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Shailen Bhatt, president and CEO, ITS America

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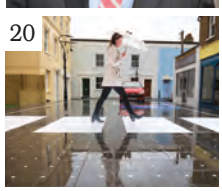
Cover story

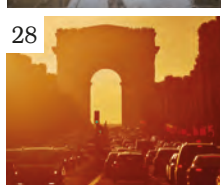
# 36 Single camera solutions

## Smart software is enabling ALPR data to be extracted from conventional cameras

Jan Stojaspal looks at how police are benefitting from the systems and considers their viability for traffic management applications




## Technology Profiles








# Editor's letter


I'm currently in the process of selling most of my CDs and DVDs. A vast collection built up over many years, now rendered virtually worthless by streaming services. Some CDs still command a few pounds, although most are valued in pence. The depreciation of DVDs is even more startling – many popular films of the last 10 years aren't even accepted by the online bulk-buying merchants, their value is so low.

Looking beyond the realm of home entertainment, countless products, services and industries are being transformed by virtualization. But what impacts will 'downloadable everything' have on traffic management? One interesting new development – camera-agnostic ALPR software – is investigated in our cover feature. Just as music can be easily and instantly accessed using software, so those wishing to identify highway traffic accurately can now do so using downloadable solutions that tap into existing roadside CCTV video streams. Can such systems ever match dedicated cameras for quality and durability? Turn to page 36 for more on the state of play.

Another exciting area of change in the industry is the continued convergence of traffic management with automotive manufacturing. For nearly three decades those involved in ITS have been clear about the value of engaging directly with car makers to enable the seamless integration of systems. But only recently has this dream started to become a reality. It first came into sharp focus in 2014 when the ITS World Congress visited Detroit and the OEM decision makers there began to take notice. Testament to this new era of cooperation is the fact that, just four years later, another major ITS event – the ITS America Annual Meeting – is returning to Motor City.

It's one of the subjects ITS America's new president and CEO Shailen Bhatt touched on when I interviewed him a few weeks ago about preparations for Detroit (read more on page 14). He was also vocal about the need for technology to be used as a means to improve safety, reduce congestion and make tax dollars stretch further than ever before. Which technologies should we use? Whichever work and are available right now to improve safety. Bhatt is clear that saving lives today is more important than worrying about which technologies will still be around and working tomorrow.

As OEMs become more heavily involved with ITS, it's exciting to think about what new technologies and plans they will reveal in Detroit in June, and in the coming months and years. I also can't help wondering how long it will be before they completely phase out in-car CD players.

**Tom Stone**
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*Traffic Technology International* USPS 012-893 is published bi-monthly – in January, March, May, July, September, and November by UKIP Media & Events Ltd, Abinger House, Church Street, Dorking, Surrey, RH4 1DF, UK. Airfreight and mailing in the USA by agent named Air Business Ltd, c/o Worldnet Shipping USA Inc, 155-11 146th Street, Jamaica, New York 11434. Periodicals postage paid at Jamaica, New York 11431.

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





UKi MEDIA & EVENTS

**Published by UKi Media & Events, a division of UKIP Media & Events Ltd**

**Member of the Audit Bureau of Circulations**

Average net circulation per issue for the period January 1-December 31, 2017, was 17,411
**Annual subscription US$110/£85**
USPS Periodicals Registered Number **012-893**

ISSN 1356-9252 (Print)
ISSN 2397-5970 (Online)
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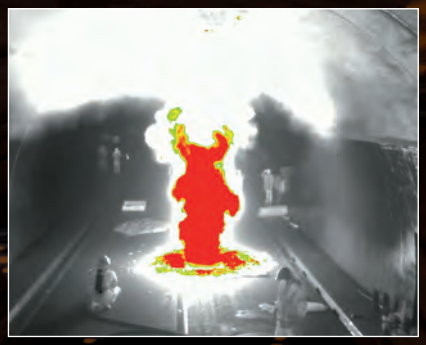

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# the FUTURE of TRANSPORTATION World Conference

From June 19-20, thought leaders will gather in Cologne, Germany, to predict and plan the future of our transportation systems. **Rachelle Harry** caught up with a key speaker who will be at the event, to discuss how we can head off the unintended consequences of disruptive change


Köln Messe, in Cologne, Germany will host this year's Future of Transportation World Conference

There are several elements changing the landscape of the transportation industry at present – autonomous and connected vehicles, ridesharing and Mobility as a Service (MaaS), to name a few. While it's easy to envision smoothly operating transportation systems in the future, how can we ensure that transportation does not become 'over-disrupted'? How can we ensure that new elements of transportation are integrated smoothly and do not cause problems that, by the time they are identified, cannot be resolved?

"We're seeing a lot of disruption based on the maturity of the technology," says Andreas Gissler, managing director of automotive at Accenture Strategy. "But we're also seeing a lot of investment, especially from OEMs keen to defend their mark.



Above: **Andreas Gissler, managing director of automotive at Accenture Strategy**

"From my point of view, the question is, should they defend themselves, or should they try to conquer new products entering the market? It's an interesting battle and I wonder how long it will continue before we see an outcome. Perhaps it will take 5, 10 or 15 years."

He uses the development and deployment of electric vehicles to illustrate his point.

"A big threat to traditional OEMs over the next few years is that a lot of them have invested in electric vehicles, but the public isn't necessarily showing willingness to buy them."

## Key frameworks

Some countries' governments have provided funding to support electromobility. One such example is the UK, which offers grants toward the purchase of electric vehicles and chargers, as well as incentives such as free parking in major cities.

However, Gissler believes that despite such encouragement from governments, electromobility is unlikely to become a success unless supporting infrastructure is in place. "We can't just release electric vehicles onto normal roads with normal infrastructure," he says.

It's not just Gissler's opinion that is strong. So is his knowledge of the figures. "Last year 1.5 million electric vehicles were sold across the

## Get with the program

**Nine not-to-be-missed presentations taking place at The Future of Transportation World Conference**

**Urban air mobility: real-world lessons**
Clement Monnet, COO, Voom, an Airbus company, USA
Stream 1, 9:25am, June 20

**Smartness of urban mobility and quality of life in Vienna**
Hermann Knoflacher, university professor, Vienna University of Technology, Austria
Stream 2, 9:50am, June 20

**Race of legislations – an overview of the international legal landscape of autonomous driving**
Dr Volker Hartmann, head of legal – autonomous driving, Daimler, Germany
Stream 3, 9:40am, June 19

**Shaping the digital future of transportation**
Russell Goodenough, client managing director – transportation sector, Fujitsu, UK
Stream 4, 11:20am, June 20

globe, which isn't much," he says. "Interestingly at least 750,000 were sold in China alone. That's because China has the infrastructure in place, so the market is there.

"Other than China, I can't see this electric revolution that everyone seems to be planning for, with their new models coming out in 2019 and 2020."

So what can be done to ensure that the electric revolution does in fact take place? "The success and implementation of electromobility is not just the responsibility of automotive companies," says Gissler, "It is essential that supporting organizations, such as utilities companies that manage the electricity, communicate and get together to ensure it happens."

## Anticipating autonomous

Despite the hype surrounding autonomous technologies and getting them onto the road, Gissler believes there may be trouble ahead. "There are two types of parties involved in the development of autonomous vehicles: traditional automotive companies that add functionalities to cars to enhance them and to give them autonomous capabilities; and technology companies – like Google [parent to self-driving car project Waymo] – many of which are based in Silicon Valley in California.

"Although there are fleets already in operation in California, I don't think we'll see autonomous vehicles driving at Level 4 or Level 5 on our roads before 2030. For this to happen, much more investment needs to be made, particularly in the area of vehicle security.

"Creators of autonomous vehicles undertake tremendous efforts to make their products as secure as possible," Gissler continues, "but we know from other contexts and other industries that nothing is ever 100% secure."

Gissler is not completely pessimistic, however, and remains positive about the technology's potential – as long as standards are in place to minimize the risk of security breaches and accidents, as well as ensuring that systems are interoperable in the future. "As soon as autonomous vehicles are ready and there's a willingness to pay, the technology will and should be used," he says. "As with any technology, there will always be risks, but if standards are in place then advantages won't be overshadowed by the potential disadvantages."

## Complete connections

He adds that if a single pioneer product proves successful, then standards can be based around it. "Some companies will lead the race in autonomous technologies," he says, "and other companies will observe and then follow that lead. Now is the time for companies, if basing their products on a pioneer, to strive to make their systems compatible." This will ensure that autonomous technologies have interoperable connected systems, so that they can seamlessly interact with surrounding infrastructure.

So should action be taken now, or should the industry adopt a wait-and-see approach? "I think the issue of interoperable connected and autonomous technologies will be solved automatically, over time, as they develop toward becoming fully mature," Gissler concludes.

*Andreas Gissler will be giving his presentation **The future of automotive – how to succeed in digital hyper competition** in Stream 8 at 1:40pm on Tuesday, June 19, www.thefutureoftransportconference.com*

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**Mobility as a Service and how it changes cities for good**
Sampo Hietanen, CEO, MaaS Global, Finland
Stream 5, 9:40am, June 19

**Designing and building the future of transportation**
Paul Direktor, head of business, WARR Hyperloop, Germany
Stream 6, 9:40am, June 19

**Transformative research in transport, land use and urban planning**
Harald Frey, project leader, Vienna University of Technology, Austria
Stream 7, 11:45am, June 20

**Moving the industry from making vehicles to making journeys**
Nathan Marsh, director – intelligent mobility, transportation UK and Europe, Atkins, UK
Stream 8, 11:30am, June 20

**European Investment Project Portal – a transparent project pipeline**
Michael Feith, policy officer, European Commission, Luxembourg
Stream 9, 9:00am, June 20

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# Security issue

**James Allen** looks at how road authorities and technology firms around the world are ensuring that connected and autonomous vehicles always remain safe and secure

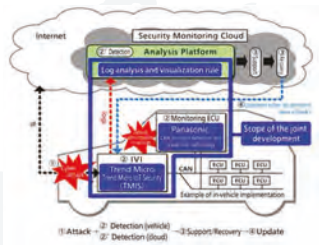
## Two heads are better than one

### Panasonic and Trend Micro team up to develop cybersecurity solution for CAVs

**Panasonic and Trend Micro have formed a partnership to jointly develop cybersecurity solutions to detect and prevent cyberattacks against connected and autonomous vehicles (CAVs).**

**The partnership aims to achieve high security of CAVs by developing solutions to detect and prevent intrusions into the ECUs that control driving behavior, as well as in-vehicle infotainment and telematics devices.**

**The partners note that the risks of hackers taking control of steering and braking systems in CAVs are real. New security vulnerabilities are discovered every day and pose a risk for remote exploitation. It is therefore more important than ever not only to implement security measures in each vehicle, but also to analyze new attacks by constantly monitoring in-vehicle systems from the cloud and using the results to implement countermeasures against cyberattacks to all vehicles.**




## Innovate not imitate

### Maryland launches new multidisciplinary transportation research institute

The State of Maryland in the USA has launched a transportation research and education institute uniting engineering, planning, social sciences, computer sciences, business, public policy and public health experts.

Based at the University of Maryland, College Park (UMD), the new Maryland Transportation Institute (MTI) will coordinate more than US$20m in annual research in order to spur innovation in the transportation

sector. The institute will focus on transportation big data and security, connected and automated transportation, congestion mitigation, freight and logistics, infrastructure planning and policy, transportation safety and security, smart cities and communities, and future mobility systems.

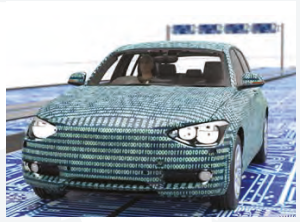
## Protective power of light

### Coventry University and Crypta Labs test quantum technology for CAV security

A UK government-funded project will see researchers and quantum technology experts investigate how security systems based on the randomness of light can help protect CAVs from cyberattack.

The new project – which involves the cybersecurity group at Coventry University's Institute for Future Transport and Cities (FTC) and a team of quantum experts at the London-based cybersecurity startup Crypta Labs – aims to improve CAV security and consequently the safety of drivers and passengers.

The technical and commercial feasibility of applying Crypta Labs' system to connected and



autonomous vehicles will be assessed ahead of the company rolling out and commercializing its technology internationally.

The 12-month project is funded by the Center for Connected and Autonomous Vehicles (CCAV) through InnovateUK, under the government's Connected and Autonomous Vehicles 2 scheme.

## Data-sharing doubts

### Here Technologies study reveals public concern over location data sharing

**According to a major new study by Here Technologies, a fundamental rethink is needed in the way that companies gather and use location data in order for people to embrace new services such as CAVs and drone deliveries. Mistrust, concern and uncertainty over how companies and service providers collect and use location data are revealed in the survey of 8,000 people across eight countries, with many respondents concerned about possible abuses of public trust.**

**According to the study, just 20% of people feel they have full control over their personal location data, with 44% sharing location data with apps and service providers unwittingly despite trying to restrict others accessing their personal information.**

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**15 million**
In China, the number of cars has increased by 15 million every single year for a decade

Left: **More than 350 exhibitors will showcase products and solutions**

Below: **A bilingual smart mobility conference will take place this year**

# Converging in China

Smart mobility, autonomous driving and Mobility as a Service will be the order of the day at Intertraffic China 2018

The world's largest traffic and mobility technology show, Intertraffic China, is preparing to open its doors to the public once more. For three days, from May 28-30, the New China International Exhibition Center in Beijing will be the focal point for the traffic industry's movers and shakers.

Smart mobility will be a dominant theme of the show, with Eindhoven University of Technology's director for the smart mobility strategic area, Dr Carlo JT van de Weijer, kicking off proceedings as keynote speaker.

Further insights are expected from the bilingual smart mobility conference organized in cooperation with ITS China for this year's event.

Mobility as a Service and autonomous driving will be supporting themes on the Intertraffic China agenda, while more than 350 exhibitors will be showcasing leading solutions for the traffic industry, addressing issues around road safety, parking and traffic management.

Richard Butter, director of traffic technology at RAI Amsterdam, is responsible for management of all Intertraffic events around the world. "The plans for China are coming together nicely," he says. "In my opinion, a lot of new technologies are coming out of China in the field of traffic and smart mobilities, so we're really looking forward to it."

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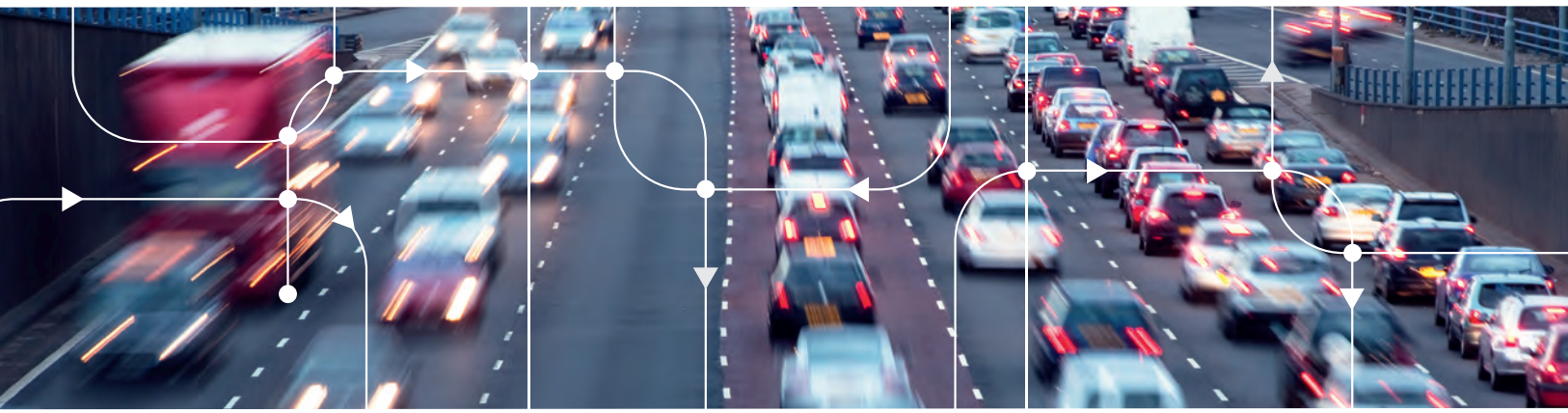

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# ITS America president and CEO **Shailen Bhatt** reveals the highlights of his new role, as well as topics that will be discussed at the 2018 ITSA Annual Meeting

**Interviewed by Tom Stone**

ITS America's new president and CEO, Shailen Bhatt, is busy preparing for the biggest event in his organization's 2018 calendar – its Annual Meeting, in Detroit, Michigan, June 4-7. But, while this is his first ever ITS America event in charge, it's far from being the first he's ever attended. And the process of organization has given him a reason to reflect on the past.

"I've actually been attending the ITS America Annual Meeting and ITS World Congress for over a decade," Bhatt tells *Traffic Technology International*. "What's interesting is how ITS has evolved in that time. When I first got started, it meant signs over highways and connected signals. And then, when I was at federal level, connected vehicles meant a car that would shake my seat or shake the steering wheel if I tried to merge and there was a hazard in my blind spot. In 2014, at the World Congress, they put me and a couple of other state DOT directors in a car and took us out on the freeway – and the driver took his hands off the wheel. And in 2016, we saw what the future can hold around things like hyperloops and new technology."

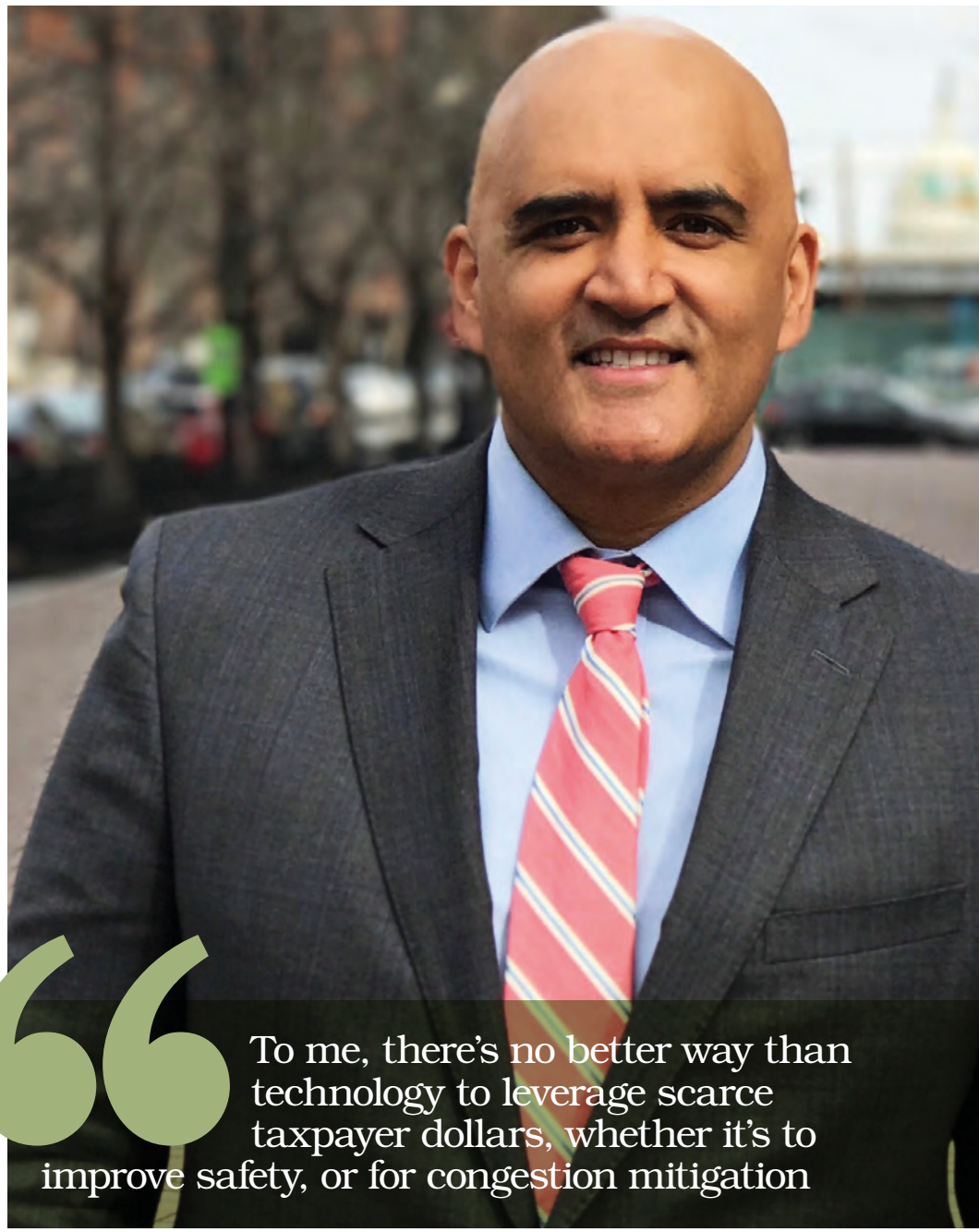
## New automotive OEM partnerships

Before taking on his new role, Bhatt was director of Colorado DOT, and has also worked for Delaware DOT and the FHWA. But he is aware that the transportation industry has now reached an important point – where the work of auto manufacturers and transportation departments is becoming more intertwined than ever before.

