traffic
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Experts from academia and industry
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WINTER ROAD WEATHER MANAGE
PROPOSED PLANNING SOLUTION

PLUS

➔ | Sam Schwartz

**"I was jealous when London
introduced congestion pricing;
I wanted it for NYC back in 1971!"**

➔ | Always stop on red

**Richard Retting, the father
of intersection safety, lists
his top 10 considerations**

➔ | Up to speed

**Motorola's Chip Yager and
Bill Cusack on why Mesh
Networks are on the move**

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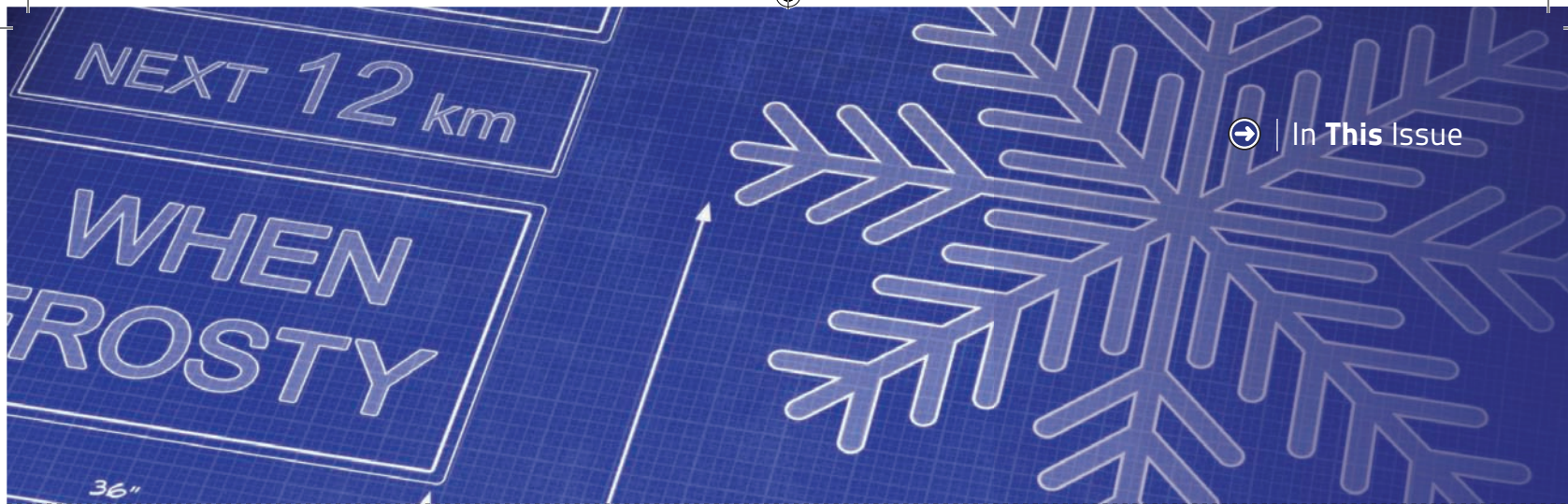
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48 Best laid plans

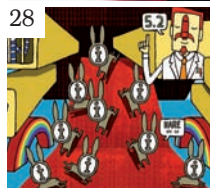## A blueprint for successful road weather management

Experts from academia and industry reveal their technological and strategic tips to enhance mobility, safety and cost efficiencies when the weather takes a turn for the worse

Foreword

Some people dread the prospect of waking up in the morning; another day in the office too much to bear, the maelstrom of a daily commute too stressful to contemplate. So while admitting that a couple of snooze buttons for my two daughters wouldn't go amiss sometimes, I'm happy that coming to work for me isn't a chore. I enjoy what I do. What I particularly find rewarding is that every six weeks or so I end up with a new issue that (fingers crossed) relegates any suffering along the way to the backburner. This October/November issue is one of those editions.

Not wanting to cause offense to anyone I've quizzed in the past, I have rarely put down the receiver following an interview and thought to myself, 'I could have talked to that guy all day long…'. But that's how I felt after a 90-minute conversation with Sam Schwartz – known to millions of New Yorkers as 'Gridlock Sam'.

I first became aware of him a few years back after he was recommended to me as an ideal 'Freedom Fighter' for our October/November 2008 cover story. Unsuccessful in my pursuit of him at the time, I'm delighted to devote four pages to the man in this issue (*p60*). He has seemingly been ahead of the curve in the traffic management industry ever since he entered into it in 1971. Such terminology is all too often used liberally, but in Sam's case it's impossible to dispute. He clearly loves his job. When asked what he wanted to be remembered for when he retires, his response? "I don't want to retire." After a career that has so far spanned four decades, he has so many stories to tell, so much success to report, you could easily dedicate a whole issue to him. I hope we've done him justice in just the four pages.

During the course of writing the road weather management cover story (*p48*), I spoke with seven experts equally as passionate about their work, including the head of the FHWA's Road Weather Management Program, Paul Pisano, and an enviably young and gifted Dr Lee Chapman, who incidentally holds a patent for route-based forecasting, developed as part of his PhD around a decade ago. Although winter maintenance teams do everything possible to ensure safe and efficient mobility when severe weather strikes, long before the gritters even hit the road an entire road weather community has been hard at work developing innovative forecast models, monitoring equipment, application methods, and various tools to aid the decision-making process.

It's an area of ITS that never fails to produce a story, such is the pace of the advances. But Pisano provided me with the latest FHWA figures: between 1995 and 2008, on average, 7,130 people are killed and more than 629,000 injured every year in adverse road weather conditions on US roads. Pisano is the first to admit that, despite the advances, there is still much more to be done.

Nick Bradley
Editor, Traffic Technology International

MESH NETWORK

Up to speed

Mesh Networks boast many benefits for ITS, as well as targeted solutions for DOTs and traffic engineers. Motorola's Chip Yager and Bill Cusack tell **Jim Gunn** why a carefully designed broadband communications network could be the best investment you ever make

Illustration courtesy of Magictorch

Much-needed support

Historically, a key early transportation application for communication technologies has been traffic light signaling networks with over 50 years of deployments, utilizing low-speed modems. More recently, deployment of video cameras for remote video surveillance has become very popular. Video requires significantly higher bit rates, which usually dictate upgraded communication networks, often utilizing high bit-rate fiber links. As a result of cost and right-of-way constraints, video has been most easily deployed along freeways and other areas supporting cost-effective installations. However, video surveillance has value, if cost-effective, for residential, secondary, and arterial roads. Motorola's Chip Yager and Bill Cusack state that the company's AP 7181 Mesh Network products are designed to support pole top (as opposed to expensive antenna tower) operations cost-effectively in roadways with sufficient bit rates and capacities for video surveillance cameras.

Mesh Networks are a hot topic for public sector communication network stakeholders. The personnel responsible for communication networks in the public sector face many issues, not least limited budgets that are often allocated piecemeal over time. Other pressures include changing communication requirements in terms of coverage areas, as well as end-application requirements that demand continuing network updates. Additionally, the increasing bit rate requirements to accommodate video surveillance cameras, and increasing pressures in the current economic environments to accommodate multiple agencies on integrated communication networks, add to the complex mix. Transportation agencies often appear best situated to take the lead in such projects as they typically have access to right-of-ways, pole tops, etc – resources needed to deploy these networks.

A robust broadband network
Fundamentally, Mesh Networks are self-configuring (e.g. self-forming and self-healing) in initial network deployments, upgrades, as well as changing communication loads. If a network element fails, a Mesh Network can self-heal to best continue essential communications until the failure(s) is repaired. This potentially offers network planners and operators great ROI benefits as manual network changes, upgrades, and configurations often require expensive human resources and truck rolls.

Although Motorola has prior generations of Mesh products, the focus of Chip Yager and Bill Cusack here is on the company's Mesh Wide Area Network AP 7181 product that was first released in June 2010 and is based on the IEEE 802.11n standard that was ratified in September 2009 after a seven-year discussion period. The 801.11n technology provides a big increase in the maximum raw bit rate from 54Mbit/sec of the legacy IEEE 802.11a, b, and g standards to 600 Mbit/sec with the use of four spatial streams at a channel bandwidth of 40MHz. Although the in-practice bit rates experienced on individual links are substantially less (also true for legacy standards), this is a huge enhancement. It should be noted in communications networks that higher bit rates (similar to increased road traffic flow) increase capacity as well as reduce delay (transit), which are important system design considerations.

The 802.11 standards are specified for operation in the unlicensed ISM bands of 2.4GHz and 5.8GHz that, with variations, are generally available internationally. Although the unlicensed bands eliminate often troublesome licensing requirements, other users also are authorized to operate in the bands. These include the legacy WiFi (WLAN based on the earlier 802.11 standards), Bluetooth, plus others that are widely deployed. These can potentially cause interference and degraded system

According to IMS Research, Mesh Networks will penetrate the three largest markets for wireless video surveillance, including transportation

> **The key to multi-vendor interoperability are standards that define features and operational parameters in sufficient detail to facilitate interoperability**

performance or in some cases inability to operate. The 802.11 standards include protocol and etiquette rules that help to minimize and mitigate interference. Yager and Cusack emphasize that Motorola has developed and included interference mitigation algorithms and methods in its products. Although many operate successfully, interference can be an issue and should be carefully accounted for in system planning, design and operation. In the USA, public safety organizations can operate in the 4.9GHz public safety band, a licensed band, which provides 50MHz of spectrum and allows use of 802.11 standards. Node bandhaul links and end-device links for network performance and capacity considerations often operate on different frequencies (e.g. backhaul links 5.8GHz or 4.9GHz, and access links 2.4GHz). This is a system planning and design consideration.

The great outdoors

Both Yager and Cusack provided some interesting thoughts on the use of the 802.11n in outdoor environments. Most legacy 802.11a, b and g – as well as new 802.11n applications – target indoor Wireless Local Area Network (WLAN) applications. The AP 7181 targets use of the 802.11n standard devices in an outdoor environment for public safety applications. In the USA, FCC regulations (Part 15, 15.247) authorize up to 4W of radio frequency (RF) power with more recent rules allowing higher effective power with directional antennae. In outdoor applications, greater RF power facilitates better coverage and system performance with fewer nodes. Indoor WLAN applications are often limited to less than 300-400mW as indoor applications typically provide

required coverage and capacity more cost-effectively with more, lower-powered nodes. Motorola says one of its significant differentiators is many years of outdoor RF system experiences that are embodied in its AP 7181 products. Discussions with Yager and Cusack provided not only excellent information on Motorola's targeted market differentiators and customer value propositions, but a very good general framework for system design and competitive evaluations. The specific technologies Motorola emphasizes are its ADEPT MIMO (Multiple Input Multiple Output) antenna technology, its Mesh Connect Secure Mesh technology, and its One Point Wireless Suite planning tools.

The 802.11n standard uses the same general RF modulation technologies that are used in commercial broadband technologies, including Long Term Evolution (LTE) and WiMAX. Specifically, Orthogonal Frequency-Division Multiplexing (OFDM) uses multiple overlapping RF carriers (i.e. frequencies) in a user's transmission – a technique that has been demonstrated to substantially reduce multipath fades, nulls and interference performance degradation. The LTE, WiMAX, and 802.11n technologies and other related standards all provide for use what is generally referred to as 'smart antennae', employing multiple antennae at both the transmitter and receiver to provide multiple paths and data streams from transmitter to receiver. When only one transmit and one receive antenna is used, multipath deep nulls or fades can occur, which degrade performance and coverage. By adding MIMO and multiple transmit and receive antennae, multiple transmit-receive paths can substantially reduce multipath null and fade degradations, thereby increasing performance, capacity, and coverage. Additionally, the multiple paths can often support multiple data streams adding to

Rajant

Corporation reports the application of wireless Mesh networking to V2V communications will open many doors to OEMs and consumers

Access and distribution layers

Although Mesh technologies can be (and are) applied to higher communication layers, the applications and benefits for the public sector and ITS communities have focused on the access and distribution layers to provide communication capacity and coverage to intersections, streets, freeways, vehicles, etc. Communication network architectures are typically based on hierarchical or layered approaches. Point of Presence (POP) interfaces are provided by higher layer nodes to lower layers. The lowest layer is the access layer that connects network nodes to end-users or end-devices and typically has the

lowest bit rates links. The Distribution Layer (typically < 10 Mbps) connects network nodes to higher layers and aggregates end-device communication to higher speeds. A key purpose of the

distribution layer is providing cost-effective POPs to end-users and end-devices. The Backhaul layer (typically even higher bit rates of tens of Mbps) further aggregates communication traffic to higher speed links. The backbone layer further aggregates to even higher-speed links for regional, national, or even international communication. In most public and commercial networks, the access layer nodes and distribution layer typically represent ~70+% of the network capital expense (CAPEX) and operations (OPEX) costs. So, potential Mesh Network technology ROI benefits for public networks are very significant.

Mesh Networks provide the required ease of deployment and high throughput in even the most difficult environments

Application specifics

The transportation applications that Mesh potentially supports with enhanced ROI include traffic control, changeable message signs, transit monitoring, bridge monitoring, traveler information, freeway management, corridor management, video surveillance, and emerging vehicle-to-infrastructure communication requirements. In the current era of shared agency communication systems, Mesh technologies appear ideal for sharing among multiple public agencies, including police, fire, emergency services, publicly operated utilities (including water and sanitation), plus most others operating in covered areas. With proper system design, security, and business model considerations, shared operation with private organization is potentially feasible perhaps including taxi and public utilities such as electricity and gas. It is not hard to envision public-private partnerships that address broadband digital divide goals and provides broadband to the public on a shared public-private network. However, such public-private networks would undoubtedly require additional system design, technology integration, and careful public/private business model developments with more detailed and joint 'win-win' responsiveness than has been observed to date.

capacity. However, this 'spatial multiplexing' to provide multiple data streams depends on the RF environment and cannot always be achieved. Motorola's intelligent ADEPT (Advanced Element Panel Technology) antenna system provides the AP 7181 with multiple RF antennas (3x3 MIMO or three transmit and three receive antennas) and dual data streams in an outdoor environment. The AP 7181 uses dual-polarized antennae that further improve performance and capacity. The integrated antenna design also has a software-controllable down tilt that facilitates enhanced coverage and interference control without the need for an often expensive truck roll to accomplish manually.

A key technology embodied in the AP 7181 is Motorola's patented MeshConnex routing technology. Yager and Cusack states MeshConnex provides "efficient routing, low-hop latency, low routing overhead, high-speed handoffs, and proven scalability". A key element is Opportunistic Radio Link Adaption (ORLA) – a decision making element that, based on the RF operating environment and network configuration, configures the network to provide reliable throughput at the highest data rates.

Another key element of Motorola's product and service offering is its 'One Point Wireless' Suite of software-based network design, deployment, and management tools. Included in this suite is its BroadbandPlanner tool, which provides advanced RF modeling, integration with Google maps, and measurement and verification capabilities. Many RF experts often state that RF network design, deployment, operation, and management are more art than science. So, public organizations considering Mesh network deployments should ensure that appropriate RF and Mesh tools and expertise are part of their planning and eventual vendor and deployment team. Even advanced technologies such as Mesh with ROI-enhancing, self-forming, and self-healing features provide best experiences when properly designed, deployed, operated, and maintained.

Sales of
WiFi chipsets are predicted to reach one billion by the end of this year, and five billion in 2011, with 802.11n the dominant protocol

Interoperability

A key consideration (and historical problem area) for public sector communication deployments has been multi-vendor interoperability. Although greenfield deployments facilitate competitive procurements, later upgrades often can only be procured from the successful initial vendor. The key to multi-vendor interoperability are standards that define features and operational parameters in sufficient detail to facilitate interoperability. Care must be exercised in procurement of standards-based products to ensure that appropriate subfeature sets are specified from often available broad standard feature sets.

Although the use of the widely deployed IEEE 802.11n standard would seem to guarantee multi-vendor interoperability, this is not always

Mesh Networks support a host of applications in the ITS field

true. WLANs have required the additional work of the WiFi Alliance to specify (and select) application-specific feature subsets from the IEEE 802.11 standards and to develop certification and test capabilities to ensure multi-vendor interoperability. Similar methods will have to be accomplished if the public sector is to achieve desirable multi-vendor goals in public communication deployments. Motorola offered inputs on its support of these goals.

First, the IEEE has a 802.11s standard for Mesh Networks progressing toward ratification that is anticipated in mid-2011. This will define capabilities in several areas including topology discover, path selection and forwarding, channel allocation, security, communication traffic management, and network management. Motorola says it's been an active contributor to the 802.11s standard process and will guarantee its products are compliant with the standard.

Second, network management has been an area of multi-vendor interoperability problems for commercial telecommunication operators as well as public sector network operators for many years. Network management includes such functions as frequency management, routing, fault management, configuration management, network provisioning, operating statistics collection, performance management, security management, etc. The Simple Network Management Protocol (SNMP) has been a popular standard for public sector networks and functions such as sniffer and alarm monitoring and reporting are typical. Mesh Networks – by definition providing self-forming and self-healing capabilities – require network management functions to achieve their goals. Motorola, similar to most vendors, provides its proprietary network management capabilities. It additionally supports more popular network management systems such as HP's Open View. Operators of multi-vendor public networks should thus carefully consider and address their interoperability goals in planning, procurement, design, operations, and maintenance. ○

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MAIN APPLICATIONS

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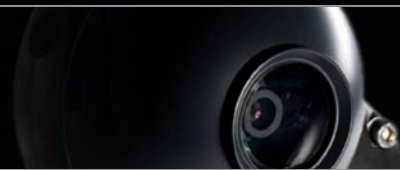
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It's good to share

With single-occupancy vehicles being a prime cause of congestion, **Jonathan Guard** details an advance in a real-time ridesharing technology that could bring a multi-modal, Shared Transport layer closer to reality

Images courtesy of Avego & University College Cork

S ingle-occupancy vehicles (SOVs) have been a contributing factor to many of the problems currently facing transportation planners. But advances in real-time ridesharing could transform SOVs into part of the solution.

SOVs don't have a good reputation among TDM professionals, and with good reason. Despite soaring fuel prices, increased traffic congestion, dwindling parking spaces, and higher carbon emissions, 76% of US drivers are still in SOVs. This over-reliance on private cars – in spite of the many compelling reasons not to drive alone – poses a unique challenge to transportation planners. Although high-occupancy vehicle (HOV) lanes have had some success, the sheer number of SOVs still on the road suggests they are in themselves not enough to effect a modal shift to ridesharing.

For many, the inconvenience of traditional ridesharing is the biggest barrier to a change in commuting behavior. Rideshares must be pre-arranged, and riders and drivers must stick to a rigid schedule for it to work. Any deviation from the routine – due to sickness or having to work late, for example – can throw a traditional rideshare into chaos. But now an emerging mode of travel called real-time ridesharing is poised to overcome these barriers, and promises to harness the unused seats in SOVs to offer a new, complementary layer between public and private modes of transportation.

Power to the people

What if you could rideshare whenever you wanted, from wherever you happened to be? A new technology from Avego called Shared Transport will allow you to do just that.

Using GPS-enabled smartphones, drivers and riders who want to rideshare along the same route are dynamically matched in real-time. Once a match is made, 'Shared Transport' manages the rideshare from pick-up to drop-off, as a result of a combination of automated security features, real-time passenger information, and electronic micro-payments that allow riders and drivers to easily share the cost of a journey.

Commuters expand the network by adding new stop locations at convenient places along their routes. As others join, a multi-modal,

How it works

Avego's free iPhone app allows riders and drivers to connect in real-time. Riders can also search and book rides from any web browser. The following shows how a Shared Transport real-time rideshare works.

First, a driver turns on the iPhone app and selects the route they're going to drive. Someone then searches for a ride along the same route, by using the iPhone app or their online user account.

The system automatically matches the driver with the rider, calculates the maximum fee to be charged to the rider, and offers the ride to both users. When both users have confirmed the ride, they are directed to a convenient pick-up location near the rider. The rider is also provided with reliable real-time passenger information (RTPI) – so they know exactly when the car is due to arrive.

When approaching the pick-up point, the driver receives an audio prompt informing him when to pull over. The driver then authenticates the rider by entering their auto-generated PIN into the iPhone app and drives the rider to their destination.

During the journey, the rider can sit back, relax and monitor the progress of the journey, accessing reliable real-time arrival information and a map view of their progress.

At the end of the journey, the system automatically charges the passenger a fair and predetermined price for the journey, based on a per-mile default rate, and manages the payment to the driver. Both users rate each other between one and five stars. If either user rates the other with one star, they will never be matched again.

A driver running the iPhone app is matched in real-time with anyone searching for a ride along the same route

> " This over-reliance on private cars – in spite of the many compelling reasons not to drive alone – poses a unique challenge to transportation planners

interconnected network of fixed stops and user-generated stops grows over time. User-generated stops can be used to bridge the gaps between other modes of transport, offering a new option for people traveling to areas traditionally underserved by public transport, such as radial routes, business parks and rural areas.

Shared Transport is possible as a result of the ingenious integration of several technologies. With GPS, for instance, the software doesn't need to ask users where they are, or where they're going. Users can easily add stops to the system from wherever they happen to be.

The GSM mobile phone network keeps the application in constant contact with users, providing real-time passenger information throughout the experience. Avego's geographic information system (GIS) makes real-time decisions to intelligently match drivers with riders. In relation to APIs, the Shared Transport platform enables external developers to create applications to use the transport, content, geographical, microtransactional and matching features of the technology. This makes dedicated transport applications and integrations with existing, legacy applications possible.

Sharing a ride with someone you don't know poses its own set of risks. Shared Transport manages these risks through several built-in security features. For example, there is a self-policing rating mechanism, whereby drivers and riders rate each other at the end of a journey. Once a user is matched with another user, they are provided with their details, including their photo and user rating. Drivers must authenticate riders by entering their auto-generated PIN at the start of each journey. Users can choose to travel only with people they already know and trust, while an audio notification means drivers don't need to interact with the app while driving. Lastly, every user is registered with the system and journey progress is logged using GPS.

Daimler's
car2gether pilot in Ulm, Germany, will pool drivers and passengers in a web-based scheme, with passengers charged 9.5¢ per mile

Real-world results
In a recent Shared Transport pilot program conducted at University College Cork, Ireland, 16 real-time ridesharers created 794 stops over

a four-month period. The stops sprouted up throughout the Cork region, demonstrating how the service can add a complementary layer to existing modes of transport.

Pilot programs are a great way to build a 'critical mass' of Shared Transport users along heavily used transport corridors. Upcoming pilots are planned for Nottingham, UK, and Bergen, Norway, with several also in development in the USA.

Moving forward
By using market forces to harness consumer self-interest, Shared Transport extends the public transport network to include private vehicles. SOVs have a financial incentive to offer their wasted excess capacity to the public. The result is greater options for commuters, and a reduction in pollution, congestion, and parking demand. For transport planners, these results can be realized with minimal capital expenditure and no additional infrastructure requirement.

Shared Transport also provides a rich stream of useful data to commuters and transport planners. Commuters can generate detailed trip reports, calculate vehicle kilometers traveled (VKTs) and CO_2 emissions, while transport planners can quickly see the commuting patterns around their city.

Planners can help make Shared Transport a viable transport option by helping to build critical mass through pilot programs. Incentives, in the form of improved access to bus lanes, priority parking, and discounts on public transport can also help get commuters to consider a multi-modal approach to their daily commute.

In time, SOVs – with their excess capacity no longer being wasted – may someday be part of the solution to the problems facing transportation planners. ○
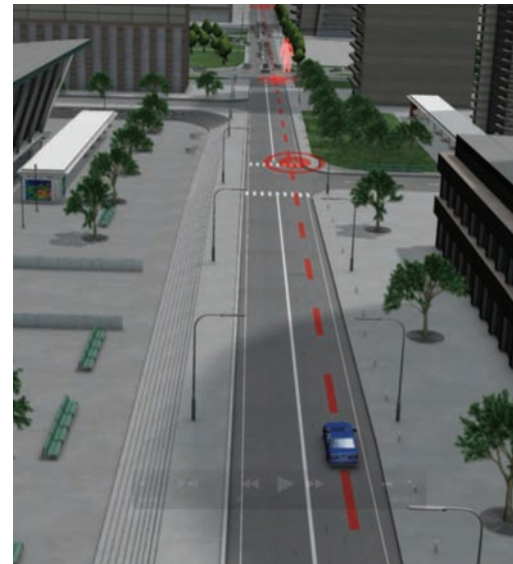
Shared Transport enables private cars to become part of the public transport network by providing a marketplace for drivers to offer their empty seats to others in real-time

MOTOA4 Mission Critical Portfolio

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Clean air act

Logica's **GBS Bindra** feels it's time to positively influence driver behavior and pollution by deploying what *The Economist* has classified as one of 10 game-changing solutions to combat climate change

Images courtesy of Rapid Eye Media & Stefan Redel

> **"** The principle behind this approach is that stakeholders as different as insurance companies, emergency services, governments and such players can team up with each other or commence individually to build further value-added services and commercially viable innovative services around the emissions-information platform

Sustainable resources is a key factor fostering global economic convergence. Governments, regulatory agencies, entrepreneurs, natural gas and oil companies, fleet operators and vehicle OEMs have all attempted to address the perennial problems of air pollution and fossil fuel consumption. But there needs to be a paradigm shift in the way we view transportation, as well as the ways we search to combat the resulting carbon footprint.

