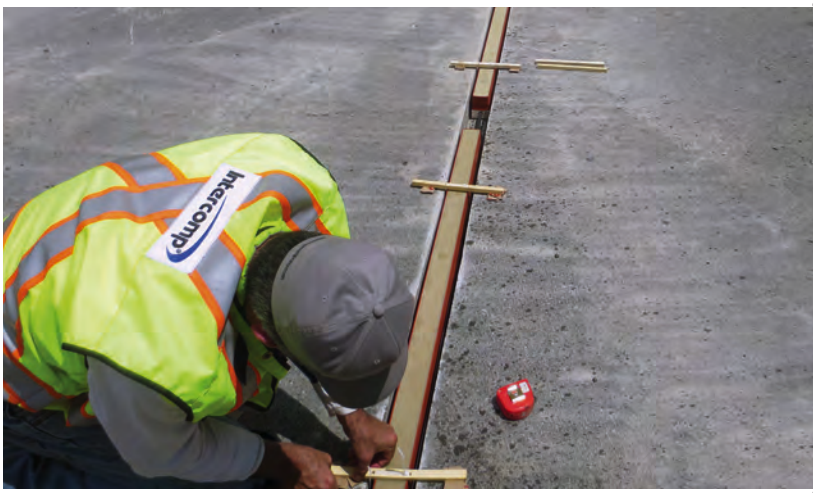
Need to know

WIM systems can collect vehicle data without interrupting traffic flow

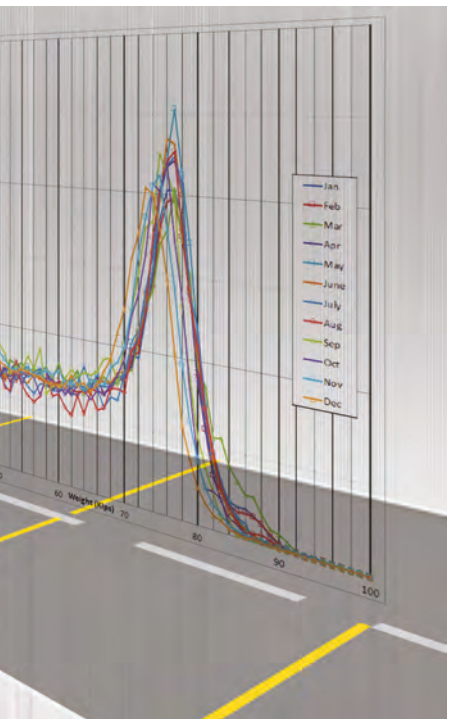
- With strain gauge strip sensors, temperature compensation is accomplished internally, generating consistent readings over a wide temperature range
- Stability of readings over time and temperatures is achieved, giving operators confidence in the data without having the system electronics compensate for variations in local conditions
- The strain gauge sensors have an operating temperature range of -40°F to 175°F (-40°C to 80°C), which enables operation in the harshest environments



(Above) **Intercomp's strain gauge strip sensor** (Right) **Accurate data collection from the WIM system** (Below) **Installation can be completed within eight hours**



Intercomp finds that four-sensor (two pairs) and six-sensor (three pairs) configurations are sufficient for most applications to deliver high-quality data without the need for the extensive civil works and system expenses associated with other WIM systems. The strain gauge strip sensors can be integrated into new or existing sites, and have the ability to interface with operators' current electronics and software. This gives operators the desired quality of vehicle weight data, with the flexibility to



deliver the data from the most efficient system configuration for the site requirements.

For data collection in mainline installations, typically a single pair of strain gauge strip sensors coupled with a loop, CPU and electronics are employed. As high degrees of accuracy are not required in data-collection applications, a single pair of Intercomp sensors will typically exceed the required accuracy at a wide range of vehicle speeds. Accurate vehicle data and overload frequency information improves the quality of data that the WIM site generates for further analysis.

by **J J Eden**

New technologies are driving innovation and changing business

There has been a lot of controversy lately surrounding several new industries that rely on new technologies in order to operate. How will these 'innovations' affect traditional transportation operations? How will we adapt – or can we?

Disruptive businesses are not new. Did you ever think movie rental magnate Blockbuster would go away? Well it did, due to the launch of video streaming services. Remember years ago when an unlikely startup challenged conventional shopping? Amazon, a company that started selling books online, changed one of the most traditional businesses models: shopping. Today, conventional bricks-and-mortar stores are struggling despite recent studies showing competitive pricing.

Now we see similar 'innovative companies' springing up in transportation. Companies such as the app-based Uber have exploded in popularity. Users like the convenience, and the ride providers like the income. Yet traditional transportation providers are fighting politically to keep market share.

Waze, a traffic reporting social media application is rapidly gaining popularity. Users really like it. Will companies such as Waze be disruptive to traditional intelligent transportation systems? How will interfacing with a cell phone in a vehicle fit with laws against distracted driving? I know that the Waze application specifically asks if you are driving, but could this become a legal issue? Can social media applications such as Waze reduce or eliminate the need for variable message signs and other intrusive and expensive traffic sensors?

Technological changes are not only driving new innovative businesses; they are also changing traditional ones. What changes will we need to make to adapt to the coming popularity of autonomous vehicles? How will these cars interface to the connected city of the future?

Even traditional payment systems are in danger. It is not just the 'younger generation' that are not carrying cash. The 'older generation' are shedding their traditional wallets, too. Technologies such as Apple Pay and Google Wallet are gaining popularity. Would you have believed even a year ago that you'd now be able to make payments with your watch? A year ago I had stopped wearing a watch because I had a smartphone.

Our challenge is not to fight innovation, but to find a way to embrace and integrate it

So what if all this innovation came together? Apple and Android phones are being integrated into vehicles, autonomous vehicles are now on the road, and BMW is building in an application that finds parking spaces. Your watch can now call for a ride or guide you on a walk. Now add applications such as Waze and Apple Pay to your car. Locate, start or even have your car pick you up with your watch. Pay your user fee, whether toll- or mileage-based, through your vehicle's built-in payment system.

All this sounds like the Jetsons but so did robotic vacuum cleaners several years ago. Our challenge is not to fight innovation, but to find a way to embrace and integrate it, leveraging existing commercial applications. Our business models are going to change. We either give our customers the technologies and service they want or risk being another Blockbuster.

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Modern audiovisual technologies for traffic management centers

The demands on the technologies installed in control rooms for traffic management and road traffic security are constantly increasing. This is especially true for the visualization and control systems that provide operators with an overview of the current traffic situation.

These days there is usually a team of operators from different institutions present in the control room to survey the signals coming from the cameras, as well as different management systems, emergency services and infrastructure systems. This improves the response times and cooperation of services in critical situations, as they can coordinate their activities more quickly and smoothly. Here, control centers rely on the latest technologies to handle the available information.

A modern visual display system is essential, so that all required data is represented in an appropriate way and all staff receive a comprehensive overview of the situation. This data can include camera signals, TV signals, live video and audio information from the emergency services in the field, tracking systems, interactive maps and management systems.

To handle this wide range of available signals in an intuitive and efficient way, the system should be carefully planned from the very beginning. It should also be future-proof and upgradable. A slight change in technology or the inclusion of a further task should not require refurbishment of the entire installation.

Network architecture

There are two major trends in AV technology that influence the equipment and design of control room upgrades, and new installations. One is the shift toward signal transmissions over IP networks; another is the availability of new display devices that provide certain advantages for control rooms.

For larger traffic control systems that include several control rooms and adjacent conference rooms, a graphic controller alone is often not able to manage all the input signals and connected displays. Complete systems that enable an uncomplicated installation, easy control and flexible expansion are necessary. The basis for this is the network architecture for the signal distribution, and the control of the video walls and single displays. This has to be

(Right) **An Eyevis video wall system handling more than 2,000 camera signals and more than 85 connected LCD screens in the Glasgow Operations Center**

Need to know

Sophisticated control-room solutions enable more efficient traffic management

- Eyevis's LED-lit slim cubes have a narrow installation depth, which enables their use in small control rooms where space is crucial
- With a lifetime of 50,000 hours, a nearly zero bezel design, absolute readiness for 24/7 operation and no danger of burn-in effects, DLP is the favorable technology for video walls
- Network-based signal transmission and control is the modern way to transfer video streams and other visual data. It makes systems much more flexible compared to old analogue or standard digital systems

adjustable and easy to extend as required. Moreover, an easy, real-time transmission of data via the network must be possible.