"For about 100 years, the DOTs have been building and repairing roads and bridges," says Bhatt. "Car makers simply had to give the public a product that would drive on roads. In short, it was an easy relationship.

"Now we're using connected and autonomous vehicles, as well as smart infrastructure. So, the relationship has become much more complex."

Given the growing need to cultivate these new relationships, it's no surprise that this year's Annual Meeting should take place in Detroit, aka Motor City, the home of the



> To me, there's no better way than technology to leverage scarce taxpayer dollars, whether it's to improve safety, or for congestion mitigation

The Cobo Center on Detroit's waterfront will host ITS America's Annual Meeting this year

US auto industry. The location is attracting increased levels of participation from OEMs, just as the ITS World Congress did when it was hosted there in 2014.

With the theme of this year's event – Transportation 2.0 – firmly in mind, the week will bring together automotive OEMs, suppliers and technology firms to meet and debate with federal and state DOT professionals, in order to plan the transportation systems of tomorrow. Highlights include keynote discussions and roundtables with representatives from Motor City's famous rivals Ford and GM, as well as OEM visitors from around the world.

"The meeting will be attended by various OEMs, tech industry folk, military professionals and governors," says Bhatt, "including Governor Snyder of Michigan, who's been a huge proponent of pushing ITS forward, and my former boss, Governor Hickenlooper, from Colorado.

"And that's the value of the ITS America annual meeting. We bring together private sector players, public sector agencies, states, cities and researches to have an in-depth discussion about what all of us are doing and what we need others to be thinking about."

## President Trump and funding

The move to connected and autonomous vehicles will require supporting infrastructure to be brought up to scratch, which will require money. President Trump's infrastructure funding plan has received plenty of media attention, but is yet to deliver any meaningful results. When asked whether he thinks the plans will be successful, Bhatt is diplomatic. "The president's infrastructure plan is still being debated," he says. "I think those discussions will play out and obviously there's a lot of other issues for Congress and the administration to figure out. But when they talk about a US$1.5tn package for infrastructure, it includes everything – ports, airports – so we still have a big funding challenge for surface transportation."

But, rather than simply waiting for extra funding, Bhatt believes technology offers ways in which money can be made to go

Left: **When asked if there's anything new he wants to do Bhatt says, "I want to spend more time with my family!" Luckily his children (now 4 and 2) and wife, were able to join him on this recent trip to Detroit**

further. "There's no better way than technology to leverage those scarce taxpayer dollars, whether it's improving safety, or for congestion mitigation," he says. "For example: we are studying crash data at a notorious intersection. As a solution, we can install a traffic signal, which will lead to more crashes; or we can install a grade separated interchange and spend US$60-70m to fix it. Or, for a fraction of the price, we could install smart connected signals to provide signs and indications to drivers."

> The safest autonomous vehicle is one connected – to the infrastructure and to other vehicles

Another example of such smart infrastructure is intelligent ramp metering, "We are going to deploy that technology in Colorado later this year," Bhatt says, "and we think it will lead to a 20% reduction in congestion that will cost us US$8m, where the alternative solution of adding a 15-mile stretch of roadway would have cost us hundreds of millions of dollars. So, if folks want to leverage scarce taxpayer money, technology is a great way to do it."

## Cellular vs DSRC

But choosing which technology to roll out isn't always as simple as balancing costs. When it comes to communication protocols, debate is still raging over whether cellular solutions in the form of 4G, 5G and its successors will naturally supplant wi-fi-based DSRC communications in the connected vehicle realm, or whether there will always be a need for both.

"It's a million-dollar question – or should that be a billion dollars?" laughs Bhatt. "This is an important decision that a lot of our members are wrestling with. ITS America is technology-agnostic, so we don't say it's one or the other. But I can tell you this – DSRC is the only technology right now that supports short-range crash avoidance for V2I and V2V, but I do believe cellular, whether it's 5G or 6G, when that comes out, or C-V2X [cellular vehicle-to-everything], which is now being discussed, can provide benefits. So my, and our position, is yes we need DSRC. And yes we'll incorporate cellular, but when it comes to safety, we want the best of all worlds."

Again with safety in mind, Bhatt is passionate in his belief that the best kind of autonomous vehicle will also be a connected

## ITSA Annual Meeting 2018 keynote speakers

**Tuesday, June 5, 2018**
**Heidi King, deputy administrator, NHTSA**
Heidi King joined the National Highway Traffic Safety Administration in September 2017 following a distinguished career in the public and private sectors, with experience in public safety, innovation, risk management, evidence-based decision-making, and law enforcement. She will speak on the challenges now facing markets, governments and researchers, as transportation systems are modernized.

**Wednesday, June 6, 2018**
**Mark Reuss, EVP global product development, purchasing and supply chain, GM**
Mark L Reuss leads the design, engineering, safety, quality, research and development, advanced vehicle technology and program management of General Motors cars, trucks and crossovers around the world. He will talk about the potential for ITS and new vehicle technologies to make communities accessible, equitable, sustainable and economically vibrant.

**Thursday, June 7, 2018**
**Tom Gebhardt, executive officer, Panasonic Corporation, chairman and CEO, Panasonic Corporation of North America**
Tom Gebhardt is a leading technology partner and integrator to businesses, government agencies and consumers across North America and also responsible for formulating and executing Panasonic global business strategies. He will consider solutions to the regulatory and funding challenges in deploying ITS technologies.


> I want everyone who comes to Detroit to know that they will be contributing to a better future, where cars don't crash and people aren't sitting for hours in congestion

vehicle. "There's a lot of talk about whether autonomous vehicles even need V2V technology" he says. "But the safest autonomous vehicle is one connected – to the infrastructure and to other vehicles. For now we're saying we want DSRC *and* we want cellular. But DSRC is here now, so we should deploy and then make sure that they are compatible as we go forward. Ultimately, the market will decide which technology wins."

## Uber crash fallout

Bhatt has always spoken passionately about the potential of transportation to make a difference to people's lives. So what did he make of the recent fatal crash involving an autonomous vehicle being tested by Uber?

"It was absolutely a tragedy, and we should not lose focus on that," says Bhatt. "But we also shouldn't lose focus that there were 100 other fatalities on US roads that day. We say 'toward zero deaths' – but in my experience, we've been going the wrong way.

"It was right for Uber to suspend their testing because they clearly had a key role in this tragedy and they need to understand what happened. What's also happening is that other companies are assessing in a very robust fashion all the elements of safety that are part of their fleets. But because we had one tragedy, we shouldn't suspend all work in this area as there are a lot of other safety issues and mobility issues that need addressing. There are people with disabilities who are counting on this technology to help with their quality of life. And so I just think we need to be prudent, but we need to move forward, with safety always our top priority."

Bhatt has started planning for the 2020 ITS World Congress, which ITS America will be hosting in Los Angeles. "The Port of LA will be a key component because 40% of goods consumed in the USA come into LA and Long Beach ports," Bhatt reveals. "So how do we get that through in an intelligent fashion? Whether it's on the existing surface network or a new form of transportation – that has to be part of the discussion."

Returning to the subject of June's ITSA Annual Meeting, Bhatt's hoping the week will be inspiring. "The vision for an organization is incredibly important," he says. "Our vision is a better future transformed by intelligent mobility. I want everyone who comes to Detroit to know that they will be contributing to this better future, where cars don't crash and people aren't sitting for hours in congestion.

"I took this job because for 10 years I've been saying that DOTs I was leading were saving lives and making people's lives better. I'm thrilled this is what I do now – I get to work with pretty much all the DOTs in the USA."

*For more information about the ITSA Annual Meeting and to register for the event, visit: itsdetroit2018.org*

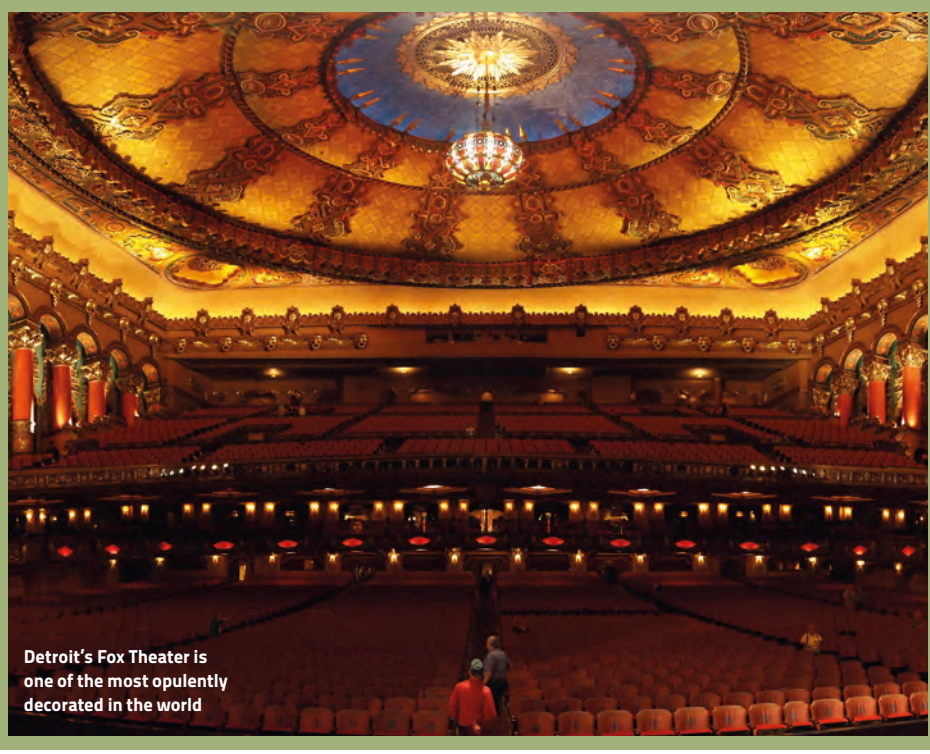
# Make the most of your visit

**Eric Shreffler, managing director of Auto Office, Michigan Economic Development Corp, picks two top Detroit attractions**

As you'll see, Detroit is a city on the rise. The economic and cultural resurgence has earned praise from around the world. During your visit, you'll find many great places to explore. There are two I would highly recommend.

First: Detroit Institute of Arts. Most of the world's best-loved cities have major art museums that inspire. Detroit is no different. I think visitors who have never been will be very pleasantly surprised at the volume, breadth and depth of the collection. You'll find the museum impressive, but manageable in size. Inside, not only will you find works by masters such as Van Gogh, Degas and Picasso, but also a great mix of new and old, including artifacts from ancient Egypt. It is truly a must-see attraction.

Second: Take in a show at the Fox Theater. One of the most lavishly decorated entertainment venues in the world, it boasts awe inspiring sitelines and great acoustics. It's also across Woodward Avenue from Comerica Park, so you might even be able to fit in a Tigers baseball game.



**Detroit's Fox Theater is one of the most opulently decorated in the world**

Photograph: DDohler

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# Invulnerable road users?

As the focus on road safety grows around the world, some authorities are increasingly turning to technology to help protect the most at risk. **Saul Wordsworth** looks at what systems are currently available – and what the future could hold in our quest for zero fatalities

Pedestrian crossings are nothing new. In fact their use dates back thousands of years: raised 'stepping stones' for crossing streets have been uncovered in the ruins of Pompeii, which was buried under volcanic ash in AD79. But it wasn't until 1868 that the first signalized pedestrian crossing was set up on Bridge Street in London's Westminster. Built by railway engineers and resembling a railway signal, a design flaw in the red and green gas lamps used to light it meant that it burnt down after only a year's use, injuring the police officer who was required to stand underneath to manually operate the contraption. The project was abandoned and not revived until well into the 20th century.

It wasn't until the 1940s that pedestrian crossings became commonplace on roads around the world. Since that time, little about their design has changed. However, the manner in which we inhabit our cities has changed; streets are busier; smartphones rest in our hands, distracting us; and bicycles are more prevalent. All of which adds up to greater levels of distraction for drivers and greater vulnerability for anyone not in a vehicle.

"When we hear about road technology, so much of it is about cars," says Usman Haque, founding partner with Umbrellium, a UK-based urban technology company. "What we want to create is a pedestrian crossing technology that puts people first."

The Starling Crossing creates crossings of different sizes, and at different locations, to serve the needs of pedestrians using it at that particular time

Umbrellium has designed what it calls the Starling Crossing (STigmeric Adaptive Responsive LearnING Crossing), a responsive, dynamic and interactive road surface that produces pedestrian crossings where it wants, at will. Although currently only a prototype, it opens up the possibilities of how we might protect vulnerable road users (VRU). The LED surface lights up at any location on the road, reacting in real time to configure patterns based on understandable road markings and colors, projecting crossings and alerts where required to prioritize pedestrian safety.

"Early in the morning when there are few pedestrians, the Starling Crossing will appear when someone approaches," says Haque. "Later in the day, at closing time when many people need to cross together, Starling automatically widens to accommodate increased pedestrian traffic."

## Lit the road

Starling uses a neural network of cameras that tracks and identifies moving objects, calculates their trajectories and velocities, then predicts their progress such that the surface lights up just before the object's arrival, bright enough to be seen in the daytime. This is especially helpful if a 'smartphone zombie' (or 'smombie') steps off the pavement, or if a child runs into the street. In both cases, a lit-up buffer zone will be painted around them to alert any oncoming driver. A future iteration of Starling may also be able adapt to different environmental conditions, creating larger pedestrian buffer zones in wet weather or keeping polluting vehicles away from school crossings.

> Our neural net solution shows you, to the millisecond, exactly where and when the line was crossed, who crossed it, on what trajectory, what speed and where in 3D space
>
> **Usman Haque, founding partner, Umbrellium**

"The current detection systems are a little like the old-fashioned ribbon across the finish line," says Haque. "When it is broken and the sensor triggered, you know that something has crossed the line, but it doesn't tell you anything about what it is, which direction it's going, what speed it's at, or where along the width the crossing is. Our neural net solution is more like the multi-camera photo system you see in sports today, where you know to the millisecond exactly where and when the line was crossed, who crossed it, on what trajectory, what speed, and where in 3D space."

While a full-scale Startling prototype is in operation in south London, by Umbrellium's own admission, more safety testing is required. Furthermore, the current solution doesn't offer anything for the visually impaired. A future version would need to explore similar interaction through texture, height and edges, as well audible signals. Interest, though, is huge.

"We are currently talking to people on almost every continent, but

Right: **Pedestrian Countdown at Traffic Signals (PCaTS) notify pedestrians of how many seconds they have left to cross**

the system needs more real-world testing and evaluation," says Haque.

## Today's reality

Umbrellium's solution may yet be the future for pedestrian crossings, but what are the best, most affordable and appropriate solutions for VRUs across our road networks today? Transport for London (TfL) is committed to achieving Vision Zero by 2041. Besides investing in safer junctions and removing the most dangerous heavy goods vehicles from London's roads, it has a portfolio of detection systems in operation for VRUs.

> "We have found that using a combination of [VRU detection] technology is often best, with limited-range thermal camera used at the stop line, and radar technology further away
>
> **Adam Duff, area performance manager, TfL**

"TfL uses different detection systems (see sidebar, *What works best?*) for different VRUs on a site-by-site basis, to ensure balanced signal timings," says Adam Duff, area performance manager for TfL. "For pedestrians we use above-ground detection. An optical detector counts the number of pedestrians waiting to cross within a detection zone and a thermal imaging detector counts the percentage occupancy within the crossing zone. Every second each detector sends the number of pedestrians to the processor, which converts this raw data into one of four priority levels. This priority level equates to additional green-man signal time [the 'green man' light is the signal for pedestrians to cross in the UK], ensuring pedestrians have sufficient time to cross the road. Just before the green man, our Split Cycle Offset Optimisation Technique [SCOOT] system will check the requested priority level and extend the green-man period as required."

## Detection selection

TfL has two approved detectors to keep cyclists moving safely across London. An above-ground thermal imaging camera identifies when

# What works best?

**There is no one-size-fits-all when it comes to pedestrian and cyclist detection systems. Here are the pros and cons of the mainstream solutions**

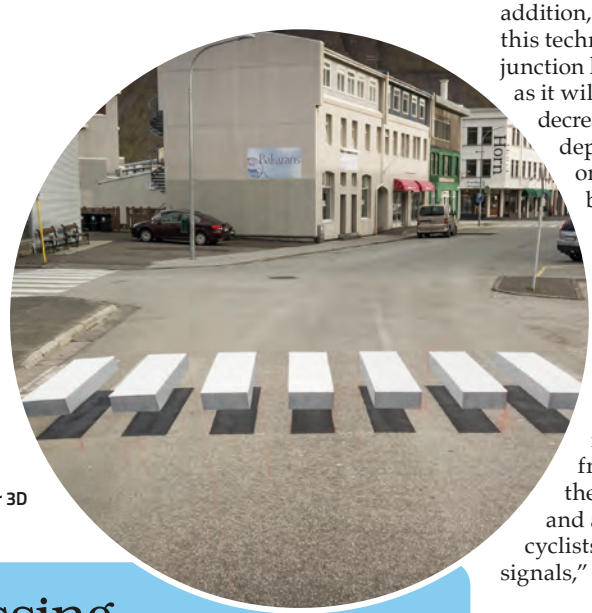
| TECHNOLOGY | PROS | CONS |
|---|---|---|
| **Video (image processing)** | ▪ Intelligent image interrogation algorithm is effective for VRU detection<br>▪ Detection area is highly configurable<br>▪ Fastest and most accurate | ▪ Only serves small area (e.g. 2x3m/6.5-9.8m)<br>▪ Costly |
| **Radar** | ▪ Detection for large areas and moving objects | ▪ Not good for small objects or stationary objects<br>▪ Can be slow |
| **Infrared (IR)** | ▪ Effective in areas where there is good temperature contrast between pedestrians and the ambient environment | ▪ Problems arise in hot weather (IR fails to identify VRUs above a hot road surface)<br>▪ Least reliable and effective as only indicates the presence of an object which could be anything from mouse to steamroller, says nothing about its location or trajectory |
| **Bluetooth (BT)** | ▪ Good for detecting specific user groups (who wear the BT devices)<br>▪ Requires specific BT devices (e.g. phone) and configuration. | ▪ Privacy issues (storing people's mobile identifiers) and does not provide accurate location. |

Dedicated cycle lanes and signals improve safety in Manchester, UK

a cyclist is approaching the junction or crossing and builds a queue in the SCOOT model. TfL also uses radar wireless technology, which picks up cyclists traveling over the magnetometer installed in the road and, like the thermal imaging camera, builds a queue in the SCOOT model. These detectors sense bicycles in the same way as SCOOT technology and insert them into the SCOOT algorithms to help optimize traffic signals, including for cyclists.