An obvious way to achieve such a major change is to provide drivers with better information, making them aware of their behavior and the impact they're making. Although the technology, engineering and communications may be available, we need to accelerate widescale deployment by building sustainable business models and overcoming the persistent organizational and institutional barriers that cause delay and limit the benefits.

The emissions-information platform
By deploying a system to help measure in real-time and report vehicle emissions to drivers, we can make a breakthrough because once we start to measure something we can manage it too. So, by basing our approach on an 'emissions-information platform', we can achieve a number of quick wins and build for a more sustainable future.

The emissions-information platform is a real-time monitoring system of vehicular emissions that uses a plug-in device connected to the onboard computer, which transmits emissions values to a central office. The data is then used to offer differential fuel pricing to the driver, which means that gas stations can offer prices tailored to every individual vehicle and the associated driving behavior, in doing so incentivizing 'greener' behavior. If the driving behavior is green, the fuel is priced lower and conversely if the driving behavior is poor, the cost increases.

The principle behind this approach is that stakeholders as different as insurance companies, emergency services, and governments can team up with each other or commence individually to build further value-added services and commercially viable innovative services around the emissions-information platform. All this, by ensuring that driving behavior and hence carbon footprint is analyzed and accordingly incentivized.

So not only are we creating new business avenues and developing new and innovative services that can be built via the solution, we are working toward a greener, fuller environment with minimal greenhouse effects. Isn't that what sustainability's all about – where business and economics are optimized while ensuring the larger environmental concerns are addressed?

Use cases for the platform
There are some tangible and substantial use cases foreseen with such an emissions-information platform for corporations, governments and other stakeholders:
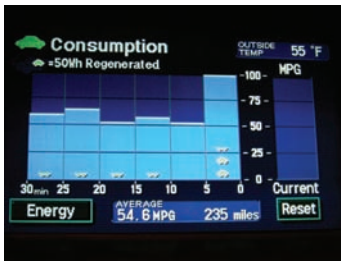
Bottom-up approach

A change to greener transport based on a bottom-up approach will produce more long-term impact and results. Although adapting and completely overhauling existing fleets and automobiles to adopt green technologies is a Herculean task, altering and developing policies to promote eco-friendly driving as an alternate may not seem as staggering but certainly needs an innovative approach – one that will have the ability to compel every driver to adopt better driving styles to result in reduced carbon footprint and hence, importantly, also succeed in inclusion of individual citizens in the eco-system. This must come first. Once the foundation of greener driving is laid, the number of possibilities that this generates for the creation of innovative policies and business models is tremendous. And they would all serve the same fundamental purpose but with different kinds of benefits to eco-friendly drivers. This undoubtedly is game-changing. And this is where intelligent transport systems will play a big role in the future of transportation.

This will not only spring multiple possibilities as far as drivers are concerned but will also create a number of new eco-systems where everyone benefits.

Gas stations could potentially offer prices based on an individual vehicle and associated driving behavior

Vehicle infrastructure management: Most corporations spend much money and time in maintaining fleets to service their personnel and other business needs – especially if they have multiple offices, in which case there are local centers to manage these fleets. With this solution in place, it is highly possible for such companies to optimize their resources, congregate costs and double operational efficiency and services. The emissions-information framework platform installed on the vehicles will make it possible for them to track vehicles for employee safety, receive information on service requirements, and get an SOS on breakdown assistance as well as driver performance. All this, to a central location that acts as vehicle management center, in doing so allowing them to cut down on operational and infrastructure costs, and increase value-added services.

Pay-as-you-drive and Pay-how-you-drive insurance: Insurance is another industry that can utilize the emissions-information platform to build new and innovative business models. Traditional car insurance premiums incorporate a range of risk factors such as vehicle and driver history but don't assess miles a vehicle has covered. So essentially, they generally charge the same premium to a driver who drives less and so has lower exposure to accident (low risk), as to a driver who drives more and therefore has higher exposure to accident (high risk). By converting these fixed costs to per-mile coverage, premiums can be spread out across driver profiles based on mileage and driving pattern.

Pay-as-you-drive and PAYD insurance have been floating about for some time now, but their adoption has been hampered by the absence of a safe and reliable technology to measure driver mileage and driving patterns. The emissions-information platform can provide such a solution to enable auto insurance companies to track driving patterns and charge premiums accordingly.

Taxes and tariffs: Meeting the green challenge posed by vehicles today is easier to deal with using a step-by-step approach, rather than issuing a blanket ban on vehicles of a certain size or engine capacity to curb greenhouse emissions. Governments are best placed to promote the application of the emissions-information platform approach and to make the most of the opportunities it provides. They can maintain stricter emissions norms, yet make it rewarding instead of punishing. As the platform measures the eco friendliness of a person's driving skills, it provides an important technology enabler to incentivize people for their green driving habits.

Vehicle-to-vehicle communication: The emission-information platform in one vehicle could also be interfaced with others to enable them to communicate with each other. Drivers can be given feedback when a vehicle drives too close to another. Lost vehicles could even be located, or perhaps even empty parking slots found in a busy parking lot.

Emergency call services and breakdown assistance: Getting emergency assistance to distressed vehicles as soon as possible can mean the difference between life and death. In such cases, having a system such as this platform that can send out distress signals immediately on impact and then guide emergency services to the exact location of the vehicle can help save valuable time and save lives.

An unrealistic dream or a structured approach to empowerment? Your comments are welcome…

• *GBS Bindra is the global director of Innovation at the business and technology service company, Logica*

Vehicles in the 2012 model year could feature a label to give US car-buyers more information on the fuel efficiency of the vehicle they're looking to buy

Roads to the future

Oscar Lázaro discusses the importance of the European iTETRIS project – a research program designed to encourage greater adoption of cooperative ITS technologies and strategies

The importance of cooperative ITS for improved, sustainable mobility cannot be denied and various solutions in this arena have already been investigated and implemented by several major companies. One of the most important questions being raised by road authorities today, though, is how can the worth of this actual investment as well as effectiveness of traffic engineering applications on city traffic be estimated. To answer such questions requires new decision-support tools, which can guarantee accuracy and realism, thereby paving the way for the next-generation of ITS.

Traffic congestion costs the European Community around €50 billion a year. The majority of European citizens live in urban areas where there is a significant increase in demand for mobility of both people and goods. Given that urban environments do not generally allow for building additional roads to tackle this situation, wireless vehicular cooperative systems are an attractive solution to improve road traffic management. V2V and V2I communication technologies can improve traffic management through the real-time exchange of traffic information (RTTI) among vehicles and road infrastructure. However, before cooperative ITS projects can be successfully deployed worldwide and evaluated in Field Operational Tests (FOTs),

road authorities are demanding clear evidence (at city level) of the benefits and impact of these solutions within their own particular scenarios.

Real-world versus virtual world

The development of new urban mobility policies and traffic management solutions that rely on cooperative technology demand that engineers and policy-makers are provided with decision-making tools that are flexible, accurate and technologically sound. The positive evaluation of FOTs and future deployments of cooperative ITS solutions will be affected by our ability to anticipate, understand and engineer best-of-breed solutions for effective management of cooperative ITS. This is unavoidably linked to our capacity to model and reproduce in simulated and controlled environments the real-life conditions that will be encountered by such systems. The effectiveness and worth of investment of next-generation cooperative ITS will therefore be driven by the correct dimensioning of the real chances of traffic information reaching the right car, at the right time, at the right place. Such probability is fundamentally affected by the fidelity of the communication models employed in the analysis

Main objectives

The overall aim of iTETRIS is to focus on the various technical objectives that still need to be solved to prove the ability of the wireless vehicular communication technologies that could improve road traffic management. A number of subsidiary objectives were also identified, including the need to address large-scale vehicular communication scenarios, which have never been analyzed with this level of accuracy before. A pan-European standardized and open platform for advanced evaluation of cooperative ICT solutions for road traffic management also needed to be facilitated, which is currently non-existent worldwide.

New hybrid traffic control strategies were key and needed to be developed more autonomously and adaptively, with a new level of granularity that relies on cooperative technology and can be analyzed with the performance metrics defined. Current traffic mobility and vehicular communication platforms would also need to be augmented with highly accurate energy, noise, pollution and wireless link models respectively, and integrated in a unique simulation platform.

Other objectives include the definition of new traffic metrics to quantify the overall traffic network performance, new protocol ideas for data dissemination and routing, and the proposal of advanced V2V-V2I cooperative ICT strategies to handle low density V2V systems scenarios. Meanwhile, optimal and suitable communication strategies to handle transient periods when V2V technology is at a low penetration level would need to be proposed and analyzed. Development of adequate communication protocols for vehicular communications to guarantee QoS was also key.

The EC estimates that traffic congestion currently costs €50 billion per year, or 0.5% of the EC's total Gross Domestic Product

Assessment parameters

The iTETRIS simulation framework is equipped with a number of advanced features to assess sophisticated traffic management strategies, such as fine-grained, sub-second traffic simulation support for evaluation of traffic management strategies under realistic context information disposability, and emission and noise modeling support for sustainable traffic management strategies evaluation. It also includes intelligent re-routing simulation support for dynamic online route adaptation, Traffic Light System (TLS) algorithm support, as well as ADAS modeling support.

" Quantifiable results of large-scale deployments and investment on cooperative ITS applications can now be presented to road authorities
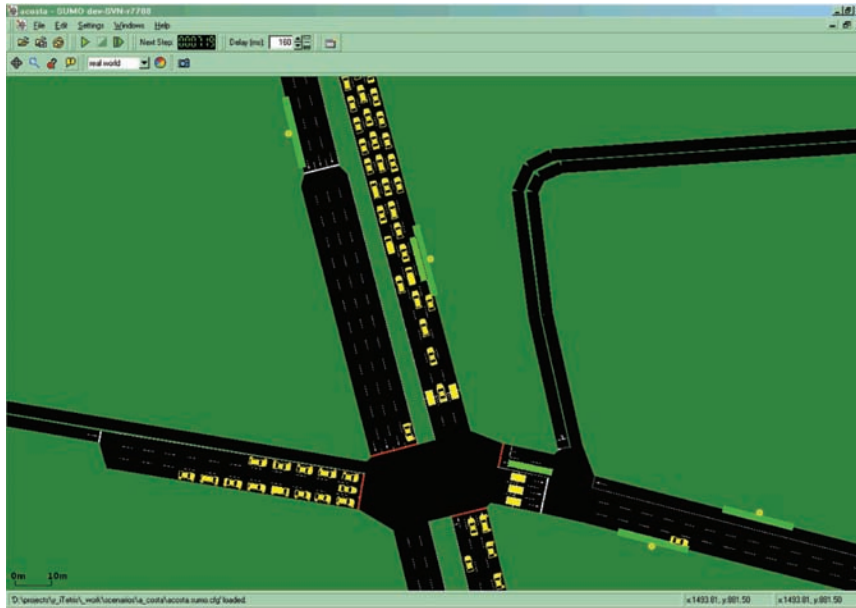
Integrating wireless communications and traffic simulation is a key part of iTETRIS

and the scale over which the impact assessment of the traffic management policy takes place. Small-scale evaluations of cooperative ITS systems could exhibit a high level of effectiveness at a local level but hide the problems caused by reallocating traffic on a wider scale. Hence traffic engineering companies and road authorities are demanding more powerful platforms for the evaluation of new types of strategies at city level.

The iTETRIS project[1] has developed an open, ETSI standard-compliant, flexible simulation framework to satisfy this need. iTETRIS integrates high-fidelity wireless communications and road traffic simulation platforms in an environment that is easily tailored to specific situations, allowing performance analysis of cooperative ITS at city level. The accuracy and scale of the simulations leveraged by iTETRIS clearly reveals the impact of cooperative, ITS-assisted traffic engineering on city road traffic efficiency, operational strategy, and communications interoperability.

iTETRIS
is a 30-month EU FP7-funded research project (from July 2008 to December 2010) that involves nine partners from five different countries

The importance of communication

The project has devoted a great deal of effort to the development of accurate wireless ITS communication models that could bring together high fidelity in terms of information distribution accuracy and communication availability. For this purpose, iTETRIS considers the main technologies involved in V2V and V2I communications for cooperative ITS as four radio-based technologies – ITS 5.9GHz, UMTS, WiMAX, and DVB-H – which can be configured in multibearer and multichannel modes. Moreover, iTETRIS implementation follows the ETSI ITS Facilities specification for supporting

Local Dynamic Map (LDM) concepts, messages, mobile stations, relevance checks and location referencing facilities.

Networking protocols

The Networking and Transport layer contains the different protocols required for fully functional communication in ITS scenarios. Each networking protocol may be connected to a specific, dedicated ITS transport protocol or to pre-existing transport layer protocols, such as UDP or TCP. This means that iTETRIS supports both C2C-CC and IP communication stacks. iTETRIS has been developed for unicast, multicast and broadcast ITS applications and implements a number of networking protocols including standard compliant geo-networking addressing schemes.

The simulations leveraged by iTETRIS have so far revealed the impact of cooperative ITS on city road traffic efficiency. Quantifiable results of large-scale deployments and investment on cooperative ITS applications can finally be presented to road authorities in meaningful formats for informed decision making. ○

[1] *www.ict-itetris.eu*

Always stop
on red

The leading authority on red light cameras, **Richard Retting**, reveals his top 10 considerations to authorities looking at implementing an intersection safety camera program

Photography courtesy of Exkalibur & Mbbirdy

Traditional intersections place vehicles on a collision course and expose non-motorized road users to considerable risk. Conflicts between such road users and associated collisions are controlled (but not eliminated) through the use of traffic signals and stop signs, which regulate the entry of vehicles, pedestrians, and cyclists into intersections. High levels of voluntary compliance with such traffic control devices are essential to maintain safe and orderly flow at intersections.

However, studies from coast to coast show that drivers frequently run red lights under a wide range of environmental conditions, intersection geometry, signal timing, police enforcement practices, and traffic speeds. Drivers that either deliberately or inadvertently disregard requirements to stop for red lights or fail to comply with stop signs put themselves and other road users at risk of serious injury crashes. In fact, according to the National Highway Traffic Safety Administration (NHTSA), 5,223 fatal crashes and an estimated 589,000 injury crashes occurred at traffic signals and stop signs in 2008 alone.

Automated for the people

In most cities, police resources and staffing levels are inadequate to provide consistent enforcement at busy intersections. However, automated traffic enforcement technology can supplement limited traditional enforcement and deter violations as a result. The first US application of red light cameras

The vocal minority in the USA is loud when it comes to opposing safety camera programs

" According to NHTSA, 5,223 fatal crashes and an estimated 589,000 injury crashes occurred at traffic signals and stop signs in 2008 alone

↘ | Emphasize fairness in program design and operations

It is important that photo enforcement programs are perceived as fair. To this end, program managers should ensure governmental control over all major aspects of camera enforcement. This includes the selection of camera enforcement sites and final say over which photos result in citations. Camera programs should be designed to emphasize deterrence, with secondary emphasis on ticketing violators. That means making drivers aware of the increased enforcement through signing and public information. As camera enforcement greatly increases the certainty that violators will be ticketed, consideration should be given to avoiding excessive penalties and late fees, as these add to the perception that cameras are being used to raise revenue. Adequate enforcement tolerance levels should be provided to ensure drivers are not inadvertently labeled as red light runners (a grace period of 0.3 to 0.5 seconds is fairly common). Program planning and ongoing operational assessments should include a variety of community stakeholders.

↘ | Identify factors that affect red light running

Red light running is influenced by many human and environmental factors, including the design and operation of traffic control devices, traffic volume, intersection approach speeds, traffic signal cycle length, yellow signal timing, traffic signal visibility/conspicuity, the number of traffic signal heads, and the perception of traffic enforcement. Traffic engineers and police officials should consider these and other factors that influence red light running when evaluating driver behavior at specific intersections.

↘ | Focus on safety

Careful consideration should be given to the selection of intersections for red light camera enforcement. Site selection should be determined by government officials and not photo enforcement vendors. Similar to all limited traffic safety resources, red light cameras should be deployed at locations where safety benefits are likely to be realized. Although there are no formal warrants or universal criteria for selection of camera enforcement locations, engineering and law enforcement agencies should consider intersections that have recognized crash histories and other safety-related factors. It is important to avoid placing cameras at locations where the public might perceive automated enforcement as unnecessary. Proper site selection is a critical component of program success. Criteria for selection of cameras sites include violation frequency, red light running crashes, citations issued by law enforcement officers, and difficulty of conducting traditional enforcement. Consideration should be given to problem corridors as well as 'black spots' for targeted enforcement. Agencies should compile and retain documentation regarding the site-selection process.

↘ | Get the engineering right

Prior to implementation of camera enforcement, community officials should consider engineering measures to reduce persistent traffic violations and crashes. This includes evaluating the yellow signal timing and posted speed limits approaching intersections, and making adjustments as warranted. Engineering measures that can potentially reduce red light running and associated crashes include measures such as improved signal visibility, the use of 'signal ahead' signs at appropriate locations, and the adjustment of signal phasing and cycle length. Other measures might include the modification of changing of interval timing (yellow and all-red), the elimination of the need to stop (e.g. signal removal), the installation of traffic signal backplates, increased street lighting (night-time crashes), as well as the implementation of traffic-calming measures.

Avoid the appearance of a revenue motive

Appearance of a revenue motive negatively affects public attitudes toward automated traffic enforcement. To address these concerns, communities implementing or revamping red light camera programs should avoid 'revenue sharing' methods of vendor payment. Other measures to avoid the appearance of a revenue motive include posting traffic signs throughout the community to alert drivers to the use of photo enforcement. For the first few weeks of new camera locations, consider installing temporary signs ahead of each deployment, and periodic financial audits should be conducted and published.

was implemented in New York City in 1991. Since that time, more than 400 communities in 25 states have instituted red light camera programs.

Increased compliance

Such safety cameras have been shown to dramatically increase driver compliance with traffic signals and reduce injury crashes. Reductions in red light violations range from about 40 to 90%. Properly designed crash evaluations have reported significant reductions in angle crashes, injury crashes, and left-turn crashes. Although some studies have found increases in rear-end crashes, this is not surprising given that camera enforcement causes many more drivers to actually stop for red lights. These overall crash effects mirror the reductions in angle crashes and increases in rear-end crashes associated with installation of traffic signals themselves, and might be viewed as a 'dosing' effect as a result.

Anticipate and avoid legal setbacks

Although no US court has ruled the concept of photo enforcement to be unconstitutional, some legal challenges have produced judicial findings that negatively impact camera programs. Court rulings that resulted in suspension or termination of photo enforcement programs reinforce the importance of subjecting program development and details to comprehensive legal review. Legal setbacks have largely been in relation to issues of program control and oversight, and preemption of red light camera ordinances by state laws. Photo enforcement planning and implementation efforts should include a broad spectrum of state and local law officials, judges, and others with appropriate legal expertise.

> " Although some studies have found increases in rear-end crashes, this is not surprising given that camera enforcement causes many more drivers to actually stop

There is growing support from those in favor of red light enforcement cameras in the USA

Work with elected officials

Transportation engineers and law enforcement officials should provide legislators and elected officials with solid information regarding red light camera effectiveness and public support. Cameras are controversial and can generate strong negative opinions. In addition to expressed opposition from individual constituents, organized opposition can come from motorist enthusiasts and others who oppose enforcement on ideological grounds. Program managers should inform elected officials/legislators about evidence of camera effectiveness; public support for camera enforcement; and potential cost-savings through reductions in injury crashes. Their deployment and operation requires ongoing communication also. Schemes can become mired in controversy when the media reports negative events and outcomes. Implementation and continued operation of programs require clear, data-driven communication with elected officials and legislative bodies. Periodic feedback regarding program results is vital. Being responsive to constituent needs and requests can head-off intervention by elected officials.

Employ effective communications

Successful and sustainable red light camera enforcement requires adequate public information and education efforts. These efforts must be applied well in advance of camera enforcement, when cameras are first introduced, and on an ongoing basis throughout the life of the program. Although there may be a temptation to rely entirely on earned (free) media to communicate with the public, program managers should seek to allocate sufficient funding to supplement free media exposure with targeted paid advertising. It is useful to develop a comprehensive communications strategy to ensure an organized approach to providing adequate public information and education outreach efforts.

Evaluate program performance and outcomes

Red light camera programs should incorporate formal procedures to periodically evaluate program performance and outcomes. These include effects on violations, effects on crashes, and public attitudes toward the camera enforcement program. Care must be taken to apply appropriate methodological approaches and statistical procedures. In agencies that lack sufficient in-house research expertise, evaluation efforts should include independent analysis of program effects by qualified outside researchers.

Mayor Cory Booker (third from left) **at the launch of Newark's red light enforcement program, which is hoped to change an unsafe driving culture**

Despite the documented safety benefits of red light cameras and strong public support for the use of cameras to supplement traditional police enforcement, controversy abounds due to vocal criticism by a small minority of motorists strongly opposed to camera enforcement, and associated media hype. In spite of such controversy, such programs are flourishing and have helped contribute to record low traffic deaths on US roads. The top 10 considerations in this article are designed to help you when implementing or revamping red light camera programs.

• Richard Retting is vice president for Safety and Research Services at Sam Schwartz Engineering. He has 30 years of traffic engineering and research experience, and is a widely recognized North American expert on traffic safety

Ensure proper contracting and procurement

Early red light camera programs in the USA frequently involved fee arrangements based on the number of tickets issued. Although some communities still use this pricing arrangement, fixed-price contracts or fixed-cost contracts plus variable charges can alleviate concerns about contractors having a revenue motive to increase the number of citations. Fee arrangements based exclusively on ticket volume generate criticism and may violate some state laws. Keep the procurement process transparent and include stakeholders to ensure the red light camera system and contract are acceptable to all stakeholders. Avoid having vendors assist with writing RFPs and do not write specifications that clearly favor a specific vendor. Photo enforcement contracting is a competitive market with relatively few vendors. Take advantage of fierce competition among vendors to obtain the best deal for your community.

> " Successful and sustainable red light camera enforcement requires adequate public information and education efforts

Automated traffic enforcement can supplement traditional methods, especially on roads where traditional enforcement can be difficult or even hazardous for law enforcement officers

Snap
decisions

The license plate recognition market often moves as quickly as a camera flash. **Louise Smyth** speaks to some of the players setting the benchmark for new products and applications

Illustration courtesy of Tim Ellis

Given that *Traffic Technology International* tends to run an in-depth article on ALPR twice a year alongside regular news items and technology profiles from many vendors, it is perhaps surprising that we don't end up repeatedly covering the same ground. But that's the ALPR market for you – there's always something fresh to talk about.

A fast-moving sector that spans several areas of expertise, there are always new vendors joining the market, new advances in technology and perhaps most interesting of all, new applications for the products and services on offer. One name that's new to these pages and that embodies several of the above points is the New Jersey-headquartered Intelligent Security Systems (ISS). The company noted a surge in demand for its surveillance products post 9/11 and its current portfolio covers everything from facial recognition to cargo recognition. Several solutions are offered in the

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The MPH-900® is the most accurate Automatic License Plate Reader available.

It identifies suspect vehicles within milliseconds of a patrol car passing them and allows officers to manage stops safer than ever before.
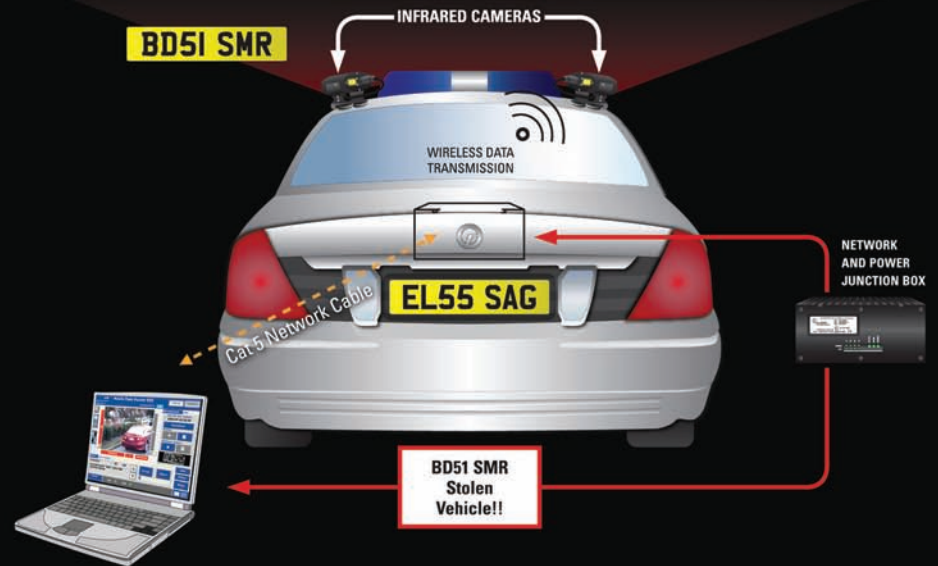
Complex, proprietary algorithms give the MPH-900® unmatched capabilities:

- Captures up to 3,600 reads per minute, day or night
- Processes parked and moving vehicles across 4 lanes of traffic
- Recognizes plates from the Americas, all British and Schengen member countries, as well as Arabic characters
- Finds suspect vehicles within milliseconds of passing them
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Required reading

The latest product from JAI is the VIS-CAM 500 – a 3.2 megapixel camera that offers a higher dynamic range than previous versions. Frank Long, JAI's director of traffic solutions, says that since the launch in April 2010 the VIS-CAM 500 has already seen widespread adoption: "We've got around 500 units in the field so far and are specifically targeting the ORT sector. It is allowing these users to do more with less – the higher coverage means toll operators can use just one camera per lane instead of two or three. We've already had several contracts, including one for the NTTA."