Where in the past there was a large display system that relied on a rack of graphics controllers that took the required signals and sent them to the video wall, today we have systems that rely on networked sources or a mixture of controllers and network streaming. This is the result of embedded systems such as OPS-compliant PCs that become more and more powerful, such as the Eyevis Processing Units (EPUs) used in Eyevis displays.

These displays, which have integrated decoding functionality, facilitate the display and management of several network streams without additional hardware. With ONVIF Standard S compliance, new camera streams can be integrated with a few clicks in the software settings. As a standalone solution, these displays enable the construction and operation of virtually unlimited video walls and display installations. The challenge is to bring them together in one system that controls and distributes the signals as and where required.

Through a sophisticated software solution, such as Eyevis eyeCON EPU-Wall functionality, several video walls and single displays can be interconnected into a single user interface beyond the limits of a single graphics controller.

The use of intelligent displays further facilitates the installation because, in addition to the electric cable, there is only a network connection required to operate the displays. This simple way of installing and expanding a system, without additional hardware, reduces infrastructure costs.

To make the system even more user-friendly, multifunctional keyboards, such as WEY Technology's Smart Touch solution, can further ease operation of the system. With a click of button, window layouts on the video wall or preset configurations to react to certain scenarios can be launched.

Cube technology

We live in a time when modern technology is not only assessed on its scientific or engineering capabilities, but also on its ability to perform high-power functions while simultaneously taking up as little space as physically possible.

(Above) **New slim rear-projection devices are the ideal solution for space-saving video walls**

Control rooms, for example, which are in operation 24 hours a day, often have a lack of space available. Traditional rear projection DLP (digital light processing) cube technology that is used in control room video walls has, on average, a footprint of 1.2-1.5m in depth. LED illuminated DLP rear-projection is the most suitable display technology when static graphical data is to be displayed for prolonged periods of time, for example when showing static maps or network diagrams, but some control rooms are too small to accommodate this technology and so it cannot be used.

However, the new Eyevis LED-illuminated DLP Slim Cube, the slimmest rear-projection technology on the market at just 422mm, will enable DLP rear-projection to be used on small control room video walls. When there is a choice between narrow bezel LCDs and rear-projection cubes, a sacrifice will no longer have to be made for the sake of space.

Crucially, the slim cubes can be directly wall-mounted with front access for maintenance. With all electrical, optical and electronic components, as well as the cooling system, integrated completely into a single closed projection unit, maintenance downtime is greatly reduced due to the ease with which the unit can be removed and reinserted. This, coupled with the incredibly slimline design, maximizes the space available, which is a massive bonus for smaller control rooms. The added space facilitates more flexibility with the design and layout of the room, permitting more room for other technology and operators.

Innovative approaches to reducing rush-hour congestion

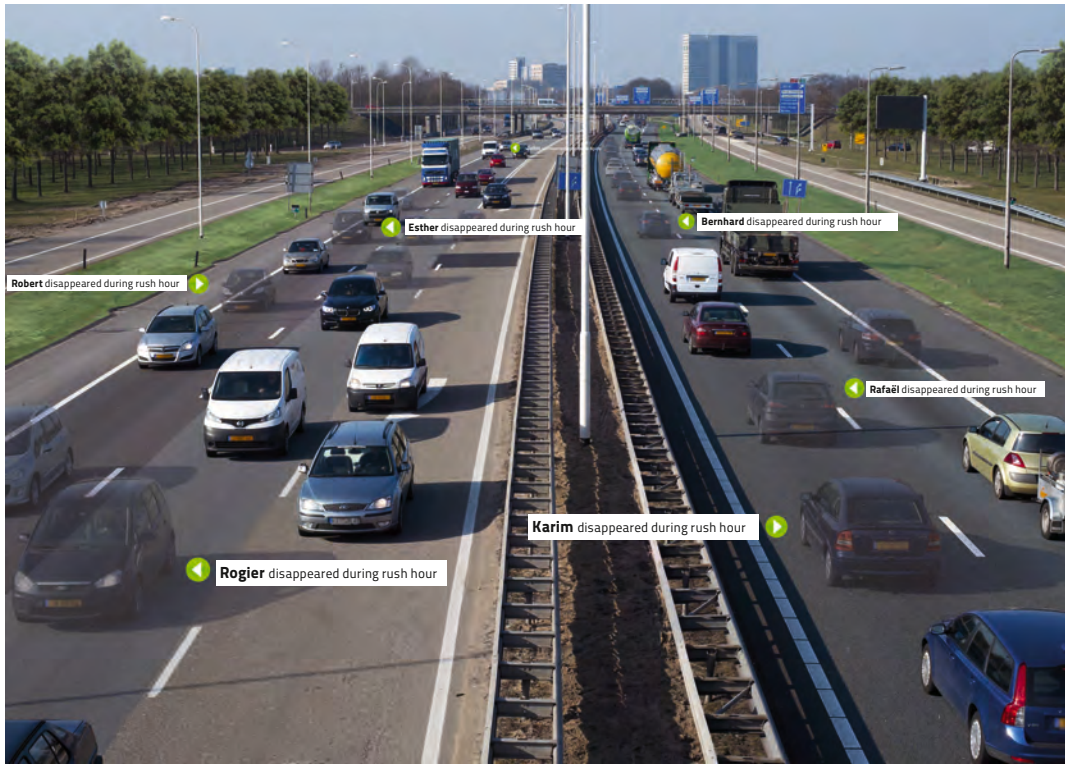
For many people, a work day starts with getting up and driving to work. In many cases this unfortunately means spending time in a traffic jam. Traffic jams are expensive; the global economic cost in 2013 was estimated to be approximately €800m (US$875m). In the Netherlands, people spend an average of 52 hours each year in traffic jams and this number increases annually.

Building more roads is one way to solve this problem, but that is very expensive. A proven and less costly solution is rush-hour avoidance (RHA) projects. Such projects have proven that commuters will change their driving patterns and thus reduce levels of congestion and pollution.

In the Netherlands, more than 75,000 people have reduced their rush hour trips by 40% by participating in such programs. Figures show that after one year, 80% of the participants have adopted changed behaviors as their new commuting habits. Rewarding avoidance with (real) money appears to be the key to positive behavioral changes.

Accessibility to the main economic centers is key for economic growth on both local and national levels. Over the past 50 years, and in line with the growth of transportation and number of cars, the Dutch government has substantially invested in new infrastructure. This resulted in 125 miles (200km) of highways in 1960 increasing to 1,100 miles (1,800km) in the mid-1990s. Unfortunately, the increase in congestion has followed a similar pattern and is still increasing today.

Since the end of the last century, the national government has introduced advanced traffic management systems to enable optimized use of existing infrastructure, such as speed management and use of hard shoulders during peak hours. These measures increase the available capacity substantially, but the economic loss due to congestion still increased from €300m (US$330m) in 2000, to €800m (US$875m) in 2013.



Time management

In addition to increasing capacity, it is understood that demand management should be part of the solution in creating an accessible network. Only a 24/7 balanced supply and demand of traffic and availability will result in a sustainable solution. That is why the national government, in addition to programs aiming at the optimization of capacity, also invests in the development of programs to influence the demand for infrastructure.