"TfL engineers review each junction and crossing on an individual, site-by-site basis to identify whether there is benefit in installing technology to reduce road danger and help VRUs," says Duff. "This review is undertaken through the annual traffic signal timing review program, which ensures the balance is correct for all road users and that user comfort levels are maximized when any changes are made to the network. TfL carries out 1,200 of these reviews every year."

> [Key switch] is a very cheap solution – it only costs us about US$30 worth of material and one hour of time to install and configure
>
> **Mark Taylor, traffic signal operations engineer, Utah DOT**



'Escher' pedestrian crossings, such as this one in Isafjorður, Iceland, encourage drivers to slow down with their 3D appearance

Pedestrian SCOOT technology is deployed selectively at junctions and crossings where pedestrians will most benefit from extended invitations to cross, particularly at busy times of the day. Currently the technology is at a variety of sites, such as outside Tube stations where there are large morning and evening peak rushes, next to a mosque that gets particularly busy midday on Fridays following prayers, and outside Thorpe Park theme park in Surrey. Whether the optical or the thermal imaging detector is used at a particular site is down to the contractor rather than TfL – both are effective. To get the best from Cycle SCOOT technology, a combination of the two detection systems can be used. However, cyclists need their own track, such as a Cycle Superhighway, as currently the technology cannot differentiate between cyclists and other modes of transportation. In addition, the greatest benefit from this technology is achieved when the junction has a cycle-only movement, as it will be able to increase or decrease the green signal time dependent on cyclist traffic only – and not be influenced by traffic on other approaches.

"We have found that using a combination of the technology is often best, with limited-range thermal camera used at the stop line to improve the green splits for cyclists, and radar technology further from the stop line to improve the coordination of signals and assist progression of cyclists through a series of signals," says Duff.

### Mindful in Manchester

"For new signal installations we deploy Siemens Heimdall pedestrian detectors, which use radar technology," says Glyn Boucher, Transport for Greater Manchester's infrastructure design manager. "These are used as both pedestrian curbside detectors, to confirm presence of a waiting pedestrian, and as on-crossing detectors, which extend the clearance time at the end of the pedestrian crossing green-man time, if people are still crossing the carriageway. There are also numerous existing products installed on-street performing these functions

## The 'Escher' crossing

**Using geometric optical illusions when painting lines for crossings is creating virtual 3D shapes, which make drivers slow down**

An element of the surreal has embedded itself in parts of China, New Delhi and the small fishing town of Ísafjörður in Iceland. All three locations have been trialing 3D pedestrian crossings, Escher-like optical illusions which make the zebra stripes look like they are floating. The design, which is hand-painted onto the road, encourages drivers to slow down for fear they will plow into apparently-raised platforms. The idea took hold in Iceland after the country's environmental officer, Ralf Trylla, saw something similar on a trip to Ahmedabad. The painting takes a few weeks and, once complete, gives the impression the zebra crossing is shifting depending upon your angle. From above, the white lines resemble columns, while at ground level they seem to be hovering.

"A pedestrian crossing like this makes it look like there's something blocking the road," commented Icelandic street-painting company, Vegamálun GIH.

at signal sites, some of which use video technology."

According to Boucher, video technology provides the 'go-to' form of detection that simply didn't exist in the past and has enabled the introduction of 'Puffin'-style, pedestrian-detecting crossings at mid-block crossings, as well as at junctions. For cycles at junctions, they have a small number of installations that use the Q-Free HI-TRAC CMU Cycle Priority detection system. This system uses established piezo-electric sensor technology to detect bicycles in either dedicated cycleways or mixed traffic lanes.

## Thrifty in Utah

Utah has installed radars at most of its signalized intersections. These detect bicycles or motorcycles without any difficulty as long as they appear within the detection zone, no further than 50ft (15m) away.

"We have been using Wavetronix Matrix Radar technology since 2010," says Mark Taylor, traffic signal operations engineer, Utah Department of Transportation. "The radar costs US$6,000 per approach, so we're installing it as resources allow. We have some inductive loops and video for detection. However, the inductive loop configuration we use struggles to pick up cyclists. Video detection battles with accuracy and is affected by lighting and weather, so we're trying to replace our loops and video with radar as resources allow. We have also purchased the Strava Metro dataset to help better track and plan for bicycles."

At signalized locations with school crossings a thriftier approach has been devised, with the development of a special 'key switch' for the crossing guards. When the switch is turned to 'on', the key locks in place. The crossing guard then receives additional 'walk' crossing time for the school children. When the guard is done, they remove the key.

"This is a good compromise between efficient operations and safety," says Taylor. "It only costs us about US$30 worth of material and one hour of time to install and configure."

Meanwhile in some parts of Utah, cities provide orange flags at crossings so pedestrians can hold or wave a flag if they cross at a slower pace than others, or to improve visibility.

Photograph: Xerti

Above: **'Stepping stones' in Pompeii, Italy, enabled people to cross roads without touching muddy surfaces**
Left: **Radars can detect bicycles and motorcycles at signalized intersections**

> Personal mobile devices are expected to become part of the connected system, alerting motorists about vulnerable road users, to reduce the risk of crashes
>
> **Jon Douglas, acting deputy chief engineer, Queensland Department of Transport and Main Roads**

## The future

At what stage we might see interactive, real-time pedestrian crossings à la Umbrellium's solution is anyone's guess. In the short term, and at the high-tech end of the market, sensors and algorithms are likely to improve to allow for greater accuracy in mixed-mode conditions. Costs and scales of economy will also improve, enabling wider use as cost becomes less of an issue. Meanwhile, rich data sources such as vehicle-to-infrastructure communications and anonymized cell phone data could revolutionize how journeys are understood and optimized in near-real-time.

"Personal mobile devices are expected to become part of the connected system, alerting motorists about vulnerable road users, to reduce the risk of crashes," says Jon Douglas, acting deputy chief engineer, Queensland Department of Transport and Main Roads.

As for Robert Miles, director of traffic and safety at the Utah Department of Transportation, he believes that, "When VRU systems are truly integrated into the larger traffic management system, they cease to be unique solutions and become part of the day-to day business of the system manager."

Transport for Greater Manchester, UK, is undertaking a trial to automatically count pedestrian and cyclists through the InnovateUK-funded, Internet of Things demonstrator CityVerve.

"The increased use of machine-learning techniques for image processing methods for identifying and classifying different road users is the next step," says Boucher. "With improved reliability of identifying pedestrians and cyclists, this could reduce waiting times for them, as well as hopefully providing a safer environment on the roads."

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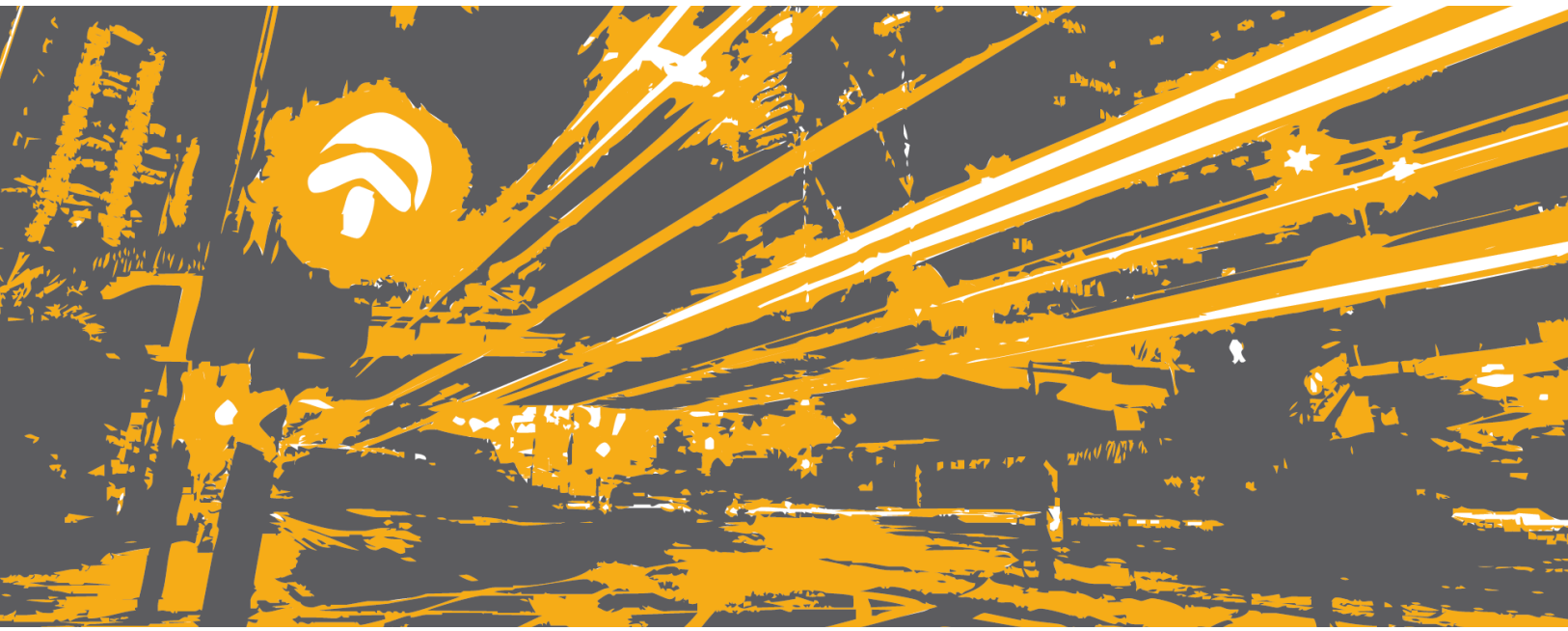

# Next-generation product solutions for traffic and pedestrian control

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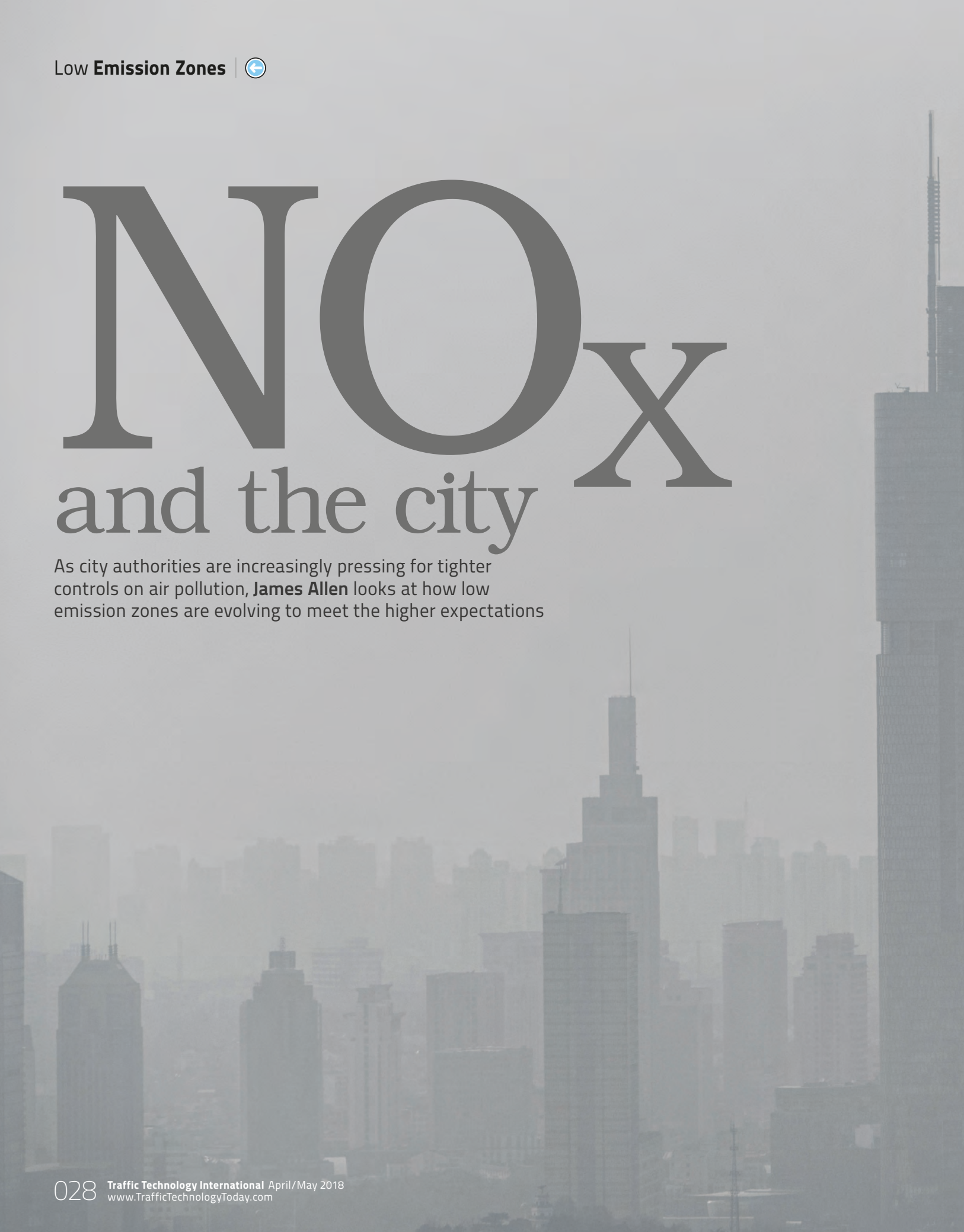
# $NO_x$ and the city

As city authorities are increasingly pressing for tighter controls on air pollution, **James Allen** looks at how low emission zones are evolving to meet the higher expectations



In many cities, the low emission zone (LEZ) is now an established weapon in a road authority's armory in its quest to combat urban air quality and congestion. However, for some, the LEZ is still very much an unknown quantity to be approached with caution.

Europe has been at the forefront of LEZ trials and testing, with many schemes now developing and evolving, so it is a little peculiar that Brussels, the Belgian – and de facto European Union – capital is jumping on the LEZ bandwagon at this relatively late stage.

Holding back, however, has enabled its road authorities to consider what has worked elsewhere and introduce an LEZ on a scale that few others have so far achieved.

The vast majority of schemes have focused on relatively small areas, confined to the few streets designated as the city center, but Brussels' LEZ covers the city's entire 161km$^2$ (62 square miles) land space that falls within the R0 ring road.

By contrast, the LEZ in Antwerp – the first in Belgium, introduced in February 2017 – is restricted to 20km$^2$ (7.7 square miles) of the city center.

"There are differences between the two systems, but it was much easier for us to plan the Brussels LEZ because of the Antwerp project," explains Sarah Hollander, head of sustainable mobility for the city of Brussels.

"We allowed it to inspire us. The reasons for it being so different are political but also practical. The Brussels zone is much bigger because it was logical to cover the whole territory inside the ring road."

The sliding-scale scheme allows initially all but Euro 1 diesels into the region, but gets increasingly stricter until 2025, when only Euro 6 diesel vehicles, and Euro 3 petrol vehicles, will have unfettered access to the city.

It means that, for this first year, only about 1% of vehicles entering Brussels will be affected, but this was no accident, according to Hollander.

"We didn't want to start with too many cars, otherwise the acceptance by drivers would have been much more difficult and it gives us time to prepare the public to change their

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behavior and accept the measures," she explains.

Prohibited vehicles will be afforded a maximum of eight days' access to the city annually upon purchase of a pass amounting to €35 (US$43) per day.

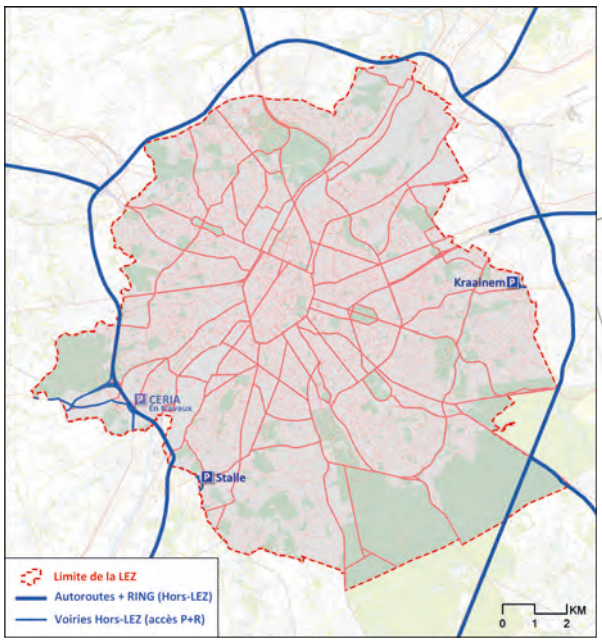
Offending vehicles are currently not being fined as the system beds in and the citizens get used to their entire city being one big LEZ. The scheme will rely on ALPR technology, with 176 Macq-produced cameras deployed around all the boundaries, as well as inside the zone.

Hollander says, "The cameras used for enforcing the LEZ are also used by the police for protection and security purposes; some were therefore positioned according to police needs, while others were installed in order to ensure full coverage of the LEZ."

It is a little premature for organizers of the scheme to be able to say with any certainty what impact the measures have already had on traffic and air pollution; however, there are growing doubts that LEZs, in their current guise, can actually achieve what they're intending to.

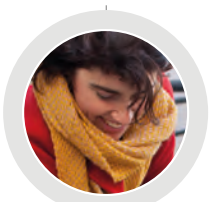
## Rearranging the deck chairs

"The key challenge for LEZs is that even newer diesel vehicles aren't that much cleaner and are, in some respects, arguably worse," worries Dr James Tate, associate professor for the Institute for Transport Studies at the University of Leeds.




Left: **The Brussels LEZ covers the entire 161km² (62 square miles) of the city's land space**


> The cameras used for enforcing the LEZ are also used by the police for protection and security purposes
>
> **Sarah Hollander, head of sustainable mobility, city of Brussels**



In addition to his role in academia, Tate is an established road transport emissions advisor, shaping policy on improving air quality for various UK government departments and governmental bodies.

The Dieselgate scandal that Volkswagen Group was so publicly embroiled in brought attention to the lack of robustness around engine standards, and Tate believes that designers of LEZs are continuing to misunderstand the issue.

"To be effective, you need to restrict access to all but those diesels that comply with on-road testing measures outlined in Euro 6 standards, otherwise you're not reducing emissions but just encouraging vehicle stock turnover.

"Euro 6 cars actually have to comply with on-road testing so will be a lot cleaner because, up

to and including Euro 5, is only really addressing particulate matter and hardly addressing the $NO_x$ issue," says Tate.

It is perhaps an acknowledgement of such criticisms that conversations around air quality are moving on from LEZs, with more and more city authorities making public their commitment to ultimately ban all diesels and, in some cases, all petrol-powered vehicles too.

## No emission zones

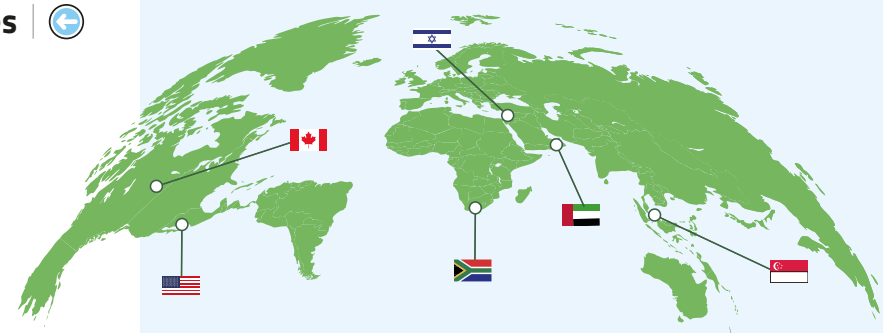
The UK's Oxfordshire County Council, in cooperation with Oxford City Council, have outlined plans that, if enacted, will make Oxford the first city in the world to have a no emission zone (NEZ).