Long has observed a growing adoption of the use of color systems, suggesting this complements what might be done on the manual review side. "In North Carolina, for instance, they have both red and blue characters on a white background but where you might normally use an infrared light at night, that compromises the readability of red characters. The color enhances the ability to read such plates and adds greater distinction between the plates of various jurisdictions."

This approach links nicely to something else that JAI offers – its vehicle-recognition suite of products. "License plate fingerprinting technology allows us to take a different approach," Long explains. "If you've got a specialty plate, a temporary plate, or even a partially occluded plate, for example, the vehicle fingerprinting allows the system to say 'without having a fully readable plate we can now see that this is the actual plate that relates to this specific vehicle'. That becomes an element of the database and enhances overall read performance in an automated format – it reduces the need for manual review."

Naturally, that advantage is being embraced by toll operators. As well as reducing manual verification, it helps with the billing process when it comes to infrequent users. "It allows the infrequent user to drive on a tollway and instead of getting a violation just get an invoice," Long states. "But instead of issuing multiple invoices for the various transactions, the matcher can quickly identify all of the transactions for that vehicle and place them all under one invoice. One of biggest projects that's had widescale success with it is the 407 ETR in Ontario."

The VIS-CAM 500 is becoming a popular tool for ORT applications across the USA

ISS software is used for a variety of applications, including Homeland Security and traffic surveillance

> Standard OCR can only read horizontally, like scanning text from a book. Instead of this, we conduct image analysis pixel by pixel

Wolfgang Ritter, director of sales and marketing, ISS, USA
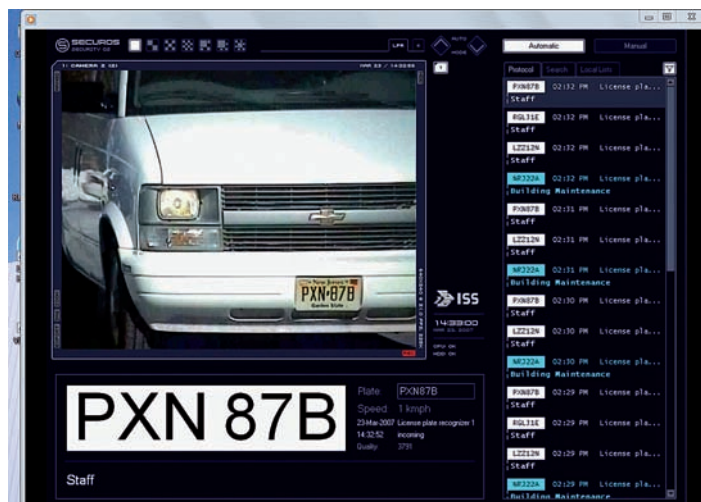
ALPR sphere, including a high-speed LPR system for highways and a cheaper equivalent that works for vehicles up to 50km/h, for parking lots and access control. ISS also offers an SDK so its LPR software can be incorporated into other vendors' solutions – becoming 'invisible' in the end product of system suppliers. Wolfgang Ritter, who has a solid security background, explains how ISS technology is sold: "Our main customers are systems integrators and other OEMs, such as IBM," he reveals. "The end systems often do not feature our branding, so we're not a household name – despite our growing presence."

Standing out from the crowd

As well as having broad experience in the surveillance sector, ISS has a number of very smart software developers, including former rocket scientists. This behind-the-scenes expertise is what Ritter feels sets ISS software apart from other offerings. "Most of our competitors do have a decent functioning LPR, but certain advanced features make ours unique," he suggests. "We can, for example, detect color in a license plate. Standard OCR doesn't have the ability to do that nor can it read vertically; it can only read horizontally, like scanning text from a book. We don't do simple OCR – instead we conduct image analysis pixel by pixel."

This means that ISS software is particularly useful when it comes to obtaining more information from a plate –

and quicker. "We can find little bitmaps in the image to ascertain which country a plate comes from," Ritter explains. "Imagine we find a plate from Germany with a 'D' on the left-hand side, we know that a German plate always starts with one or two letters and a dash, so if the system identifies the first character as an '8', we know it can't be an '8' as it has to be a letter. The extra information we can read really helps to streamline the whole recognition process."

Current ALPR deployments for ISS technology include a large rollout with a systems integrator in Chicago for a city surveillance project as well as a contract with the US Department of Homeland Security. "We're also in the middle of a major software release (from version 4.3 to 5.2)," Ritter adds.

Below left: **Dacolian's software is used in the Stockholm congestion charging scheme and in many tolling projects throughout the USA**

"We're introducing an improved algorithm for utilizing megapixel cameras. More and more high-resolution 180° and 360° cameras are being introduced, so we had to respond and make sure we help to reap the benefits offered by this newer breed of cameras."

Behind the screens

Another software expert in a similar position with regard to marketing its products is Dacolian, now owned by Norwegian giant, Q-Free. As with ISS, the end-users of Dacolian products may not even be aware of what's powering their ALPR systems. For instance, Gatso's speed enforcement cameras rely on a Dacolian software

> Now we're part of Q-Free, we're actively promoting more products with our own logo – so you'll see some new offerings coming up soon

Jos Nijhuis, general manager, Dacolian/Q-Free, Norway

engine – as do the products on offer from CA Traffic, Milestone and JAI. In fact, Dacolian is the biggest supplier of ALPR software for video tolling in the USA. But who knew that?

For Dacolian, allowing or even encouraging vendors to sell the products without alluding to the software behind them was a conscious business strategy, and one that Jos Nijhuis, general manager, feels has benefited the quality of the software immensely. "Now we're part of Q-Free it's a different ball game," he says. "We're actively promoting more products with our own logo so you'll see some new offerings from Q-Free coming up soon. But our whole 10-year history has been devoted to software development. We wanted

Smarter thinking
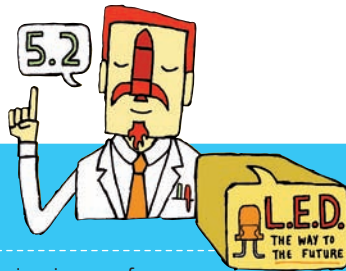
As a global player in ALPR, ARH has a history of bringing new innovations to market. Its latest products are the FXCAMd ALPR camera series and the SpeedCam for speed enforcement.

This year saw the company bring new FXCAMd camera models (including megapixel and color versions) to market. "Although our Carmen ALPR software is able to read license plates from most camera images, the best OCR accuracy is achieved through the use of dedicated ALPR cameras," explains Erno Szucs. "The new SpeedCam includes a speed detector with an ALPR processing unit. Its automatic output is the photo of the vehicle with timestamp and license plate text."

An overview image of the vehicle is given with the new color sensor models, while plate color recognition is also possible when the camera is used with the Carmen software.

With the cameras being equipped with a built-in infrared illuminator for continuous day and night operation, Szucs is keen to highlight one other feature that he describes as 'unique': "We offer sunlight reflection correction technology that is used to maintain good image quality in extreme lighting conditions. White light LED illumination is also available to achieve high-quality color images at night."

ARH has picked up a number of new contracts recently. In Morocco, 65 FXCAMd

FXCAMd is a smart ALPR camera with a built-in CPU, allowing ALPR processing within the camera

102c smart camera units have been installed, and similar sized projects have been completed in Columbia, Estonia, Portugal and the USA.

The in-camera OCR offered by the SpeedCam is proving popular with Hungarian law enforcement authorities – more than 20 units have already been deployed. "The advantage of having several functions in one unit is very appealing to users," Szucs says.

the entire company (now 40 people) devoted to this side of the business, not to have three engineers and the rest of the staff in sales and marketing."

How, then, has this approach helped? "We've been able to create a set-up that allows us to get an error rate that's unmatched by our competition for tolling," Nijhuis explains. Dacolian claims automation rates of 98%, but Nijhuis is the first to observe that what vendors claim often differs greatly from rates achieved in real-world conditions: "Everyone will say 'We can do 99.9%' but in reality toll operators would be very happy if they get 80%! In real life there are all sorts of weather and lighting conditions to contend with, not to
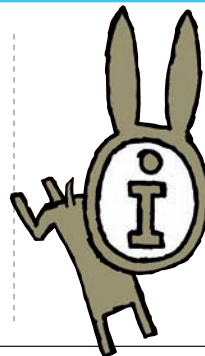
mention the shortcomings of the imaging system itself. We always look at the individual customer to gain accurate data. In Stockholm, for instance, we provided the LPR software and back-office system to IBM and when they now talk about 95% automation and an error rate of 0.01%, that means on all passages. On decent images we can say we perform 99% correct recognition, but in the real world, I'm more than satisfied with 95%."

Obviously a 100% recognition rate is never going to happen – whether due to software system shortfalls or physical variables such as obscured plates. But Nijhuis says that where software can still be advanced is in its ability to recognize more quickly when a plate cannot be read accurately. "The software will be able tell you that for whatever reason – snow on the plate, for instance – it cannot read it, so you can't bill this one; it will save time wasted on trying to analyze it," he predicts. "The driving force for LPR in tolling is only to minimize operational costs."

Seeing the light

As much as the software we can't see, the hardware we can is just as crucial to getting accurate ALPR data. Investing in the latest camera units is a trend being followed by many systems integrators and vendors, but until recently the need for high-quality lighting systems was somewhat neglected.

Gardasoft Vision is setting out to change this and educate ITS practitioners on understanding the importance of lighting. "We supply very high brightness strobe lights for vehicle monitoring systems, usually in the infrared spectrum," explains company founder and MD, Peter Bhagat. "These systems are typically safety systems – speed or red-light enforcement, for example – and ORT applications, but they can be used for parking lot entry systems, too. Road systems require high brightness due to the high speeds of traffic. Until now, these systems relied on Xenon strobe lights because there wasn't anything else available that was bright enough."

Gardasoft's technology uses LEDs and Bhagat regards this approach as the way forward. "The raw power from LEDs is not as high as Xenon, but LED systems are typically 80% efficient in terms of how much of the light generated is useful to the system. All of the light is output in one direction and in a narrow spectrum, although white is also available. Xenon systems radiate over a very wide spectrum and in all directions. Such systems usually need infrared pass filters on them to prevent drivers being distracted. Xenon bulbs need replacing regularly and are not popular with maintenance engineers as they require very high voltages during operation."

Bhagat views red-light enforcement as a prime example of an application where LEDs trump Xenon: "Typically, two to three flashes in quick succession are required. Xenon lights suffer here as the recharge times make this problematic. With the Gardasoft VTR, it is possible to configure a set of up to five flashes of different durations from a single trigger."

> ❝ Whereas ALPR alone requires relatively low light levels, the newer requirements need far more light

Peter Bhagat, managing director, Gardasoft Vision, UK

The VTR range of lights offers a reliable, high-intensity solid-state lighting solution for ALPR and intelligent traffic systems providers

As with some other players in ALPR, Gardasoft is approaching the ITS market from a background in the notoriously demanding machine vision sector. Keeping up with the needs of machine vision clients means that Bhagat is well versed in the importance of evolving, which is just as well given the speed things are moving in the ALPR sector. "Increasingly, ALPR customers are asking for vehicle model recognition and images of the driver's face," he reveals. "Whereas ALPR alone requires relatively low light levels and can work with a wide range of wavelengths, these new requirements need far more light."

As well as the UK being a key market for the British company (it currently has 350 lighting units being used for average speed systems), Gardasoft's products are also popular further afield. Blaz Turbovc from Slovenia's Iskra Sistemi has invested in 12 of the VTR infrared strobe lights for use in the country's vignette-based tolling scheme. "We have to detect the small label-style vignette using cameras during the day and at night on moving vehicles," he explains. "If we don't detect a vignette on a vehicle, we need a good quality image of the license plate to be able to issue a bill. We cannot use visible light on highways at night as it's distracting, hence the use of infrared."

Prior to the Gardasoft lights, the scheme had relied on other non-strobe-based lighting, which had to be constantly on, wasting energy in the process. "The Gardasoft lights emit more energy than the older lights, with less power consumption – and they don't need to be constantly on," Turbovc says. "We bought four light units in December 2009 and were so pleased with the results they enabled us to achieve that we decided to buy a further eight."

The criminal element

Another recent client of Gardasoft's lighting range is PIPS Technology, now part of the Federal Signal Corporation. PIPS has long been known for its fixed and mobile law enforcement ALPR cameras, the latest additions to the range being the Slate mobile system and the SpikeHD fixed system. Tim O'Leary, vice president and general manager PIPS Technology, can recount numerous anecdotes of PIPS systems being used to catch criminals, the latest being a man whose license plate led to him being arrested for armed robbery and impersonating a police officer.

As much as this sort of positive feedback is rewarding, O'Leary is keen to drive forward development even further – not only in

> **We've been asked to devise a method to trawl through the data to pull out two vehicles traveling together for a considerable amount of time, to help identify suspicious activity earlier**

Tim O'Leary, VP and general manager, PIPS Technology, USA

terms of producing smaller and higher-definition camera units, but also with regard to the back-office. "We want to conduct a greater degree of data analysis," he states. "Where today we can capture plates and send reports to agencies for them to analyze, we want to offer more sophisticated data analysis ourselves. One request we are working on is the ability to identify what are known as 'cohort vehicles'. These are typically seen in drug-running scenarios where one vehicle acts as a cohort to the other by providing a distraction if the other is pulled over by the police. We've been asked to devise a method to trawl through the data to pull out two vehicles traveling together for a considerable amount of time, to help identify suspicious activity earlier."

Another interesting development for PIPS is its move into EVR systems. In June 2010 it announced a huge, several million dollar EVR project in Thailand that will use hundreds of PIPS cameras coupled with Sirit tags and readers. "Coming under the Federal Signal umbrella has certainly been a positive move for PIPS," says O'Leary in a somewhat understated way. ○

Schooled in the
fast lane

What has the 91 Express Lanes taught us about congestion pricing and PPPs? HNTB's **Gregory A. LeFrois** takes a look back at Orange County's trailblazing program to establish how similar schemes can go forward elsewhere

Images courtesy of the Orange County Transportation Authority

Promising customers a fast, safe, reliable commute, the California Private Transportation Corporation implemented an industry-first in 1995. It built the 91 Express Lanes, a 10-mile, four-lane, high-occupancy toll (HOT) facility designed to improve mobility, relieve congestion and reduce trip times by providing more capacity on SR-91 – one of Southern California's most heavily traveled and highly congested corridors. Fully automated, cashless and delivered via a public-private partnership, the toll facility was like no other in the world.

It now has been 15 years since the first vehicles opted for the express lanes and shortened their commutes by some 30 minutes. Since then, the facility has saved more than 32 million commuting hours, logged more than 100 million vehicle trips and generated more than US$480 million in added economic productivity and quality of life benefits to the area. The Orange County Transportation Authority (OCTA) purchased the facility from CPTC in 2003 and now operates it.

The 91 Express Lanes is today regarded as a successful model of contemporary toll road operation, and serves as a classroom for our industry, validating some of our expectations while schooling us on others.

Going strong

Perhaps the biggest compliment the 91 Express Lanes could have received came when the State Legislature passed Senate

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⤵ Congestion pricing is a sound policy

The 91 Express Lanes are the first US congestion-priced facility with true demand management. HNTB Corporation helped introduce the concept to the CPTC and served as the engineering lead on the original 91 Express Lanes implementation team. The organization designed the managed lanes to maximize existing highway capacity, improve critical peak-period traffic flow, and ensure dependable travel times.

To accomplish those objectives, the OCTA board of directors approves the 91 Express Lanes toll policy, which increases tolls when traffic volumes consistently reach a trigger point and can become unstable. Conversely, OCTA decreases tolls when traffic volumes for a specific hour consistently decrease below 80% of optimum capacity. Once an hourly toll is adjusted, it is frozen for six months. This sound approach balances traffic engineering with good public policy, encouraging customers to plan trips to maximize convenience and travel times and creates value for the customer while meeting demand and managing congestion.

The OCTA's toll policy has been so successful it received the International Bridge, Tunnel and Turnpike Association's 2008 Toll Excellence Award for Administration.

Opening in 1995, the 91 Express Lanes project was the first privately funded toll road built in the USA since the 1940s

Bill 1316, allowing the OCTA to work in conjunction with the Riverside County Transportation Commission (RCTC) to extend the 91 Express Lanes by an extra nine miles into Riverside County. The RCTC – which strongly opposed the managed lane facility when it was proposed in the 1990s – now includes the extension as part of a US$1.5 billion, high-priority project slated for completion in 2016.

When they opened, the 91 Express Lanes were an international model of how to create capacity on a congestion-choked roadway. As a result of the lessons this groundbreaking facility continues to teach us, it remains a world-class model 15 years later. ○

• Gregory LeFrois is a managed lane expert and leads HNTB's toll systems and operations consulting practice. During his 28-year tenure with the firm, he has led many high-tech tolling projects, including being HNTB's project manager for the 91 Express Lanes. Please feel free to contact him at +1 973 237 1650 or glefrois@hntb.com

↘ | The lanes are a viable option – even in a recession

Just before the economic downturn, the facility experienced its best year ever. More than 14.6 million vehicle trips were logged during fiscal year 2007 – a 3.2% increase over the previous fiscal year and a historic high for vehicle volume on the 91 Express Lanes. Total operating revenues rose to more than US$49.8 million – an increase of 12.7% over the previous fiscal year.

Even in a recession, the lanes have been a viable option for motorists. In fiscal year 2008, it produced total operating revenues of US$46 million, and last year's revenue was US$43.7 million. In addition, the 91 Express Lanes continue to meet their financial obligations and receive strong ratings from Moody's Investors Service, Fitch Ratings and Standard & Poor's.

↘ | Everyone uses them

The 91 Express Lanes carry all types of customers – from tow-truck drivers and commuting college students to expectant mothers in labor. There is no upper-class ceiling effect as suggested by the opposition when it initially dubbed them 'Lexus lanes'. A number of university studies show everyone uses them, no matter what their socioeconomic standings. In fact, the existence of the Express Lanes has even freed up some capacity in the free lanes, easing that commute as well.

"

In a 2009 customer satisfaction survey, 87% of respondents said they were satisfied with the 91 Express Lanes and cited saving time as the number one reason

Toll rates vary depending on the direction of travel, time of day, and day of the week

↘ | Drivers will pay a premium to use them

In a 2009 customer satisfaction survey, 87% of respondents said they were satisfied with the 91 Express Lanes and cited saving time as the number one reason. And motorists are willing to pay top dollar for that benefit.

When the facility first opened, the maximum toll was approximately US$4.00. Today, during super-peak periods, eastbound motorists pay as much as US$10.25. The fact that people are willing to pay to save time has turned the managed lane facility into a successful operation.

Typically, HOT lanes are not revenue-generators. An operator's ultimate goal is to collect less money as more people are using the lanes for free by car-pooling or taking the bus, both of which help the lanes produce the greatest amount of throughput.

But the 91 Express Lanes are unique. For HOT lanes to expand mobility and entice customers, they must be adjacent to congested roadways. The 91 Express Lanes were built in the median of California's Riverside Freeway (SR-91). They provide two toll lanes in each direction from the SR-91/55 junction in Anaheim to the Orange/Riverside County Line. However, there is no alternate route to SR-91. So if motorists want to avoid the congestion, the express lanes are their only option.

With both location and convenience going for it, the facility has enjoyed uncommonly high revenues. As a result, the 91 Express Lanes are able to pay all their expenses and provide seed funding for general improvements along the SR-91 corridor.

That's not to say the 91 Express Lanes haven't increased car-pooling. Under the OCTA's 'Three Ride Free' policy, the number of HOVs with three or more passengers has jumped more than 7%, comprising 21.8% of the total trips in 2008.

↘ | Franchise agreements must strike a balance

Born when no public funds were available to solve SR-91's critical transportation problem, the 91 Express Lane facility was the first privately financed US toll road in more than 50 years. It is a great example of a PPP's ability to get a project off the ground. The managed lane facility – a US$135 million project – most likely would have spent years in development and waiting for funding if not for the P3 agreement. The contract brought funding to the table, delivered the project in two years and relieved SR-91 congestion almost immediately.

The problem was in operating the facility. A non-compete provision in the franchise agreement – required by the bond community before funding the project – prohibited Caltrans from making any improvements to the SR-91 corridor until 2030 unless CPTC was made whole from resulting decreased revenues on the Express Lanes. Frustrated by the restriction – which was creating mobility issues – the OCTA bought the facility in 2003.

If anything, the 91 Express Lanes taught us to draft a more balanced franchise agreement, allowing for necessary improvements to the corridor and adjacent general-purpose lanes while also protecting the private partner's investment.

As seen on screen

Louise Smyth goes behind-the-screens to get the inside story on Cape Town's new Transport Management Centre

Images courtesy of eyevis

South African ITS stories have been dominating the trade press recently. Whether it's the Gauteng ORT system or various BRT schemes, the region is rarely out of the news. For the past few months, the focus has obviously been on traffic and transit management during the 2010 FIFA World Cup. Following

Cape Town's TMC is home to an array of operations that all need to be visualized

a few well documented initial hiccups, South Africa coped admirably with the extra traffic generated by such a huge event.

Cape Town was a World Cup host city, and as such, was a transport hub for many visiting soccer fans. Given that its new TMC opened just a few weeks before the tournament kicked off, it did an amazing job of keeping people moving during such a hectic period.

The TMC itself is a fine showcase for the merits of integration. Built for the City of Cape Town, the TMC houses Cape Town's freeway management system, which is a combined initiative between SANRAL (the South African National Roads Agency Limited), the city and the provincial government. "I think it's a very good example of three authorities working together for the benefit of the public. In my view, it's unique. The control rooms I've seen during my work tend to be segregated – you see policing in one building, signals in another, and so on. They may be linked in terms

of technology but the people aren't sitting together and collaborating as an integrated unit," says Christoff Krogscheepers from ITS Engineers, the consultancy behind many of the ITS parts of the TMC project.

The TMC is certainly unique to South Africa: it's the first ever integrated public transport, traffic, and safety and security management center.

ITS Engineers is part of the ASTII consortium, which was appointed by the city and tasked with designing and overseeing construction of the TMC. Krogscheepers and his team were also heavily involved in the rollout of the freeway management system. "This entailed the installation of around 190 cameras and 48 VMS on freeways," he explains.

When you consider that the freeway management is just one part of the TMC's day-to-day operations, the scale of all the data being fed in and out of the building becomes evident. For such an ambitious project spanning so many systems, effective visualization of that data is crucial.

Displaying the data

When it came to choosing visualization equipment, Krogscheepers recalls that the city was initially considering back projection technology: "They'd seen it elsewhere and thought it would be quicker and more cost effective to install – there was a big push to finish it all before the World Cup, so time was an important factor. But ultimately, we decided on front projection and that was what we put the tender out for. One of the companies that responded offered some narrow bezel LCDs and they turned out to be the most cost-effective option both in terms of capital expenditure and maintenance."

The company in question was Basix, the South African agent for eyevis. For the initial deployment, 48 EYE-LCD-4600-SN-V2 were installed. These are super narrow LCDs, each with a 46" screen (diagonally) and WXGA resolution.

As well as the actual display modules, eyevis's NPX-3804R-DE-G2.3 graphics controller for visualizing video and data signals was also purchased, along with the company's wall management software.

In the past, LCDs have been criticised because the bezels that separate the screens are distracting – and on older systems this was a valid point. But eyevis has tackled this issue so that its latest products have just a 7.3mm gap between the screens.

As well as the fact that these LCDs offer good image quality with high brightness and contrast, there was another selling point for the TMC: the fact that they are cascadable, i.e. they can easily be combined to build up large screen walls. This meant

The progress of the wall: from installation of the display modules to live operation

that the Cape Town team could get exactly what they needed, when they needed it. The main priority initially was to rollout the freeway management and signal operations in time for the World Cup, but as Krogscheepers explains, there is more to come: "Only one half of the TMC is currently occupied. The other half is planned for the city's BRT system operations. We are going to expand the wall by another four-by-four module, which will be installed in the next year."