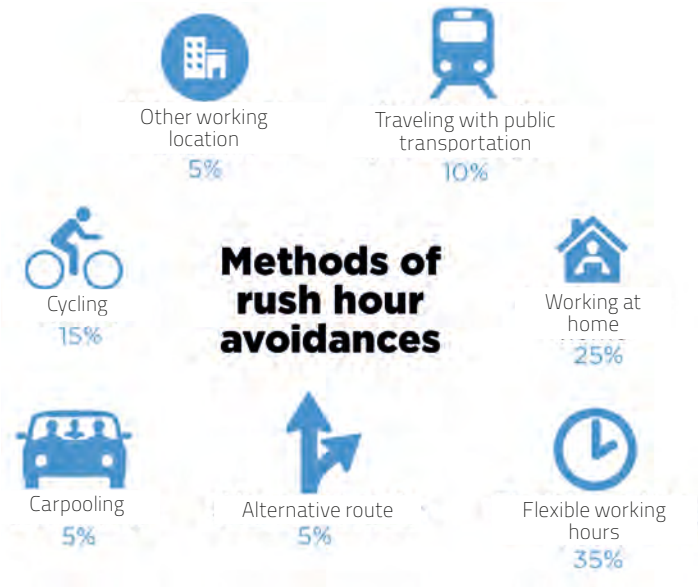
One of the first programs was a campaign aiming at creating awareness with employers that not all employees have to start their job at 9:00am and leave at 5:00pm; some could work from home or a 'flex office'. This resulted in more flexible working hours and flexibility in the location of the office.

Subsequently, commuters were made aware of alternative modes of transportation. Campaigns presented public transportation, carpooling or biking as convenient and cost-effective alternatives. These campaigns were supported by investments in public transportation infrastructure to facilitate the increasing demand.

Need to know

The Dutch government has been looking at new ways to change driver patterns and behavior

- ARH projects require special attention to privacy – all operators have to be registered at the privacy council and act accordingly
- This means removing data as soon as possible and not sharing any personalized data with external parties
- For sharing their data with the operator, participants will be compensated when rewarded for avoiding rush hours



(Opposite) **Individual drivers are rewarded for altering their driving patterns** (Above) **There are several ways to avoid rush-hour traffic** (Left) **The myJINI connector collects information about an individual's driving behavior**

Flexible working hours and alternative modes of transportation are essential for implementing Avoiding Rush Hours (ARH) projects. The idea is to encourage commuters not to drive during the morning and afternoon peak hours. Participants in ARH projects are rewarded when they don't drive during rush hours within a defined network or corridor. A personal budget, based on their personal reference level, is awarded to every participant. This personal reference level reflects the average number of trips during rush hours before entering the ARH project.

To define a reference level, ALPR cameras are installed along the highway prior to the start of the project. During a period of four to six weeks, all license plates are registered. Based on this data, the reference level per license plate is defined (for example four registered trips during a week). All measurements are anonymous. The license plates with the minimum required reference level or higher will later be linked to people through the national register.

All potential participants will receive a personal invitation to join the project. Based on the participant's reference, a personal budget is offered. For example, when avoidance is valued at €3.50 (US$3.80), a participant with reference level 4 will have a weekly budget of €14 (US$15.30).

If the participant accepts the conditions, he can join the program. By accepting the conditions, the participant also agrees to his driving behavior being monitored (on the defined corridor or network only). Every trip during rush hours will result in a €3.50 deduction from his available budget. If in the above example the participant does take a trip during rush hours, his reward for that week will be €10.50 (US$11.50), which will be transferred into the his bank account at the end of that week. The following week, the participant will again start with a budget of €14.

For defining the reference levels and monitoring driving behavior, ALPR, apps or an onboard units can be used. There are also different ways to reward behavioral change such as cash, credit on public transportation cards, loyalty points to be spent in a web shop, or compensating parking costs.

On average, participants in ARH schemes reduce their trips during rush hours by 40%. In the Netherlands it is proven that such schemes can reduce traffic by 5-10% during rush hours. This reduction is also the basis used for the business case. It enables future investments in infrastructure to be postponed, and reduces maintenance and losses due to congestion.

Personal incentives

The introduction of demand management as a service has also resulted in a change of responsibilities. The planning and contracting of the national road network was, and remains, the responsibility of the national government. This is not the case for demand management, which needs local knowledge about origin of demand. Therefore, 12 Dutch regions have prepared and executed regional programs aiming at better use of the existing infrastructure.

Acknowledging that ARH schemes cannot be sponsored for long periods of time, the regions also support the development of commercial services that contribute to reducing demand during rush hours. Instead of being a mere participant, the individual becomes a customer.

An example of such a new service is myJINI, a service provided by BNVMobility (a subsidiary of Egis, Brisa and NedMobiel). MyJINI offers an end-to-end smart mobility service for car drivers and includes a car insurance, gas card, access to public transportation, trip registration, and the management of mobility budgets. Linked to this service is a personal dashboard where the customer can gain insight into their driving behavior. Within myJINI, driving behavior is defined by two main parameters: what times you drive and how you drive. Based on individual performance, the customer can receive up to 30% cashback on his car insurance. The myJINI program therefore contributes to reducing congestion and helps companies reduce their CO_2 footprint and corporate costs for mobility.

Optimized traffic enforcement in the Middle East

Before deciding to replace the existing Swedish radar speed cameras on the six-lane Sheikh Zayed Road and other major traffic arteries, the Dubai Traffic Police conducted a number of tests and found Vitronic's PoliScan Speed product to be six times more efficient. Now, more than 50 Vitronic lidar systems – nicknamed Al Burj (The Tower) by motorists and media – have been installed. Their presence has notably improved the authorities' enforcement capabilities.

In addition to simultaneous speed enforcement of multiple vehicles across all lanes, the police can now automatically document vehicles that are tailgating or using forbidden lanes like the hard shoulder, which are two major causes of serious accidents in the emirate. According to official statistics, tailgating alone caused 586 traffic accidents in Dubai during 2014, resulting in 26 deaths and 446 injuries. The Dubai Police has also revealed that 11 people were killed in tailgating accidents during the first five months of this year. All in all, eight different violations will be documented with the new PoliScan systems.

PoliScan Speed employs unique detection technology called lidar (light detection and ranging), which sends out 15,000 laser pulses every second to scan the road. In contrast to radar systems, which use a comparatively thick lobe to measure, the fine high-frequency laser creates a highly accurate real-time image of the traffic situation, including the position, movement and shape of all vehicles within the detection area. This comprehensive view of the ongoing traffic situation enables PoliScan Speed to detect multiple violations at the same time: Is there a vehicle using the hard shoulder? Is the distance between these two cars safe enough for the speed they are driving? Is this truck keeping to the speed limit or using a lane that is reserved for passenger cars?

The area the system scans is wide enough to cover up to six lanes, thus making it ideal for multilane roads with heavy traffic. For the documentation of violations, PoliScan Speed

Need to know

Dubai has replaced its radar traffic system with a multifunctional lidar solution

- Lidar tracking technology enables authorities to enforce the major causes of serious accidents: speeding, tailgating and illegal lane usage
- PoliScan Speed collects photographic evidence together with other incident data such as measured speed, time and location
- More than 5,000 Vitronic lidar scanners are currently being used in traffic monitoring systems around the world

(Above) **The existing radar systems on Sheikh Zayed Road, Dubai, have been replaced with PoliScan speed** (Left) **The distinctive PoliScan systems are known as Al Burj (The Tower) in the Middle East**

has two high-resolution digital cameras that can take pictures in rapid succession, making sure all violations are reliably captured. The new PoliScan systems in Dubai also take additional video documentation of the traffic scene.

Iconic presence

In the Middle East region, the high-tech traffic enforcement systems are more commonly known as Al Burj. This is due to their distinctive appearance. Vitronic was the first to introduce a pillared housing design to traffic enforcement in 2008. The design has inspired imitation and given a new face to traffic enforcement in Dubai, Abu Dhabi, and many other places in the Middle East and around the world.

Often, the presence of Al Burj is enough to make motorists adhere to traffic regulations. 'The Tower' has become a symbol for the authorities in their determination to make the roads safer for everybody and has resulted in a notable and continuing reduction of road fatalities over the past several years.

"It is rare to have a product that is so recognizable that people give it its own name," notes Youssef El Hansali, CEO of Vitronic Machine Vision Middle East. "This is the ultimate confirmation of our philosophy to lead the industry, not only in measuring technology, but also in product design." ○

by **Larry Yermack**

The 25th anniversary of ITSA takes place at an exciting time for the industry

ITS America is 25 years old. That alone is an accomplishment, but wait, there's more. This June in Pittsburgh we had a big cake to celebrate the 25th Annual Meeting. Okay, so the anniversary was actually another day, but let's not quibble. It marks an important milestone, the welcoming of a new CEO and a fascinating confluence of the three streams of the industry.