The county council's principal transport planner, Martin Kraftl, explains, "It was quite clear, even back in 2014 – when the concept of the NEZ was first privately discussed – that battery technology was maturing.

"Therefore, we wanted to see how ambitious we could be and, because we wanted to give certainty to businesses investing huge amounts in their fleets – such as bus companies – we didn't want to keep on changing the requirements every few years."

By 2020, the plan will see a small area of the city center (approximately 300 x 300m) free of all vehicles powered by traditional fuel types, this will then expand by 2030 to cover Oxford's current LEZ, in place since 2014. The LEZ only targets public transportation, requiring all buses to meet Euro 5.

"Buses are by no means the only contributor to poor air quality, but they have been the single largest source of pollution in our city center for a long time, and that's partly because in 1999 we already began restricting other traffic in the city center.



# LEZs outside of Europe

There are no LEZs in the USA as compared with Europe. Most US cities have lower population density and are not as well served by mass transit. Thus, transportation mode alternatives are not as readily available.
***H Christopher Frey, distinguished professor, North Carolina State University***

Rather than LEZs in North America, a more likely scenario is that some progressive city implements a cordon/congestion charging system based on vehicle emissions status. There has been discussion of cordon pricing in Vancouver. I do believe congestion pricing will eventually arrive in the USA, although roll-out will be slow.
***Alex Bigazzi, assistant professor, University of British Columbia***

There are no LEZs in Africa, primarily because of the fuel industry. The automotive industry was pressured to bring in cleaner engines, but the fuel available is not compatible. The cost of upgrading the refineries is the challenge as you cannot have an LEZ where no vehicles or fuel meet the requirements.
***Paul Vorster, CEO, ITS South Africa***

To manage road congestion, we have had road pricing since 1975. The system is now being upgraded to be more equitable, so motorists will be charged according to the distance traveled on the key roads.
***Singapore Land Transport Authority spokesperson***

Haifa is the first Israeli city to have an LEZ, introduced this year. Euro 4 or lower diesel vehicles, weighing 3.5 tons or more, are not able to access the downtown and residential areas of the city. Enforcement is being carried out manually by humans on the ground, in part due to the current personal privacy laws we have regarding camera technology.
***Jonathan Strul, head of environmental planning at the Haifa District Ministry of Environmental Protection***

The United Arab Emirates is seeing significant increases in car ownership and usage on the road. In response, the capital, Abu Dhabi is currently in the process of introducing laws banning older vehicles as well as developing its public transport network and incentivizing the purchase of electric vehicles.
***Zeina Nazer, secretary general, ITS-Arab***

> The key challenge for LEZs is that even newer diesel vehicles aren't that much cleaner and are, in some respects, arguably worse
>
> **Dr James Tate, associate professor for the Institute for Transport Studies, University of Leeds**

"We used to have problems with particulate matter in the city. We don't anymore – now $NO_x$ is our main concern. It has come down by about 30% in the LEZ but, as has been widely discussed, Euro 5 didn't perform as well in the real world as was hoped, so reductions weren't actually as significant as had been promised."

## Universal support

Still to be officially rubber-stamped, the NEZ is on track for 2020, with strong backing of the proposals from across the disparate stakeholders living and working in Oxford.

It is no accident that this wide support has been achieved, according to Kraftl: "We've been keen to emphasize that we're not saying, 'Here's a zone – go and sort yourselves out'."

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Above: **Smog issues in Paris have made international headlines**

Inset: **Plans afoot in Oxford will see only electric vehicles able to access parts of the center**

He says, "This is something we'd like to achieve for the city and it is as much our responsibility as it is theirs, so we're working with people to break down the barriers. But the position is very much that we're aiming to introduce exactly what we've consulted on."

Because the LEZ targeted only buses, compliance was universal and no enforcement was necessary. It is a different story, however, regarding the NEZ.

"It is going to be much more complicated because we are rolling this out to all vehicles and that will require camera enforcement. We already have cameras for existing traffic restrictions in the city center that we colloquially refer to as bus gates, so there is some potential to use existing systems, but we will need a lot more equipment and that's one of the things we're working through now."

The expectation is that, particularly for the first phase, given the limited numbers of points of entry, enforcement will be relatively straightforward with ALPR camera deployment.

> We wanted to see how ambitious we could be and, because we wanted to give certainty to businesses investing huge amounts in their fleets, we didn't want to keep on changing the requirements every few years
>
> **Martin Kraftl, principal transport planner at Oxfordshire County Council**

## An alternative approach

Paris is exploring an alternative way of dealing with polluting vehicles on its roads. The French capital's air quality has received a lot of press attention for all the wrong reasons, with excessive levels of smog visibly smothering Parisian streets for days on end.

The city's mayor, Anne Hidalgo, has announced she wants to rid the city of all diesels from 2020, but, in the meantime, responsibility for limiting harmful emissions has been partly outsourced to parking management company ParkNow.

Since January 1, 2018, on-street parking tariffs have been amended depending on the air quality in the city at the time.

When excessive levels of $NO_x$, sulfur dioxide and/or particulate matter are detected, residents already parked in the city are automatically given 24 hours' free parking. At the same time, to discourage drivers from entering the city, parking rates are raised.

"For the moment, it doesn't affect tourists," says Olivier Koch, ParkNow sales manager. "In France, it is hard to change tariffs for all vehicles, so we are focusing on residents, but there are 50,000 resident parking permits in Paris, so that's not insignificant."

A government-run, publicly accessible website monitors the air quality of the city, updating the situation on an hourly basis. Excessive readings are then relayed to the public through media channels to inform the public, while ParkNow app users also receive notifications on their smartphones.

A few months in and the early signs are positive. "We are seeing a decrease in traffic on pollution peak days of around 30%, so there are already some quick wins, but it is very early to say for sure that 'Yes, this is the solution to all our problems.' We don't expect it to be the magic pill though, but rather to form part of a wider answer to the problem of vehicle emissions and road congestion," says Koch.

It's clear that LEZs play a key role in addressing air quality issues but, as awareness grows, the measures introduced are also adapting to the greater expectations.

## US$3.57bn

The estimated size of the global ALPR market by 2023, up from US$1.78bn in 2016, representing a compound annual growth rate (CAGR) of 9.74% between 2017 and 2023

*Source: Research and Markets*

# Single camera solutions

Cutting-edge software can extract high-quality ALPR data from any CCTV camera feed. Police departments are already using such systems for surveillance and crime prevention, but how useful can they be for traffic enforcement? **Jan Stojaspal** investigates

The police department in Mobile, Alabama, makes dozens of arrests a month based on information from an intelligent camera surveillance system that is able to read license plates and flag those that belong to a stolen vehicle or a known perpetrator of a crime. Yet it does not own a single surveillance camera, nor does it intend to purchase any.

"In Mobile it is not really the place of the police department to go out and buy thousands of cameras," says Commander Kevin R Levy, technology and cyber-intelligence section, Mobile Police Department. "There isn't money for that, and it is not the role a police department is typically taking. What we are doing is harnessing relationships with people who already have cameras."

Mobile's use of camera surveillance technology that can read vehicle registration plates is not new. Police departments all over the USA and elsewhere have been using automatic license plate recognition (ALPR) for the better part of two decades. What makes Mobile noteworthy is its reliance on an entirely camera-agnostic system, which is where ALPR appears to be heading next.

Systems that do not require a vendor-specific camera or a vendor-specific integration between the camera and the ALPR software are cheaper to assemble and operate, and can extract a much wider range of information about a vehicle than just an alphanumeric ID, thanks to cloud-based computing that harnesses artificial intelligence and machine learning.

> "What we are doing is harnessing relationships with people who already have cameras"
>
> **Cmdr Kevin R Levy, Mobile Police Department, Alabama**

## Software

The component of ALPR systems that will show the highest CAGR between now and 2023

*Source: Research and Markets*

In addition to the alphanumeric ID, the system in Mobile can also deliver the vehicle's make and model. It captures a variety of traffic flow data, including the volume and density of passing traffic. And it makes for easy travel-time calculations. "It's kind of like Disney World does with lines," Levy says. "You can figure out the travel time between two cameras and say, hey, it's taken somebody 20 minutes to get from here to here; it is going take them two hours to get out of state instead of 30 minutes."

The traffic flow data came in handy last fall when residents of Florida evacuated through Mobile ahead of an approaching hurricane, and the police department was able to use the data to gain greater visibility on where to redirect traffic. "We have traffic cameras where you can see cars," says Levy. "But seeing a bunch of cars and knowing how many are passing through an hour are two different things."

Left: **Westchester County Police turned to camera-agnostic ALPR last year**

According to Lieutenant Brian Hess at the real-time crime center of Westchester County Police, New York, an ALPR system that is analogous to Mobile's helps his police department look for stolen cars and people wanted for crimes. But it also allows the local department of public works, responsible for road maintenance, to count cars.

Neither Mobile nor Westchester use their ALPR systems for traffic enforcement – like red light or speed cameras – for reasons of privacy and local traffic enforcement laws.

Although Westchester County Police has been operating traditional ALPR units, both fixed and mobile, for some years, it turned to camera-agnostic ALPR last year because it was much cheaper.

"The problem with vendor-specific systems is the expense," Hess says. "One traditional ALPR setup, such as a fixed site on a highway, would cost us between US$75,000 and US$100,000. For the same amount I could probably deploy six camera-agnostic sites."

> If you want to capture license plates at night you will need a camera that is day/night capable and have some internal or external IR illumination
>
> **Steve Lewis, vice president for business development, openALPR**

Not all surveillance cameras produce video feeds that are ALPR-ready. Of the 5,400 feeds that the Mobile Police Department has access to (as part of Project Shield, a public-private partnership that gives the department's cyber-intelligence unit access to surveillance cameras in businesses, schools, residential communities and other establishments in and around Mobile) only about 80 are good enough to be processed for license plates information. But that number may be as high as 1,000 within a year as Project Shield expands, Levy says.

### Vendor in control

According to Alan A Quinn, a USA-based independent consultant who specializes in video detection, license plate recognition and CCTV surveillance, a dedicated ALPR system will outperform a camera-agnostic system because the vendor is in control of the setup, positioning of cameras and illumination.

"Normally speaking you will find that the vendors will guarantee you a percentage of captured plates and the percentage accuracy on those plates," he says. "It's very difficult for them to do that if there are a variety of camera technologies out there." According to him, a camera-agnostic system is far more cost-effective, but its "accuracy level will fluctuate" in low light or different weather conditions, for example.

But this is beginning to change, according to Steve Lewis, vice

> One traditional ALPR setup, such as a fixed site on a highway, would cost us between US$75,000 and US$100,000. For the same amount I could probably deploy six camera-agnostic sites
>
> **Lieutenant Brian Hess, Westchester County Police, New York**

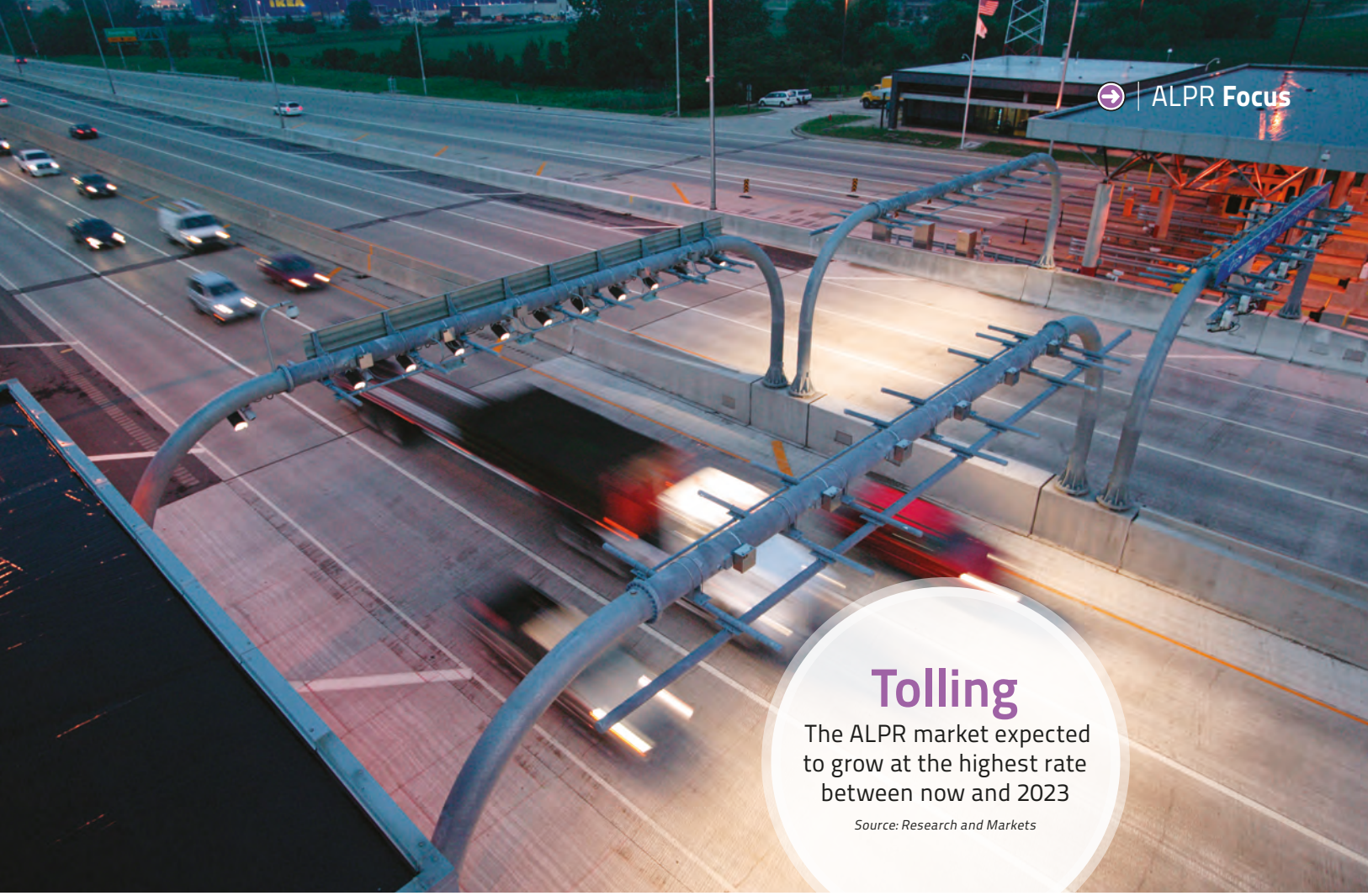
president for business development at openALPR, the software-only company that powers the camera-agnostic ALPR systems for both Mobile and Westchester police forces. "Any camera can be an ALPR camera today," he says, provided it can deliver a sharp enough image and the license plate in that image is at least 100-120 pixels wide.

"We are dispelling the myth that the industry has perpetuated

## Fixed

The type of ALPR expected to hold the largest market share from now until 2023. However, use of mobile ALPR systems will grow at the fastest rate

*Source: Research and Markets*



## Tolling

The ALPR market expected to grow at the highest rate between now and 2023

*Source: Research and Markets*

for decades that you need a special – i.e. expensive – camera," Lewis says. "Of course, if you want to capture license plates at night you will need a camera that is day/night capable and have some internal or external IR illumination."

Lower costs mean that ALPR can spread beyond the traditional confines of law enforcement and city-wide surveillance. It's worth noting, however, that dedicated cameras often have usability and durability advantages, being built for road use. They are weather-sealed, come with external lighting and are also built to last. Being able to take any camera off the shelf does not mean it will last through the rigors of being used 24/7 in all types of weather.

### For whom the ALPR tolls

Open-road tolling is one growth area for ALPR that is based on machine learning. This is because traditional ALPR systems, which are typically based on character matching, struggle with specialty and vanity plates, and also with state indicators in the USA.

Above: **ALPR in operation on Illinois Tollway 53**

Other emerging applications, according to Lewis, include parking access, VIP recognition, tracking the efficiency of delivery in logistics, and so-called frictionless retail payments where the license plate authorizes payment in a drive-through restaurant or a gas station.

Also important to ALPR's future is what one does with the data, particularly whether it continues to be kept in agency-specific silos or is put to wider use. In this respect, the Automated Regional Justice Information System (ARJIS) is a sign of things to come.

> We recognize that there is great concern when it comes to privacy. However, license plates are issued by the state and the law requires that they be displayed on every vehicle
>
> **Steve Lewis, vice president for business development, openALPR**

According to Dale Stockton, an ARJIS project coordinator, the system was created to share criminal justice data among more than 80 local, state and federal agencies in San Diego and Imperial counties in California.

"Although that sounds like common sense, and maybe on TV it is the norm, in real life it's pretty much the exception," Stockton says. "Of the over 15,000 law enforcement agencies in the USA, the vast majority don't have access or at least ready access to what agencies literally next door to them are doing."

ARJIS enables authorized law enforcement personnel to query ALPR data from a much wider geographic area than would be covered by a single agency and, at the same time, to match the data against a much wider range of criminal justice information sources, such as citations, arrests and crime reports.

And this is key when it comes to preventing or solving complex cases such as terrorist plots. "We recognize that there is great concern when it comes to privacy, and we have policy and practice to safeguard the data," says Stockton. "However, it's also important to point out that license plates are issued by the state and the law requires that they be displayed on every vehicle. By default they are in public view and law enforcement is empowered to observe and check those plates."

## Asia-Pacific

The region where demand for ALPR is expected to grow at the fastest rate until 2023, driven by public infrastructure investment. Europe will continue to hold the largest market share

*Source: Research and Markets*

# The future of incident detection

**Automatic incident detection has long been reliant on software solutions. Soon improvements in AI will mean even greater functionality**

In Europe, automatic incident detection (AID), which is another way in which video analytics is used in camera-based road surveillance, is not just nice to have. It is the law. According to European Directive 2004/54/EC on minimum safety requirements for tunnels in the Trans-European Road Network, automatic incident detection is essential for tunnels over 500m (1,600ft) in length.

AID solutions are typically radar-or video-based. The former currently produce fewer false and unwanted alarms, while the latter are cheaper and "in any case cameras must be installed in the tunnel for video surveillance," says Renato Clerici, CTO at Sprinx Technologies, an AID software and engineering company based in Italy.

Also, as video-based AID matures, it begins to offer greater flexibility, according to Andrea Sebastiani, who is responsible for electrical and technology systems on Autostrada A2 in the south of Italy. The 274-mile (441km) stretch of highway features 56 two-bore tunnels and more than 400 AID-enabled cameras.

Currently the cameras can detect events such as a stopped vehicle, the beginning of queuing or a pedestrian in the road, according to Sebastiani, who works for Anas, a government company responsible for the construction and maintenance of Italian motorways. "In the near future, I expect that systems will be able to understand vehicle behavior better, to follow and track a vehicle passing in front of different cameras and to match all this data with other technologies, thus increasing intercommunication between traffic systems," he says.

"Moreover, I think there will be fewer multiple devices and more all-in-one solutions able to provide multiple functions," he adds. "Last but not least, the introduction of artificial intelligence will increase performance, rates of detection, and add additional information not currently available with a standard AID system."

Left: **Investment in public infrastructure is driving ALPR use in Asia**

While there is the potential to use software-only ALPR systems for daytime parking enforcement, and they will certainly help with making plate identification more accurate in open-road tolling, it's difficult to see possible pure traffic enforcement applications for camera-agnostic ALPR in the near future. Currently software-only solutions don't provide the level of robust reliability required for legal enforcement. Only dedicated camera vendors can guarantee that.

> For highways and tunnels we are talking about very big tenders. Very often they cover the [cost of] building of a tunnel, the road, plus all the technology
>
> **Renato Clerici, CTO, Sprinx Technologies**

The reasons for this include the special build for a camera required to withstand 24/7 road use, to work at night and deliver sharp images from vehicles that are traveling in excess of 70mph (110km/h). This last point alone eliminates cameras that would work for a managed parking facility, for example.