So how did the TMC cope with the challenges associated with the World Cup? To say it was busy would be an understatement. The building was used as the Joint Operations Center for all of the relevant City Services, such as traffic, security and incident management, but also transportation network operations, traffic

> **One of the companies that responded to the tender offered us narrow bezel LCDs: these turned out to be the most cost-effective choice both in terms of capital expenditure and maintenance**

signals, electricity and even emergency services. Krogscheepers is delighted with how the control room itself functioned: "It proved to be a great tool for the management of the World Cup and the display wall was instrumental to having eyes on the road. As well as traffic cameras, the wall was used to project CCTV cameras around the city. Staff could simply pull up visuals of whatever they needed to see. Being able to move things around on the wall and put any camera or map layout on it is very useful for the operations team.

"The wall allows us to chop and change things as needed to enable the best operations. An added bonus is that it looks great – everybody who walks into the room is very impressed by it!" ○

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Changing places

After hard-wired and networked visualization, a third stage in the evolution of large-scale control room visualization has emerged. Activu's **Paul Noble** reveals why a more intelligent approach should significantly increase utility value and operational effectiveness

Images courtesy of Activu Corporation

There have been a number of concurrent trends in large-scale control room visualization over the past decade feeding and to some degree impeding its evolution.

The inevitable evolution from an AV (circuit-switched) to an IT, network (packet-switched) architecture has been impeded by the skill set and comfort level of the AV industry that has traditionally been called upon to design and implement data/video display systems. This evolution has subsequently been more demand-pull, driven by end-users rather than vendors. More and more client decision-makers and influencers are IT-savvy and looking for the power and flexibility of a true networked visualization solution, often with vendor pushback.

This trend – which is not by any means limited to the control room visualization market – both presents opportunities and at the same time profoundly threatens the traditional AV industry. Transformation is proving extremely difficult.

IT competency typically requires significant formal education and the industry is extremely fast-paced. AV competency has typically been based more on experience and technology change has been much slower paced. This reality has significantly constrained the AV industry's adoption and implementation of IT/network solutions.

Integrating the different layers

Wall-sized data/video displays have been a very popular element in control room design for many years, performing many functions from a visual design element to marketing tool or media backdrop to mission-critical operational functionality.

This operational functionality has been enhanced by the increased power and flexibility of network-based systems and will become more so as the integration of the visual and interpretive system layers leads to what Activu would describe as 'intelligent visualization'. Once more of an architectural decision, large-scale visualization is increasingly driven by operational imperatives.

AV-based visualization is essentially location-based. Although source computers are typically networked, the visualization system

> " Once programmed, you have a fully automated visualization system that displays only mission-critical information where and when it is required, avoiding information overload and confusion

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⊙ | The potential power of 'Intelligent Visualization'

Two hypothetical scenarios illustrate the potential power of intelligent visualization. Imagine an incident occurs on a highway. The relevant IP cameras display geo-spatially on the road map instantly conveying to all viewers both 'what' and 'where' and this section of the SCADA or map, along with the camera views are instantly routed to the relevant EMS and police command posts. An incident timer appears showing lapsed time since the incident started. Multisite white boarding, voice and instant messaging are launched to simplify site-to-site and team-to-team communication. A weather map appears tracking an approaching storm. Camera views of the highways leading to the site appear, tracking the approaching emergency services. CNN appears, close-captioned, as news of the incident reaches the press.

Now imagine a terrorist, missile attack is launched. The relevant map sector is displayed along with geo-spatially located camera feeds of the target area. A satellite image visually tracks the missiles. Missile-tracking software displays missile path and telemetrics, a subset of this visual information is routed to the President's command center and to the Chief of Staff's SmartPhone... Both of these examples highlight the potential power of 'Intelligent Visualization'.

Control rooms are the nerve centers of operations: as such, they can benefit hugely from added intelligence

itself lacks any ability to connect to and share information beyond an individual location. An IT-based, networked visualization system integrates into the network ecosystem, allowing the fluid sharing of visual information between individuals, groups and sites across the client's network(s).

In a circuit-switched, AV-centric system, every source is hardwired, typically through a matrix AV switch to a videowall processor. Adding sources requires additional cabling and switch points. If you exceed by one input the capacity of the matrix switch, it will need to be replaced with a larger switch at significant cost.

In a packet-switched, network-centric system, adding a source simply requires a small 'agent' application to be loaded and its IP address to be logged in. Visual information can then be shared, without limit, not only between locations but between individuals – on desktops, notebooks and wireless devices.

Even with network-based systems, visualization is typically quite static, as content selection and location are still typically manually controlled and require some effort and or decision-making, even when the user interface is a simple, pre-programmed touchscreen. Once content has been carefully laid out, the tendency is to leave it. Of course, information within each source window will change but the locations of the content sources typically remains static.

One benefit of and justification for this is that being a common operating picture (COP), operators become familiar with the information layout and know intuitively where to find the information they need.

But what if information display was completely and automatically incident driven? What if only mission-critical information was displayed, changing as the incident evolved? What if critical information was automatically routed up the chain of command and out into the field according to pre-agreed upon protocols? This is the next stage in control room display – the advent of intelligent visualization – and it has huge potential.

Intelligent visualization

This only becomes possible when visualization is network-based and driven by powerful visualization software that is capable of integrating with – and in turn being driven by – monitoring and analytical software. Once programmed, you have a fully automated visualization system that displays only mission-critical information where and when it is required, avoiding information overload and confusion.

Making the transition

If you have or are planning to invest in a network-based visualization system, then evolving to an intelligent visualization system requires two steps. First, you integrate your monitoring/analytical software with the visualization software which should have an SDK (software development kit) to simplify the process. You subsequently program the visualization software to respond in the most effective automated fashion to an incident or alarm condition.

The cost is purely in the human resources required to carry out these two steps. The functionality should be inherent in visualization software to respond to monitoring and or analytical software. ○

• Paul Noble is the CEO of Activu, an information technology and services company delivering end-to-end network solutions for mission-critical command and control environments

Control on the floor

Dr Morteza Fahrtash from Caltrans District 12 reveals how an ATMS central software application is leading to more efficient TMC operations

Images courtesy of Caltrans

The Advanced Transportation Management System (ATMS) is the central software application used by several Caltrans districts within their Traffic Management Centers (TMC) to monitor traffic, control messages displayed to the public on Changeable Message Signs (CMS), and control and display TV camera video in real-time. Such ATMS traffic and CMS data and video is of interest not only to Caltrans but also to researchers, the media, and various traffic information providers, and demand for such data has been growing. Up until now, requests for this data have been satisfied by custom interfaces to the ATMS on a case-by-case basis, which has created non-uniform solutions. Each interface tends to be a unique implementation, which leads to an increasing maintenance burden on Caltrans to keep each interface updated and running,

Caltrans covers many districts that all require a constant flow of traffic data

as well as the burden of creating such an interface in the first place. Some also require expensive software licenses of the end-user and Caltrans.

Caltrans implemented a number of TMCs statewide. Depending on the needs of the region, the ATMS that runs in a secure subnet is not accessible to the public. As a result, each TMC has to provide secure outside interfaces. In an effort to eliminate these issues, a feasibility study and proof of concept (POC) project was undertaken by Caltrans District 12 and the University of California, Irvine Institute of Transportation Studies with Special Solutions LLC as the systems integrator.

Project goals

A number of project goals were defined. A standardized interface had to be provided that could be used by anyone desiring to access Caltrans traffic loop data without requiring any software licenses. A mechanism was also required that was able to aggregate data for all Caltrans districts to provide a single access point for statewide data. The interface additionally had to be independent of the computer architecture, operating system, and implementation programming language. Data, meanwhile, needed to be provided in a manner consistent with existing ITS and FHWA standards. The set of available data had to be expanded to also include scheduled events and incident data, while the data had to be provided in a secure manner that met state of California security requirements to prevent unauthorized access to Caltrans systems.

Transport and encoding schemes

For the transport and encoding schemes, eXtensible Markup Language (XML), Simple Object Access Protocol (SOAP), and HyperText Transport Protocol (HTTP) were preferred as they offered programming language and computer system neutrality.

A search for available SOAP/XML toolkits was performed to ensure that there was support for a wide variety of programming languages and computer systems and the open-source gSOAP toolkit was selected to conduct the POC implementation. gSOAP has the capability to take as input a top-level Service Description Language (WSDL) file and any referenced XML Schema Document (XSD) files and generate all the stub code to perform serialization and deserialization of the data as well as generate the code to perform the actual transport. Ultimately, this eliminates the need to hand-generate a very large amount of code and reduces the hand coding to only a number of items.

It should be noted that a client need not use gSOAP. Any toolkit or process that can generate a SOAP/XML client application from well formed WSDL may be used.

The next step was to establish the data encoding standard to be used. The existing ITS XML encoding standards were researched to ensure that ATMS data could be encoded according to those and the decision was made to use the Traffic Management Data Dictionary (TMDD) for sensor and CMS data and use the Message Set for Advanced Traveler Information System (ATIS) for event/incident data.

At this point, it was time to generate the WSDL files, which would define the message content to be built from the elements defined in the XSD files to be provided by the SOAP/XML services. Although WSDL and XSD files can be edited with any ASCII editor, hand-editing can be very error prone, so a search was made for a graphical editor with drag-and-drop capabilities to build top-level structures from the predefined elements of the XSD files. Again, a variety of editors were found and GlassFish was picked as it satisfied all the requirements and was available as open source for numerous platforms. GlassFish was then used to develop the two WSDL files defining the messages to be provided by the SOAP/XML services, one for traffic sensor and CMS data and one for event data, and all files were validated to be correctly formed XML.

As the gSOAP toolkit generates code stubs for all data defined in the XSD and not all the features defined in TMDD and ATIS are available within the ATMS, those unused items were removed from the XSD

(Right) **Traffic data is sent to various sources, such as CMS** (Below) **Travelers rely on real-time, accurate information from Caltrans**

> Each interface tends to be a unique implementation, which leads to an increasing maintenance burden on Caltrans to keep each interface updated

files to reduce the generated code size. While modern optimizing compilers would remove the dead code from the executables, the verboseness of the XSD files was deemed to be causing the compile times to become a nuisance.

Two sets of server executables to provide SOAP/XML services were developed – full dataset and abbreviated dataset. The reason for two applications is that the end-users can be generally classified into two groups. The full dataset users tend to be research-oriented organizations involved in detailed traffic studies requiring data down to the individual lane level. The abbreviated dataset users, on the other hand, tend to be media and reporting organizations that are only interested in the overall flow of freeway traffic.

As the abbreviated users outnumber the full users – and the full data is roughly six times larger than the abbreviated data – this also reduces the load on the Caltrans servers. The two SOAP/XML servers (sensor and CMS data and event data) were designed to run on different ports at the same address on the District server.

The SOAP/XML servers and a set of demonstration clients were developed on HP-UX, Sun Solaris, Linux, and Windows. The demonstration clients are simple, command-line clients that obtain the appropriate data then print it to standard output and browser based clients that display it in a web page.

A practical client will, of course, do something else with the data such as insert it into a database or display it on a web-based traffic map or report. Based on that success, a set of client/server applications were developed and tested using the existing WSDL and XSD files to provide two key functions. They had to provide a service to aggregate data from any Caltrans district that chooses to send data to the service and to provide the aggregated data to the public in a secure manner, and also provide the service for a district to send its data to the aggregating service.

At this point the project was deemed to be a success and all objectives met. Resources at Caltrans HQ were found to go to limited production status with a handful of outside entities building their own clients based on the Caltrans provided WSDL and XSD files. In the future – and when resources become available – it is planned that a dedicated statewide server can be deployed for full production status and that the districts that were not part of the original study can begin providing data to the central server. ○

Roads Scholar

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Best laid plans

Leading experts in the road weather community tell **Nick Bradley** why technology is the industry's best form of defense when conditions take a turn for the worst

Illustration courtesy of Magictorch

The English Highways Agency and numerous Local Authorities came in for a bit of a tongue-lashing at the start of 2010 when depleted salt stocks during a record-breaking cold snap contributed in part to not only chaos on the roads but a bill that ran to billions of UK pounds. "In Washington, we felt your pain," recalls Paul Pisano, team leader of the Road Weather Management Program within the FHWA's Office of Operations. "We have our own share of severe weather in the USA and while many states can cope with heavy snowfall, there are others, including DC, that can be crippled by an inch."

A powerful ally

Pisano, who's been with the FHWA since the early 1980s – initially as an undergraduate before moving full-time into traffic research in 1988 and then rural ITS – agrees that in the battle between Man and Mother Nature, the latter rarely loses out. With technology we have an ally though, which as a survey of advances in road weather management demonstrate has the potential to deliver some powerful tools in the future. From the initial collection of the data and subsequent meteorological modeling and

forecasting to the dissemination of that data and resultant utilization of it by road operations, what's clear is that information truly is power when it comes to road weather management.

Smart solutions have, in fact, been instrumental to the achievements of the RWMP over the past decade. Indeed, Pisano very easily reels off a list of intelligent initiatives to have delivered safety, cost and mobility enhancements, yet he is keen to praise the backing the program has received from day one. "None of this would have happened were it not for the foresight of the FHWA leadership to create the RWMP in the first place," he says. "It's given those of us within the team the opportunity, framework and funding to take it to where we are today.

"We're in a good position at the FHWA because we have that national perspective but we're also separate enough to look at the big picture," he continues. "At the same time, we can work with our colleagues at the front line to conduct the high-risk research and explore things they might not otherwise have the resources to do themselves."

Putting technology developments aside, Pisano feels one of the biggest achievements of the RWMP has been bringing the weather and transportation communities together – academics, national labs, and public and private sectors – to focus on road weather management. "The weather community now better understands the user community and what our requirements are and that they can help us solve our problems. There were some great solutions out there already that were in development, such as in the aviation sector. Road weather has benefited from this."

Such a close-knit relationship could become even more important in the years to come if, as experts predict, climate change takes a grip. "There's a big focus on that in our Office of Environment and Planning – not so much in the RWMP," Pisano says. "They're

> ## The weather community now better understands the user community and what our requirements are and that they can help us solve our problems

Paul Pisano, Road Weather Management Program, FHWA, USA

looking at the anticipated impacts of climate change on the transportation system, including aspects such as operations." The challenge, he suspects, is understanding what those changes are going to be, particularly when so much uncertainty exists about the models. "You might have more rain events in the south than snow, but in places where you typically have snow you might end up with more freezing rain or icing events. So in parts of the country that

The road that won't need plowing?

Christiana Chang lives where temperatures rarely dip low enough to produce snow let alone ice. Yet in a lab at the University of Houston (UH), she is in the midst of perfecting something that just may garner a smile from those in regions where wintry weather wreaks havoc on commutes. "We have been able to raise the surface temperature of concrete enough to get ice to melt," she says. Her results – showing a rise from 14°F to near 32°F – were recently published in the *Journal of Smart Materials and Structures*, which details her efforts to embed conductive carbon nanofiber paper in concrete to achieve de-icing.

"All we do is apply electricity on either side of the paper," she continues. "As we are passing current through something that is resistive, it is going to convert that to heat energy."

Designed to mimic the depth of real roads, the paper rests 3in below the surface of a 4 x 10in slab of concrete. Another inch stands between it and the ground below. In tests where she applied just 6W of power to the paper in the model, the temperature on the surface of the concrete slab rose nearly 20°F in two hours.

Chang will soon take testing from the small-scale model in a modified freezer in the lab to a road-sized footprint on a stretch of real roadway in Alaska, before which she hopes to make some tweaks to the technology. For starters, she wants to ensure the paper inside the concrete can last the life of the road. So she is exploring ways to coat the paper with a polymer that may help it stay durable despite the constant strains of road traffic.

She is hopeful to keep its cost competitive or at least better than what's out there already. Yet, with the cost of carbon nanofiber paper at US$100 for an 11 x 11in sheet, it might take a while. Chang is not deterred though. "The performance is there," she says. "When we heat it and just measure the paper temperature, it gets close to 120°C (248°F).

"Last year, the 11 x 11in sheet was US$500, but now, just in the one year, the technology has improved pretty quickly to where they are about a US$100 a sheet."

Not only do carbon nanofibers resist corrosion better than their metal counterparts, they also greatly increase electrical conductivity. This can be achieved using much lower voltage during the heating process, which is safer and cheaper to use. "It is for these reasons we feel it holds promise for use on much larger scales in some of the country's coldest climates," Chang concludes.

Christiana Chang holds a sheet of carbon nanofiber paper that she is embedding in concrete in an effort to create self-heating roads

Reliance on science

Morton Satin from the Salt Institute finds himself defending the salt industry on a regular basis, particularly from environmentalists who feel the use of chlorides in winter maintenance is destroying the biota. But, he tells **Nick Bradley**, with science on his side his case is strong

Some people argue the use of sodium chloride, or salt, in winter road operations is having a devastating effect on the biota, adversely impacting roadside vegetation, wildlife, and water quality. But when it comes to ensuring safety on our roads, the alternatives are limited and costly. "In all areas of salt – from food and water-softening to road salt – controversy is abound," agrees Morton Satin, vice president, Science and Research, at the Salt Institute in Virginia, USA. "Using salt involves trade-offs," he admits. "Protecting the environment is a long-term goal of our industry and one of the many things we do here at the Salt Institute is support a lot of research into the elucidation of chloride toxicity. But there is a big difference between evidence and bullshit – and that's what we're trying to make people realize. We want to save the environment just like everybody else, but we just want the science to be right."

Satin, a trained molecular biologist, says he is generally dumbfounded by what he labels as the "general insensitivity" of toxicological evaluations to the environment they were supposed to protect. Standard toxicological examinations do not account for the water chemistry, nor do they account for the specific organisms found in the bodies of water in question. "These laboratory environments bear no semblance to the real world. In the case of road salts, it's entirely seasonal: you put them down in the winter so the run-off is in late winter or early spring, which also happens to be the time when the organisms in the biota are at their low point in their growth cycle. Based on the research I have studied, such organisms might be less vulnerable at this stage. How does that relate to standard laboratory conditions – 70°F all year round, the same light, standard organisms, etc? What we do here is bring real science to the table, not ideology."

It obviously vexes Satin that research based on potentially misleading 'science'

gives the salt industry a bad name. "We're an industry that's pretty much seen as stealing candy from kids," he says. "Science is the only defense we have. If the science shows we have a problem, we have to wake up to the problem."

One of the Salt Institute's biggest responsibilities is promoting best practices, much of which is formed from its research in the scientific arena. "Once we have the science, we do whatever we can to promulgate it, train people, and make sure that operators are following the science. We actively encourage the government to go after those operators that aren't following best practice. We don't want these 'bums' in our industry; the guy who pulls up to a stop sign and

> ❝ As an industry, we're pretty much seen as stealing candy from kids; we like to bring science to the table, not ideology

Morton Satin, vice president, Science and Research, Salt Institute, USA

leaves his spinner on, dumping 30 lb of salt at the intersection in the process."

Best practices in Satin's world encompass not only the careful management of stormwater run-off to minimize any effect on the environment, but also proper salt management and storage (near the scene of the action, for instance), and attention to road weather information systems. "A long time ago, we established a program called Sensible Salting, which is basically about using the right amount of salt, at the right time, and in the right places," he says. "There have been a number of technology advances over the years, such as the use of RWIS, GPS, and GIS, to help the industry improve best practices – it's all very sophisticated now."

Snowfighting costs for an entire season are less than economic losses from a single day of icy paralysis

Anti-icing is the big trend, Satin notes, yet it's still not universally employed in the USA. "It's a much more efficient use of the resource, and efficiency as we know is a huge factor in winter road operations." Maine DOT has been anti-icing its roads for more than a decade and has seen a decline in fatalities and serious crashes – a trend that hasn't been replicated on the roads the DOT doesn't maintain within the eastern state. Its anti-icing program involves spreading a calcium chloride brine solution on roads in anticipation of hazardous weather. In Denver, Colorado, anti-icing strategies studied on the interstate system over a 12-year period saw an average of 14% decrease in snow- and ice-related crashes, despite a more than 23% increase in traffic volume. Idaho Transportation Department is another anti-icing proponent, having used liquid magnesium chloride on some state highways for a decade or so. The chemical ensures a bond doesn't form between the snow and the road, in doing so allowing snowplows to clear the road much faster following a storm. According to the FHWA's Road Weather Management Program team leader, Paul Pisano, this has reduced winter maintenance labor hours by 62%, decreased abrasives usage by 83%, and resulted in an 83% decline in winter crash frequency – figures that cannot be argued with.

Ultimately, Satin predicts that areas such as application methods, monitoring and forecasting are where the real advances in winter road operations will come in the future. Unsurprisingly, he maintains that salt in its various guises will have a prominent role to play, regardless of the emergence of alternatives such as molasses. "The reason that I think salt will be around for a long time is that we're getting more and more roads in increasingly inhospitable areas, and salt is the cheapest material around," he concludes. "It's inexhaustible as a resource and unfortunately (or fortunately depending on your view) our political decisions are largely based on cost. It's not any more sophisticated than that."

might have relatively straightforward snow plans, they may one day have to face up to some difficult icing conditions."

Ultimately, the FHWA's top weatherman feels it's all a bit too far in the future from a road maintenance perspective. "People need to be aware of it and thinking about it, but in terms of doing anything right now, it's still too soon to know exactly what we have to do. Until we know more about what the potential impacts could be, it's difficult to make any serious investment decisions."

Will complacency be the killer?

Certainly the past two winters in the UK do little to support the existence of a warming planet. Regardless, climate change experts predict temperatures will rise by 5°C to 6°C by 2080. That's possibly not the worst news for the UK's Department for Transport, which spends £482 million on maintaining its primary road network in winter and a further £1 billion on local roads. So, could a warming climate send the humble gritter to the scrapheap? Dr Lee Chapman from the University of Birmingham's School of Geography, Earth and Environmental Sciences, thinks not.

A piece of his recent research sought to establish the impact of global warming on

It has been estimated that 23% of the non-recurrent delay on highways across the USA is due to snow, ice, and fog

traffic fatalities and subsequently the implications for winter road operations. He focused on the West Midlands and employed UK Climate Impacts Programme scenarios and a temporal analog to peer into the future. "My big concern when it comes to winter maintenance – especially when budgets are being slashed – is that it's an easy target, that climate change could be used as an excuse to make cuts," he says.

His scientific approach allowed him to quantify the changes in the severity of the winter season over the next century. Using what's known as the EARWIG weather generator, he and his colleague, Anna Andersson from the University of Gothenburg, calculated the percentage of days per month with air temperatures equal to or below two thresholds of 0°C and 5°C.

A friend at the side of the road

High Sierra Electronics installed pavement sensors at strategic locations on intersections in Denver

A report published recently by the FHWA supports the notion that weather forecasting saves lives, time, and money. The Administration's research revealed that between 1995 and 2008, an average of 7,130 people were killed and over 629,258 injured in weather-related crashes every year. For transportation and public works managers, keeping up with changes in the weather is critical for maintaining an efficient and safe roadway system.

But there is a difference between weather information and road weather information. RWIS is the means by which adverse localized weather data is obtained. Whether an agency needs to initiate alarms, mobilize emergency personnel or activate weather-related closures, RWIS stations provide vital information on current conditions.

They are strategically placed alongside the road for monitoring conditions such as wet or icy pavement, surface temperature, fog, and high wind. This real-time data gives key personnel the opportunity to respond and to make optimal use of materials and staff – i.e. utilizing deicing chemicals, activating DMS, initiating road closures, and sending bulletins via radio, TV and the internet.

In 2007, following one of the most extreme winters on record, the city and county of Denver, Colorado installed four High Sierra Electronics pavement sensors at strategic intersections around the city. This installation combined with other environmental sensor stations throughout the metro area helped reduce snow- and ice-related crashes by 14%. "We use these sensors to measure surface and subsurface temperatures, surface moisture phase, and deicer concentration," says Pat Kennedy, senior engineer with the City of Denver Public Works Street Maintenance Division. "It has performed well. We use the data in our emergency snow response...and it's improved safety for the public."

High Sierra Electronics has been supplying weather systems, data management, and maintenance services since 1992, but started in flood warning and environmental monitoring and in 2000 expanded into road weather. As of today, it has deployed more than 300 road weather environmental sensor stations.

"Our key finding was that a warming climate *won't* actually lead to a reduction in the number of accidents due to frost and ice – the reason being that most accidents occur between 2°C and 5°C. The air temperature might be above freezing, but the road surface itself might just be hitting zero, which is when ice is most hazardous."

His investigations further revealed that the number of nights when the temperature will be between 2°C and 5°C wouldn't change at all over the coming century, regardless of climate change. Thus, the number of accidents won't reduce so some level of winter service will still need to be maintained for many decades to come.

Having invented and patented the concept of route-based forecasting as part of his PhD almost a decade ago, Chapman is very highly regarded in the road weather community. "That was all a long time ago for me," he responds. "As academics, we're paid to think outside of the box and see what's coming 10 years down the line. Route-based forecasting is all the buzz at conferences today and is the big trend as far as the UK is concerned. Slowly but surely, every single Local Authority is switching from site-specific to networ forecasting. But I've already moved on to the next part of the challenge – looking at how we can control and optimize salt usage."