Let me address that last point. For many years we saw the ITS business as having three components: infrastructure, automotive and consumer products. They all pretty much developed along their own paths with little interaction. The systems integrators developed traffic management, signal and traveler information systems for the DOTs. The car companies introduced new onboard technology as they developed it and the consumer products folks sold things like GPS mapping aftermarket devices. At conferences we had the car companies in one place, all showing up together or not. We had the consumer products folks participating on occasion, but they were much more interested in the annual Consumer Electronics Show in Las Vegas.

That left the field to the system integrators to develop for the state DOTs. The systems were standalone and did not make much use of industry standards. Today, that core Intelligent Transportation Society of America (ITSA) constituency is still acquiring systems but also integrating third-party data from consumer products companies, and coming to grips with autonomous and connected vehicles. It makes for an altogether more exciting industry.

At this recent annual meeting, Google announced that autonomous cars will go on sale in four years' time. It's not important if you believe it; what's important is that a consumer software company made an automotive announcement at ITS America. That's big time news and not a new version of adaptive control.

> "The point at which ideas become conventional wisdom is the trickiest to manage"

Into this enters a new CEO of ITSA, Regina Hopper. This is the first time since its founding that a CEO has started from a position of organizational strength. I'm not telling any secrets if I say that when Jim Costentino left, when John Collins left, and when Neil Schuster left, the field of replacement candidates was not huge. After Scott Belcher left, ITSA received more than 200 resumés – many more than in any previous search.

Out of that impressive field, Regina Hopper emerged. She takes over an organization with strength in all three constituencies in a country that increasingly looks to technology to solve problems. The DOT that depends on only asphalt is long gone, but can ITSA maintain and grow a leadership position?

The point at which ideas become conventional wisdom is the trickiest to manage and a small organization has even larger challenges. I wish ITSA well and hope that Regina's tenure brings it to even greater influence in our country.

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

From systems to services: smart mobility in the digital age

As a result of the shifting power base within the smart mobility sector, there is a requirement for a greater level of adaptable, accessible service provision. In response, Kapsch has developed a new focus, IMS (intelligent mobility solutions), which complements, but does not replace or displace, ITS. That, according to Peter Ummenhofer, VP, solution management, is an important distinction to make. Kapsch's new service provision capabilities will be very firmly rooted in the company's current and historical areas of expertise.

IMS, he explains, is a natural progression into an increasingly digital and interconnected world. It is one in which end users equipped with smartphones – and other smart devices – ask for integrated, easy-to-use mobility services and offerings that enable them to travel conveniently and efficiently from A to B using multimodal transportation.

"We see this as an important step, having expanded our activities from electronic toll collection [ETC] into other ITS areas such as traffic management and parking," he says. "We're reflecting the latest mobility trends – in particular the emergence of a new services-oriented business model, the convergence of applications, and connected vehicles. But we also want to reflect more general societal trends, including communities sharing resources such as cars, and urbanization, which requires smarter mobility solutions to cope with the demand for transportation.

"What we're seeing is more and more application fields and solution areas coming together," Ummenhofer continues. "There are two reasons for this.

Technology application is becoming broader as technology develops, and there has been a shift in power from operators and service providers to road users and other travelers, which has been facilitated by the arrival and proliferation of smart devices."

The influence of the latter cannot be underestimated, Ummenhofer feels. "Individuals now hold in their own hands the ability to decide what they want to consume, and when," he says. "Where previously a highways agency could pretty much dictate the terms of access and the information provided, this is no longer the case. That's why Kapsch has taken the decision to gear up to be an IMS specialist, enabling exceptional user experiences. The existing infrastructural models will continue to be relevant, however. That's why we're distinguishing IMS and ITS, while reinforcing the point that the two are very closely interdependent."

History driving the future

The need to diversify is encapsulated in Strategy 2020, Kapsch's blueprint for the coming years. The outcome of a series of workshops within the global management team over the previous months, it recognizes the effect that digitization is having on the world. It also recognizes that Kapsch is lacking some of the core intellectual property it needs to fully realize the philosophy of IMS.

Like its peers, Kapsch has been making strategic acquisitions that will facilitate both its realignment and its reaching into new geographical areas of interest. Buying Streetline earlier this year added

In-vehicle, we can expect to see the increased use of smart devices and embedded solutions

more than just a smart parking specialism, for instance. The move also brought with it a notable data analysis capability. The acquisition in 2014 of advanced traffic management system (ATMS) expert Transdyn also increased the company's data collection and manipulation capabilities. Work is going on in parallel within Kapsch's existing R&D teams to realize more fully the potential of concepts such as big data.

Through a combination of the two acquisitions and its existing RUC capabilities, Kapsch is able to make more of its presence felt in the urban environment. That forms one part of a progression, according to Ummenhofer. Another is an effort to realize how better to package data for external consumption.

"Our own data collection and fusion capabilities are already advanced, but they are very much geared to producing data for internal use by our customer organizations," Ummenhofer says. "There's a need to be able to make data accessible and easy to use by a far wider range of stakeholders, including other service providers, but also right down to the individual traveler level, and that will most likely drive some further targeted acquisitions.

"Exactly what form we'll take as an IMS services provider is still in flux," continues Ummenhofer. "We're not going to look to become another navigation service provider, for instance, as there are already too many in that space. Part of our IMS definition strategy has been to look at who our customers might be and how they might use our data. The natural starting point for us is spaces where we have a direct link to past experience like tolling, traffic management and parking. It will be about building 'bridges' connecting those traditionally infrastructure-oriented applications with end users.

"We also believe that we could be a natural partner for the automotive sector in the connected vehicle space because we have V2X/connected vehicle expertise, for instance, and the automotive OEMs will have to offer services to their end customers that are linked to infrastructure-oriented ITS applications. We'll continue to see toll authorities operating infrastructure, although the emphasis will shift. The in-vehicle side will see far more use of apps on smart devices, or software embedded in the vehicle itself as part of the infotainment solution."

That will require Kapsch to become far more adaptable and is the true distinguisher between ITS and IMS.

Need to know

Shifting trends in the transportation sector require increasingly sophisticated solutions

- Kapsch's historical expertise is as a developer and supplier of road user charging (RUC) systems based on dedicated short-range communication (DSRC)
- These solutions remain the most important part of the company at present, but application diversification has driven the need to push out technologically

Getting smarter and faster

"ITS is a business-to-business [B2B] or a business-to-government [B2G] environment," says Ummenhofer. "It's more of a solutions sector. IMS definitely needs links to ITS, but there are differences. The end-user is very much more in evidence. Compared with ITS, I'd say it's very much more about offering services.

"That can be both directly and indirectly. An auto manufacturer might offer a tolling or distance-based charging service that is supplied by us, but rebadged as part of the vehicle's own onboard systems, for instance. Kapsch might also be able to offer those services direct to the end-user via a smart device.

"That poses challenges for us as a company used to working in the B2B/B2G environment," Ummenhofer continues. "The consumer sector is much faster moving. If a customer – the consumer – doesn't like an app, it only takes a couple of clicks to choose another one. That focuses the mind rather sharply on becoming considerably more user friendly."

In terms of full delivery of the concept, Ummenhofer says there is still a way to go – hence the publication of Strategy 2020. "We're not there yet – 15 years ago, we were a pure ETC vendor, then we evolved into being an ITS provider," he explains. "There's still more to do in the ITS space – moving deeper into the urban sector with smart parking and ATMS, for example. But there are two aspects to this – addressing municipalities' needs and developing end-user applications. So the progression has to be seen as ETC into ITS, ITS into the city, and from there to IMS. By 2020 Kapsch will offer broad-spectrum ITS capabilities and will be in the IMS space. That will bring new customers and partners into our remit, such as mobile network operators and insurance companies, as well as local and transport jurisdictions. It's a big step, but it's entirely possible."