Another important consideration is that traffic management systems are typically not sold or operated piecemeal. They are often huge commissions that require a great deal of integration and customization. "For highways and tunnels we are talking about very big tenders, so it's not just cameras and software for automatic incident detection. Very often the tender covers the building of a tunnel, the road, plus all the technology," says Renato Clerici, CTO, Sprinx Technologies.

But as software that makes simple cameras smarter becomes more commonplace and its uses multiply, we may begin to see much more crossover from other uses with traffic management. For example, as police departments begin to share data, there could also be benefits of sharing this data with traffic managers and vice versa. As with so much disruptive, emerging technology, the question quickly becomes not whether the technology can do it, but whether the law will allow it.

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# In-car, real-time traffic updates

**A collaboration between the Dutch government and businesses sees road users receiving instant notifications about local traffic conditions**

More than 1.2 million Dutch road users can now receive personal real-time warnings about traffic jams ahead, stationary vehicles and local weather conditions, thanks to the launch of live connected services by the Talking Traffic Partnership (TTP).

Users of the Flitsmeister smartphone app benefit from the real-time information, launched by a partnership between the Dutch Ministry for Infrastructure and Water Management, 60 regional and local governments, and private enterprises including KPN, Siemens and Ericsson.

New information is available to road users within one second and the TTP describes the speed of updates as being capable of turning simple navigation information into 'tactical driving task support'.

The Dutch government considers that as the TTP mainly focuses on connectivity and data exchange, it will prove to be an important pioneer for the future widespread introduction of self-driving cars and new infrastructure for connected and automated transport.

"The new, real-time information for traffic participants contributes to an improved flow of traffic and increased safety. Infrastructure is becoming smarter and smarter, and information services are becoming more user-friendly every day," said the Netherlands' Minister for Infrastructure, Cora van Nieuwenhuizen.

The system enhances road users' ability to anticipate dangerous situations, offers speed advice to ensure arrival at a green traffic light, provides information on available parking spots, and powers regular updates to variable message signs.

**46: Roadside Revolution**

New roadside hardware is enabling advanced processing at 'the edge', meaning authorities can save money by reducing data transmission costs

# Roadside revolution

Advanced edge processing can significantly reduce the volume of data that needs to be sent to the cloud, or to traffic management centers, thereby reducing costs and paving the way for low-latency connected vehicle services. **James Gordon** investigates a new trend

The traffic signals in Palo Alto, California, look like any others. That they are located in the heart of Silicon Valley ought to tell you that they are not. Hidden underneath the uniform steel casing is a set of ground-breaking algorithms that could change the way we think about traffic technology. A new service, called Tidalwave, the brainchild of California startup SWIM.AI and traffic management leader Trafficware, lets cities process data from traffic lights at 'the edge' (at the roadside) rather than on a central server or in the cloud, and make real-time predictions of city traffic available as a service.

Simon Crosby, SWIM's chief technology officer, says, "For a city like Palo Alto, using cloud-hosted, big-data oriented learning to deliver traffic predictions would cost as much as US$50 per intersection per month. Instead, real-time data

reduction, learning and prediction on standard CPUs at the network edge – at the traffic management system itself – is now possible using edge learning, at a tiny fraction of the cloud costs."

Crosby is not proposing a move away from the cloud. Nor is he advocating that cities ditch their traffic management systems. Instead, says Crosby, the technology pioneered by SWIM founder and chief architect Chris Sachs, which will be rolled-out in major US cities by the end of 2018, "will enable users of city infrastructure – whether citizens, vehicles or services – to optimize their routing choices in real time and avoid major investment or replacement of city infrastructure".

## Life on the edge

So how does this technology work and, more importantly, how does it deliver savings? Sachs begins by addressing a few common misconceptions.

"There are no changes to the intersections themselves. The only difference is in the software that analyzes their data feeds. Our 'edge' software delivers precise timing information and predicts future traffic at each intersection locally. We can predict when vehicles will arrive. This allows Trafficware, our partner, to offer a cloud-based service that delivers predictions to vehicles and other services, such as routing apps, allowing them to respond in real time to changing conditions."

> The Trafficware infrastructure in each city delivers about 50 sensor inputs per intersection… about 1Mbps per intersection
>
> **Simon Crosby, chief technology officer, SWIM.AI**

But how are the traffic lights able to 'think' and forecast the intersection's future behavior?

Crosby explains, "The Trafficware infrastructure in each city delivers about 50 sensor inputs per intersection – phase data for each light in each lane, pedestrian crosswalks, and an event for every car that crosses an in-road loop. This is about 1Mbps per intersection. SWIM.AI uses it as primary inputs for learning. Additional inputs come from the neighboring intersections whose traffic affects this intersection. In total, about 1,000 input parameters per second are used in the deep neural network [DNN]."

Sachs adds, "Instead of sending data to the cloud or a central server to be processed, SWIM automatically creates a digital twin [a virtual model] for each traffic signal – from the data. The final step is to send the current and predicted results for each traffic signal to the cloud, where it can be accessed by third parties."

SWIM.AI expects edge processing to dominate traffic technology landscape in years to come.

Sachs says, "Edge solutions can accelerate the connected and autonomous vehicle revolutions that are gathering pace."

## Live operation

With congestion estimated to cost the USA US$182.6bn by 2030, Dr Hesham Rakha of the Virginia Tech Transportation Institute agrees that a shift from linear setups to edge and cloud solutions is essential for managing traffic flow.

Rakha and a team of researchers have spent the past two years building an edge solution that has just been tested in the Los Angeles downtown area. But the system, which covers 437 traffic signals, does not rely on neural networks. Instead it uses a Nash bargaining algorithm, which abandons the concept of setting a group of traffic lights to a fixed cycle length and allows the traffic intersections to jump from one phase to another depending on real-world and real-time traffic flow conditions. Rakha and his students have demonstrated that this solution

Left: **Downtown LA is the location for a new, Virginia Tech-led, edge-processing pilot**

## Making the most of data

**A new project in York, UK, will provide authorities with an exciting glimpse into how they can get the best out of fresh data**

The York Eboracum Cooperative ITS Project uses floating vehicle data captured by roadside units and also acquired from transport analytics giant Inrix, in order to improve signal performance, rather than collecting data from inductive loops, which are expensive to install and maintain.

The project is being deployed on nine junctions of the A59 corridor leading into York city center. So what are the potential benefits?

Project consultant Andy Graham explains, "If the project is successful, it could mean fewer inductive loops. This could save thousands of pounds each year. Also, as the system is receiving a myriad of anonymized GPS data from local sensors, the traffic management system will have a much more detailed and complete picture of traffic behavior, which will enable it to better control traffic signals.

"Initial indications suggest that the project can improve congestion in the affected area by up to 10%, and we also expect there to be a sizeable reduction in exhaust emissions."

gives the network-wide Nash optimum solution.

Rakha estimates that the decentralized system could potentially deliver delay savings (relative to current centralized controllers) of up to 36%. Not only this, but it could also decrease stopped traffic by as much as 90% and reduce fuel consumption by around 5% when fully implemented.

Rakha explains why he chose Nash bargaining algorithms over AI and machine learning techniques. "Our system works independently of the traffic management centers (TMCs), and can be deployed without any disruption or changes to existing frameworks. Essentially, as long as the traffic signals can measure traffic flows and thus have access to real-time data, the algorithms will automatically update the traffic signal timings in response to local conditions. In contrast, if you use a system based exclusively on AI, there is a danger that a scenario emerges that the algorithm neither recognizes nor can cope with in real time."

Rakha, who has also developed a cloud-based system, believes that the traffic roadside infrastructure of tomorrow will not rely purely on the edge or the cloud. Nor does he think that the edge system will sound the death knell for TMCs. "Traffic technology systems will be a hybrid of all three," he says.

> Our system works independently of traffic management centers, and can be deployed without any disruption to existing frameworks
>
> **Dr Hesham Rakha, professor of civil and environmental engineering, Virginia Tech Transportation Institute**

Why does he think that edge solutions won't work on their own? "If a state department of transport were to shut down its primary TMCs and invest solely in an edge network, it would immediately narrow its line-of-sight. It would be able to optimize signaling in small pockets of a city's network, but because the system is not linked to a central or cloud-based solution it would not allow traffic managers to get to the root of a traffic jam, the cause of which might be out of the range and scope of the edge processors. But if we amalgamate the two, then we can control the signals that allow traffic into congested regions [traffic gating], while increasing the green times of traffic exiting the congested areas. Furthermore, we could integrate traffic routing with traffic signal control to divert traffic away from congested areas."

Speaking from his office in Surrey, UK, Andy Graham, the Transport Technology Forum's lead on connected vehicles, says, "In the UK we send far less data to and from the roadside than in the USA, so cloud and edge have no benefit in data reduction."

Graham, who has worked in traffic infrastructure management for 32 years, thinks that many of the "so-called next-generation edge solutions" being suggested for future traffic would simply be duplicating existing approaches – and would come at great cost.

"We believe that centralized coordination allied to roadside control in established systems, such as the split cycle offset optimization [SCOOT] or the microprocessor

## New roadside hardware

### Technology giant Nokia adds its edge-processing roadside cloud to its extensive list of innovations

Ulm Minster in southern Germany is the world's tallest church and the views from its spire are breathtaking. Yet at ground level the city's local road authority is also enjoying enhanced visibility, thanks to the Nokia roadside cloud.

MEC (multi-access edge computing) technology is currently being deployed at an intersection in Ulm, where it is being used in a local research project to support connected and automated driving technology. So how does it work?

Birger Haetty, a senior project leader, explains, "For precise positioning of road users, rapid processing and distribution of data is required at the roadside. A multi-access edge computing server processes data from roadside sensors such as video cameras and lidar at the intersection. This data is enhanced with information from central systems to create a real-time digital map of the intersection area. This local environment model is then forwarded to automated driving vehicles via V2X connectivity."

Matthias Jablonowski, global practice lead for road at Nokia, adds that the Nokia roadside cloud, won't "replace central traffic management systems but it will complement them".

Where does he think that it is likely to add most value?

"First, there are a number of situations where it can potentially be used to transform existing traffic technology infrastructure, such as real-time, interactive, private and local roadside services," he says. "Second, given that there is still much uncertainty around the technology that automated driving vehicles will demand from the road operator's communications infrastructure, the Nokia roadside cloud is addressing these challenges by providing an open, standard-based edge computing platform that is flexible for these future developments."

optimized vehicle actuation [MOVA] tools, which make decisions at a local level, will be part of our roadside infrastructure for years to come.

"Secondly, with other new approaches providing a hybrid option, we believe the infrastructure currently in use does not need to be replaced, but rather evolved to support connected and autonomous vehicles. Moving from established systems to the edge and the cloud too is simply not an option for most local councils, whose budgets are already severely stretched."

Mark Nicholson, CEO of Vivacity Labs, a next-generation transport management provider, in Milton Keynes, UK, disagrees that legacy systems such as SCOOT and MOVA can solve the challenges currently faced by city and town planners. He believes that edge and cloud solutions have a key role to play in the future.

"If these systems were functioning seamlessly and efficiently, congestion would be a much smaller issue," he says. "This is not the case and is why Transport for London is investing over £100m [US$142m] in its Surface Intelligent Transport system [SITS], and why cities like Pittsburgh, Pennsylvania, are implementing AI-led traffic signal optimization projects to cope with gridlock. This technology can offer so much more than existing architecture."

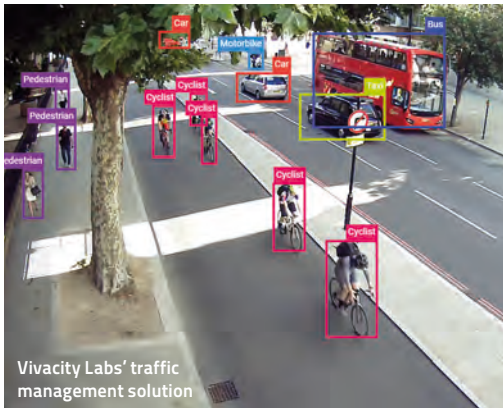
> Our system works independently of traffic management centers, and can be deployed without any disruption to existing frameworks
>
> **Mark Nicholson, CEO, Vivacity Labs**

It is this vision that Nicholson and his team are bringing to the UK. For the past few years Vivacity Labs has been developing a traffic management solution that uses both edge and cloud solutions in Milton Keynes.

Nicholson, who founded the company in 2015, thinks that the system will revolutionize transportation strategy modeling, make real-time traffic management possible, and enable enhanced traffic light optimization.

He explains, "The data processed at the edge and refined on the cloud will allow enhanced traffic signal optimization. Unlike traditional signals, the intelligent traffic lights in Milton Keynes will have the ability to differentiate between categories of road users. Therefore they can give priority to buses or cyclists, which SCOOT and MOVA are unable to do effectively. This will make for safer and less congested road networks."

Above left: **Vivacity roadside sensor in Milton Keynes**




**Vivacity Labs' traffic management solution**

# The cloud-based, signal analysis toolbox that saves time and money

Live Traffic Data (LTD) is a New York-based company that, over the past five years, has been partnering with traffic agencies across the USA to provide Automated Traffic Signal Performance Measures through its cloud-based software system, SIGPAT (SIGnal Performance Analysis Toolbox).

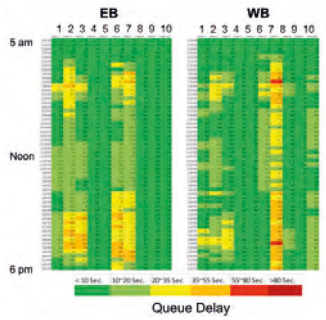
Traffic engineers utilizing SIGPAT are better equipped to control and monitor traffic signal operations in real time, optimizing traffic flows and reducing congestion.

Since 2013, many US cities have jumped on board to join SIGPAT's platform. LTD's technology is being deployed in over 21 agencies, with many more underway. Some cities that have adopted the platform include Pasadena, Las Vegas, Phoenix and Palo Alto.

## A cost-effective solution

SIGPAT comes as a cost-effective solution for traffic agencies suffering from budget constraints and limited staffing, which are major factors preventing engineers from proactively managing and upgrading their traffic signal infrastructure. In the USA alone, traffic agencies manage more than 360,000 signalized intersections, some of which may handle up to 100,000 vehicles per day.

Keeping all these signals optimized is not easy or cheap. According to the FHWA, "Agencies typically re-time signals on a three- to five-year cycle at a cost of approximately US$4,500 per intersection and not having performance data drives re-timing costs up by requiring software modeling to simulate performance, along with detailed, manually collected traffic data."




Above: **An example of a SIGPAT feature. The Arterial Congestion Report (different colors indicate different congestion levels)**
Left: **In the USA alone, traffic agencies manage more than 360,000 signalized intersections**

## Need to know

**Examples of the types of intersection data that SIGPAT allows engineers to access and evaluate**

- Signal status
- Traffic volume
- Daily and weekly flow rates
- Arrival on green
- Overall delay time
- Queue length
- Travel time
- Vehicle trajectories
- Space and time diagrams

In the era of the Internet of Things and connected mobility, there is a major need to help cities upgrade their infrastructure to keep up with the rapid evolution of vehicle technologies. SIGPAT promotes vehicle-to-infrastructure (V2I) communication by making real-time and predictive data available via the cloud, transforming traditional cities into smart cities in the process.

SIGPAT simplifies historical performance analysis capabilities. Engineers can analyze archived data and evaluate operations such as volume, arrival on green, delay, queue length, travel time, vehicle trajectories and space-time diagrams. The system is compatible with most types of traffic signal controllers and it is non-intrusive, as it does not interfere with any agency's established operations.

## Cross-industry applications

"We have used the LTD system since 2014," says Abdul B Mohamed, a city traffic engineer in Danbury, Connecticut. "It has become a major complement to our existing adaptive signal control system.

"We utilize SIGPAT in obtaining a real-time level of service information, as well as daily and weekly traffic flow profiles. That information, plus the traffic volume data that the system provides, have been very important tools in our efforts to enhance traffic operation services," he says.

Furthermore, the traffic signal status, traffic flow and derived performance measures are of value to the connected and automated vehicle worlds, including auto manufacturers, navigation, mapping companies, delivery fleets and data analysis/data science industries.

The technology is already helping cities, regional governments and businesses achieve wider goals for safety, mobility, sustainability and economic vitality. The system has been deployed on many major arterial corridors throughout the country. It has proven to be a powerful tool to simplify traffic engineers' daily work and help them to manage signalized corridors more effectively.

## Free reader inquiry service

**Live Traffic Data** inquiry no. **501**
To learn more about this advertiser, please visit: www.ukimediaevents.com/info/tfm

# Pedestrian crossing technologies to benefit all

People with sight and hearing impairments can face a number of challenges when traveling and moving around cities, including when using pedestrian crossings. Czech organization AŽD Praha, which manufactures transportation technologies, has designed a new type of acoustic push button orientation device, called PPB-02, to facilitate mobility and support independence for those with restricted sight and hearing.

When creating the PPB-02, AŽD took into consideration the requirements of Czech Blind United, which helps people with physical disabilities to integrate into everyday life in the Czech Republic.

## Acoustic output

The PPB-02 prioritizes helping pedestrians to cross streets at crossings with traffic signals. It also notifies blind and visually impaired pedestrians about the status of the traffic signal by producing unmistakable tones and knocking frequencies.

A key feature of the PPB-02 is its self-adjusting output volume capability where the volume automatically adjusts in reaction to external environmental noise in the range of pre-set minimum and maximum volume levels.

In order to prevent the PPB-02 disturbing residential areas – at night-time, for example, or when traffic is quieter – it has a timer integrated into it that can turn off its sound or limit its maximum volume. If the PPB-02's sound is switched off, the blind user can turn it on for a limited period of time by using a radio transmitter. The PPB-02 can then detect the radio transmitter's signal via its built-in receiver.


Left: **The PPB-02 includes a radio transmitter receiver, tactile elements and a haptic sensor**

## Need to know

**The PPB-02 is an acoustic button for pedestrian crossings. Features include...**

- Acoustic and vibrating signaling of the status of pedestrian crossings
- Remote control of settings and diagnostics
- Automatic volume control of acoustic output depending on environmental noise
- Tactile elements that indicate the direction of the crossing

An advanced feature of the device is its ability to play audio messages that describe the arrangements of the pedestrian crossing that the user is about to cross. A tactile relief with raised plastic symbols, representing a particular part of the crossing paths, also serves as a support component. It can relay, for example, the number of lanes, tram tracks, split islands, biking trails, etc.

## Split island crossings

There are a number of locations where there are poles with acoustic push buttons too close to each other, or where there are two-way push buttons located on one pole, most frequently at split island crossings. In these instances, acoustic signaling may be confusing for the blind and visually impaired, because they may not be able to recognize what direction the knocking sounds are coming from.

AŽD Praha has created a solution to this problem by adding a function that disconnects devices that audibly conflict. If the blind or visually impaired person is waiting on the split island in the middle of the crossing, he or she can press the haptic sensor located underneath the PPB-02 to turn off the sound of the device from the path they have already crossed – thereby only enabling the sound of the acoustic pedestrian push buttons in the required direction.

## Serving all needs

The PPB-02 has another function for citizens with combined visual and hearing disabilities. The haptic sensor has a vibrating surface with a shaped arrow demonstrating the direction of the crossing. By touching the vibrating surface arrow shape, the pedestrian can feel vibrations at the same frequency as the acoustic output of PPB-02. They can then receive information about whether or not they can cross the road.

## Remote administration

A significant benefit of the PPB-02 is that surveillance, diagnostics and settings can be remotely controlled by the operator.

The PPB-02 and similar devices have already been installed in European cities and they have positively contributed to the lives of people with visual and hearing impairments.

They are particularly useful at complicated or noisy crossings with traffic signals that are close to offices, or at bus or railway stations.

# Keeping pedestrians crossing with new technology

Solihull Council in the West Midlands, UK, wanted to improve traffic flow and enhance safety at its pedestrian crossings. A larger pedestrian detection zone would help to ensure optimal performance and a live video feed to its urban traffic control (UTC) center would help the traffic control team to remotely monitor and maintain the crossing.