Residual salt is in Chapman's opinion the big missing piece in the jigsaw. "You need to know how much salt is already on the road

Chapman's route-based forecasting development involved the development of GIS models which utilized new survey techniques based upon GPS measurements and digital image processing
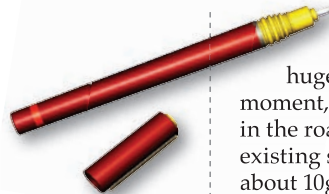
because you don't want to be chucking salt on top of salt. This is one I'm chasing at the moment. There are huge maintenance savings to be made in residual salt. At the moment, you can only calculate this with contact sensors embedded in the road, but the ultimate is an onboard probe that analyzes the existing salt coverage on the road. You would normally put down about 10g per square meter, but if you knew there was already 5g per square meter on the road, you could compensate for that."

Decision-support tools

Chapman certainly has his finger on the barometer and is watching developments with the FHWA's MDSS in the USA closely (see sidebar, *Supporting act*), although he reveals it's yet to catch on in the UK. "I see Vaisala has bought into it in a big way, so they'll be pushing it. MDSS provides you with some ideal arrangements about how the roads should be treated based on forecast conditions. Obviously you need some kind of model into which you can feed that data and that's where I feel route-based forecasting could step in." A huge advance, he suggests, would be embedding a network forecast into MDSS so you can control how much salt you put down on specific road sections. If a certain stretch is forecast to be below freezing, GPS data fed into the gritter would allow you to apply exactly the right amount of de-icing at precisely the right location. "You'd save a hell of a lot of money by doing that," he says.

A big problem that Chapman foresees, though, is that highway engineers would need to have sufficient confidence in a forecast model that informs, say, every 50m what the exact road conditions are, particularly as verifying those conditions in such small increments is challenging to say the least. Maybe this is where his brainwave about a residual salt probe could play a part? "At the moment, this can only be achieved at spot locations, but a technology that continually scanned the salt content on the road could really be a game-changer."

Protecting the cold spots

The German state of Schleswig-Holstein is an interesting case for RWIS, with complex microclimates contributing to a challenging road weather management environment

Few drivers could have failed to notice the tall, conspicuous-looking masts at the roadside, equipped with miniature wind turbines, small hats and a gray box within which wires quite literally come together. But who among these drivers knows the precise role and function of these so-called road weather monitoring stations?

They're positioned strategically behind the safety barriers on our express highways, main roads and country routes. They continuously collect current data on air temperature and humidity, wind direction and wind speed, visibility and precipitation. What's invisible to drivers, though, is the road sensor, embedded in the road itself. This measures the ground temperature on the road surface and at depth the humidity and the water film on the road, as well as the salt content during the winter period. By collecting and analyzing all of this data, specific and accurate forecasts of road conditions can be provided. As soon as the first critical sub-zero temperatures and snowfalls are detected, road maintenance managers know exactly when and where they need to take precautions to ensure road safety.

In the many microclimates of the German state of Schleswig-Holstein – between the North and Baltic Seas – it is particularly difficult to identify dangerous situations in good time. Although the state has five main climate zones, there are also many 'cold spots', such as bridges, that have characteristics all of their own. Winter maintenance managers are required to act preventively but not unnecessarily. Precise measurement data is essential for optimal decision-making. A further complication is that many critical road conditions arise due to the combined effect of condensation (saturated humidity) and freezing temperature. Air stratification means that whereas the driver may observe a displayed temperature of 2°C at a height of 1m, the temperature on the ground has

> ❝ Winter maintenance managers are required to act preventively but not unnecessarily. Precise measurement data is essential for optimal decision-making

already reached or fallen below freezing. Even small water films that arise without precipitation – which only occur due to strong temperature fluctuations between day and night – give rise to frost. At low temperatures, air holds less moisture than at higher temperatures, which leads to air saturation and the formation of dew. So-called hoar frost occurs when saturated air is below freezing.

Just how treacherous winters can be was known in Schleswig-Holstein long before 'Ice Daisy' – the notorious low-pressure system. Snow, freezing rain, frost, black ice and fog make road conditions unpredictable every winter, especially in this coastal region. But not with RWIS. Staff at the operating headquarters of the State Company for Road Construction and Transport of Schleswig-Holstein in Neumünster can now coordinate winter maintenance services for the entire state in a highly targeted manner. In doing so, Schleswig-Holstein relies on technology from Lufft of Fellbach, near Stuttgart. On

behalf of the state, 63 new RWIS made by the Swabian measurement engineers have been installed in Schleswig-Holstein since 2007, mostly on major highways in the north-south direction, but also on main roads along the state's east-west route.

These systems send their results to Neumünster at two-minute intervals, from which the data is downloaded to a computer via cable and radio. The computer not only calculates the current condition but also produces a forecast for the next one to two hours. As a result, maintenance services are working ever more effectively.

The employees responsible for the state's operations were the main architects and incorporated their entire experience and requirements into the monitoring network, based on more than 20 years of experience in dealing with RWIS technology. The result is one of the most modern and user-friendly monitoring networks for road weather that is currently achievable. Permanent manning at the headquarters

guarantees around-the-clock service to all decentralized road maintenance depots in the region. Not only is the measurement data available almost in real-time, but up-to-date short-term forecasts by the German Weather Service are also continuously processed and sent to the operational units.

Drivers are often unaware of just how much advanced technology has been installed in and on the state's roads. However, RWIS expert systems today employ the internet to provide extra benefits for drivers. Some of the measurement data, such as air temperature, road temperature, precipitation and wind conditions, is available on the public website.

Drivers also notice these developments indirectly, notably that driving on Schleswig-Holstein roads is safer than it ever has been, with far fewer accidents and as a result much less congestion. The economic record speaks for itself. There is a pay-off in reduced operating and procurement costs – a clearly positive economic effect. This also proves that not only is modern measurement technology an important component of road safety, it also helps to relieve municipal budgets. Whether or not we'll witness a new 'Daisy' this coming winter, though, the system is unfortunately not yet able to predict!

As a result of the collected data, targeted gritting takes place at the right time. In doing so, gritting operations are more efficient and regular inspection trips can be eliminated

The green card

The environment was a central theme to Lina Nordin's PhD study. Working within the Department of Earth Sciences at the University of Gothenburg, her quest was to prove a hypotheses that winter road maintenance operations were not being conducted in accordance to the data being relayed by the RWIS. "Our feeling was that the maintenance crews were being a bit too cautious and using more salt than was required. Essentially energy was being wasted by sending trucks out when it wasn't necessary," she says. "We compared maintenance personnel log books with the RWIS data and discovered around 20% of runs were taking place unnecessarily."

Her study focused on Trollhättan in the midwest of Sweden, where there are 768km of roads that might potentially require treatment, serviced by a fleet of 15 diesel-powered gritting trucks. Although they're not all in operation simultaneously, five or six vehicles will go out in teams to grit the five main routes in the area. Nordin's study was funded in part by the Swedish Transport Administration (STA), which clearly sees the potential in such energy-savings countrywide. "The main thing is that you need to have a good RWIS and I

> ## There are huge winter road maintenance savings to be made in residual salt… This is the one I'm chasing at the moment

Dr Lee Chapman, University of Birmingham, UK

guess that was one of my main findings; the maintenance operators don't really have too much faith in the data. But when you're sitting there analyzing the data, you're not just looking at whether to send trucks out or not; potentially it's making life or death decisions, balanced with the need to save money as well. It's a hard decision, so it's understandable that they might have erred on the side of caution in the past.

"We have a lot of energy and emissions goals in Sweden," she continues. "The STA really wants to do this for the environment. But while saving the environment we can save money, too, which is a huge factor." So what kind of energy savings are we talking about here? "A quick calculation from our analysis in Trollhättan showed they might be able to reduce maintenance activities by around 30 runs, which equates to a reduction of 12,750 driven kilometers or 120,000MJ of energy every winter." Extrapolate that to the whole of Sweden –

Supporting act

Over the past decade, the National Center for Atmospheric Research (NCAR) has led a multi-institution effort to develop the Federal Maintenance and Decision Support System (MDSS) Prototype. The MDSS ingests weather forecast data at locations important to a user's operations and predicts the road surface and subsurface temperatures and the snow depth at each forecast lead time. These forecast road conditions are used to generate treatment plans at each site based on rules of practice guidelines.

Release 6 of the MDSS has been refined to include new datasets (e.g. Automated Vehicle Location or AVL information, truck camera images, and webcam images from fixed locations) to help to provide additional tactical information on weather events. The observation processing subsystem has also been enhanced to allow easier spin-up of forecast sites by using weather forecast elements as

Internationally, plans are under way to port the MDSS to Spain and test its functionality in new topographic conditions
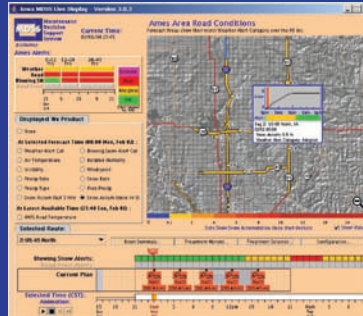
surrogates for missing RWIS data. This allows new (and intermittently observing) sites to work more seamlessly within the requirements of the new METRo road temperature model. An event-playback capability has also been added to view previous weather forecasts and treatment recommendations. This capability requires that previous data be maintained on the MDSS server for an extended period of time.

Looking to expand the functionality of the MDSS beyond the winter season, NCAR has examined to what extent the addition of data from the Clarus System can improve road and atmospheric condition forecasts under different weather conditions. Early results suggest that the addition of Clarus data into the MDSS framework, in particular METRo, leads to a significant reduction in forecast error for road and atmospheric temperature. The effect of the Clarus data is most noticeable in the 0–6-hour timeframe, with superior results in winter. The latter is believed to be related more to the model than the observational data. Working with Mixon Hill, Inc and several state DOTs, data from MDSS is also being used to enhance decisions for summer maintenance, such as spraying, weeding, and striping. This work is funded by the FHWA as well.

The MDSS remains freely available to any interested parties.

The cold weather in the UK in February 2010 was predicted to cost the economy £690 million a day and up to £14.5 billion in lost business

and potentially Scandinavia – and it's easy to see why the STA is keen for Nordin to continue her research in the area.

The value of weather information
Nordin's findings highlight further the value of information in road weather management and consequently the need for continued research into new techniques and technologies. But weather information also has a financial value, which Dr Pekka Leviäkangas predicts may alter the dynamic of weather services in the future.

Leviäkangas is the chief research scientist at VTT in Finland and recently delved into the driving principles of values being placed on weather information by the entities responsible for road weather management. "There are two types of managers with slightly different motivations," he says. "Road authorities want to ensure mobility while maintenance managers want to optimize their efforts at the same time as ensuring mobility."

He predicts there will be a shift from public road weather information systems and services to private or semi-private systems and services. "There is still a trend toward the unbundling of public services and having private or semi-private entrepreneurs delivering those functions," he says. "The value of information will become increasingly 'cash-based'. It used to only be for safety, but it's becoming a business tool. He warns that unless care is taken, the value of weather information in terms of the public good could be surpassed by business values. "We should make sure both aspects are balanced. Information for the public good, i.e. to enhance safety and mobility, is easy to share. But business information isn't because in a business environment, it provides a competitive edge."

Pulp Friction
The likes of Chapman, Nordin and Leviäkangas are all well aware of ROADIDEA – a three-year, EC-funded project that kicked off in 2007. The goal was to develop new and intelligent services and techniques for the transport and traffic sector, including solutions

"When you're sitting there analyzing the data, you're not just looking at whether to send trucks out or not; potentially it's making life or death decisions

Lina Nordin, University of Gothenburg, Sweden

for road weather management. Two ROADIDEA seminars were staged and during the second a handful of ideas were pinpointed as worthy of further development.

One of these was a new friction model and slipperiness-warning system, the aptly titled 'Pulp Friction'. Marjo Hippi, a duty forecaster from the Finnish Meteorological Institute in Helsinki says: "Our idea with Pulp Friction was to forecast friction values, i.e.

> ## "With this new model, road maintenance personnel can be better prepared for the upcoming poor friction using forecasted data
>
> **Marjo Hippi, Finnish Meteorological Institute, Finland**

slipperiness. There are currently around 110 Vaisala DSC111 sensors in use in Finland, which optically measure the thickness of water/ice/snow and estimate prevailing friction. We studied these observations and tried to find a correlation between the observed friction and other road weather parameters – such as temperatures at 0m and 2m, humidity, precipitation, as well as water/ice/snow thickness. Our friction model is purely a statistical model based mainly on these DSC111 observations."

Friction is not an easy phenomenon to observe nor forecast, although Hippi is encouraged by the results achieved so far. "We established that friction is a function of the thickness of water/snow/ice as well as a small temperature dependency in the cases of snow and ice on the surface, so the input parameters of our model will soon include thickness of water/ice/snow as well as road surface temperature. We also have our own weather model in use and the required parameters are calculated there also. So all we did was add our developed friction formulas into our road weather management and now we have a new output – the value of friction. We are not entirely satisfied with the accuracy of the forecasts yet, but we know what the problem areas are and we're working on them. After a year or so, maybe we will have a better model in use."

The Finnish Road Administration sets limits for friction thresholds in its winter maintenance operations, so once those limits are reached and the road is deemed too hazardous, winter operations can commence. "With this new model, road maintenance personnel will be better prepared for the upcoming poor friction using our forecasted friction data," Hippi says. "They'll be able to better schedule when to start and where to put the salt down."

Intelligence-led management

"Road weather forecasting and pavement temperature modeling has improved a lot," acknowledges FHWA's Paul Pisano. "I like to see what's happening in the national labs and weather communities. We all have a need for better modeling, particularly at the high-resolution boundary layer, your surface modeling, and this is where IntelliDrive comes into play. To do high-resolution modeling you need high-resolution data, which you can't really obtain with fixed sensors. I feel more observations are needed from across the network, which is where IntelliDrive really has lots of potential.

"There are so many opportunities in terms of IntelliDrive but it's not all related to safety," Pisano says of the USDOT initiative. Yes, it could potentially see cars communicating advance weather warning data to vehicles further upstream – a patch of ice or flooded roadway, for instance – but Pisano's excitement revolves around the weather data that could be extrapolated and subsequently fed that into the models so that much more information could be made available to traffic managers, shippers, and basically anyone else using that particular route. He concludes, "It's all about better information and as a result better management." O
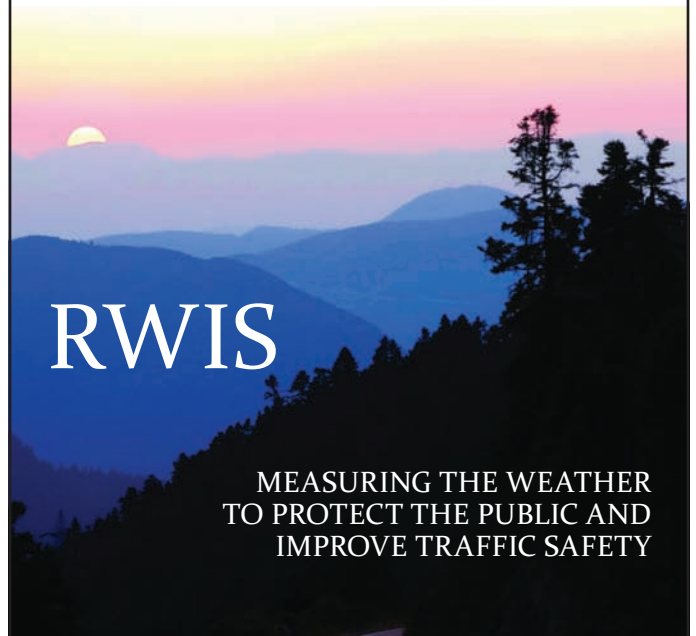
◉ | "I don't give up – I've only been working on it for 40 years now!"

Bern Grush asks: What has to happen to bring back the move toward congestion pricing in Manhattan – and what has to happen to make it succeed this time?
"Wasn't it Einstein who said the definition of insanity is doing the same thing over and over again and expecting different results? It can't be viewed as a tax, and that's one of the reasons it's always failed. It hasn't offered enough to the boroughs and to the politicians in those boroughs.

At the moment we have a very dysfunctional pricing scheme – I've written about this and pressed the case to politicians and ultimately I'm hoping there will be broader support. If it's viewed as a money-making machine for the Transit Authority, it will not pass. In New York, we've artificially raised tolls in the outer boroughs to support transit; the tolls don't fund the bridges.

You can introduce congestion pricing in Manhattan, but at the same time you must reduce or eliminate tolls that have nothing to do with congestion pricing. We currently have a toll to drive within a borough – from the Borough of Queens to the Borough of Queens across the Cross Bay Boulevard Bridge – but we don't charge to go from Queens to Midtown Manhattan across the Queensboro Bridge. I suggest flipping many of the tolls that we have in the wrong place. What that does is firstly show people we're not all about taxing; it demonstrates fairness. Secondly, all those tolls in the wrong places are in the outer boroughs and almost the identical areas where congestion pricing has received least suppport. I've already spoken to some elected officials in the outlying areas, and I am making the rounds personally, pro bono, because I really believe in this.

I applaud Mike Bloomberg for going ahead with his PlanNYC, but I would have approached it in a different way. I'd be interested to see congestion pricing in New York go to a referendum instead of letting these elected officials make the call. Public support is split, but I think we could get the 51%."

New York giant

Sam Schwartz has been ahead of the traffic management curve seemingly since he entered the field. **Nick Bradley** speaks with him about his glittering 40-year career – and where transportation goes from here

Portrait photography courtesy of Sam Schwartz Engineering

The notion that you can be born into a certain field – like Elvis was born to entertain, Pele to wow in soccer, Hendrix to play guitar – is one you either believe or you don't. If true, in Sam Schwartz's case, he was born to solve congestion. "I always enjoyed math and science and got my degree in physics," he says, speaking from his New York office. "But my older brother, a physicist, cautioned me against it as a career. I remember him saying to me, 'What do you like?', so I replied 'I like cities'. 'Science, math and cities equals transportation", was his assessment." It was the best piece of advice – not just for Schwartz but for New York's traveling public as well.

Concrete jungle
While getting his physics decree and after his masters in civil engineering at the University of Pennsylvania, he spent a few years driving an infamous yellow New York cab ("I can tell people that cab drivers have calmed down a lot since my day!") before joining the New York City Traffic Department in March 1971. "Those early years were very exciting," he recalls. "At the time, Mayor John Lindsay proposed his Clean Air Plan,

which included putting tolls on the East River and Harlem Bridges, so I was working on congestion pricing almost 40 years ago! We looked into a car ban for Midtown Manhattan; we closed off Madison Avenue completely for Earth Day; and even investigated closing Times Square permanently to cars. Many of the ideas that germinated in the Lindsay years are coming to fruition today, so the gestation period has only been about four decades!"

Schwartz held a number of positions in various divisions within the Traffic Department before becoming assistant commissioner in 1978, notably working on the 'Transit Strike Plan' of 1980. "I was the chief architect of it," he reveals. "We faced 11 days without subways, buses and trains, and it was on my shoulders to essentially keep things moving in New York City. That was the year I released the word 'gridlock' into the lexicon, which described the grid system of Manhattan 'locking up'." More on this later…

In 1982, Schwartz, the son of Polish immigrants, was promoted to the role of traffic commissioner, which allowed him to leave his own imprint on New York transportation and make some bold decisions about the

"The most fun you can have as a traffic engineer is modifying arterials"

Phil Tarnoff asks: The majority of state DOTs emphasize the operation of their freeway systems, and generally place the operation of arterial state routes on the 'backburner'. How can this emphasis be shifted to a more balanced approach?

"The most fun you can have as a traffic engineer is modifying arterials. You can do a whole lot of other things with traffic signals and personnel out there, such as introducing progressions, reverse progressions, setting of signals. You can treat areas linearly or you can treat them as quadrants and make all sorts of modifications. It becomes a chess game and it's very attractive as a traffic engineer to try to wrestle with intricate problems. I found these tools to be a great deal of enjoyment in solving those kinds of traffic conundrums. ITS spends very little time on that.

We sit and we watch monitors and report incidents more quickly, but we don't realize arterials may be carrying an equal amount or even more traffic. We now have more data than we could have ever possibly imagined – it's more real-time and it's more accurate. But we're doing virtually nothing with it on our arterials."

"There's a real timidity among transportation officials to tell you what they feel are the better routes"

Bernie Wagenblast asks: In a city as congested as New York, can ITS really make a difference in moving people more efficiently, or are they more of a convenience?

"I think they can be helpful in a metropolitan area if they gave you choices. If they just tell you that it's congested and you don't know what to do – if you're not Gridlock Sam and know all the short cuts – what are you going to do? If they gave you highway choices – if it tells you that Grand Central Parkway is moving better than the Long Island Expressway – then you do have choices. It's the same thing with the river crossings. You can almost have the rundown when you're coming into Brooklyn and it tells you Manhattan Bridge is jammed, the Brooklyn Bridge is moderate and the Battery Tunnel is literally free-flowing. You could achieve the same thing with advice such as the time to Times Square by each of the facilities. But there's such a fearfulness among officials to do that; they're doing a bit of it now in Nassau and Suffolk County where they're beginning to display information such as 'four minutes by the Long Island Expressway', 'seven minutes by the Grand Central Parkway'. We have to see more of that – we have to be bolder. But I feel there's been a real timidity on the part of transportation officials to tell you what they feel are better routes. If you viewed yourself as a manager of a traffic system – as I did when I was Commissioner – then you do have the opportunity to use ITS in that way. But if you're merely going to be passive, I don't think you'll be as effective as you could be."
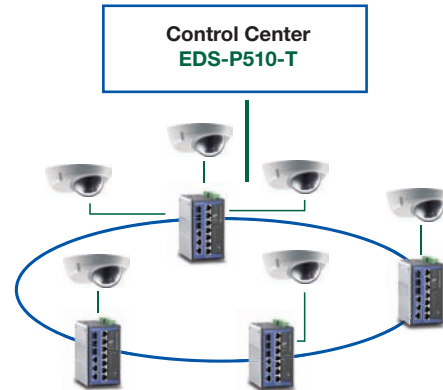
city's infrastructure development. "We had around 3,000 uniformed traffic officers back then, which made it a lot easier to implement various projects. We introduced a number of bus lane projects, the city's first bicycle lanes, and we even tried to ban driver-only cars from using the free bridges and make them pay at peak hours." That was until Schwartz and the Traffic Department were sued by the Automobile Club of New York. "We lost," he says.

"In January 1986, virtually all of my colleagues were fired and many of them arrested as part of a scandal that hit what by that time had become the Department of Transportation." Schwartz was effectively the last man standing and elevated to become the DOT's chief engineer and first deputy commissioner. In 1987, alongside the then commissioner, Ross Sandler, Schwartz once again tried to introduce congestion pricing, but ended up with thousands of people demonstrating on the steps of City Hall. "People took out full-page advertisements against us, labeling our ideas as 'draconian'. Ultimately we had to back down. I can still recall William Vickery – widely regarded as the father of congestion pricing – coming to the meetings. Little did I know that he would one day be a Nobel Prize winner!"

Gridlock Sam
When David Dinkins was elected New York's mayor in 1990, Schwartz was not reappointed. And with that decision ended

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⟲ "We're all looking for skilled people..."

Phil Tarnoff asks: The industry is facing a shortage of skilled traffic engineers, particularly those with training in operations. How can we encourage more universities to adjust their programs to address the increased need for operations education?
"I think we need to make the connection that there are jobs out there, although I think maybe we haven't been communicating that enough. Academia is literally in the clouds and they like the sexy subjects – and traffic is not terribly sexy – so a lot of the people are going into other fields. Even the University of Pennsylvania, where I went, is not emphasizing transportation and they turned out so many transportation professionals.

I'm concerned that people aren't seeing this as a field. A lot of students want to go into fields where they will find jobs. What we need

to do is make the universities aware that there are jobs out there. This is the toughest market I've seen in my lifetime, yet we're all looking for skilled people.

In the USA, we can't find people who are home-bred; many of our talented traffic engineers have been trained in other parts of the world. I love having the mix of people but I don't have enough Americans. Our system would come to a halt if we didn't allow for the immigration of people from Pakistan, India, China, Korea, and so on. Yet it does make a difference when you don't have locally grown transportation engineers as well – both groups bring a lot to the table. Having people from other countries brings a lot of viewpoints and a lot knowledge that you wouldn't have gained locally, but not having the local knowledge is a setback as well. It's a loss to not have that."

'Gridlock Sam' on the streets of New York, where he has built up one the transport industry's most respected engineering consultancies

a glittering, controversial but ulimately rewarding 20 years working in public office. "I used to have a lot of fun with the media when I was traffic commissioner; I was constantly giving traffic forecasts whenever there were problems – a snowstorm, for instance, or a Presidential visit. My brother, once again a source of inspiration, suggested I go by the name of 'Gridlock Sam'. So I approached a couple of newspapers and they accepted my idea for a column. I now write about transportation issues in four different New York papers, including the *New York Daily News*. [He even writes for a Yiddish paper in Brooklyn under his Hebrew name]. After leaving the DOT, I worked for a consultancy for five years, kept up my writing and taught at the Long Island University and Cooper Union, at which I founded the Infrastructure Institute." He established Sam Schwartz Engineering in 1995 and over the course of the past 15 years has assembled an all-star cast of transportation thinkers.