The technological evolution of license plate recognition

Over the past few years, automatic license plate recognition (ALPR) has become increasingly popular for tolling and access control systems. This is largely due to the fact that license plates are a worldwide identifier and are unique in each country. The competitive market for cameras, the latest optical sensors, and the generalized use of Gigabit Ethernet, have enabled this development.

The Tecsidel OCR Plus ALPR system is based on three pillars – the camera, the video server, and the OCR (optical character recognition) software.

Cameras play the lead role in identifying a vehicle and capturing a picture of its license plate. In order to do so, a camera must be equipped with a digital photographic sensor. The lens is very important for framing the target at the desired distance. For a free-flow system, lenses larger than 23mm are used; for stop-and-go solutions, 12-16mm lenses are used; and 6-8mm lenses are used for CCTV cameras.

The ALPR system must have a case or cabinet that is suitable for all weather conditions and must also have an integrated or external infrared light with a wavelength between 750nm and 850nm.

The video server guarantees the optimal parametrization of the cameras depending on the light conditions; the image resolution; the number of frames per second (fps) provided by the camera; the shutter time; gain; and the JPG comprehension level. The video server also monitors and controls the cameras. A number of cameras can be controlled by the video server, depending on the flow of pictures from each one.

The market for OCR engines has grown over the past few years. Most current libraries are based on OpenCV (open source computer vision).

(Above) **Monitoring cameras and statistics of OCR quality** (Below) **Distributed architecture from Tecsidel OCR Plus system**

Customized solutions

The Tecsidel OCR Plus system is based on flexibility and a distributed architecture. The system enables 'all-in-one' distribution, where the camera and the OCR engine are both placed on the same device. Although such all-in-one distributions are easy to install, the final system is costly due to the inclusion of OCR functionality on each camera. Tecsidel OCR Plus therefore recommends a more flexible configuration that balances the triad of performance, reliability and cost.

With a distributed architecture, certain shared functionalities, such as processing the pictures for OCR, as well as permanent storage, can be clustered together in a central system. A larger or more powerful processing unit can be used instead. With a distributed architecture, it is easy to scale the OCR engine resources required for the toll system. Furthermore, the traffic of heavy picture files is minimized since the files are sent direct to their final destination.

According to the needs of video enforcement, Tecsidel OCR Plus has been diversified so that it enables the coexistence of OCR and CCTV cameras under ONVIF protocol. The video system control has been unified.

Need to know

A flexible approach to ALPR-based enforcement promises optimized reliability

- Most OCR systems are based on automatic vehicle detection or autotrigger mode
- Video streaming is continuously analyzed by the OCR engine, which triggers an event when the license plate number is recognized
- Tecsidel's OCR Plus includes the autotrigger, but it recommends also using external AVC (automatic vehicle detection) systems to guarantee a reliable trigger regardless of the state of the license plate or the light conditions

Establishing new standards in multimodality

Transportation authorities all over the world are making it their duty to improve the accessibility of public transportation. Park and Ride (P+R) facilities play an important role in this. To enable authorities to accurately analyze the demand, quantity and placement of P+R sites, there are new functions available in the new PTV Visum 15 software.

"These features make it possible to evaluate the existing and future capacities of P+R sites," explains Johannes Schlaich, director of traffic software product management and services at PTV Group. "For example, you can determine how the demand is distributed along several P+R sites for each origin-destination relationship."

Whereas car drivers tend to prefer direct, more cost-effective routes, cyclists avoid overly strenuous or dangerous routes. Research results suggest that the overall slope on a route will have a notable impact on cyclists' path choice.

"To enable our users to model these events realistically, we have upgraded the stochastic assignment so that path-level impedance elements can now be reflected in the path choice," explains Schlaich.

Closing the gap

Commercial transportation is changing alongside the economy and society. It is a crucial aspect of urban planning, yet it is often represented simplistically and unresponsively in strategic models. In PTV Visum 15, the 'tour-based freight' module now closes this gap. This is a new demand model, specifically tailored to logistical needs in an urban context.

With the new module, users can integrate relevant logistics concepts into their strategic traffic models. They can differentiate by sector, and also by vehicle type, within each sector, such as HGV, car or scooter. As a result, they can obtain a view of commercial transportation for retail sales, craft activities or the care sector, for example, and adequately model the inbound and outbound traffic for each.

The new module is based on the savings algorithm applied in the logistics sector, whereby potential cost savings are evaluated by creating tours and defining their internal order.

"In PTV Visum, the savings algorithm ensures that the order matrices calculated by the generation and distribution step are converted into trip matrices that take into account connection trips with different levels of tour optimization in addition to outgoing and incoming trips," says Schlaich.

Furthermore, the scenario management tool has been refined to enable teams to collaborate even more closely. It is now easier for planners to exchange projects and use password verification.

Planners can also make their work visible externally. "Using the new General Transit Feed Specification (GTFS), planners can share data with the general public via Google Maps or with other planning systems," says Schlaich. "How much they wish to publish is up to them. In this way, planners can share certain parts of their public transport network – without losing ownership of their data."

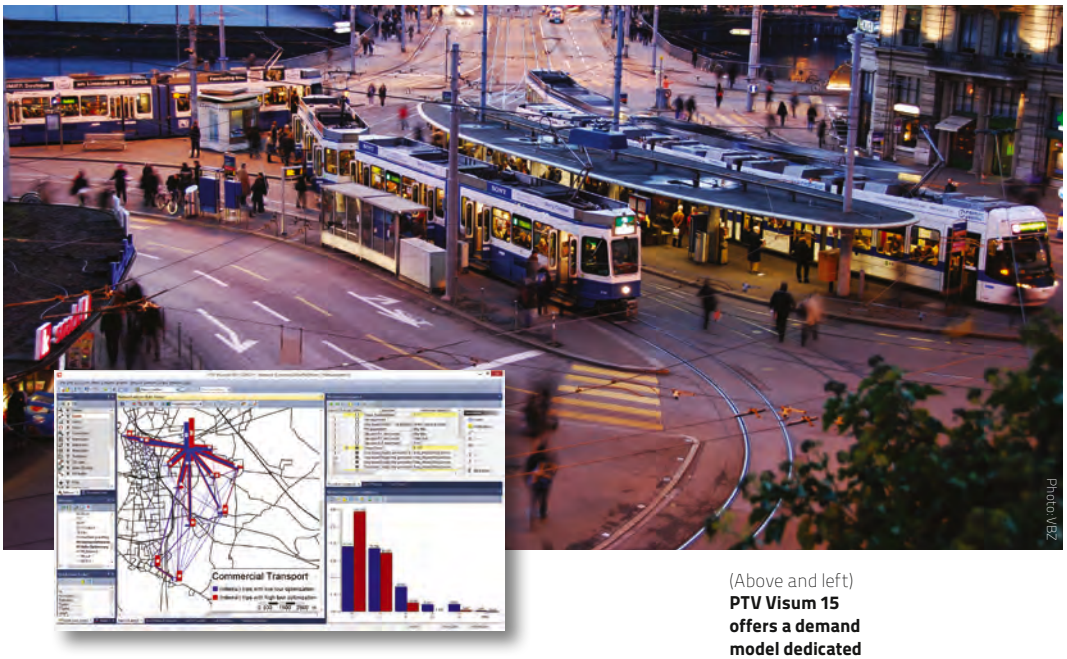


Photo: VBZ

(Above and left) **PTV Visum 15 offers a demand model dedicated to commercial transportation**

Need to know

New features in PTV Group's Visum software make transportation planning more effective

- PTV Visum 15 enables authorities to model P+R site capacities, consider path-level impedance elements, model commercial transport in a well-defined demand model, and share models and data with colleagues and the general public
- Transportation experts use PTV Visum to model transportation networks and travel demand, analyze expected traffic flows, plan public transport services, and develop advanced transportation strategies and solutions

New electronic screening system improves safety and efficiency

The Oklahoma Department of Transportation (ODOT) recently found it necessary to update its commercial vehicle enforcement operations. Facilities were getting old, were not ideally located and were unable to deal with increased truck traffic on the state's major highways. With Oklahoma's infrastructure at risk, ODOT decided to invest in new, technologically advanced facilities that would enable cost-effective screening of all commercial vehicles.