Jag Mudher, an engineer for UTC and CCTV at Solihull Council, explains, "We were looking not only to enhance the detection zone, but also to have more flexibility regarding the way data was collected and fed back to the control room – as well as reducing the need for on-site visits by engineers."

The new AGD 645 pedestrian detector offered a solution to these issues. Mudher and his team installed a trial unit at a location that was not only within walking distance to enable them to regularly test the performance of the 645 within the set zone, but where there was also a nearby CCTV camera that enabled them to view and compare the live CCTV image with the video output of the 645.

## Improving performance

Puffin and toucan crossings use pedestrian detection to minimize delays to road users. Curbside presence detectors, the function of which is to sense/identify pedestrians standing in the crossing wait area, are normally mounted on a traffic signal pole.

When a pedestrian presses the call demand unit, the controller checks the output from the detector to confirm the presence of pedestrians. It then continues to do so until the stage where the crossing halts traffic for pedestrians to cross. If the detection area is unoccupied for more than a preset period, the call is canceled and the pedestrian stage will not appear.

Above: **The AGD 645 pedestrian detector can be set up with any device that has wi-fi, such as a smartphone**

## Old ways

Typical curbside solutions don't always provide the detection zone coverage that enables this process to be fully realized.

False detections caused by shadows, or failures to detect caused by restricted zone coverage, can adversely affect detection efficiency. Another concern is that where authorities have especially large wait areas, additional units are normally required – thereby adding costs to the setup.

If a problem occurs on-site, an engineer is required to investigate the crossing, costing both time and money. In some instances, the problem may be caused by a specific environmental condition that may have changed by the time the engineer gets to the site.

"Until now, some crossing equipment has failed to cancel the pedestrian phase if, for example, people crossed before the green man showed while the traffic was still running," says Mudher. "This meant we were losing a lot of valuable time that could have been given back to the traffic. There were even instances where, because of trees or shadows, the unit would cancel out the demand altogether. The pedestrian may not have been fully aware of this and so was frustratingly pressing the button again and again."

## Better detection

Mudher and his team used AGD's new 645 pedestrian detector to solve the issues at the crossing. The 645, which was designed while taking into account feedback from local authorities, has a larger 10 x 3m (32 x 10ft) detection zone, which will adequately cover waiting

areas for larger crossings in smart cities.

AGD's pioneering 3D HD optics bring affordable, high-definition image capture and enhanced processing to curbside detection. Advanced optics deliver improved detection performance, while the 645's IP capability means it can feed real-time video back to control rooms, where detect zone adjustments can be made remotely.

The performance of the new AGD 645 is far superior to that of its predecessors – it gathers more data and uses smarter processing to make highly accurate detections. Testing on live pedestrian sites has proved accuracies of over 99.9%.

"False detections are a thing of the past with the 645," says Mudher.

## Simple setup

The detector hosts its own setup software and generates its own wi-fi, so engineers don't need to download anything prior to installation.

The 645 can be set up using any wi-fi device such as a smartphone, tablet or laptop. Its unique and secure wi-fi AGD Touch Setup technology allows installers to configure the device in three simple steps: name device, select zone, click to calibrate.

Multiple 645 detectors can be set up at the same time from a safe position on the ground, or in a vehicle from up to 100m (328ft).

"AGD took to the site and showed us how to set it up," says Mudher. "It was really easy and you don't need any specialist tools, leads or software."

The AGD 645 can be directly integrated with a UTC system. This enables remote device monitoring and maintenance and overcomes the need for site visits after installation.


Above: **Solihull Council, UK, will specify AGD's 645 pedestrian detector use in the future**

## Need to know

**The 645 is an above-ground pedestrian detector used at road crossings**

- The 645 covers an area of 10 x 3m (32 x 10ft)
- It uses 3D HD stereo-vision sensors to detect moving and stationary objects
- It generates its own wi-fi signal for ease of remote setup
- It can be set up on-site or in a vehicle up to 100m (328ft) away

"It's great to be able to tap in to the device from the control room and watch what's going on at the crossing in real time," says Mudher. "The 10 x 3m [32 x 10ft] detection zone is also a bonus because we can adjust it to cover the exact size and requirements of the crossing; with previous devices it would sometimes be a struggle to cover the entire zone if you only had one detector."

## Smart city functionality

When integrated with a UTC system, data on detections and canceled demands can help local authorities understand how often and when crossings are being used. This deeper insight allows for more informed decision making on network design, pedestrian flows and maintenance.

Data collected can be used in a number of ways. Thresholds can be set for the number of demands or rejections, alerting the UTC system if a particular crossing seems too quiet or too heavily used, which may indicate a problem. The 645's real-time video capability lets control room staff see what is happening on the ground – for example, the detector may have been knocked or there may be a puddle that's causing pedestrians to wait outside the normal detection area. This allows the detection zone to be adjusted in real time to keep pedestrians safe and traffic moving.

Users of the 645 can also download information for a particular unit, assess it to see whether optimal performance is being achieved, and adjust where necessary.

"The data is really useful," says Mudher. "If we get any complaints, we can go back and see what was happening at the time and of course we can use the data to inform our future planning."

# The importance of optimizing ALPR for better results

The performance of any automatic license plate reader (ALPR) system relies heavily on the quality of the images and the accuracy of the optical character recognition (OCR) engine. When poor images are run through an OCR – no matter how powerful it is – error rates increase and accuracy rates decline. A number of factors contribute to inadequate image quality, from uneven illumination across a lane to incorrect placement and angles of the cameras.

## Performance is key

Capturing images of license plates on vehicles moving at high speed and from a considerable distance can be difficult. The cameras not only need to be tuned properly, but the geometry of the system setup must be carefully configured so that the camera can capture the image at exactly the right time and at the correct angle. If done improperly, the license plate can appear too dark or too bright, too large or too small, out of focus, at an obscure angle, or missed entirely.

If characters on the license plate are blurry or pixelated, the OCR cannot define the lines around the characters and therefore may interpret certain characters incorrectly. For example, the letter 'B' may be interpreted as the number '8'. Smaller stacked characters are completely unreadable.

If an image is overexposed or underexposed, the identification number cannot be distinguished from the background symbols. The OCR will not only be unable to read the characters, but the chances of correctly identifying the state and plate type will decrease too.

If the image is from the wrong angle, the license plate can appear slanted, so the OCR can't distinguish between similar characters. For example, the camera may not be able to recognize the horizontal line separating the two parts of the letter 'B', thus registering a letter 'D'. There are many other factors that will degrade the quality of the images from ALPRs and, as a result, affect the bottom dollar.

## The cost of image quality

Poorly functioning cameras can be very costly. Properly tuned cameras can reduce operating costs, as yield and accuracy rates will rise and fewer images will require manual review. Although manual review can be helpful, the addition of a human into the license plate recognition process does not guarantee that an accurate result is achieved. If a poor-quality image does not render enough data to be tied to a record, the manual reviewer would still need to be paid for reviewing the image.


There are also often financial penalties for not meeting required specifications. The time and effort it takes to analyze images from a poorly performing camera, followed by carrying out corrective action on the camera, can be immense. Therefore, it is increasingly important for cameras to be configured properly before they leave the factory, and to be precisely tuned using a tool – not the human eye – as they are being installed.

As with RFID technology, imaging equipment still requires regular tuning and maintenance to optimize performance. Unfortunately, the knowledge and skill set required to provide support to imaging systems is not widely available, which is why Perceptics has

Left: **ALPR cameras must be performing adequately in order to be effectively used** Below: **An over-exposed license plate image** (right) **can be extremely difficult to read**

launched its image optimization services. Perceptics engineers and technicians have decades of experience building, installing, tuning and maintaining ALPR cameras and they can provide customers with the resources they need to get the best-possible performance from their legacy systems.

Better-performing systems result in a higher level of automation, increased accuracy, decreased operating costs and better value for the customer.

## Need to know

**Perceptics offers image optimization services for ALPR systems. These include:**

- Camera performance audit
- On-site camera adjustments
- Pre-installation engineering support
- Consultation with a Perceptings imaging expert during installation

## Free reader inquiry service

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



**Richard Butter**

# Intertraffic Amsterdam was an inspiring moment for the transportation industry

March 20, 2018, marked the start of the 24th Intertraffic Amsterdam show – a leading international event in traffic technology and smart mobility. As you may have guessed, your man in Amsterdam was particularly excited, because Intertraffic 2018 was hosted in my home town and the event is at the core of my occupation. It is a week where global traffic technology professionals gather to get an insight into the latest mobility innovations.

Cora van Nieuwenhuizen, the newly appointed Dutch minister of infrastructure and water management, announced her new policy: "I want 2018 to go down as the year smart mobility truly took off – from startup to scale-up!" declared the minister. It was a confirmation of the importance of fully integrating startups in the process of tomorrow's business case.

I couldn't ignore the question of "What's tomorrow's business case?" The importance of getting this question answered became clearly visible during the show.

First of all, there was a CEO summit taking place with an interesting central question: "Do smart cars need smart infrastructure?" Among the panelists, there were CEOs from some of the biggest civil engineering contractors in the Netherlands and senior advisors from the Dutch Ministry of Infrastructure and Water Management. The outcome of the session showed that it is essential to invest more in tomorrow's business case – whatever that will be.

I also recently read an intriguing article on the same subject, which argued that machine-readable infrastructure simplifies smart car design considerably, but removing pedestrians and cyclists from the roads should be taken into account as a genuine option.

Something else to emerge from Intertraffic was the belief that OEMs and telcos can't be viewed separately anymore when dealing with 'our' smart mobility industry. A full integration of OEMs, telcos, Tier 1 suppliers, big data and ICT is necessary for our industry

> "This industry is full of opportunities and offers plenty of space for innovation"

to work on tomorrow's business case to make our world greener, decarbonized and safer on the roads.

Paul Warburton, global account director and head of automotive at Fujitsu, made an interesting statement in an article he wrote concerning the integration of the automotive sector in the traffic technology industry.

"Manufacturers need to partner with technology infrastructure, service and content providers to make their in-car platform the most compelling," Warburton said.

It is clearly an interesting time to be the captain of the Intertraffic team – this industry is full of opportunities and offers plenty of space for innovation. Hopefully we can contribute to accelerating the connections of today's and tomorrow's mobility challenges.

*Richard Butter is director of traffic technology at RAI Amsterdam and is responsible for Intertraffic worldwide events,* ***www.intertraffic.com***

# The intelligent management parking system

Intelligent management parking system iMAPARK was nominated for an Innovation Award at Intertraffic Amsterdam 2018. It is an on-street smart parking system that helps drivers to find and reserve available parking spaces by using studs in road surfaces, electronic displays and an app. Each parking space has a light signal and a sensor that sends information through a wireless network.

Drivers can receive information in real time about available parking spaces in the area via an app or electronic displays installed on public roads. With the app, as well as reserving parking spaces, drivers can also pay for their parking and extend their parking session time.

This smart-city solution enables municipalities and parking management companies to manage parking areas much more efficiently, as well as analyzing, optimizing and managing street assets through a single platform. The payment system is fully integrated into the parking management system.

## Need to know

**This is what makes iMAPARK unique and made judges choose the system:**

- Search for parking spots based on points of interest or preferences;
- View in real time the available parking spots;
- Reserve parking spot for certain hours;
- Extend parking time;
- Pay for the service (payment system integrated – no need for third party system).

## Fighting congestion

When installed, iMAPARK – which was developed by Sernis Technology Solutions, Altice Labs, Globaltronic and Present Technologies – can reduce traffic density in busy city centers and increase the revenues of municipalities and parking management companies by increasing occupancy and reducing non-payments.

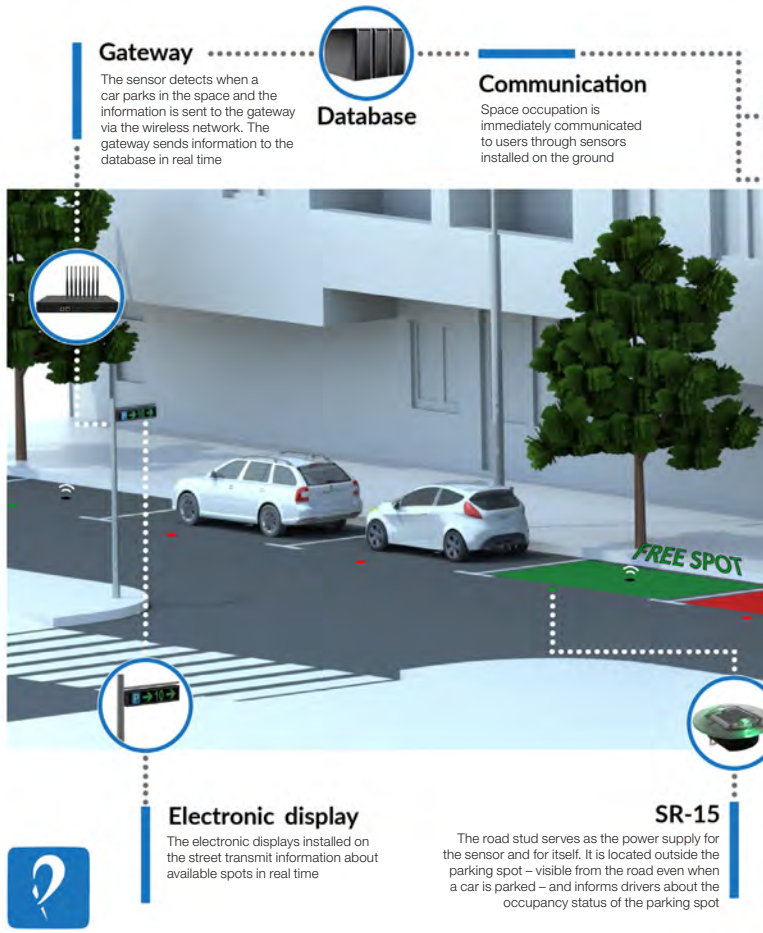
Large cities are having to deal with increasing amounts of traffic congestion. According to a report by ITS America, cars are parked on average 90% of the time and around 30% of traffic congestion in urban areas is caused by drivers seeking an available parking spot. This not only wastes drivers' time, it also increases harmful emissions.

Often driving can be stressful. Driving to a destination, only to find that there are no available parking spaces, causes more stress.

It not only affects motorists – the town or city also suffers from the shortage of convenient parking. Having to search for a long time for a parking space in a city center ultimately encourages people to consider out-of-town shopping centers or shopping online.

If people cannot find a parking spot, they probably will not go back to that city again to shop, eat, or spend money in any other way. Therefore on-street parking spots are very important for cities.

While often an afterthought, creating good parking spaces is essential in creating a smart city with a more efficient, sustainable and liveable environment. A smart city needs to have parking that is easy to find, leave and pay for. Badly coordinated parking provisions can make any city a frustrating place to visit or live in.

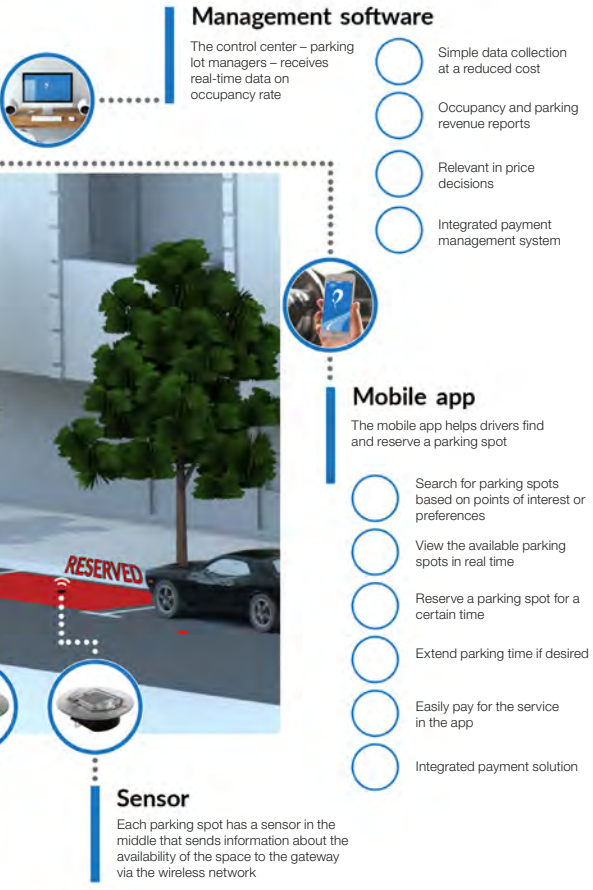




## A smart solution

iMAPARK is an on-street smart parking system, developed with smart cities in mind, that helps drivers reserve and find an available parking spot by means of road studs in the ground, electronic displays and a smartphone app.

The system consists of the sensors, signaling and the communication hardware devices needed to monitor parking spots, as well as




Above: **iMAPARK alerts drivers to parking spaces through an app**

dedicated electronic displays to communicate availability.

Each parking spot has a light signal and a sensor contained within the SR-15 road stud, which is powered via a solar panel. The sensor sends information to a gateway through a wireless network.

The road studs are intended to be located just outside of the parking area so that they are visible from the road, even when a car is parked. They inform passing drivers about the occupancy status of the parking spot – which can be available, occupied, reserved, or designated for the use of disabled drivers only.

Drivers will receive information in real time – via the smartphone app or on the electronic displays installed on the public roads – about the available parking spots in the area.

## For drivers and managers

iMAPARK is a solution with advantages for both drivers and parking management companies. For drivers, it offers the convenience of being able to search for parking spots based on points of interest; view available parking spots in real-time; reserve spaces, and extend time once parked; and pay for the service directly via the app.

For parking managers, it simplifies parking data collection and reduces costs. iMAPARK enables detailed occupancy and parking revenue reports, with precise timing information that is relevant to pricing decisions.

The system is integrated with the field parking information devices through gateways that provide the data used by the application platform.

The application platform has a web-based back-office channel for the use of administrators. It supports the preparation of basic solutions for scheduling and IoT integrations, as well as full back-office support.

The functions of the software for parking management companies include the ability to: search and withdraw information about the business; manage accounts (customer, billing) and monetization services; perform customer account management operations; manage top-up requests; manage payment requests via the fully integrated setup (no need for third party system); manage vouchers; analyze data; and use the interface to send bills to external billing systems responsible for invoice generation/receipts.

iMAPARK enables municipalities and parking management companies to operate their parking facilities much more efficiently, allowing the analysis, optimization and management of street assets in a single platform.

When installed, this system will reduce traffic density in the center of a city as well as increase the revenues of municipalities/car parking area managers by increasing occupancy and reducing issues of non-payment.

*This article is part of the Sernis internationalization project (identified as Norte-02-0752-FEDER-19975 Incentive System to the internationalization of SMEs according to Portugal 2020) and is co-funded by the European Structural and Investment Funds (ESIF) from European Union, framed in the Norte 2020*

# Camera-enabled V2X to improve pedestrian safety

The ITS community's focus on vehicle-to-everything (V2X) technology is increasing. Although it is mainly regarded as a way to avoid collisions between vehicles, V2X technology could also lead to increased safety for pedestrians and cyclists, as well as benefits in terms of traffic safety and efficiency.

The practical applications for V2X are numerous. By providing real-time traffic information, V2X enables vehicles to receive pre-emptive warnings about hazardous situations, such as hard-breaking vehicles ahead.

## Signal status

Using V2X technology, vehicles can even receive messages about the status of traffic signals ahead of them, allowing them to adapt their speed and drive more economically. V2X also plays an important part in paving the way for connected and automated driving.