Transport's Harlem Globetrotters?
"One of the nice things about being on the smaller side as a company is that we've attracted a group of people who want to work in a hands-on environment – and we've attracted the very top

> **They demonstrated on the steps of City Hall…People took out full-page advertisements against us, labeling our ideas as 'draconian'**

⟲ "I'd like to believe we planted the seed for Livable Streets"

Charles Komanoff asks: Since becoming NYC Transportation Commissioner in 2007, Janette Sadik-Khan has implemented much of the 'Livable Streets' program you'd advocated for three or more decades. As you contemplate her success, do you feel pangs of regret that you're not still at the helm?
"Absolutely! I think Janette has done a fantastic job, and I think she is a superb

Commissioner with incredible vision and backbone. Would I like to have been implementing many of these things? Charlie is right, yes!

Livable Streets is basically the concept that streets are moving all modes of transportation and are designed in such a way as to be sustainable. On October 10, Janette implemented along First and Second Avenue dedicated lanes for buses, for

bicycles, for cars, for parking, greater areas for planting, for water retention, etc – it's all those aspects of infrastructure. We began the program back in the 1970s, which we called 'Green Streets' – essentially the forerunner to Livable Streets – so I'd like to believe that we planted the seed and it's lain dormant for many years and now Janette Sadik-Khan has come in and watered it, nurtured it, and made it grow."

> **"When there's that much money around, the decisions are not being made by the local commissioners"**

Jack Opiola asks: In a city that is embracing open standards for ITS for traffic signals (and thereby reducing costs by competition, commoditization and standard interfaces), how can NYC continue to support and dismiss open-system standards in such important and financially productive markets, such as tolling and parking, through procurements of proprietary systems? "Having been on the government side for 20 years and another 20 years on the private side, I have a good perspective. When there's that much money involved, the decisions are not being made by the local commissioners or local agency heads – they're being made by the people who move the money around. They are very skittish and only see in one-, two- or three-year horizons – and they want to ensure there is no interruption in the money.

I believe in the case of E-ZPass and others, that has led to a reluctance to upset the apple cart. You'll see greater risks in bridge designers than in financial system adjustments, which seems very odd to me. We'll do more open, competitive bidding when designing a complex bridge than we will on something that provides a revenue source. I'm afraid we're gonna see more of that as people begin to embrace some of these long-term programs with the private sector – and it may very well squeeze out the smaller players.

You can see the whole world is now descending on the USA for P3s. In fact, a Spanish company recently won the billion dollar street furniture agreement in New York and you'll find firms all over that are not local. We owe so much to foreign governments now – we are owned by foreign governments!

people in their fields." Among the 100-strong lineup is Richard Retting, formerly of the Insurance Institute for Highway Safety, Howard Roberts (who held leadership positions at SEPTA as well as New York City Transit), and Harris Schechtman, famous for introducing E-ZPass back in the 1990s.

"We're innovative planners," Schwartz insists. "We designed the transportation system for New York's first Ikea store," which from what he says is just as hellishly busy in the USA as they can be in any other country. "The study included over 40 intersections, recommendations for alternative modes of transportation, including free shuttle service, a bus route extension, and even a free weekend ferry service." Schwartz's engineering expertise was also called upon by the Port Authority of New York and New Jersey (PANYNJ) to assist in the transportation and logistics planning during the reconstruction of the World Trade Center. "If you can imagine 300 to 500 trucks trying to get into eight different gates every day in such a confined area, it's almost as if we're the conductor of an orchestra. We're intimately involved with complex traffic, trucking and pedestrian issues at the site." Once built, the WTC Memorial is predicted to become the biggest attraction in the city, with nine million people estimated to visit every year. "It's an enormous number when you consider the Metropolitan Museum, our biggest attraction today, attracts 5.5 million people

Sam Schwartz Engineering has been fortunate enough to work on some of the most challenging traffic and transportation projects in the industry, many in New York itself

> **We're going to have to be highly skilled with public-private partnerships because we can't rely solely on government**

a year." A born-and-bred New Yorker, Schwartz's pride to be involved in this project in particular is plain to hear.

The question of funding
So, after 40 years in the business, where does he suppose transportation's going next? Does he agree with most other practitioners that funding will hold the key? "New York and New Jersey have been hit as hard as any state," he says. "New York has been quite dysfunctional for a while now: we've had a terrible scandal with one Governor, then we had a weak Governor come in, and now we're all awaiting the next one. He's not going to have a lot of money to play with. We're going to have to be highly skilled with public-private partnerships because we can't rely solely on government." Speaking of which, how does he feel the man at the top has done so far? "I am encouraged by some of the things the Obama Administration has done to increase money for transit, but I am fearful that the tea parties will not just throw the tea into the ocean – they'll throw the infrastructure in, too!"

Has the picture therefore changed forever – the global financial meltdown leaving an indelible mark on our ability to finance our future mobility? "We need to look at new ways of funding, for sure. We're beginning to find that user fees are getting a more broad appeal. In the USA, the conservatives are looking at congestion pricing as a funding source, while the liberals are looking at it for climate change. Both are realizing that we're going to have to involve the private sector. I see some huge changes over the next few years as people wake up to the fact that there are no alternatives."

Perhaps Gridlock Sam will get to see his 40-year-old vision touch down in Manhattan after all? "I believe in congestion pricing," he concludes. "I'm very determined – and I'm trying to stay healthy just to someday see this through!" ○

• In the January 2010 issue, Sam Schwartz will share his thoughts on developments in technology and what the future could have in store for ITS

A Members of basketball team. Resting before the game continues. They are without proper guidance, their coach is resting too. A little bit of depression is present due to series of lost games.

B Members of basketball team "B". Their coach is giving them excellent instructions, what to do, how to synchronize their efforts, how to use maximum of their abilities. His management will ensure their good play.

A

B

MANAGEMENT...

Q: Who stands the best chance to win this game?

A: The answer is quite obvious, team "B" will win the game, under management of excellent coach. Similar to this sport situation, in ITS you definitely need best management to use maximum of abilities and to synchronize all your subsystems. You need topXview™.

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TELEGRA
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Dr Brendan Hafferty
reveals how advanced visualization is bringing digital ITS environments to life, making models a whole lot more realistic

Interviewed by Louise Smyth

> " If you can get the real world into a digital format, there is just so much more that you can do and so many more questions you can answer

When we in the ITS sector consider visualization solutions, we tend to think of the huge screens used in traffic control rooms. But there is an entirely different meaning of the term that has not been as widely known – until now.

Brendan Hafferty is western regional general manager of the UK office of Forum8 – a visualization software solutions company that's experienced enormous success in Japan. Hafferty's visualization is about bringing simulation to life via some very smart computer wizardry. "A picture speaks a thousand words," he says, referring to the old adage. "But we're not just talking about a single picture. It's about building a 3D digital model of the real world – whether a streetscape or a whole city – and then playing 'what-if' scenarios with it. What would be the effect of building a bridge in a particular location, or a pedestrianized area in another?"

From virtual to reality
Forum8's UC-win/Road software is a virtual reality package that can be used for an array of purposes. Having taken the Japanese market by storm, the archaic modeling methods being used in the UK are a constant source of amusement for Hafferty: "Architects here still use balsa wood models!," he scoffs. "And to plan events – traffic management at a big sporting event, for instance – desktop planning is still widely used; 2D maps on a desk using toy cars to simulate real traffic! But if you can get the real world into a digital format, there is just so much more that you can do and so many more questions you can answer."

Popular in a variety of sectors from driving simulation to emergency response planning, Hafferty has also observed a growing interest from the ITS market for UC-win/Road, particularly in the bridges and tunnels sectors. This is far from its only deployment, however: "It's an interactive simulation system and can be used to visualize anything to do with the real world, whether that's mass transit, pedestrians walking down the street, or vehicular traffic," he points out.

Forum8 began life as a civil engineering consultancy, designing roads using software suites that were available at the time. Ten years ago a client requested a 3D image of an intersection, which led to the initial version of the software being created and the past decade has seen its evolution. As we speak, Hafferty is busy with the launch of Version 5, which, as he explains, has two new developments: "One side relates to developing the software itself," he says. "We've really improved environmental conditions, for example, so as a wheel spins on a car on a wet road, you can see water splashing up the back; as rain falls, puddles form on the road and we can even visualize a mirage effect on the road surface.

"We've also been developing more third-party plug-ins, covering software products

such as InRoads, Vissim and S-Paramics. It means that users can conduct their data development within those products but use UC-win/Road for all of their visualization. It enables them to have the best of both worlds – excellent simulation coupled with superb visualization."

Copy and paste visualization

Another intriguing advance on the plug-in side relates to the product's ability to accept laser scanning data, a function known as 'Point Cloud'. Imagine you want to visualize an existing bridge, you just point a laser scanner at the bridge, send that data to UC-win/Road and then you can visualize the bridge exactly as it is in the real world. There's no need for drawings or CAD work or inaccurate measurements; it's like having the capability to copy and paste from real life – and the resultant time-savings it could bring are immense.

A key point to emphasize is that this is not just about pretty pictures for designers or architects – the product has a plethora of applications of huge value to those involved with operating roads. "Tunnel operators, for instance, can now very quickly build a model of their tunnel and then mimic the real-world conditions," Hafferty says, citing a highly popular use of the tool. "Their software links in to UC-win/Road for training purposes. They can take live feeds from all of the ITS equipment in the tunnel – incident detection, fire detection, etc – and then run real-time simulations, to instantly find out what would happen if they close a lane or respond in any other way to the data the ITS is providing."

This is where the true strength of Forum8's software lies. Ignoring the staggeringly detailed imagery for a second, it is these links to other products that enable users to achieve so much value from the initial investment. "We're a software house – we're not in the game of dealing directly with road operators," Hafferty agrees. "Instead, we are looking for partners – whether consultants or other software vendors already in the market – who will use their own software to link to ours and develop it for wider use."

An obvious benefit of enhanced visualization is the greater understanding that it brings to projects. The beauty of UC-win/Road is that you don't need a degree in engineering or a black belt in CAD. Those planning new transport projects can simply incorporate all of the technical elements – engineering drawings, CAD work and so on – into what is effectively a mirror image of the real world. If you want to construct a new road through a town, for instance, you could call a town meeting and demonstrate to local residents,

> We've really improved environmental conditions, so as a wheel spins on a car on a wet road, you can see water splashing up the back; as rain falls, puddles form on the road

politicians and anyone else you need to get on side exactly what it will look like and how it will work. Perhaps this is why the software is gaining so much interest from consultants in the USA who are tasked with implementing roundabouts, aka traffic circles. The software allows those who will ultimately be using the roundabout to explore interactively how they look and how to drive on them.

The cost factor

Hafferty is also keen to note that this level of detail before a project even begins to be implemented helps save costly mistakes later on in the process. "I was recently talking to a guy in Las Vegas who was involved with building a new bridge," he recalls. "Construction was well under way when one of the nearby hotels realized that it was going to be blocked off from the highway. They objected, work stopped and it's going to cost several millions of dollars to put right. 'If only we'd been able to visualize it!', he told me. If they would have had our software – which they will do shortly when they become one of our partners – they could very easily have built the model of that streetscape and made the whole thing available on the internet so anyone could look at it interactively and pinpoint any likely problems."

Asked to list the three most important selling points of UC-win/Road, Hafferty is quick to answer. "Ease of use, competitive price and comprehensive functionality," he says. The starting price for a regular user with a license is US$5,400 ("Compare that to any other software in this marketplace", Hafferty suggests), which links to his point about functionality. At such a price, the software is available to not only consultants with deep pockets, but is affordable for academics, too. On this note, Hafferty refers to a current project being tackled by the University of Sunderland as part of the UK's One North East scheme. "They're embarking on a project using UC-win/Road along with one of our drive simulators to investigate electric vehicles," he reveals.

Hafferty predicts a busy time ahead for Forum8 and its global partners in the coming years. The software developers are already working on Version 6 and he feels that by the time it's ready, the wider market will have realized the true benefits brought about by such a product. "Coupled with improving the ability to put those models interactively on the internet, as the requirement for 3D visualization increases, word will spread quickly. Many people around the world can all be working on the same project. To be able to offer that ability is a step forward." ○

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Break
the mold

The IBTTA's Toll Excellence Awards is the epitome of innovation in the tolling sphere, and acknowledges the projects, programs and people that have really stretched the boundaries. **Nick Bradley** was in San Diego to monitor proceedings

Main image courtesy of Ben White

What we at *Traffic Technology International* really like about the IBTTA's Toll Excellence Awards is that behind every crystal trophy there's a great story to tell. Whether it's an infrastructure developer spending millions educating kids so they one day become safer road users, or an authority adopting a truly multimodal approach to enhancing commutes in a busy 13.4-mile corridor, you can be sure the judges have reached their decisions following diligent, expert consideration.

For the fifth year running, *Traffic Technology International* was on hand to find out exactly why these organizations in particular broke the mold. These victors in the fields of Social Responsibility,

Technology, Administration, Operations and Customer Service all exemplify excellence in every sense of the word, as well as creativity, innovation and a positive attitude.

"We are extremely proud of and excited for this year's Toll Excellence Awards winners," reveals Pat Jones, executive director of the IBTTA, who alongside Steve Snider, IBTTA president, steered the awards ceremony before a packed auditorium at the Hilton San Diego Bayfront, September 13, 2010. "Since 2002, this program has recognized IBTTA member toll operators that are advancing the aims of the toll industry. The hundreds of entries we have received over the past few years are testament to the excellent work that our members perform each and every year.

"The role of the Awards Committee is to evaluate each project based on well established criteria and to select a winner from among dozens of projects submitted in each of the five categories. On behalf of IBTTA, I want to say thank you to the Awards Committee and congratulations to all of the awards recipients. They truly represent what is best about the toll industry." ○
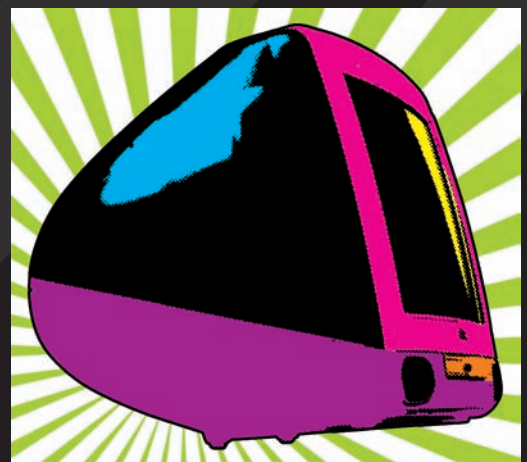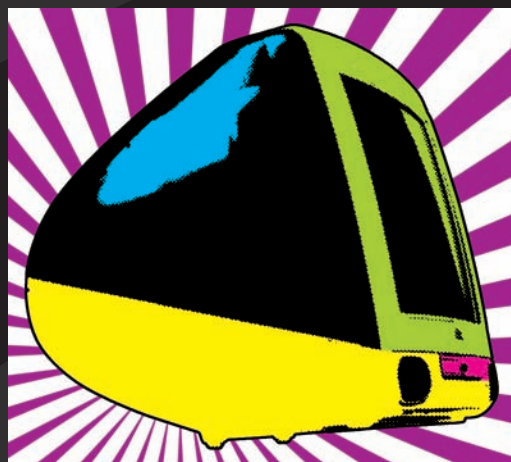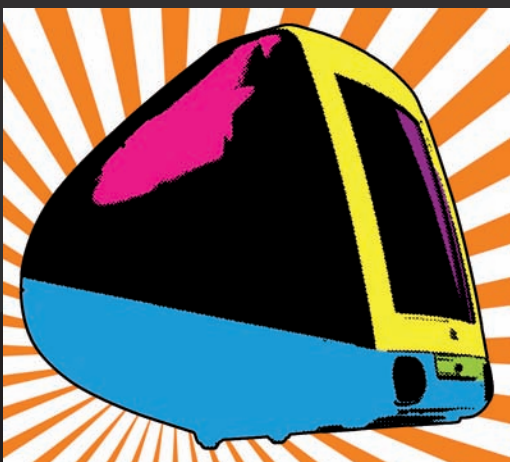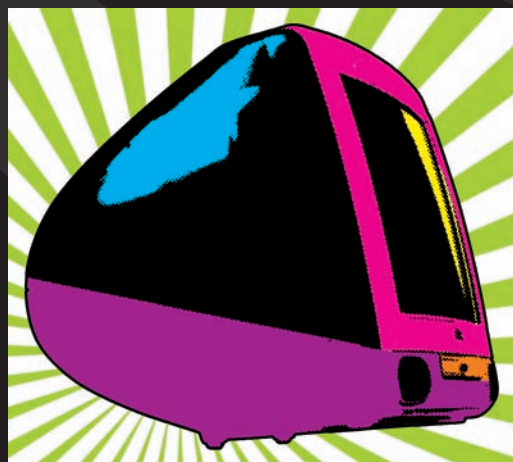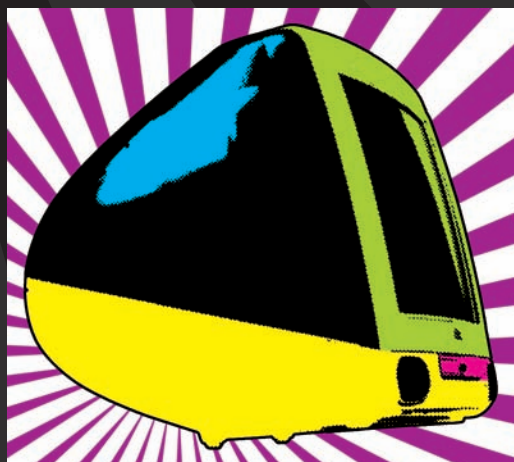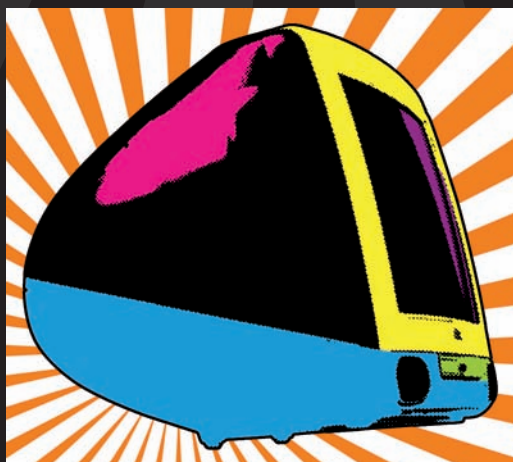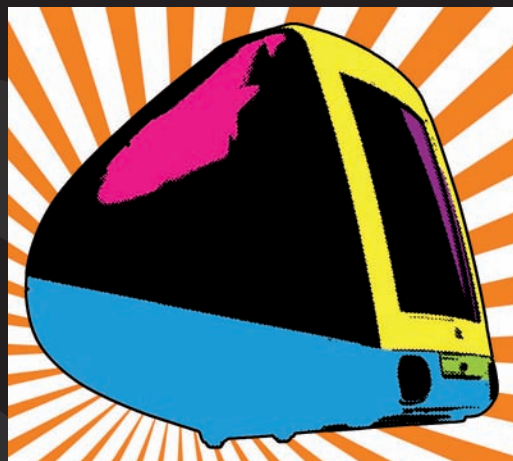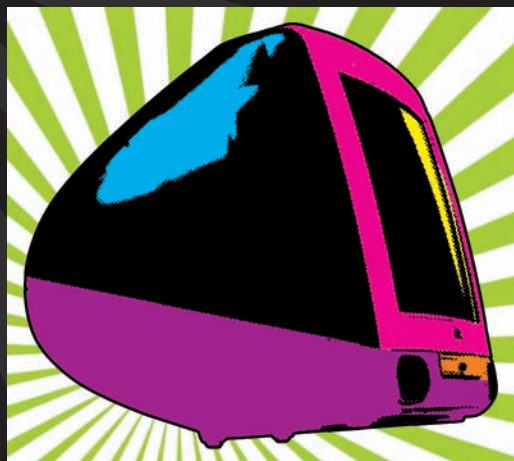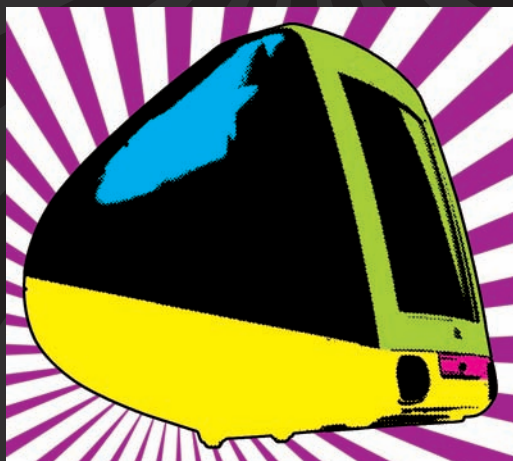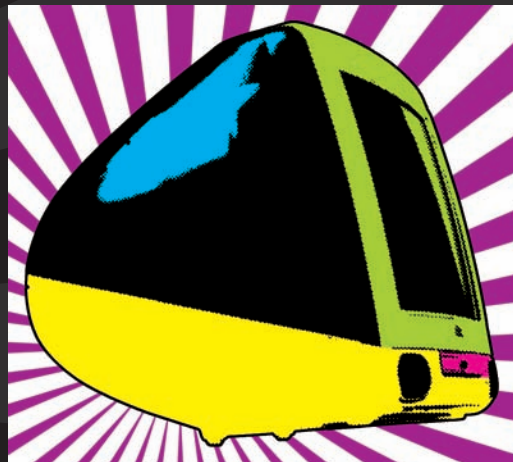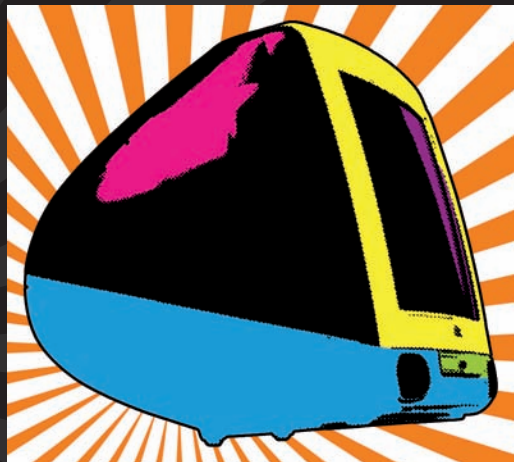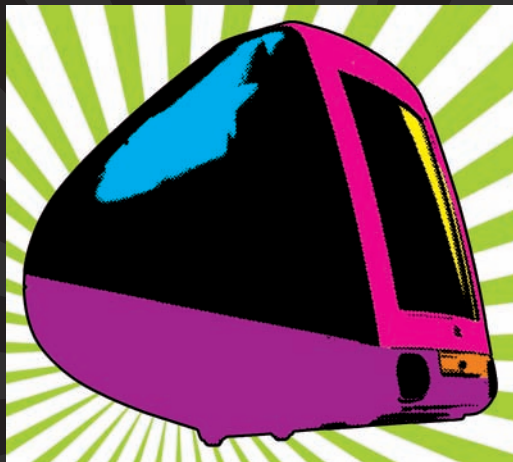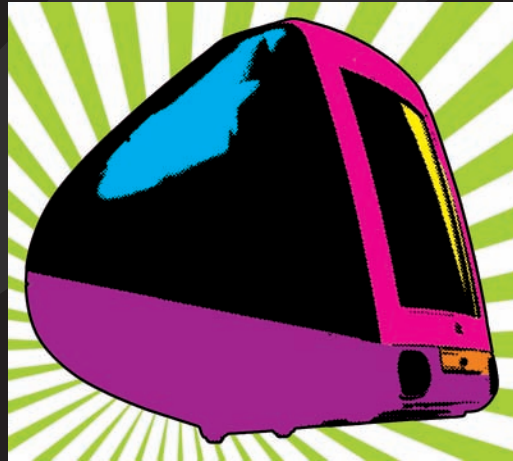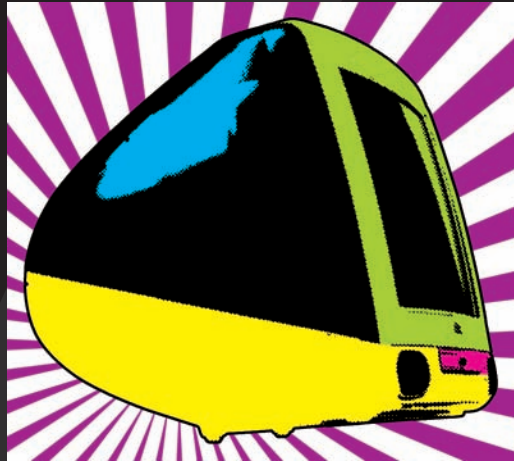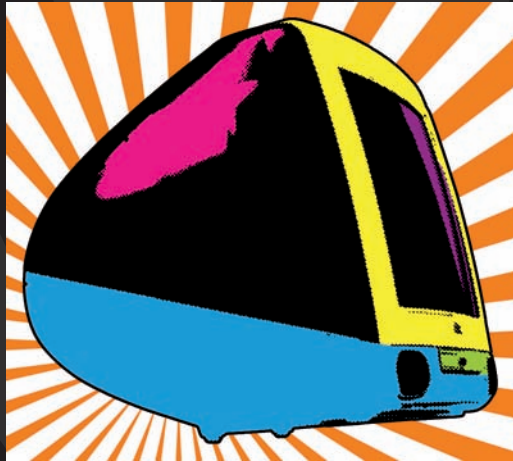
ℹ | Winner

North Texas Tollway Authority

Customer Driven Management

John Bannerman, customer service director, NTTA (bottom right)

"The things that Customer Driven Management (CDM) has accomplished are all things that our customers did, so this is their award," suggests John Bannerman, customer service director at the North Texas Tollway Authority (NTTA) as he collects not only the Toll Excellence Award for Customer Service but also the much-coveted President's Award.