International Road Dynamics (IRD) was selected by ODOT as its technology solution provider and has commissioned two electronic screening systems (ESS) with a third system currently being deployed. These systems provide optimized commercial vehicle electronic screening and enforcement at the ports of entry (POE) into the state. The systems leveraged IRD's expertise as a system integrator by integrating multiple sensor and machine vision technologies with state-of-the-art operational control centers and back-office systems for credential validation.

WIM and static weighing

The mainline lanes use double-threshold IRD-PAT Bending Plate weigh-in-motion (WIM) scales for weighing trucks at speeds of up to 80mph (128km/h), providing accuracies typically within 3.5% of actual gross vehicle weight (GVW).

Message signs and, for those trucks so equipped, active transponders direct individual trucks to either 'report to' or 'bypass' the weigh station. Reporting trucks are re-weighed and re-sorted at a lower speed ramp system, also using double-threshold IRD-PAT Bending WIM, providing accuracies typically within 2.6% of GVW. Trucks with no axle spacing or WIM violations, a clear credential record, and that have not been selected for a random inspection, are directed into the static scale bypass lane. All other trucks are directed to the static scale.

Weighing commercial vehicles at the static scale is a fairly easy but repetitive task, which presented an opportunity for partial automation. IRD AutoWeigh automatically directs trucks on and off the static scale, checks the truck weights and credentials, and alerts enforcement officers in the event of a violation. This feature is designed to operate with officer supervision and, as such, the officer can take control from the AutoWeigh system at any time. If an officer does not intervene after a predetermined time, trucks are directed to exit the facility. This enables the truck queue to keep flowing in all circumstances.

Screening

Two laser scanners mounted above the mainline detect over-width trucks and operate in conjunction with over-height detectors. Oversized commercial vehicles are identified and if they do not have an associated oversize or overweight permit they are directed to report to the station, where officers can initiate further inspection.

In addition to screening commercial vehicles for size and weight violations, the ESS captures license plate and USDOT number data from trucks traveling at highway speeds in all conditions. This data is compared with an on-site state and federal credential database to identify trucks with a poor safety history. Operators can adjust ESS safety thresholds and thus automatically have trucks exceeding these thresholds identified. Other checks, such as current registration and insurance, are done at the same time. Any commercial vehicles exceeding operator set thresholds are then directed for additional inspection.

(Left) **Laser scanners measure vehicle width**
(Above and right) **Double-threshold IRD-PAT Bending Plate WIM scales**

Need to know

The truck screening system in Oklahoma has undergone a major upgrade

- The purpose of the ESS is to better focus limited resources on potentially high risk or non-compliant commercial vehicles
- The ESS allows trucks with compliant weight, dimensions and credentials to bypass the POEs at highway speeds, thereby reducing the number of trucks that are required to stop at each inspection station
- With fewer delays at these facilities, compliant carriers save time, while safety and efficiency is improved, and greenhouse gas emissions are reduced

Reporting

All data from each of the ESS systems is to be merged into an enterprise reporting system. The system then makes the full data set available for monitoring or analysis on a daily, weekly, monthly and annual basis. This system enables ODOT to monitor real-time operations via custom dashboards and investigate commercial vehicle and operational trends to help optimize ESS operations.

To ensure that the ESS provides a high level of availability, an automated maintenance online management system is also being provided. It provides a dashboard display that interfaces with ESS equipment and auto-notifies ODOT and IRD service staff of any changes to equipment operational status. The system also has workforce and inventory management components to automatically create work orders for scheduled and corrective maintenance while managing spare part inventories.

by **Don Hunt**

The biggest challenges facing western road authorities today

It's not easy to be part of a senior team in a road authority in the western world, dealing with trends that include a decline in per-capita driving, emerging travel alternatives such as web-enabled ride sharing, and funding uncertainty. Yet there are consistent trends in any future scenario that can be imagined. The largest risk is to do nothing. Public bodies are notoriously slow to react and ignoring the rapid technological changes all around will be devastating to the credibility of transportation agencies.

In this new series of columns, I will draw on my experience as director for Colorado DOT to look at emerging trends in the era of transportation connectivity, big data and automation, and what agencies should do to react to them. First is the new era of traffic information.

DOTs have long had relationships with the private sector, especially in engineering and construction. Now is the time to extend those relationships to a new industry sector – traffic data companies, who compile data from consumer and fleet vehicles, as well as mobile devices, and provide real-time data services to public agencies. Florida DOT (FDOT) and Waze recently entered into a data-sharing partnership that cross-licenses traffic data between the two entities. FDOT will share its traffic incident and road closure data with Waze, and Waze will share its traffic speed and incident data with FDOT. This is a great example of a public-private partnership that will extend FDOT's capabilities in dealing with big data sets.

It's reasonable to say that the future sophistication of private data analytics will outstrip the ability of public transportation departments to keep up with traffic data reporting. Furthermore, companies will be developing original manufacturer and aftermarket systems that reside on vehicle dashboards that will outperform information disseminated by DOTs. DOTs will continue to collect specialized traffic data and operate cameras on heavily traveled routes. But the era of road authorities as traffic information reporting entities will disappear in the next decade.

It will not only be about phasing-in new technology, but also about phasing-out the old. Authorities should be cautious about investing in internet-based traffic reporting systems, fixed variable message signs (VMS), or telephone-based information systems (511 in the USA).

> Partnerships with the private sector for data reporting to consumers will yield a better ROI

If consumer traffic data reporting is moving to the private sector, the information will not only find its way to smartphones, but also to car dashboards; it is unwise to continue to invest in traffic information reporting systems that will be obsolete within years. Partnerships with the private sector for data reporting to consumers will yield a better return on investment. With smartphone penetration in the USA at 67% and growing, fixed VMS are a questionable investment. It's also time to evaluate the value of the 511 traveler information system. It probably uses resources that could be better deployed.

There are exceptions to this overall recommendation. For example, actively managed express lane corridors will continue to need a range of dynamic signing to enable safe and effective operations. But an overall strategy for evolving traffic management capital investments is needed now.

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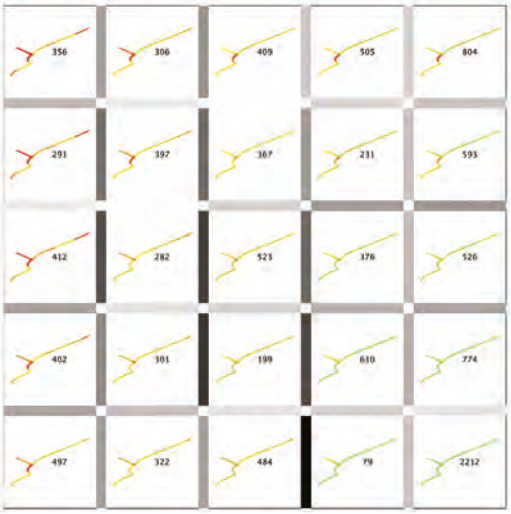
A self-learning system optimizes active traffic management

Reliable identification and prediction of traffic situations are crucial for intelligent traffic control and active traffic management. With static traffic lights, for example, green times are designed around a best possible compromise for all relevant traffic situations. When adaptive traffic control schemes are in place, optimal green times for each relevant traffic situation have to be found.