### Need to know

**FLIR's ThermiCam is an intelligent thermal camera system. Key benefits include...**

- The camera and detector being integrated into one unit
- Simple and quick installation times
- 24-hour detection, even at night-time and in the most difficult weather conditions
- No need for additional lighting
- Detection over long range and across up to four different lanes

Will V2X also improve safety for pedestrians? The question becomes even more relevant when autonomous vehicles are considered. Currently, the detection of pedestrians and cyclists by autonomous vehicles relies entirely upon vehicle-mounted sensors. The performance of these sensors depends on many factors, such as sensor type, weather conditions, pedestrian/cyclist behavior and, importantly, obstruction and occlusion from infrastructure, parked vehicles, or any other obstacles in the vehicle's field of view. Vehicle-mounted sensors are limited to only being able to 'see' the path ahead. Hence, they cannot see pedestrians who are around a corner or hidden behind a parked car, for example.

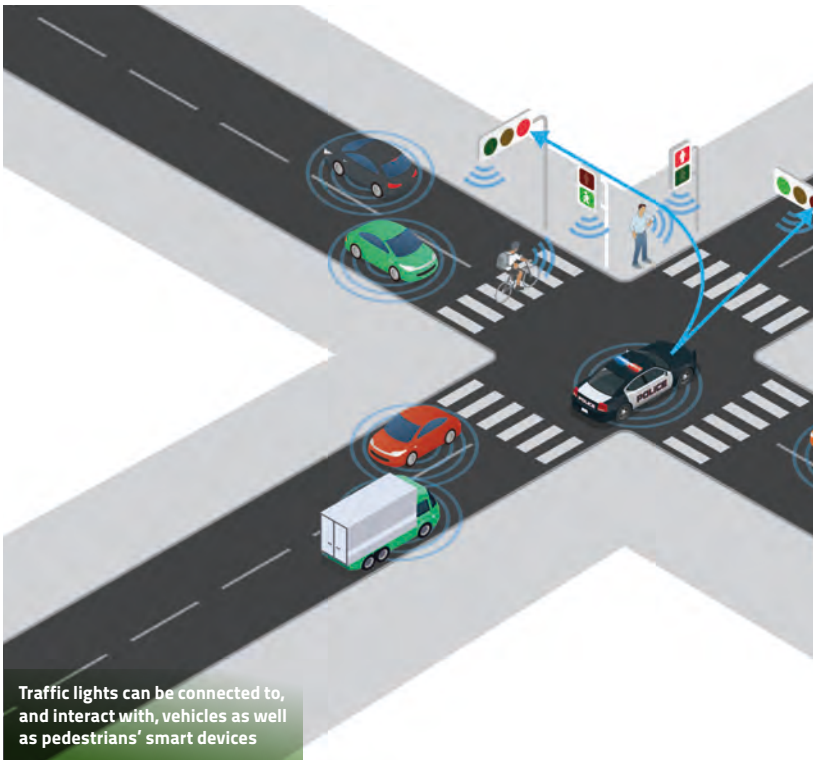
A more efficient approach for warning vehicles of imminent danger could be to make use of the infrastructure-mounted pedestrian and cyclist detection sensors we already find in our traffic scenes today.

## Traffic monitoring sensors

Traffic signal control systems have often made use of sensors and cameras to monitor traffic as well as detect traffic users in real time.

By combining the detection capabilities of these systems with real-time V2X communication, even more capabilities can be unlocked. For example, a pedestrian or cyclist can be brought into the V2X communication system when it is detected by that sensor and this detection information can then be transmitted as a warning message to the drivers of surrounding vehicles.

Sensors mounted on existing traffic light infrastructure usually have a much better viewing angle. They can see the traffic scene from high up and have no occlusion problems. In addition, when connected with V2X technology, they have the ability to position pedestrians and bicycles on the local dynamic map, which is the real-time overview of all objects influencing an intelligent transportation system.



Traffic lights can be connected to, and interact with, vehicles as well as pedestrians' smart devices

## Intelligent thermal camera

Combining intelligent cameras with V2X can be done in two ways – either by connecting a camera via TCP/IP to a commercially available off-the-shelf V2X modem, or by means of an embedded intelligent camera platform hosting a V2X chipset and radio transmitter.

The ThermiCam V2X thermal traffic sensor from FLIR Systems is an example of the latter approach. ThermiCam V2X includes a thermal sensor for vehicle and bike detection at nearby intersections and crossings, and uses thermal energy emitted from vehicles and cyclists. In addition, it contains an integrated V2X modem that can capture the video detection information via XML messages and process this together with the received V2X messages from vehicles.

## Low-risk investment

The benefits of V2X may be clear to many city authorities today, but tight city budgets and cumbersome procurement guidelines for public agencies often get in the way of good intentions. However, that does not mean that cities are not willing to experiment and explore the possibilities of V2X.

Traffic authorities are looking for V2X applications that provide

short-term benefits and offer low risk. V2X applications, such as traffic signal prioritization for emergency vehicles, do not require deployment of a large number of vehicle-mounted V2X units and offer immediate short-term benefits such as improved estimated time of arrival (ETA) and reduced emergency vehicle response time.

And with cost-effective V2X solutions such as the FLIR ThermiCam V2X, which already has a V2X roadside unit integrated, city authorities might be even more inclined to make this low-risk investment.





by **J J Eden**

# In order for the tolling industry to survive, openness to change is essential


We in our industry are proud of our past. In fact, we talk about the past so much that it sometimes feels like we have never left it. In the 20th century toll roads in the US were built with multimillion-dollar plazas, and customers could briefly chat with staff while paying for their tolls. But traffic rapidly increased beyond system capacity. Traffic backlogs led to major customer dissatisfaction, and toll agencies found a solution to provide mobility with electronic toll collection, not because it was cheaper or even increased revenue, but because it provided mobility and allowed user fees to grow to support infrastructure needs.

Soon another technology – video – had matured to a point where it could be used for enforcement, and electronic toll collection was born. But change doesn't come without challenge. Agencies, integrators and consultants had to adapt. Fast-forward 10 years and we have reached another fork in the road as we aim to stay relevant. Yet again, we find ourselves facing our biggest risk and threat: complacency – and even worse in our industry, strong resistance to change and standardization to meet market needs. New technologies such as electric and autonomous vehicles are no longer being deployed by the typical government study and design method, or even within the tolling industry. Innovation from in-vehicle technology to mobile payment systems such as Apple Wallet and Google Pay are being designed and deployed by private sector industries outside of tolling as we reluctantly discuss these changes.

I believe that we are in the middle of natural transition. We, as an industry, went from stop-and-go cash collection, to slow-speed electronic toll collection, to all-electronic tolling – all in a relatively short period of time. We now have commercial mobile payment systems developing outside of our industry. Within the past year, we have seen an increase in companies that deploy payment systems in parking, fast-food and fueling, trying to connect into the large footprint of the toll collection industry. Each one of these markets is larger than the tolling industry. A mobile payment system connected to these industries will generate over US$50bn in sales per year.

> "We've reached a fork in the road and we find ourselves facing our biggest threat: complacency"

We are starting to see the automotive industry drive the transponder decision by picking what they will connect to. The next transition in tolling will involve large mobile payment systems that will be integrated into autonomous and electric vehicles. This integration will provide agencies with low-cost transaction rates, where lane and business systems are provided by individual agencies, and the back office and collection systems will be managed and integrate into outside commercial payment systems entities. The popularity of electric and autonomous vehicles will grow due to customer demand and not because we, as an industry, have decided to go in any particular direction.

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

# Managing traffic in real time

What if traffic managers in the control room could eliminate traffic jams before they occur? What if they could initiate strategies to intervene in real time? No two rush hours are the same and no two days of traffic management are the same. In order to manage incidents in real time, the teams in the control room need huge experience to first estimate what is likely to happen, and then decide which interventions work best.

With PTV Optima, traffic managers have a constant overview of their entire network, and this includes a rolling horizon of predictions at set intervals from five minutes to an hour. Updated in real time, the transportation model provides information about what is currently happening and what will happen in the short-term future.

## From reactive to proactive

Thanks to the explosion in the amount of real-time data available, faster computer processing and innovative software, traffic managers can use transportation modeling to influence their real-time decision making. Models developed for snapshots of time are converted into real-time and predictive models.

When, for example, an accident happens or a road is closed due to a construction site, PTV Optima identifies the build-up of traffic and immediately predicts the likely effects. The real-time traffic management software also simultaneously runs scenarios to mitigate against them. To help traffic managers to advise motorists about alternative routes, PTV Optima estimates travel times of different routes, taking countermeasures into account to suggest diversions.

This proactive approach completely changes what is possible. In the past, transportation modelers collected and used network data to predict how changes to it could affect the traffic. However, they used historic data to create models for typical days or peak periods. PTV Optima's model continually updates itself, fusing real-time data from various sources, such as the network's structure, traffic flow dynamics and the route choice behavior of road users. Detectors and floating car data providers also play an important role in reworking the model so that it is able to react to changing conditions.


Above: **With PTV Optima, cities can reduce congestion and emissions in order to optimize existing infrastructure**

### Need to know

**PTV Optima is a model-based solution by PTV Group**

- It offers precise, real-time traffic information for the entire traffic network
- It produces reliable 60-minute traffic forecasts
- It combines proven off-line traffic modeling with real-time data and algorithms
- It can be used to assess and compare different strategic actions


Left: **PTV Optima helps cities improve key performance indicators**

Operators managing the network can stay in control and can better evaluate what the best action is to execute for current, upcoming or specific events. PTV Optima's traffic management decision support evaluates the different scenarios based on the city's individual key performance indicators (KPI). A success factor could be to minimize the travel time or the travel distance, decreasing detours and cutting emissions.

## Informed decisions

Based on the relevant KPI, road operators know how to react. They can be sure to initiate the right intervention strategy, load-leveling the network more efficiently and steering traffic away from the incident across the whole of the network. With PTV Optima, it is even possible to provide information about the traffic conditions to motorists directly into their in-car satellite navigation systems or smartphone apps.

But in a town or city, motorists are not the only ones being affected by traffic jams. Public transportation services also need to run according to the schedule.

With PTV Optima, cities can use HyperPath, the multimodal journey planner, to balance the usage of their system and propose alternative routes for public transportation vehicles based on the predictions by PTV Optima's ETA (estimated time of arrival) module.

## Closing data gaps

Traffic managers working with the dynamic model-based and real-time approach always keep a virtual eye on the entire network, even when there is an absence of data for a road. To ensure the best-possible overview, the model can fill in the blanks predicting the demand based on the conditions of roads where data sources are available.

Apropos data: PTV Optima can be connected to the Sydney Coordinated Adaptive Traffic System (SCATS) to further optimize a city's network in real time. Enriched with more data, its goal is to reduce delays, increase efficiency and reroute vehicles in the most optimal way.

To deliver measurable results and to ensure the best timing of signal phases for any traffic situation, SCATS uses sensors at traffic signals and induction loops installed within the road pavement. SCATS allows traffic signals to communicate traffic data among themselves, so they can synchronize and minimize wait times at intersections. Users of PTV Optima benefit from this additional data input and can make more informed decisions, as they know the exact traffic flow at every intersection and traffic signal.

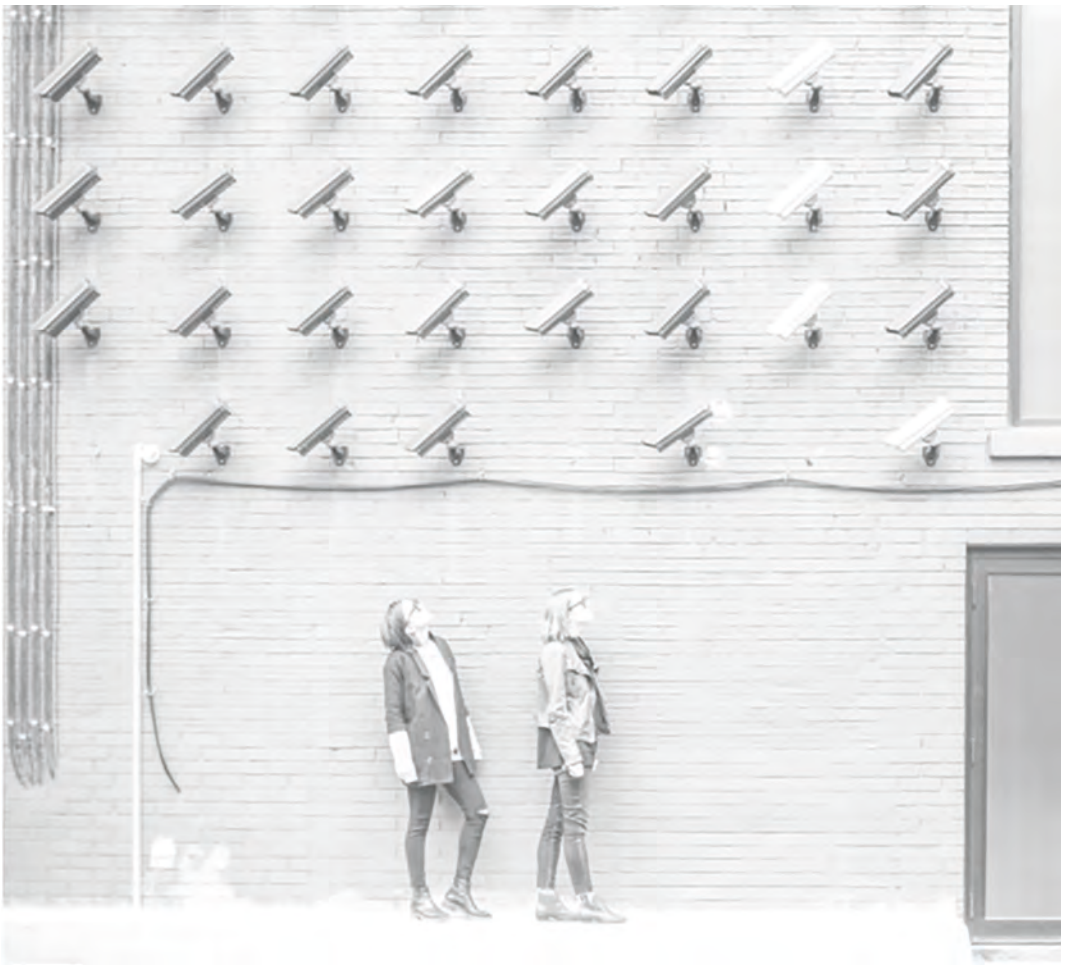
## From traditional to smart

The traditional reaction to smoothing out the traffic flow is to increase lane capacity either through widening or building new roads. The smarter solution is investing in a real-time traffic management tool because the more informed traffic operators are about their network's conditions, the better and more efficiently they can do their job.

Some roads are always busier than others and technology can help to make the best use of the entire network. By using the right strategy, traffic management centers can prevent jams before they arise because they always initiate the optimal strategy to maximize the capacity of their city's infrastructure.

# Camera-vendor independent LPR systems

LPR (license plate recognition) systems are complex solutions that use several hardware and software elements, usually sourced from different vendors. Multisourcing is not necessarily a bad thing, but in most cases – and where LPR systems are concerned – it leads to a lack of compatibility between system components. Many professionals working in this industry have experienced how lack of compatibility has derailed an otherwise straightforward project technology integration.



## Creating compatibility

Incompatibility and its numerous collateral issues are tackled either by purchasing all the components required for an LPR system – hardware and software alike – from one vendor, or by investing development resources into making each component compatible. The latter option is great for the rich and leisurely, as it involves months of intensive development in most cases, as well as weighing heavily on the budget.

Purchasing system components from a sole vendor also has its downsides. In an instance where one of the components fails, the system operator will need to replace it with the same specific component. There is little or no room for deviation. Problems can include a lack of backward compatibility, the item(s) no longer being manufactured, or not in stock.

Whatever the issue, the replacement is still needed, within the maintenance budget. This is a real challenge, because it usually does not cover the development costs of unexpected system updates involved with integrating new components.

There are also other cases where camera-vendor independence is the prime requirement. Just think of the millions of IP cameras on streets all over the globe that could be used for LPR-based parking and access control, tolling, ITS and law-enforcement projects.

A recent case in Singapore shows that there is an increasing demand for such systems. Traffic surveillance was installed on the site a couple of years back – a CCTV system provides footage of passing vehicles. The investment was steep enough for the operator to not even consider the option of changing the existing camera network, but it would like to enhance the system with LPR.

## Camera-free system

For each of the issues above, the solution is a camera-independent LPR system that uses the one common aspect of IP cameras – provision of visual data in the form of a video stream. The logic is simple. Feed the stream to the LPR system, which returns the license plate, country and an image of the event with a time stamp. Should a camera unit fail, simply replace it with any IP camera. If the operator is using an existing camera to retrieve video footage of traffic, they can simply enable LPR using the visual data provided by the system.

Asura Technologies' Asura recognition unit (ARU) is a camera-independent LPR system. The plug-and-play system enables LPR technology to be integrated into any new or existing traffic or parking data-

by **Don Hunt**

# Autonomous vehicle manufacturers and road operators should communicate

"Opening a dialog between AV makers and roadway operators would yield useful information for both"

As I have watched state DOTs over the last few years anticipate how to ready their systems for autonomous vehicles (AVs), it does not seem that they are getting much closer to prioritizing activities. How AVs will deploy and what type of roadways will be needed remain unknown outcomes of the biggest tech experiment for a century. Vehicle automation is approaching our roads in two ways: driverless ride hailing and Level 2/3 private vehicles.

Companies represented by GM, Ford, Waymo, Uber and Lyft have stated their plans to implement driverless services in urban settings in the next few years. Waymo is operating its Phoenix Early Rider vehicles with an empty driver seat and safety personnel riding in the back seat. It may only be a matter of months before Waymo introduces commercial driverless ride hailing in a cordoned area.

The second emerging segment of AVs is private vehicles. Included are both cars and trucks with the capability of off-loading driving duties from humans, but not operating in a driverless mode. Importantly, neither segment of these emerging AVs requires V2V or V2I technology. The vehicles are connected to the cloud via cellular connections that send and receive information. But the vehicles utilize mapping and sensors to operate without communication to surrounding vehicles and infrastructure. So far the USDOT and states are spending much more effort on CV pilots than trying to understand the roadway environment challenges for AVs. Much of this response is probably due to the reluctance of industry to disclose the problems of early automated driving systems, leaving DOTs with no one to talk to about how to improve their roadways for AVs.

To launch its SuperCruise feature, GM made the decision to lidar map the entire limited-access highway system in the USA to create an operating domain for its vehicles. Where there is a lack of clarity about lane location or lane merging, GM disengages SuperCruise and requires the driver to resume control. If DOTs could work with GM to identify and understand these locations, perhaps improvement projects could better respond to the AV future, and even improve safety for all vehicles.

In San Francisco, GM is using its Cruise Anywhere employee ride service to test its automated driving system. As GM points out, the city is full of street conflicts that make AV operation difficult. Reports are that the Cruise vehicles have to avoid many streets in the city where the driving system cannot yet operate, adding significant time to a trip when compared with a human driver. Physical street challenges include faint traffic lights, complex roundabouts, narrow two-way streets, and short lane merges. Some of these urban street barriers could be eliminated or mitigated by DOTs, while others will eventually have to be handled by automated driving systems.

Opening a dialog between AV makers and roadway operators would yield useful information for both parties. But while we continue in a proprietary phase of technological development we are still some time away from the beginning of a meaningful exchange.

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

## Need to know

**Asura Technologies' ARU camera-independent LRP system can...**

- Connect to any IP camera and various image sources
- Adapt to multiple streaming formats
- Read license plates and distinguish traffic by lane
- Recognize license plates' country of issuance (more than 110 countries)
- Store license plate data in an easily applicable database

Left: **The Asura Recognition Unit (ARU) enables LPR technology in new or existing traffic systems, or in parking data collection systems**

collection system. The ARU can connect to any IP camera, regardless of streaming protocol (HTTP or RTSP) or format (MJPEG or H264). This means that operators will not have to replace existing cameras and infrastructure to enhance their LPR systems. The ARU is compatible with any IP camera – not just special LPR cameras, but general surveillance (CCTV) cameras as well. Asura Technologies' ARU LPR solution has been nominated for a 2018 Intertraffic Innovation Award.

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# A smart tunnel incident detector solution

With global attention focused on reducing congestion on roads, authorities in Europe have taken significant action. Improved digital and video analysis technologies have turned many traffic management systems into intelligent traffic management systems.