Developed by Tamer Partners Corporation, CDM is an enterprise management solution that helps companies synchronize customers with frontline staff to provide an affordable yet high-quality sales and service experience. "Delivering great service can be costly, but delivering poor service is more expensive and negatively impacts the customer as well as our employees," Bannerman says. "If we can determine our customers' needs and wants and match those to our actions and strategies, we can deliver the highest level of service at the lowest cost possible as a result.

"Customers are accurate, passionate, reliable, credible – and almost infinite. At NTTA, we understand that and now leverage CDM to tap into one of our most powerful resources – our customers. They are now helping advise, monitor and coach employees directly and on a daily basis."

So what impact has this new strategy had? Reduced expenses, customer loyalty, streamlined process, changed behavior and perhaps most importantly a dramatically improved customer service. "In some ways, reduced expense and streamlined process are connected," Bannerman explains. "Once we understand our customer satisfaction results, CDM is able to determine where our gaps are at the individual employee level. That's how we improve satisfaction."

Through CDM, customers can define what our employees need to work on – better empathy skills or a little more energy during customer interactions, for instance. "Once a performance gap is identified, CDM then starts collecting advice from an additional percentage of an individual employee's contacts."

Bannerman does, however, stress that it's not all about the negatives. "Many learn the things they are doing great and are encouraged to keep it up," he says. "Employees have access to a portal where they can see customers' coaching recommendations in real time. Their managers also see this data and can provide added support. On average, our employees get coaching feedback and advice from a little over 10% of contacts."

Such monitoring and coaching would ordinarily have been a massive expense if an outside resource was hired – a fact that Bannerman says is vital in these challenging times. "I've actually been able to increase the span of control between agents and supervisors," he says. "This alone has saved me headcount.

"Another example is the management hours saved. It would take a manager 144 hours to do the work for each of their teams and that doesn't even include the thing required to actually change behavior. Once you monitor an employee and coach them on the things to work on, you need to stick around and observe so you know when the performance improves, or even correct when old habits return. That's a full-time job that's being fulfilled by our customers!"

NTTA simultaneously reduces the expense associated with gathering customer insight. "In the past, we might use focus groups to gain insight from our customers, such as in the deployment of new signage or changes to invoices. With CDM, we allowed thousands of customers to view the signs and invoices over two days. We received great feedback and were able to implement these initiatives right, without creating confusion."

Attaining high levels of customer service for the lowest possible cost might seem like a difficult thing to achieve, but Bannerman says the challenge comes from guessing what your customers want, which usually results in doing more things than your customers really care about. "The synchronization that CDM provides allows you to stop doing the things that really don't matter and focus on improving the things that really do," he says. "The challenge is getting synchronized and CDM takes care of that."

Such customer engagement in tolling is unparalleled, a fact that no doubt caught the attention of the judges. "Our perspective toward customer service has changed with CDM," Bannerman concludes. "We started by treating customers the way we wanted to be treated. With CDM, we treat them the way they want to be treated. Every single one is different – and that's how our perspective has changed."

President's Award & Customer Service

ⓘ | Winner

CCR Group, Brazil

Road to Citizenship program

The fact is many roads in Brazil are woefully maintained, which is a contributory factor to more than 37,000 road deaths every year. But this can't be leveled at all roads in Brazil. Francisco Bulhoes, CCR Group's head of communications and marketing, says that since its operations began, the number of fatalities on its 1,922km network has been reduced by around 60%. Apart from generally improved highway conditions and medical assistance services, numerous

programs for traffic education and awareness that CCR has put into action have played their part, including the Road to Citizenship program.

"The program aims to take information on traffic safety and citizenship to those public schools within the cities along some of the main highways in the State of Sao Paulo," Bulhoes said after picking up the Toll Excellence Award for Social Responsibility. "This year we expanded the program to include Rio de Janeiro and Paraná."

Through the program, kids receive information regarding traffic signs and signals, municipal statistics, and other points that wouldn't normally be discussed in classrooms. "Kids could potentially even influence the driving conduct of their parents; it's a chain of influence that should last throughout the years, as children will be more aware and informed." To date, more than 750,000 children from nearly 1,200 schools in 72 municipalities have taken part.

Social Responsibility

Carried out in partnership with the local education departments, the scheme is fully funded to the tune of US$1.7 million a year by CCR concessionaires: "We believe by helping prepare future drivers to be more conscious about their role as motorists and as citizens we're contributing to the social development of those regions as well as to the continuation and safety of our business – but particularly to the safety of our road users."

Values such as respect, responsibility and solidarity

Francisco Bulhoes, head of communication and marketing, CCR Group, Brazil (third from right)

are a key focus, according to Bulhoes. "One of the big challenges is to bring about wide-ranging dialog, offering new perspectives in the approach to citizenship and traffic, while linking educational content to knowledge obtained in everyday experiences.

"It's an enormous source of pride to have one of our actions recognized by the biggest organization in our industry, the IBTTA. This shows that CCR's work is aligned with international needs, and that it can be relevant to the highway concession business globally."

ⓘ | Winner

Texas Department of Transportation, USA

TxTag In-Lane Tag Sales

Above right: **Mark Tomlinson**, director of the Texas Turnpike Authority Division of Texas DOT (pictured bottom left)

The elimination of cash collection is an ambition of many toll authorities, yet signing up the majority of customers is an entirely separate challenge. Many agencies have found that some are simply not willing – or are unable – to convert.

"We don't have firm plans to switch to AET at the moment," confirms Mark Tomlinson, director of the Texas Turnpike Authority Division of Texas DOT. "We still offer the cash option as well as Pay By Mail, but by far our

Operations

greatest number of transactions are electronic." In fact, of the 800,000 TxTags in active service, there are some 470,000 accounts, which equates to around a 77-78% penetration.

Tomlinson says TxDOT encourages as much tag usage as possible, as it's cheaper and quicker for customers as well as being a more efficient means of collection for the authority. "So, back in April 2008 we introduced our TxTag In-Lane Tag Sales Program, whereby we offered tags to cash customers in-situ in the cash lanes," he says. "They receive the tag for free, deposit US$20 into an account, and can start using the tag immediately. We've sold around 140,000 tags via our In-Lane program. The face-to-face interaction with the customer at the booth is vital; it's a great opportunity to inform customers about the advantages of paying electronically, not least that tolls are around a third cheaper than cash. I'm not aware of such a practice going on at any other

authority, but over an eighth of our total tag sales have been sold in this way, so it's not an insignificant number. One of the marketing approaches we've adopted is to inform motorists via CMS about the opportunity at the booth, so they're prepared before they arrive." The whole process takes no more than 15-20 seconds, so the delay to the customer is minimal.

"IBTTA is the pre-eminent tolling association worldwide, so to receive the Toll Excellence Award for Operations is a huge honor," Tomlinson concludes. "We think the folks who have put this program together are top-notch – they're industry leaders – so it's great to have an organization such as the IBTTA recognize their efforts as well."

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ⓘ | Winner

Queensland Motorways, Australia

Free-Flow Tolling Project in Brisbane

(Left to right) **Alan Winfield**, Thales, **Sue Caelers**, Queensland Motorways, **John Hawkins**, IBM, and **Phil Mumford**, Queensland Motorways

Queensland Motorways' experience in switching from a hybrid form of toll collection to electronic tolling in the guise of Brisbane's Free-Flow Tolling Project makes for pleasant reading for anyone looking at moving to AET. "We've made this transition seamlessly with minimal impact on our customers," says Sue Caelers, chief information officer. "We've also reduced traffic congestion, improved travel times and reliability, and enhanced safety for motorists traveling the Gateway, Gateway Extension, and Logan Motorways – even while road patronage has continued to grow!" Freeflow tolling, in fact, immediately increased lane capacity on the Gateway and Logan Motorways from around 300 vehicles per lane an hour to well over 2,000. Moreover, incidents around tolling points have reduced by as much as

69%, while across the network, motorists are enjoying travel-time savings of approximately 10 minutes for southbound travel, 13 minutes at morning peak, and five minutes during the evening peak for northbound travel. "Around 40% of these savings are down to freeflow tolling, while the remainder is the result of the Gateway Upgrade Project," Caelers says. New systems and technology have also enhanced customer services through improved and increased channel offerings.

The tolling technologies deployed are also delivering more reliable data for traffic management. The combination, for instance, of tag readers with two ALPR engines means vehicle identification rates achieve the highest possible level of accuracy. Class one vehicles in particular, such as motorcycles, are being detected in higher rates, including those that travel along the shoulder of the road.

Also, in a first for Australia, an innovative single-gantry roadside tolling solution was introduced to house the tolling technology and create 3D vehicle modeling at the roadside. The system subsequently generates 2D profiles that are sent to the central system for more accurate vehicle classification. "We also developed Australia's first off-road development and testing facility," Caelers adds.

Technology

"Here, complex traffic scenarios and test simulations can be executed to continually improve the systems without impacting customer travel experiences or staff safety." A staging gantry was also installed on the road network at which system upgrades could be verified against real traffic conditions before being migrated to the production environment.

The Brisbane system was built according to a Service Oriented Architecture – other systems use a black box proprietary system and thus not easily scalable – so Queensland Motorways can seamlessly change any of its components as needed. "The sensor subsystems feature intrinsic redundancy, allowing them to continue to operate even if a sensor fails. In such a situation, the system is able to make use of information from adjacent sensors to compensate. These operate independently and the gantry controller is able to continue functioning even in the unlikely event of a complete subsystem failure."

The toll point can even automatically adapt its transactional configuration to provide the central system with the best possible information (e.g. if the DSRC has stopped, the system will switch to 100% video). Overall, the roadside system is highly configurable and easily managed by remote configuration. One of the most important features of the architecture, Caelers points out, is the incorporation of multiple OCR engines to increase the capability to process video transactions without manual intervention.

Traveling some 7,200 miles to collect the Toll Excellence Award for Technology was certainly worth the effort for Caelers. "It's well-earned recognition for us and for our principal technology partners – Thales Group, IBM and Vitronic. We started with a vision that through the Free-Flow Tolling Project we would position Queensland Motorways to take advantage of opportunities in the ITS space and in the provisioning of smart transport technology solutions. Technology has really been the enabler and has allowed us to achieve what we set out to do."

Winner

Metropolitan Washington Airports Authority, USA

MWAA Dulles Corridor Enterprise Initiative

(Left to right) **Cyndi Ward**, Dulles Toll Road manager, **Andrew Rountree**, acting vice president for finance and CFO, MWAA and **Thomas Flowers**, technology operations manager

The Dulles Toll Road operates as a major commuter route for the Washington metropolitan region

In 2005, when the Metropolitan Washington Airports Authority (MWAA) submitted its proposal to operate the Dulles Toll Road, it distinguished itself from the other offers on the table by pledging the toll revenues generated would be reinvested into local infrastructure. So, in accepting the bid, Virginia DOT (VDOT) will by 2016 realize a 40-year ambition for the Commonwealth – the construction of a Metrorail system linking Washington DC with Dulles International Airport and beyond into Loudoun County, which should go a long way in helping relieve the pressure on a much-traveled commuter route.

"When the federal government built Dulles International Airport back in 1962, the median of the airport access road [which has always been maintained by the airports authority] was designated for rail, which just goes to show how long it's taken for multimodality to finally touch down in this corridor," explains Andrew Rountree, acting vice president for finance and CFO at MWAA. "Our proposal was a win-win for everyone because it's all on the same corridor. The tolls that people pay to drive on the Dulles Toll Road are going toward the construction of the Metrorail project, which will ultimately support access to the airports for domestic (Ronald Reagan Washington National)

and international travel (Dulles International), as well as alleviate some of the pressures on the toll road as people will have the choice to switch to transit."

The +US$5 billion project will be completed in two phases. "We're currently about halfway through phase one," Rountree continues. "The first segment will be open for service in 2013 and the second – which will extend to the airport and beyond – will be complete in the latter part of 2016. The Metrorail project is a 23-mile extension, integrating with an existing 106 track-miles. Once we've completed the construction, the operations will be handed over to the Washington Metropolitan Area Transit Authority, which operates the DC subway system."

As the image below shows, the Metrorail will be located in the center of the corridor, with the airport access lanes either side, and the eight lanes of the Dulles Toll Road (four lanes in each direction) on the outer edges. Although other authorities have multi-modal operations – including airports, rail, and toll roads – Rountree feels MWAA is the only one in the USA with responsibility for managing and leveraging assets to improve mobility in such a defined geographic area. However, what he believes may have impressed IBTTA judges in particular when announcing the Initiative to be the

recipient of the Toll Excellence Award for Administration is that the successful transfer and securitization of the Dulles Toll Road proves the skills, resources and expertise available in the public sector can all be used to achieve many of the benefits sought through privatization and other asset maximization strategies. "The Dulles Corridor Enterprise Initiative provides an example of how state and local governments can work together to leverage existing assets and resources to develop and finance infrastructure improvements," he says. Although an airports authority issuing toll revenue bonds to finance a rail project may seem unique, Rountree suggests there are many aspects that could be useful for other authorities that may be a fair way down the road to selling off a potentially valuable asset.

He does, however, admit that the Initiative's not been without its challenges. "It took a year to negotiate and execute the key agreements between the Airports Authority and VDOT," he reveals. "Direct responsibility for the Dulles Metrorail Project and the Dulles Toll Road was transferred in stages over a period of about 18 months. But the benefits from the Dulles Corridor Initiative will accrue over the next 50 years as we invest hundreds of millions to improve the corridor.

"This is one of the largest public works projects in the region. The key for us was to translate the experience gained from operating two major airports and managing several billion dollar capital improvement programs to the toll road and rail projects. We found that most, if not all, of our financial activities for the aviation business were relevant to the Dulles Corridor Enterprise, including rate setting, long-term capital planning, cash and debt management, issuance of financial reports, revenue and disbursement management, and operational-related issues."

According to Rountree, MWAA was extremely honored to be recognized by IBTTA in this way. "We're new to the tolling industry and especially new to the IBTTA, so for them to acknowledge our activities in this way is really rewarding."

Administration

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Road fatalities are on the rise in many countries across the globe. Morpho has addressed this problem by developing a wide array of modular solutions for its clients, ranging from automated speed measurement and red light running solutions to automated number plate recognition.   **www.morpho.com**

Bus lane enforcement comes to streets of NYC

After two years of intense lobbying, New York City finally received permission from the state's governing legislative body to launch a pilot program using cameras to keep dedicated bus lanes free of traffic.

Environmentalists and bus riders in the city teamed up with Mayor Bloomberg and DOT Commissioner Janette Sadik-Khan to get the program approved, albeit on a limited scope. The enabling legislation specifies the cameras may only be used on portions of specific bus routes during a pilot program that runs from November 2010 through to December 2012.

American Traffic Solutions (ATS) of Scottsdale, Arizona, has been selected to install and administer the program. Now officially the market leader in road safety camera installations in North America, ATS is also the vendor for New York City's 200-camera intersection safety camera program. The city has been using cameras since 1993.

Environmental gain

Keeping buses flowing smoothly and efficiently is both an environmental and an economic issue for the city. According to a report released by the city in April 2009, two-thirds of New Yorkers commute to work without a car, the largest percentage of any US city. Car ownership among New Yorkers is about 23 cars per 100 residents compared with about 78 in the rest of the country. If New Yorkers drove as much as average Americans, the city would have 4.5 million more cars in the five boroughs of Manhattan, the Bronx, Queens, Staten Island and Brooklyn. The room needed to store these vehicles would require a parking lot of approximately 25 square miles – larger than the entire island of Manhattan!

As New Yorkers use transit so heavily, they avoid 48 billion miles of driving annually, use 2.4 billion fewer gallons of gasoline and avoid 23 million tons of carbon emissions annually. 'New York City's Green Divide', prepared by the CEOs for Cities, revealed that residents who use mass-transit and walk save a whopping US$19 billion annually, at least US$16 billion of which remains in the local economy.

The problem for New York is that vehicles that are not authorized to use the 'bus only' traffic lanes do so. ATS reports that 60% of the vehicles violating the rules are standard vehicles and trucks, while 40% of the violators are taxis. Private vehicles and taxis may only use the designated bus lanes if they're making a right turn at the next intersection, or if they're expeditiously dropping off or picking up passengers. Any usage of the bus lanes other than these two activities will earn the violators a US$115 violation. Citations will be issued to the registered owners of the vehicles.

ATS's patent-pending Axsis BLE-500 bus lane enforcement system comprises a PlateID camera, a video camera with digital video recorder, and a controller cabinet. The PlateID

(i) | **Need to know?**

Program will deter scofflaw motorists from keeping transit-reliant New Yorkers from getting to work and school on time

> The MTA and the DOT authorized to use camera technology to enforce bus lane rules on Select Bus Service routes in New York
> American Traffic Solutions awarded contract to implement the front and back end technology required to implement NYC bus lane program
> ATS program will ensure the success of the Select Bus Service initiative, which seeks to make city bus service faster, more efficient and reliable for New York City's 2.7 million daily riders

(Top) **New York drivers lost a staggering 380 million hours stuck in rush-hour traffic in 2007, the second-highest rate in the USA** (Right) **Bus lanes in force on New York's streets**

camera utilizes automatic license plate recognition to detect and read license plates of vehicles in the bus lane and compares the plate numbers to the syntax of permitted vehicle classes.

When the system detects vehicles that are not permitted to use the bus lane, it captures the vehicle license plates and videos that provide the context of the potential violations, together with metadata that shows the date and time, location, and other pertinent information. The captured events are subsequently transmitted to a remote server wirelessly for further review and violation confirmation.

An individual challenge of bus lane enforcement in New York City is to address vehicles other than buses that use bus lanes to make legal right-hand turns or to pick up or drop off passengers. To effectively address this challenge requires clear definition of bus lane violations and understanding of bus lane traffic statistics to determine the optimal configurations for camera placement. This technology will notably assist the city in increasing the service delivery of their public transportation system by reducing congestion and allowing the free flow of buses, as well as significantly contributing to improved transit times and reliability for bus users.

Proved elsewhere

Although bus enforcement cameras are new to the USA, a bus lane enforcement system has been used in London to keep traffic flowing smoothly since 1997. London uses both bus-mounted and fixed roadside units. The New York program will use roadside cameras to capture violators. Other cities that use cameras to enforce bus lanes include Birmingham, Bristol and Manchester in England, Auckland in New Zealand, Sydney in Australia, and finally Helsinki in Finland.

The New York pilot will be carefully evaluated throughout the life of the two-year pilot, according to James Tuton, president and CEO of ATS. But either expanding or extending the life of the program will require additional state legislative approval. "Mayor Bloomberg and Commissioner Sadik-Khan have made a major commitment to the mayor's PlaNYC sustainability agenda," Tuton says. "Gridlock is not acceptable to them, from either an economic or environmental perspective. ATS will do all it can to help them meet their goals." ○

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A while back, after the UK election, I read an article in a newspaper and was then childishly pleased to be able to say to my friend, Thomas Ingham: "The Secretary of State for Transport says that for you, Tommy, the war is over." All a bit odd when you think about it. He said he was stopping the war on the motorist and for the life of me I can't see what he meant.

Back in the days of John Prescott and the *1998 White Paper* (still very apposite and convincing), there was a feeling that the motorist was the target for various types of nastiness. But the *White Paper* read, "…so we also want to make life better for the motorist…" as well as "We have had to make hard choices on how to combat congestion and pollution while persuading people to use their cars a little less – and public transport a little more." Granted, the 1997 moratorium on starting new road schemes was not very driver-friendly but the history of Labour has been a big reduction in the cost of driving in real terms set against very large increases in real ticket prices for public transport, especially rail at peak times.

Moreover, the *White Paper* had some very good ideas for the introduction of road user charging, but the Government consistently did nothing to push the case when Local Authorities (LA) devised weak schemes or got trapped in a web of small town party politics – and to its eternal shame didn't lift a finger to lead by example by putting charges on the worst pinchpoints in the national network.

Anyway, it's official: all this has stopped. So what do we get instead?

So far, there have been about five government transport policy statements: there's not going to be a third runway at Heathrow; the high-speed rail link initially to Birmingham is to go ahead; LA funding for safety cameras is to be reduced, ditto LA road safety spending. And we're going to have more 'localism' and presumably that means less national policy-setting. As Gilbert and Sullivan put it, 'Modified Rapture'.

Europe's most influential airport is now doomed to zero expansion. An already fast rail link to a place of secondary importance is going to be speeded up a bit and the real need – a considerable journey time reduction to Leeds, Newcastle, Liverpool, Manchester and Thirsk – is pushed way back. The safety pundits predict massive increases in road deaths. We'll see if that's true quite quickly, but there is a reasonable debate to be had here. Daily road deaths are between six and seven. Forty-four a day die from bowel cancer, 77 from bronchitis, 68 from pneumonia, 12 from an accident in the home and 15 commit suicide. Is transport the top priority for expenditure to reduce deaths?

And as for 'localism' what nonsense! Transport is all about moving people and goods across the country or countries. Local or national boundaries are artificial but real barriers to doing that efficiently and effectively. Any hopes this government has of developing seamless travel and through ticketing will be considerably damaged if the number of bodies able to intervene increase.

So, I'm unimpressed by what's been done so far and even more unimpressed by the apparent decision to forget road user charging for this parliament. Hasn't the Secretary of State noticed his roads are congested and need more modern management tools; that he will soon have a much reduced budget; and because rail franchises are contractual his scope for spending reductions is either cutting roads spend or cutting roads spend?

I can't say I was thrilled by the last government's 'war' scenario but it looks to me as if this 'peace dividend' is going to be a lot worse.

> **❝** I'm unimpressed by what's been done so far and even more unimpressed by the apparent decision to forget road user charging for this parliament

Professor Eric Sampson, Newcastle University/ITS-UK, UK

READER ENQUIRY NO. **502**

(i) | Need to know?

How machine vision cameras are at the heart of China's push toward a smarter ITS infrastructure

> Machine vision cameras from AVT being deployed on check-points, at intersections, and for traffic flow monitoring on highways

> Ultra compact, lightweight Prosilica GC machine vision cameras with flexible features and GigE networking capability

> The Prosilica GX integrated lens control feature was specifically designed for the traffic market

A smarter view of China's ITS infrastructure

(Below) **The five megapixel GC2450 is a very high-resolution CCD camera with GigE output** (Below right) **The fast, ultra-compact GigE GC for machine vision**

The rapid expansion of the Chinese road network, the National Trunk Highway System (NTHS), has been driven by the country's enormous economic growth. But China's expansion strategy has led to increasing freight transport, huge demographic shifts, and a growing middle class that could see car ownership reach a projected 75 million vehicles by the end of 2010.

The need for ITS in China

Comprising expressways, class 1, class 2 and class 3 highways, the NTHS is expected to reach a total of three million kilometers by 2020. Meanwhile, the expressway network – currently second only to the USA with 65,000km – is expected to expand to 85,000km by 2020.[1] The current National Expressway Network Plan

includes the development of seven highways radiating from Beijing – nine north-to-south expressways and 18 east-to-west expressways – with an emphasis being put on linking cities with 200,000 and more inhabitants to serve over one billion Chinese people.

With congestion such as the recent jam on parts of the Beijing-Tibet Expressway that stretched 100km for several days becoming endemic, Chinese authorities have invested heavily in the past few years in the development of ITS, inviting domestic and international firms to design and implement solutions to make roads safer for all users. In the fourth quarter of 2009 alone, 1,063 ITS projects worth just over ¥2 billion (US$33 million) were underway, including 384 traffic light control systems, 238 law

enforcement systems, 238 check-points, and 203 traffic surveillance projects.