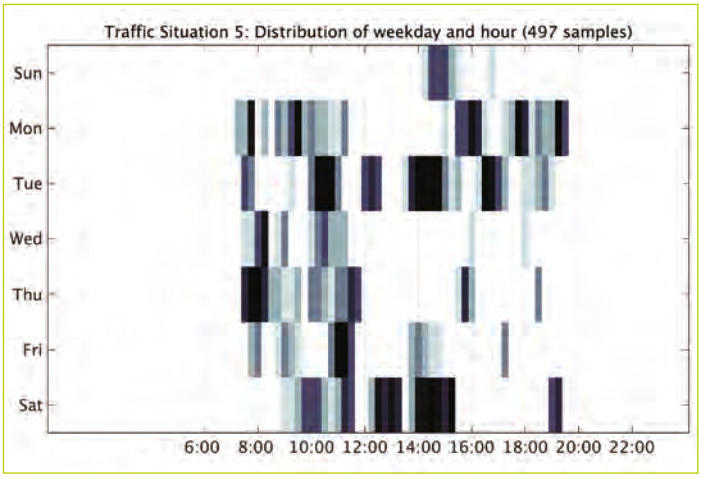
What are the 'relevant' traffic situations and how can they be identified? Too often, misidentification or consideration of non-relevant situations at the design stage cause sub-optimal green times or unnecessary system complexity. However, researchers and engineers at Andata – an Austrian R&D company – has developed and implemented a new, self-learning method, which can automatically and autonomously identify the relevant traffic situations of particular streets, crossings, road networks and even complete city sections. This is done by considering all kinds of traffic information, from floating car data (FCD), to static traffic sensors, to virtual sensors, or a combination of any of these. The information is put together using special metrics, before artificial intelligence is used to automatically cluster and sort it into a catalog of real-life scenarios that occur at the investigated region.

Exemplary results can be seen in Figure 1. Each of the boxes represents a separate traffic situation and the traffic situations are sorted by similarity. The box in the lower right corner shows a situation with very low traffic in all directions. The upper left box shows high traffic volumes in most directions. All boxes in between represent traffic situations of various volumes as they appeared in the investigated time period.

Timestamps and other available data are also recorded for each situation. This information can be used to analyze the potential circumstances that lead to the observed situation.



(Left) **Figure 1. Resulting catalog of actually observed traffic situations. Green is traffic with low density, red is dense and only slowly flowing traffic**



(Right) **Figure 2. Frequency evaluation showing when and how often (shade of grey) a certain traffic situation occurs**

Figure 2 shows the times and frequency of one of the observed traffic situations.

Dynamic control

An intelligent traffic control system must, at least, be able to identify and manage the most common and critical situations. Once such a situation is detected, an appropriate action, such as a dedicated phase coordination plan with optimized green times, has to be triggered. These actions are either developed offline in advance, or the implemented control algorithm must be able to find the optimal green times online in real time.

The described solution is available at Andata as a service, as well as individual software, which can be plugged into a traffic management system. ○

Need to know

Intelligent traffic systems rely on accurate data and real-time monitoring

- The Andata system can also be used for anomaly detection (such as traffic situations that have never been observed before)
- In such cases, the system identifies the traffic situation as a new one, initiates the search for optimal green times (online or offline) and afterwards adds the situation, with the appropriate action, to the catalog of relevant scenarios

Using technology to reduce street noise in urban areas

Noise reduction is an important consideration for operators of urban streets. Numerous studies have shown that excessive noise can contribute to illness, such as problems with the circulatory system and the brain. Noise can be reduced if drivers can be encouraged to adopt more appropriate driving behaviors.

To help solve the problem, German company RTB has connected two of its successful products – the Dialogue-Display and the TOPO classification system – using the combined technologies to reduce street noise.

The Dialogue-Display provides a friendly and personalized communication

(Above left) **TOPO device using the FSK process** (Above right) **TOPO device without FSK** (Below) **RTB Dialogue-Display in French**

that drivers cannot ignore. If the speed limit is observed, the driver receives a 'Thanks!' in green LED letters. If the speed limit is exceeded, 'Go Slow!' appears in red letters.

Several studies have shown that the Dialogue-Display permanently reduces drivers' speeds, making it an essential contribution to road safety. The Dialogue-Display is available in different sizes, variants and extensions. The motifs can be tailored for individual purposes.

TOPO is a classification system with four classification options. The first type can be installed on a mast at a height of 250cm and can be used as a permanent counting station. The second type is integrated into a small box that can be installed by the side of the road. It can be used in a variety of ways to classify passing traffic. The third option is to integrate the TOPO system into a standard guide post. It can be installed on roads outside city limits and does not affect the appearance of the street.

There is also a laser-based option. This system can measure the length and speed of a vehicle and is able to detect partially or totally masked vehicles. It uses multibeam lidar sensors that detect vehicles from the side of the street.

Recent improvements now see the TOPO device using the FSK (frequency shift keying) process. This is a distance measurement of moving objects whereby the distance between the census device and the vehicles can be obtained. The main advantage is that it is not affected by reflections. This makes it possible to expand the application of classification devices to locations that have reflective infrastructure such as guard rails. Furthermore, the rate of detection in urban locations can be optimized.

Trial success

Studies conducted by the Technical University of Munich and DEKRA Bielefeld have shown that choosing the correct Dialogue-Display message not only leads to speed reduction, but that drivers also shift to a quieter gear. A combination of the Dialogue-Display and TOPO – integrated into a guide post, for example – is a good way to make noise reduction transparent. In this way, it is possible to achieve an exact measurement of noise and an accurate classification of vehicles. This device combination has, for example, already led to noise reductions of 8dB at highways highly frequented by motorcycles.

Need to know

A combination of dynamic signage and vehicle classification successfully impacts driver behavior

- RTB's TOPO system has received BASt-certification from the German Federal Highway Research Institute (Bundesanstalt für Straßenwesen, BASt) and is now being tested extensively
- TOPO classifies vehicles based on their length and the distance between axles in the 4+1 vehicle classes: bicycle, motorcycle, passenger vehicles and trucks
- It is possible to store data for up to 500,000 vehicles. Optionally, this data can be transferred for further processing via GSM or Bluetooth interfaces

Brazil opts for advanced speed-enforcement technology

In anticipation of hosting the 2016 Summer Olympic Games in Rio de Janeiro, Brazil, the National Department of Infrastructure of Transportation (DNIT) began looking to make country-wide infrastructure improvements to the traffic management and enforcement presence. The authority realized that vehicular traffic would not only increase exponentially during the two weeks of the event, it would also increase in the two years leading up to the Games, due to contractors, coaches and competitors preparing for the event.

A decision was made to test new methods for speed enforcement in the São Paulo area before moving the new technologies to Rio and surrounding metropolitan areas.

To facilitate a possible solution, the Ministry of Transportation sent out to bid in late 2013 for traffic enforcement capabilities. The ministry was looking for reliable speed measurement integrated with a digital camera that offered the following characteristics: a compact size with all components to fit in a self-contained enclosure; low power consumption for solar panel use; GPS for the location of the enforcement infraction; wi-fi for setting up parameters and maintenance; 3G/4G transmission capabilities for cellular data and image transfer; night-time functionality; and a solution that is easily mountable on poles to conserve valuable gantry space or VMS real estate.

Need to know

Laser-based enforcement will optimize traffic management during the 2016 Olympic Games

- LTI's laser sensors can measure speed, height, length, and vehicle spacing, giving authorities the information needed to classify vehicle types, compile vehicle quantities, and determine traffic density based on speed and spacing
- The LTI TruCapture accurately captures enforceable speed readings at close proximities using an elongated laser beam that can cover the entire width of a single lane

One of the bids returned caught the ministry's eye. It was for a system called the TruFix from Laser Tech Brasil. Laser Tech Brasil had been called upon in the past when the ministry put out a tender in 2006 for equipment that could capture speed readings from a handheld device, as well as the image of the violator.

Advanced solution

Laser Tech Brasil has been a partner of Laser Technology, Inc. (LTI), USA, for many years. It took the LTI 20/20 UltraLyte unit, added a camera and data collector to it, and designed the first Laser DigiCAM system. This product ended up successfully working for police agencies throughout Brazil for accurate speed detection, along with a captured image of the violator, their speed and their GPS location. This served the law enforcement community well, and with the advent of the Laser DigiCAM successor, the TruCAM, Laser Tech Brasil has had much success in meeting the needs of police agencies throughout the country.

(Main) **Trufix units have been permanently installed throughout São Paulo**
(Left below) **Speed violation detected by the Trufix system**

The project at hand, which called for a permanently mounted speed-enforcement tool, was also solved by Laser Tech Brasil with the TruFix system. Scattered throughout the São Paulo region at a height of 4.5m and with a capture distance of 40m, the TruFix system is successfully enforcing speeds and driving behavior. It will soon make its way to Rio de Janeiro and surrounding towns in the period leading up to the 2016 Olympic Games.