## Legal requirements

In 2004 a directive on safety requirements in tunnels (2004/54/EC) was issued, requiring video surveillance systems with video analysis and automatic incident detection (AID) be installed in tunnels, plus ensuring integration between technological systems – such as lighting, emergency call points, ventilation and variable message signs.

Indeed, the real added value no longer lies exclusively in the performance of each technology but in the ability to integrate them, which ultimately enhances and optimizes the result in terms of information and safety.

A complete solution for video monitoring of roads, freeways and tunnels, in fact, requires automatic incident detection and content analysis algorithms, which can be integrated with OCR software (for license plates) and ADR code (a European agreement concerning the international carriage of dangerous goods by road) recognition, and third-party automation systems. They should also interface perfectly with higher level supervision software such as SCADA (supervisory control and data acquisition).

## Connecting north with east

The D3 Svrčinovec-Skalité motorway in Slovakia is part of multimodal traffic corridor VI, which, after completion, will make quality and fast connection between Northern and Eastern Europe possible.

A 15km section of the motorway was inaugurated in mid-June 2017. The D3 links to the D1 motorway, which forms one of the country's primary east-west routes. The project will positively affect the redistribution of traffic among Slovakia's north-south corridors.

One of the cores of the D3 solution is the AID that detects incidents inside the Svrčinovec and Pol'ana tunnels. To ensure efficient management combined with the latest technology concerning video analytics for traffic applications, a Sprinx Technologies server-side solution was selected and provided by the local partners Gemtech and ADTS.

Sprinx Technologies is an Italian software and

The newly built D3 required planners to follow EU directives on tunnel safety requirements


## Need to know

### Key facts about Sprinx Technologies' tunnel incident detector

- The technology was awarded a Special Mention at the Intertraffic Innovation Awards in Amsterdam in March
- It simplifies the calibration of traffic algorithms
- The system includes license plate recognition and ADR code software management
- Easy to deploy and maintain
- Quickly alerts operators about traffic incidents
- The operators can take action based on their assessment of the issue



Above: **The Slovakian national highway authority (NDS) traffic control center monitors incidents in the tunnels in real time**

engineering company that develops solutions for video surveillance and video analytics dedicated to the intelligent transportation industry, and it is one of the few market players able to provide total solutions for video monitoring of roads, motorways and tunnels.

## Intertraffic award winner

The introduction of Sprinx's AID software with 3D object-tracking, winner of a Special Mention at the Intertraffic Innovation Awards in Amsterdam in March, has reduced the number of false alarms in addition to reducing and simplifying the calibration activity of the traffic algorithms dramatically. Moreover, the license plate recognition/ADR software management system developed and provided by Sprinx Technologies enables integration of additional critical information about traffic flow into a standard intelligent traffic system, increasing tunnel safety in the process.

The SX-Traffic AID software, provided for the Svrcinovec and Pol'ana tunnels, automatically monitors traffic and detects events such as stopped vehicles, pedestrians, wrong-way drivers, smoke, spilled cargo and traffic congestion. The system can also collect statistical traffic data across the entire tunnel's infrastructure.

Events are integrated into the Siemens SCADA and signaled to the traffic operators at the Slovakian national highway authority (NDS) traffic control center in Horelica, with vital real-time information through video analytics. The control room can then investigate using the video surveillance system and the recordings of the incident. They can take action based on their assessment of the issue and send a highway patrol, the police or an emergency crew. Moreover the system includes an LPR system – intelligent cameras, which read both vehicle number plates and ADR codes, are installed at the tunnel's entrance and exit.

Considering most of the traffic in this section of highway is trucks, knowing the type of vehicles in transit inside the tunnels and the presence of any dangerous goods becomes an extremely important piece of information to enable targeted and timely interventions in the event of a tunnel incident detected by the AID system.

## Blossoming relationships

Despite over 6,500 AID video channels being provided in under 10 years, this experience in Slovakia has been extremely stimulating for Sprinx, highlighting the professional quality and skills of the NDS.

The NDS's continuous search for advanced intelligent traffic solutions not only to increase the level of security on the highways, but also to enhance the work of the control rooms, is in line with the mission of Sprinx Technologies. As such, Sprinx Technologies was glad to cooperate with NDS.

# The new era of shared mobility and active transportation

There is an increasing effort throughout the industry to shift focus away from roadway improvements to vehicles to investing in shared mobility and active transportation (human-powered transportation, such as walking, cycling or skateboarding). Researchers in these areas are now asking frank questions such as, "Is anyone interested in saving enormous amounts on buying and maintaining vehicles that are unused at least 90% of the time?" and "Are cities worldwide interested in saving an estimated U$5tn annually by 2050 while improving livability and increasing the likelihood of meeting climate change targets?"

Above: **There is growing investment in non-car modes of transport**

## Need to know

**Vulnerable road users' safety and mobility is being assessed before connected and autonomous vehicles reach our roads**

- Unprecedented levels of policy support are required to ensure the adoption of on-demand travel, with substantial ridesharing and greater use of public transit, cycling and walking, to reduce vehicle use
- Advancing shared mobility services and the public uptake of automated vehicles will not happen until pedestrian and bicycle safety issues are addressed
- Detection systems at intersections are becoming more prevalent, ensuring that bicycles and pedestrians are being detected by sensors, whether or not they are equipped with apps

## Key research

These questions are answered in the *Three Revolutions in Urban Transportation* (3R) research report on transportation network electrification, car sharing and automation, prepared by the Institute of Transportation Studies at UC Davis, California.

The 3R research is global and breaks the world into eight regions, including five major markets: USA, Europe, China, India and Brazil. A central finding of this research is that while vehicle electrification and automation may produce potentially important benefits, without a corresponding shift toward shared mobility and greater use of transit and active transport, these two revolutions could considerably increase congestion and urban sprawl, while also adding to the likelihood of missing climate change targets.

Achieving the full 3R scenario of electrification, automation and multimodal shared vehicle trips is shown to bring by far the greatest societal benefits for every country in the study. Unprecedented levels of policy support are called for to ensure that all three revolutions move forward and prepare cities around the world for a new era of travel. These ideals include a widespread adoption of on-demand travel with substantial ridesharing and greater use of (high quality) public transportation, cycling and walking to reduce vehicle use by well over half by 2050.

The 3R scenario policy narrative calls for increased, ongoing investments in walking and cycling, as well as systems for improved safety for active transportation users. Right on time, the National Association of City Transportation Officials (NACTO) released its report, *Designing for All Ages and Abilities* (December 2017) to help cities decide what types of bike infrastructure will best achieve their goals to build bike networks that are safe and comfortable for riders of all ages and capabilities. Two recommended examples from the report include providing protected bike lanes for any road with more than 6,000 vehicles per day and proposing a maximum 25mph (40km/h) speed limit within cities.

## Safety before automation

The USA's Pedestrian and Bicycle Information Center digs deeper into pedestrian and cyclist safety along with mobility considerations in its *Discussion Guide for Automated and Connected Vehicles, Pedestrians and Bicyclists* report (2017). It emphasizes that advancing shared mobility services and hastening the public uptake of automated vehicles will not happen until pedestrian and bicycle safety issues are

addressed. The paper presents key challenge areas that need to be addressed through research, innovation and policy-making.

### The detection problem

At the top of the list of challenges is the 'detection problem', considered a top priority due to the 25-60% of pedestrian and 37-65% of bicycle injury and fatal crashes at intersections.[1] Effective safety treatments are noted to include separated bike lanes, lighting improvements, pedestrian crossing islands and gateway treatments. Detection systems at intersections are also now becoming more prevalent, ensuring that bicycles and pedestrians are being detected with sensors whether or not they are equipped with mobile devices and apps. These new features from a variety of solution providers are being slowly rolled out, but are showing effectiveness in various localities.

The process in which agencies set priorities for such projects can be enhanced by solving another key challenge area: the data problem. Access to data streams, such as video systems and big data analysis tools, may provide important insights. The policy implication is clearly stated for agencies to improve the detection of pedestrian and cyclists while providing a larger safety margin as a service to both human drivers and automated drivers in the future. ○

[1]Source: www.pedbikeinfo.org/pbcat_nc





by **Larry Yermack**

# The tolling industry will be disrupted beyond recognition – just as the television industry was


"Will toll roads survive? Surely not as we know them"

Are toll road operators like network television executives? I admit that it's an odd question, but please allow me to explain why I ask it. To do so, we'll need to roll back the clock several decades to what some of us nostalgically refer to as 'the golden age of television'.

For a long time, broadcast TV truly ruled the entertainment industry roost. The top shows had enormous audiences and sponsors paid dearly for coveted spots during the most popular shows. Television benefited from two factors. The first was that stations each operated under a hard-to-obtain government license. There were not many issued, so TV stations had a captive audience and, as a viewer, you had limited choice.

The second was that they had a technology that required you to watch the shows as well as the commercials in real time. The advertisers who paid for the shows had guaranteed eyeballs.

After decades of essentially an oligopoly, the first crack in the wall was the introduction of video recording that allowed for both time shifting and skipping commercials. The subsequent cracks were the expansion of broadcast outlets to cable television, followed by streaming. Network TV has managed to survive, but companies have had large-scale disruptions and have had to make major changes to their business model.

How are toll roads similar? They depend on government-issued permissions to build and operate toll facilities and they rely on technology, tags and readers to exclusively collect the tolls. Both of these foundations are far from solid and we are already starting to see cracks.

As states talk more and more openly about road user charging as a replacement for the gas tax, toll roads will become little more than roads with a different price structure. They will no longer be unique entities and states may think about simply acquiring them. Not hard to imagine as they operate today under state approval. It's already happened in several states and this trend could accelerate.

But another threat, like that which faced broadcast TV, is from advancing technology. Toll roads, in part, maintain their independence because toll collection traditionally relies on a tag and reader system, overseen by the operator. If that link is broken and others can also accurately identify and collect from drivers, then operators will be faced with a huge dilemma – this scenario is now emerging in various guises.

First, video tolling is getting so good that tags are being supplanted and third-party services are offering Mobility as a Service. When the alternative to a tag was a small startup company they were easy to ignore, but what will happen when a major bank or car company approaches a toll road and says, "We have thousands of your customers in our system and we want to send you their tolls." I think the governor's office will direct them to accept it.

We are now at a point when tolling is threatened by both government and technology. Will toll roads survive? Surely not as we know them.

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

# Defining levels of MaaS

Mobility as a Service (MaaS) is still in many respects a nascent concept. It is the result of a series of profound technological and societal shifts, some of which are continuing to evolve. As MaaS is still so new, it is a real challenge to provide a business model for all stakeholders. This is the point at which clarity is needed and should be fostered. Levels of MaaS provide that clarity.

Despite its infancy, communications and cooperation are central to developing what may be a true revolution in managing and providing mobility services.

The MaaS stakeholders (or 'players') are: the traveler, the private operator, public transit, government, and technology providers. Each stakeholder has a distinctive role to play in maximizing the chances of success for both themselves and seamless mobility services.

## Human intervention

The degree of, and need for, human intervention decreases as MaaS matures. By comparison, some models that produce a MaaS index of maturity use multiple characteristics to feed a complicated algorithm. The result is a somewhat sterile and abstract number that loses its meaning amid the methodology to produce it.

Level 0 is the base level, relative to all means of transportation available today. Paradoxically, it is unfortunate that the available mobility services are so numerous. Each provides only part of an end-to-end journey, and the traveler must switch between them and manage them individually. Access, functionality and payment options, where they exist, can be extremely limited.

Above: **A levels-of-MaaS approach can help to make mobility more sustainable**

### Need to know

**Pillars of MaaS are complementing advances moving us toward a MaaS-driven future. They include...**

- Technological influences, such as the move from 3G to 4G and beyond
- Societal influences, such as the movement toward cashless payments
- Ecosystem influences, such as standards and regulations implemented to protect data

Level 6 is the overall integration of all mobility and other digitized services. Each day the traveler's smart home recognizes their departure and shuts off lights, locks doors and sets home heating and cooling services to maintain levels of comfort that have been set by the user. Any security services are activated.

Simultaneously, arrival at the workplace can be determined and all modes of transportation that fit the traveler's preferences are reserved, ticketed and realized. The traveler's arrival time is also used to prime environmental and other services at the workplace.

| Level | Description | Explanation |
|---|---|---|
| 0 | Base level, relative to today | There are account-based systems in place, individual modes of transportation already have a digitized interface and the traveler has information available online for each |
| 1 | One-to-one integration between some private services | Services start to develop joint offerings. For example, tolling and car park; private car and ferry; and park-and-ride bus services |
| 2 | Integrated payment and ticketing across modes of limited public and private modes of transportation services | Greater integration of services occurs, but this time between privately operated and public transportation. Integration shows promise but other public transit modes are skeptical and continue to stay separate |
| 3 | Unified interface for single account used in multiple modes of transport services | Instead of having multiple channels, an interface is unified across modes, providers and services, where the traveler can plan their journeys |
| 4 | All modes are integrated, private and public, including routing, ticketing and payment | Open data and standards are defined and commonly used |
| 5 | Active artificial intelligence choices are taken based on travel preferences and near real-time data for ad-hoc changes | Based on traveler-specific behavior and profiling, minimal intervention is needed by the traveler for an end-to-end journey |
| 6 | MaaS connects beyond mobility, interfacing with the IoT, smart buildings and smart cities | As MaaS evolved, so did other systems that were involved in the traveler's day. For example, food, groceries, entertainment and sport, to provide seamless interfaces that encompass the traveler's ecosystem |

Above: **Levels of MaaS could provide clarity for business models created for stakeholders**

At the end of the day the process is reversed and the near-real-time monitoring of mobility services seamlessly suggests routing and services, and ticketing and payment that are appropriate to the traveler's needs in terms of journey time and other factors such as carbon footprint. Level 5 sees the traveler's level of intervention set at minimal to none; level 6 adds active artificial intelligent choices based on traveler-specific behavior and profiling. In parallel, all anonymized data is provided to public and private operators, as well as government transportation planning services, in order to enable the planning of further improvements to services and performance.

## Using levels of MaaS

The abundant knowledge and active discussions that are taking place will continue to foster the environment for perfecting the MaaS model. Having a common framework in which to promote communication effectiveness and foster smoother discussions will focus the energy spent by each stakeholder on the emerging issues and shared needs, while focusing on the end user. The common framework suggested above should help both parties to gain an understanding of a road map that MaaS may follow and to create an environment of acceptance from all players.

With the levels of MaaS services that are outlined above, one does not have to know the details and underpinning technologies.

The framework provides a common understanding of the road map of how stakeholders – public and private, government and technology providers – can describe their long-term goals. Everyone can have a clear vision of where they are on the path to a fully automated MaaS reality and what the next level may be for planning and budgeting.

# Express lanes

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

"The key challenge for LEZs is that even newer diesel vehicles aren't that much cleaner and are, in some respects, arguably worse"

*Dr James Tate, associate professor, the Institute for Transport Studies, University of Leeds,* ***on the effectiveness of low emission zones in reducing pollution***

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**"If you want to capture license plates at night you will need a camera that is day/night capable and have some internal or external IR illumination"**

*Steve Lewis, vice president for business development, openALPR,* ***shares his insight into the limitations of camera agnostic ALPR systems***

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**"Van traffic is the fastest growing element of road traffic in the UK, and this is set to continue"**

*Laura Shoaf, managing director of Transport for West Midlands (TfWM) and lead board member on freight for the Urban Transport Group,* ***on the growing challenge posed by UK road management authorities. For more information, visit TrafficTechnologyToday.com/vans***

"We thought that this technology could really benefit the department when it comes to bridge inspections, surveys and communicating with the public"

*Carmen Swanwick, UAS Committee Chair for Utah DOT,* ***explains why the state is investing in drones. Watch the full video at Trafficktechnologytoday.com/drones***

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**OEM's, suppliers, and technology firms are in a race to modernize our current transportation systems.** These changes will bring about adaptations in how people fundamentally interact with transportation and how they provide and receive goods and services. What new business models will emerge from these changes? What challenges? Will modalities be combined? These are the overarching questions that are vital to answer in order to prepare markets, governments, and researchers for the future.

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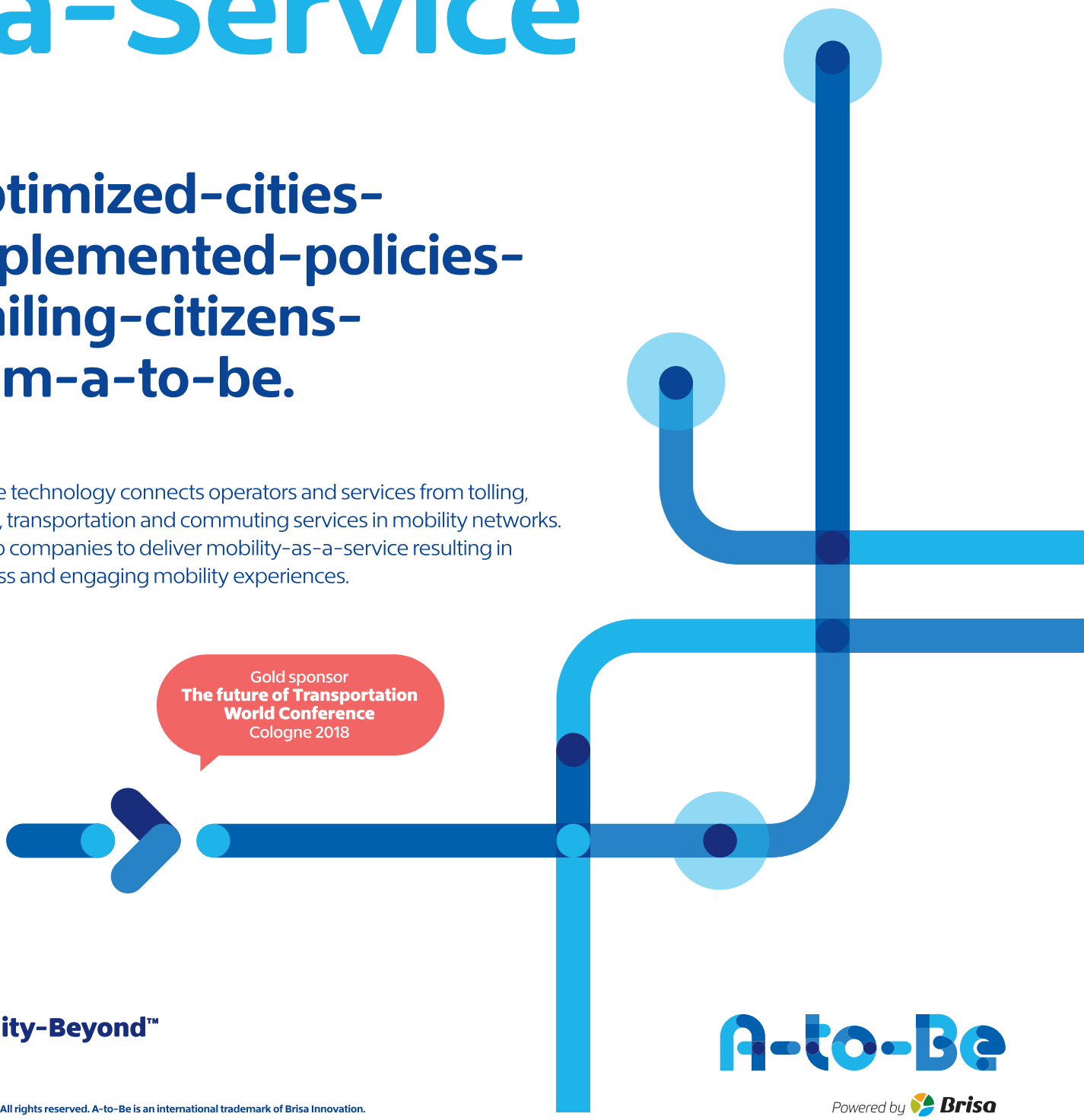

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