The TruFix unit, designed by Laser Tech Brasil, uses the TruCapture laser sensor recently developed by LTI. The sensor projects a cone-shaped laser beam, giving it the ability to successfully monitor the full width of a lane with no obstructions, assuring the integrity of the speed reading.

Turkey invests in modern traffic management solutions

Istanbul's Fatih Sultan Mehmet Bridge, also known as the Second Bosphorus Bridge, spans the Bosphorus Strait to connect two continents – Asia and Europe. The bridge carries approximately 400,000 vehicles every day. Last year, a multilane free-flow (MLFF) toll collection system was put into operation on the bridge by Aselsan. The aim was to provide a highly accurate solution that would not interrupt traffic flow.

The Aselsan MLFF system, which covers five lanes and an additional emergency lane, is one of the widest free-flow gantry structures in the world and it achieves very high accuracy rates. The system was designed to replace and assume the functions of conventional plaza-based toll collection systems, including multi-subsystems and multitask structures.

Lane-free vehicle detection has been achieved with: overlapping laser curtains to detect vehicles; cameras and lighting modules to capture vehicle license plates; DSRC antennas for ETC tag detection; underground fiber-optic sensors and control units for vehicle classification and axle counting.

One of the main challenges encountered during the project was the high traffic density, which results in stop-and-go traffic at peak hours. The system's advanced capabilities for detecting and separating vehicles makes it possible to accurately detect and toll each vehicle in these conditions.

The success of the project has led to a decision by the Turkish General Directorate of Highways to replace all existing plaza-based toll collection systems in Istanbul with Aselsan MLFF ETC systems by 2016.

(Left) **The Fatih Sultan Mehmet Bridge in Istanbul** (Below) **Aselsan's MLFF system in action**

Need to know

Advanced traffic management and tolling systems are improving Istanbul's roadways

- Aselsan has delivered more than 1,000 toll collection lanes to various customers around the world, servicing more than 10 million ETC/contactless card subscribers
- The company aims to provide innovative and reliable solutions that enable integrated traffic control and uninterrupted traffic flow, which could eventually create added value for the economy, improve traffic safety, and benefit the environment by reducing carbon emissions

Intelligent management

Aselsan has also implemented a traffic management system in Istanbul that improves traffic safety using traffic sensors, road weather information systems (RWIS), travel time measurement, traveler information systems, and a CCTV system comprising more than 70 PTZ cameras at critical sites. All system units are controlled via the video wall in the traffic management center.

(Left) **Istanbul's traffic management center combines information from sensors, RWIS and CCTV to improve safety and optimize flow**

The company has also recently been contracted to provide an active traffic management system (ATMS) for the 40km Gebze-İzmit section of the Istanbul-Ankara highway. This section of highway is known for heavy traffic, an insufficient number of lanes, and high incident rates.

During the project, the highway section will be equipped with two traffic management centers, a camera surveillance system with 100 cameras, 12 speed enforcement systems with automatic license plate recognition (ALPR) capability, 50 variable message signs, 200 variable traffic signs, six RWIS, and 60 video-based traffic flow sensors.

The system's distinctive function is to determine the optimum traffic scenario based on system measurements through a simulated environment. The system suggests speed limitations and lane-management guidelines, which are displayed to drivers via VMS and traffic signs. The system also optimizes traffic flow by using ramp metering to limit access from junctions.

Optimized efficiency on China's toll roads

In March 2014, the Ministry of Transport of the People's Republic of China announced that the electronic toll collection (ETC) systems in 29 provinces would be integrated by September 2015. Following the integration, all ETC users will be able to use their existing tags to travel across various expressways within these provinces. Toll collection will be expedited and congestion at toll lanes will be greatly reduced.

Although toll fares are collected for more than 100,000km (62,140 miles) of expressways across China, the ETC systems are not integrated and thus are not interoperable. When crossing a province, ETC users are required to switch tags or pay with cash. There are also several incompatibilities among the various ETC systems. In this nationwide integration, many ETC facilities will be upgraded and standardized. In addition to aiding interoperability, the initiative will also increase ETC coverage within the country.

By September 30, 100% of inter-province mainstream toll plazas will provide ETC, with 90% of toll lanes supporting the technology. The integrated national system will serve more than 20 million road users, via 10,000 ETC lanes.

ETC integration

The ETC system uses DSRC 5.8GHz technology with a two-piece electronic tag, incorporating a dual-interface central processing unit smartcard that holds the electronic purse. This approach has enabled a seamless coexistence of manual and electronic toll collection. At ETC lanes, road users pass through without stopping. At plazas that do not provide ETC, road users detach their smartcard from its onboard unit and use the e-purse by touching it on a contactless reader at the toll lane. As well as the ISO 14443 TYPE A/B compliance interface, the smartcard has an additional contact interface that complies with ISO7816. This is a highly secure framework for e-purse top-up.

The vehicle throughput of an ETC lane has always been the main design criterion. Conventional ETC lanes use a 0.6 or 0.8 second automatic lane barrier (ALB). Theoretically, vehicles could pass through at 6-9mph, but due to worries about smashing into the slow ALBs, actual vehicle speeds and throughput at ETC lanes are much lower. They are therefore highly vulnerable to congestion.

Ultra-fast ALBs, which deliver an opening/closing time of 0.3 seconds can be used to resolve the bottlenecks caused by conventional ALBs. Currently, the most widely adopted ALB is the Transpeed A3D, a double-boom ALB that comprises a 1.5m lightweight carbon boom on each side of a lane. When a driver is detected in the 5.8GHz communication zone, the superfast ALBs are opened almost at the exact instant the ETC tag is activated. Drivers can confidently maintain their speed and drive through the lane without having to wait for the ALB to be lifted.

Field tests conducted on fast ETC lanes equipped with Transpeed A3D show that a pass-through speed of 25mph can been comfortably achieved. This almost doubles vehicle speed and increases the throughput of a conventional ETC lane by two to three times.

(Above) **Variable message signs advise drivers about the ETC system**

(Above left) **Ultra-fast ALBs optimize traffic flow through ETC lanes** (Left) **The Transpeed OBU**

Need to know

An integrated approach to ETC will facilitate interoperability and reduce congestion

- Many ETC lanes in China are now equipped with ultra-fast ALBs that have an opening/closing speed of 0.3 seconds. These increase lane throughput by two or three times, compared to conventional automatic lane barriers
- Integrated automatic license plate recognition (ALPR) systems are also widely adopted
- With faster ETC lanes, the latest LED-based toll fare indicator (TFI) has been broadly adopted to optimize user experience

Express lanes

Your shortcuts to the biggest and most interesting stories in this issue – and beyond!

"We believe that this transformation to connected and automated mobility will be a game changer for safety, efficiency and energy"

Peter Sweatman, director, Mobility Transformation Center, University of Michigan

Watch the video at trafficTechnologyToday.com/mcity

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"Automation is not the solution to everything. If automated highways were to lead to a shift from rail to road, the result would be more congestion, pollution and an uncertain effect on safety. Automated road transport systems will need to remain last-mile solutions to complement existing collective transport"

Adriano Alessandrini, project coordinator, CityMobil2

Read the full story at trafficTechnologyToday.com/citymobil2

"Many forces are at work that are driving us to be more fuel efficient, to use less gas while we continue to use the roads just as much – or more"

Adrian Moore, VP, Reason Foundation

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"If I were to write a list of 20 people that I would really like to talk to in the industry, I can be pretty certain that 18 of them would be in Bordeaux"

Eric Sampson CBE, senior advisor, ERTICO – ITS Europe

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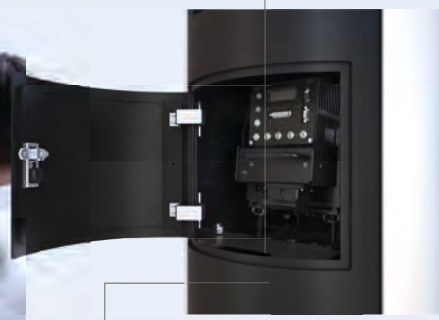
Vehicle application



Stationary application in TraffiTower 2.0

Container application

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