Allied Vision Technologies (AVT) is currently involved in multiple ITS projects in five major metropolitan areas as a provider of machine vision cameras to system integrators in partnership with a well-established local distributor. Unlike in Europe or North America, ITS solutions in China are planned in advance, often integrated in the roadway during construction, in doing so eliminating the need for additional civil work, on-site

reconfiguration and most importantly road closures or service interruptions. ITS in the city and on expressways is commonly used in China for three main applications: intersections, check-points and traffic flow on highways.

Large intersections are monitored to detect several types of violations depending upon the local requirements, including red-light running, incorrect use of lane (wrong turn) and license plate reading (LPR). Each installation includes four cameras, one on each side of the intersection, paired up

A unique feature of the Prosilica GX is that it provides three-axis motorized lens control as well as video auto-iris controls

with two LED lights on either side for night-time image capture. The equipment is positioned 20m from the traffic light's stop line and is aimed in the direction of traffic flow. A two-megapixel industrial camera, such as the Prosilica GC1600C model from AVT, is used to track up to two lanes of traffic, while a five megapixel camera, such as AVT's Prosilica GC2450C, is preferred for three lanes; 16mm focal length C-mount lenses are mounted onto the cameras for a wide field of view and crisp image detail.

Two in-ground loop detectors are installed below the roadway surface, positioned before and after the intersection stop-line to detect vehicles and trigger the camera. To provide proof of red light violations, images of the vehicle are captured before, during and as it exits the intersection. Installations are often networked to reduce hardware costs. Detected traffic violations are transmitted via fiber-optic cabling on a dedicated communications network to a remote police center, where they are analyzed and stored. Police operators can

manage intersections remotely by setting up parameters for the front-end equipment via the software interface.

Installations for check-points on expressways in China are automated traffic control systems that typically feature up to three, two-megapixel color cameras and one LED light, depending on the number of lanes to monitor. Check-points are used for law enforcement and traffic management. Police authorities use these to detect suspicious vehicles, which might include a car without a license plate or a stolen vehicle. Once a suspicious vehicle is detected, an alarm is raised automatically to alert the local police authorities. Traffic management personnel, on the other hand, use the check-points to monitor flow and measure the average speed of vehicles.

Benefits of machine vision
Although traditional film and digital consumer cameras are common in traffic imaging, the industry is starting to see the many benefits of integrating machine vision technologies. These include digital shutter sensors, high-speed interfaces and a Software Development Kit (SDK) provided by camera manufacturers such as AVT.

Interline frame-transfer CCDs and global shutter CMOS devices have eliminated the

dependence on a mechanical shutter; a necessity for ITS system providers that integrate high-resolution SLR cameras that rely on a rolling shutter CMOS device. Similar to any other mechanical component, a mechanical shutter has a much shorter lifetime compared to a digital shutter, often leading to system downtime and a costly maintenance budget.

The networking capabilities and long cable length support provided by high-speed interfaces such as GigE has allowed instant transportation of images to a central location, therefore reducing police response time and improving traffic management. High data bandwidth sustained by GigE Vision cameras allows manufacturers to support high-resolution imagers operating continuously at very high frame rates, 365 days a year.

Designed for system integration, machine vision cameras play well with others. The SDK and improved third-party compatibility – provided by an understanding of the XML parsed feature – allow integrators to develop ITS systems using a machine vision camera with ease. This also provides ITS system integrators with the capability to transition to different camera models without having to recreate the application software.

Advanced features
Machine vision cameras also offer many advanced features, such as low-latency trigger for timely image capture, flexible exposure, gain and binning modes to adapt to any outdoor lighting conditions, digital shutter (global shutter) and high sensitivity to minimize motion blur and image distortion, as

well as configurable I/O to synchronize the image-capture process with traffic system peripherals such as ground loop, radar or laser triggers and LED or Xenon lighting.

Some machine vision camera manufacturers are introducing new features specifically for the traffic market. Integrated lens control, for instance, supported by the Prosilica GX family from Allied Vision Technologies, eliminates the lens control box previously necessary for users wanting to incorporate remote zoom, focus or iris lens control.

Smart city solutions
A new ITS project aiming to regulate traffic in one of China's major metropolitan areas is currently underway, which will study the city's traffic flow for the prevention of traffic jams and reduction of congestion. The system analyzes traffic density and average speed and automatically sends an alarm when a stalled, slow or illegally parked vehicle is detected. Further law enforcement installations are added such as license plate recognition to detect suspicious vehicles (vehicles with no license plate), or illegal use of lanes.

With further projects planned, China is leading the way in the development and implementation of ITS while other countries, notably in Europe and North America, have seen ITS projects put on hold. Maybe the Chinese example will provide government bodies in other countries with the motivation to evolve their own policies and treat ITS as a real solution to many law enforcement and infrastructure challenges that we currently face today. ○

[1] *Ministry of Communication (2009)*

Why embedded means enhanced in ALPR

As automatic license plate recognition (ALPR) technology has evolved, fully embedded concepts have become the preferred choice. However, many ALPR systems still employ an industrial PC and video card for image capture, which might be simple to develop but can be unstable, potentially inconvenient, and certainly have limitations in terms of overall packaging dimensions. The operating system, meanwhile, could be prone to attack from computer viruses, which might have a resultant negative effect on overall stability.

A core component of Dahua Technology's Linux-based ALPR system, though, is an embedded integrated camera, incorporating image capture, compression, storage, plate recognition, and video detection all within a single housing. Such a simple structure offers stable performance, with the capability to endure continuous operation in extreme environmental conditions.

Dahua's ALPR system comprises a vehicle recording system at the front-end, a communication transfer system, and a central management system. The camera captures

Need to know?

The trend toward integrated, embedded ALPR solutions in ITS deployments

> Fully embedded Linux system able to operate in harsh environments
> Technology incorporates two megapixel, high-resolution CCD
> Dual encoding streams supported; real-time alarm for blacklist and speeding alert; remote management and ultra-low power consumption
> Embedded speed-measuring system incorporates narrow wave radar for accuracy
> Ep200 red light enforcement system composed of HD camera, intelligent analysis, control host and LED light

(Above) **The HWS200+ vehicle speed measuring system in mobile format** (Top right) **Dahua's two megapixel Mega HD camera**

The HD camera delivers a high-quality image, not just of the vehicle plate, but even facial features

a vehicle image and reads the license plate automatically with the passing of each vehicle. The technology records a variety of data sets, including time, vehicle type, license plate, and even direction of travel, etc. All of this information is then transmitted to a central management system for data management and storage via the communications system.

In short, the all-weather, high-definition embedded integrated camera from Dahua Technology effectively resolves any of the problems associated with existing industrial PC solutions. Dahua's main component features industrial/military-grade chips to help reduce power consumption while ensuring continuous and stable performance, even in severe roadside environments. 'Double-watchdog' software and hardware technology even

wipes out the risk of a system crash. Additionally, installation is simple, maintenance is convenient, while configuration is flexible enough to allow for multiple detection methods. Moreover, the front-end power supply and the overall housing construction is robust but lightweight, while cable connection is simple and power consumption is low. An option for solar power also allows it to be deployed in remote locations where a mains feed might be an issue. Such features have made it highly popular among users.

Dahua's integrated intelligent camera not only features a built-in video analytical module to capture the vehicle, but can also connect to multiple vehicle-detection devices such as loop detectors, radar, and so on. As a result, the advantages of each detection device can be integrated, with detection methods according to actual conditions enhancing system performance and stability, in doing so promoting successful capture rates in all environments.

The dual-stream embedded integrated camera also provides

an image and video recording at the same time, so via the files it has saved can not only show an offense via the image but also show recorded video footage – all while allowing users to monitor real-time road conditions simultaneously.

High definition is certainly a trend in intelligent ALPR systems. Featuring a two megapixel (1,600 x 1,200 pixel) resolution camera, a progressive scanning CCD and built-in high-speed DSP chip ensures very high-quality images are generated. Also, the use of an intelligent flash lamp and smart light-operated system allows HD images to be obtained both in the day and at night-time, with the resultant images clearly showing facets such as vehicle color, license plate detail, and even the facial features of the driver and front-seat passenger. As a result of this clarity and detail, public authorities are provided with an irrefutable evidentiary record to ensure a successful prosecution.

In addition to an ALPR system, Dahua's integrated embedded technologies have also been successfully used in a separate radar speed-measuring as well as a red light enforcement system. The embedded speed-measuring system employs advanced narrow wave radar to measure vehicle speed, which combines many advantages in one, such as embedded system structure, rapid setup, powerful functions, as well as stationary and mobile use in all-weather conditions.

The embedded red-light enforcement system, meanwhile, takes several images of vehicles that illegally go through an intersection when traffic lights are red and records the whole progress. It also performs continuous stable work in outdoor extreme environments. ○

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Adrian **Walsh**

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The EC has now adopted an ambitious Road Safety Programme, which aims to halve road deaths in Europe in the next decade. The program sets out a mix of initiatives, at a European and national level, focusing on improving vehicle safety, the safety of infrastructure and road users' behavior, education and training for road users and better enforcement. But a key initiative that appears in a road safety plan for the first time is a boost for smart technology.

I am delighted that applied technology is seen as an important contributor to the strategy. I am particularly pleased that advanced vehicle safety systems form a key element of the strategy, and encourage all who are procuring new vehicles to understand the benefits of these esafety technologies such as ESC, which can reduce crashes by up to 40%.[1]

But it does seem to me that an opportunity has been missed in the program to explicitly encourage the private sector, which should be asked to play its role in improving the management of those who drive for work.

The use of telematics is however growing fast in fleets as managers wise up to its potential cost benefit. But employees are often reticent to the move toward technology, voicing concerns over lack of trust and privacy. So, how do they get your business drivers on board?

Proven improvement in customer service as a result of telematics is key to bringing employees on board with these technologies. Benefits include connected satellite-navigation with traffic avoidance, making journeys easier and less stressful, hands-free voice communication and emergency and breakdown support where the driver presses a button to be connected to a breakdown provider with a similar scenario for emergency services.

Companies increasingly see the vehicle as an extended part of the workplace, so need to ensure that telematics is accepted by drivers and technicians as a vital tool to run the business more effectively and provide real-time information to customers. It's not about being 'Big Brother'; it's about the 'bigger picture'. It is about helping increase productivity in a costly environment.

Health and safety for both company and driver is often a stated reason for installing telematics. With duty-of-care issues so important, companies have an obligation to their drivers to ensure they are not putting themselves at risk. Systems that alert the company if a driver is in a crash or breaks down are important. Many businesses now using these systems report that they almost always improve driving behavior. Once people know they are being tracked, speed compliance improves and wear and tear reduces.

[1] *www.esafetyaware.eu*

> **Companies have an obligation to their drivers to ensure they are not putting themselves at risk. Systems that alert the company if a driver is in a crash or breaks down are important**
>
> Adrian Walsh, director, Roadsafe, UK

Situational awareness in the control room

Today's control rooms are complex, networked environments handling an ever-increasing number of video and data sources. Companies and authorities increasingly seek to collaborate beyond the traditional boundaries of control centers and agencies. By consolidating their efforts, they are striving toward distributed decision making so that even smarter and faster decisions can be made, in the end solving crisis situations more quickly as well as managing processes more efficiently.

Barco's universal visualization platform consists of a networked hardware platform, including source-capturing units, powerful display controllers and display-generating units. It also includes the company's control room management software, as well as its high-quality rear-projection modules or LCD panels. Such technologies help control room professionals to collect all possible types of sources and data; understand the data by organizing it in the most efficient and transparent way; and create visual information, distribute the information, and collaborate with decision makers and information stakeholders in the most efficient way to ultimately make solid decisions and coordinate actions.

Diverse sources

Control rooms in the traffic industry are often handling a highly diverse spectrum of information sources. As a result of Barco's universal visualization platform, though, it is possible to collect and display nearly any signal format, ranging from analog to internet protocol (IP). Such source types might include the real-time signals being received from highway sensors, vehicle GPS and other ITS, SCADA sources, digital maps or video sources. As a result of the high-resolution graphics and video input modules within Barco's visualization platform, all of these sources can be visualized without the need for specialized cabling or routings.

One of the major advantages of networking technology is the switching capability. Visual content, for example, can now be sent around anywhere, wherever there is network connectivity.

Another example is the reduced cabling, which has a subsequent impact on cost. By making use of a standard IP network with unified cabling, the cabling cost and the use of all kinds of switchboxes or complex routing setups can be significantly reduced.

New visual sources can be added anytime, wherever they are located. In addition, Barco's integrated streaming video solutions offer unmatched performance for the simultaneous processing of large amounts of streaming video signals in real-time with minimal latency.

By organizing data intelligently, this can subsequently lead to enhanced knowledge. In this regard,

ⓘ | Need to know?

Faster and smarter decisions inside the control room and beyond

> Source to display: any source type, grab once, use anywhere, reduced cabling and reduced cost
> Data to knowledge: shared situational awareness, easy knowledge generation, and field-proven display technology
> Flexible distribution and intuitive collaboration with decision makers and stakeholders: collaboration without boundaries, fast and easy interaction, and system redundancy
> Quality information allowing for smart decisions and prompt actions: coordinated responses, easy dissemination of decisions

Barco's control room management software allows operators to create a personalized view of their sources and present it on a wide range of displays, from small screen to large videowall.

The networked platform allows operators to easily share data with colleagues or supervisors and thus create shared situational awareness. Operators can create personal layouts and views and bundle them into perspectives that can be shared with others for collaboration or approval. These can then be pushed on to more public group display walls locally or at remote locations.

The visualization platform allows operators and decision makers to easily generate a preview of a multitude of sources (e.g. video, application screen data, external DVI feeds, etc). By combining all these sources into a new perspective, they have a unique way to generate new knowledge on any type of display, from simple PC workstation to large-screen display system.

Barco's solutions fulfill practically any control room need, from wide-screen operator display to personal wall, to large-screen videowall for collaborative use. Dedicated

Barco's visualization technology is deployed in traffic control rooms across the world

solutions for daily business use or 24/7 mission-critical applications are available.

Collaboration

Efficient collaboration and decision making is only possible if operators and decision makers have easy and timely access to quality information. They need a common operational picture and the ability to share their situational awareness with other stakeholders, be it inside the control room or across multiple control rooms or agencies.
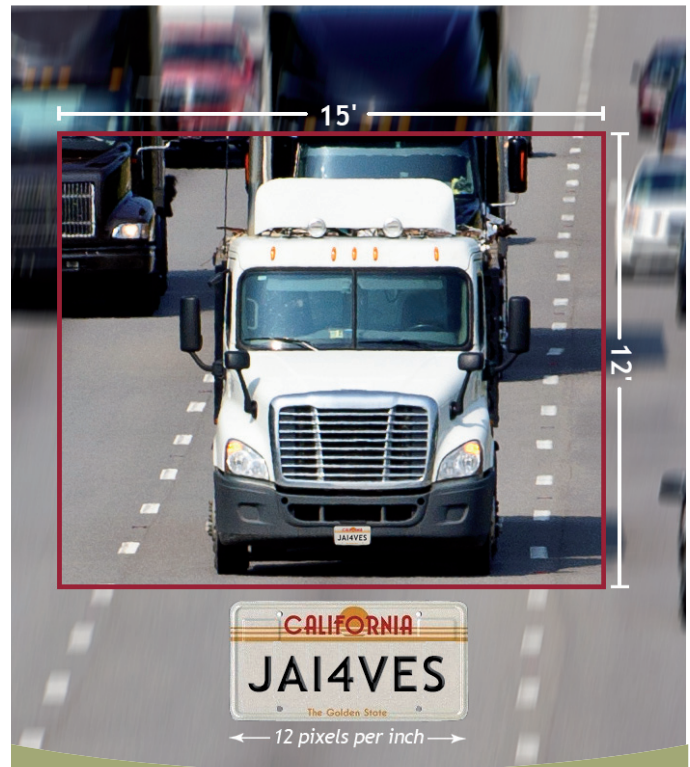
The distributed architecture of Barco's platform enables the content to be captured once, on any location, and distributed and displayed as many times as required in any location. It even opens up the possibility to take over the control of remote sites, or to make use of back-up sites.

The control room management software allows for fast and easy interaction. Personal operator views can easily be shared with other stakeholders for collaboration and then pushed on to group display walls. Reversely, the control room management software can bring up (pull) sources that are displayed at remote display walls or workstations onto the local operator's screen. If required,

the operator can again push this remote view to the local videowall or any other PC with Barco's software loaded on it.

The NBMS system hardware platform offers high levels of redundancy: redundant networking based on IP technology, duplication of the central processing machine and N+1 redundancy on the output modules when combined with dual input projection modules.

Decisions are only as good as the information they are based upon. Thanks to Barco's visualization platform, decisions can be made based on qualitative information, which in turn can be effectively disseminated toward the relevant stakeholders.

The control room management software and control room displays allow for quick and user-friendly exchange of information, which is a reliable basis for coordinated actions and responses with multiple stakeholders or even multiple control rooms.

Network technology allows information to be easily disseminated toward the end user, ranging from other decision rooms, mobile control displays or even visual public announcement systems.

By making use of the existing IP network, the universal visualization platform is able to make information omnipresent throughout your organization. Authorized decision makers and stakeholders benefit from this as they are able to collect and process any incoming source type, visualize it on any display device in the network, and monitor and control this information with smart control room management software. ○

Virtualizing a traffic world

Driving simulation has long been used in research, industry and training, but integrating Aimsun software into the SCANeR driving simulation engine now makes it possible for users to drive in SCANeR immersed in a detailed virtual world and in a completely realistic traffic situation.

To improve driver immersion in the virtual world, the traffic situation needs to be realistic from the driver's point of view. The blending of these two complementary simulation worlds of Aimsun and SCANeR opens up a whole host of applications. For example, it makes it possible to study driver behavior in dangerous situations, or even help car manufacturers to develop and test innovative driver assistance technologies. Users can implement and test V2V (vehicle-to-vehicle) systems, V2I (vehicle-to-infrastructure) systems, as well as evaluate various ADAS in various real traffic conditions. It even allows for the testing of prototype navigation systems against real-time alerts for congestion, incidents or workzones, as well as analyze emergency vehicle training in rush-hour conditions.

Innovative electronics

Oktal's SCANeR traffic simulation model includes realistic surrounding vehicle movements, advanced driver behavior models, tools providing high-quality 3D visual restitution, complete vehicle control, and scripts to provoke situations or customize behavior. To embed these innovative electronics systems into a virtual world, they need more complete information on a larger scale; realism reaches a whole new level with

ⓘ | ## Need to know?

Integrating SCANeR simulators with Aimsun simulation software to enhance the virtual experience

> Collaboration between Aimsun and Oktal brings traffic reality to world of driver simulation
> Assists in the analysis of applications such as driver behavior, development and testing of V2V/V2I and ADAS
> Realism reaches new levels with information about traffic density, accidents, workzones, rerouting, etc

(Above) **The SCANeR driving simulator**
(Below) **Screenshots showing the realistic traffic situation that is created by blending Aimsun with SCANeR**

information about traffic density on major roads, accidents, workzones, rerouting etc. This means dealing with thousands of cars and kilometers of lanes and the ability to simulate traffic on the scale of a whole city or even an entire region. This is where Aimsun steps in.

So how does it actually work? Although Aimsun handles the traffic signals and traffic in the whole network, there are some defined zones where the traffic vehicles will be controlled by the SCANeR traffic model. The main zone surrounds the driver's vehicle and moves along with it. Other zones can be freely created and positioned by the user. When Aimsun vehicles enter the zone, they are dynamically created in SCANeR and Aimsun releases control. Conversely, when they leave the zone, they are destroyed in SCANeR and control is restored to Aimsun. The SCANeR API and Aimsun SDK were used to create a SCANeR module embedding Aimsun and exchanging simulation information in real-time. Both models need to share a common description of the

road environment, such as road geometry, intersections, signs, limitations, etc. The standard and open RoadXML format was the perfect solution. SCANeR uses it as a native file format and import and export functions have been developed in Aimsun. Moreover, using RoadXML as an exchange file format allows users to import, create and edit complex road networks through SCANeR studio terrain and Aimsun tools. For example, users can import the SCANeR database in Aimsun and prepare a complex traffic situation, or export a network from Aimsun, import in SCANeR studio and generate the databases needed to drive in the virtual environment – a 3D database for the visual module, road description for dynamic vehicle road-query, and road network description for the SCANeR traffic module. ○

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TSS
www.aimsun.com
Oktal
www.scanersimulation.com
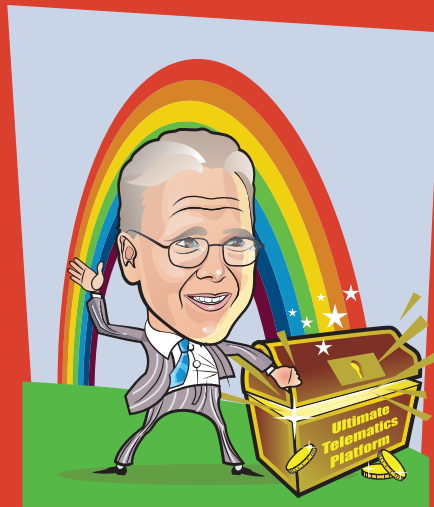
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There is a glaring difference between collecting fuel taxes and collecting road use taxes. To collect fuel tax, governments tapped into existing fuel distribution infrastructure for a near-free collection platform. Relative to any of the current proposed approaches to collecting road use fees per vehicle (RFID/DSRC, GPS, cellular, camera, OBD, odometer, vignette), collecting at a small number of fuel distribution nodes is smart, easy and cheap.

Shifting tax from fuel consumption to road consumption is all uphill. The tax collector's business model is to build an elaborate, dedicated, complex, confusing, and expensive infrastructure that is subject to greater user resistance and mischief, to collect a few dollars a week from each vehicle. This is a terribly complex operation for a small amount of money.

This is why the economically inefficient fuel tax is preferred, why even less efficient sales taxes and property taxes are preferred, and why the USA is currently back-filling sagging fuel tax revenues from the General Fund. Pretty much anything other than metering each vehicle is more expedient to administer.

If vehicles already had a reliable telematics device running a number of desired and indispensable applications – comparable in importance to having fuel in your tank – it could carry an embedded road use meter and become the collection platform for the replacement of the fuel tax.

We already know how to make such devices. But we don't make them coveted and indispensable. We are missing a pre-existing, easily exploited, free collection platform to rival the fuel distribution platform governments used over the past century. This is why building a dedicated telematics tax collection infrastructure that reaches into every vehicle is wrong headed. And this is why promoting telematics systems for safety, convenience, traveler services, parking payment, PAYD insurance and infotainment – systems that can carry road-use metering functionality at little or no extra cost – should be the first order.

Such systems can be made desirable, useful, reliable and nearly self-enforceable. They can make our roads safer and less congested, drives more pleasant, trips more efficient, and save almost all of us money. Much more importantly for funding, demand management, emissions management and oil independence, such systems can provide the basis for private enterprise to offer profitable and competitive services, just as fuel distributors offered profitable and competitive services a century ago.

If markets for telematics-based parking and insurance metering, safety systems, traveler services and infotainment were standardized, encouraged, and regulated or legislated in smarter ways, private enterprise would build the telematics platforms governments could then exploit to collect road use fees while avoiding system operational costs of dedicated road tolling – the same thinking used to exploit the fuel distribution system a century ago.

> " If vehicles already had a reliable telematics device running a number of desired and indispensable applications, it could carry an embedded road use meter and become the collection platform for the replacement of the fuel tax

Bern Grush, chief scientist, Skymeter Corporation, Canada

READER ENQUIRY NO. **506**

Law enforcement officers can view valuable LPR data on their in-car computers

ALPR upholding the law

Law enforcement has entered a new era with the development of ALPR technology – and it's proving to be an incredibly empowering tool. Elsag North America develops and manufactures one of the world's most advanced ALPR systems, the Mobile Plate Hunter-900 (MPH-900). The product is being embraced by law enforcement agencies around the world as it raises officer efficiency and safety, while identifying vehicles that are wanted by authorities for infractions, misdemeanors and serious crimes. Scofflaws now have a harder time hiding, drivers with unregistered vehicles and suspended licenses stick out from the masses like neon lights, and criminals are being apprehended faster with indisputable probable cause provided by the system.

Reading license plates

On the MPH-900 ALPR system, two cameras are mounted to the exterior of a police vehicle, which are aimed at the license plates of cars on both sides of the patrol vehicle. These digital cameras take up to 3,600 photos a minute of license plates on cars coming and going, stationary or moving, at up to 140mph (225km/h). A processing unit housed in the back of the vehicle uses

Need to know?

The MPH-900 operates behind the scenes, allowing officers to keep their hands on the wheel and eyes on the road

> Real-time technology greatly increases the odds of resolving issues
> Captures up to 3,600 license plate reads per minute, accurately recognizing plates from all 50 states, Canada, Mexico and many Arabic characters
> Processes parked and moving vehicles across up to four lanes of traffic, day or night, in any weather
> Alerts officers of suspect vehicles in milliseconds

Vehicle-mounted LPR units are a popular tool for law enforcement

sophisticated algorithms to isolate the plate in the photo and accurately translate the individual characters into a series of letters and numbers, such as BD51 SMR, for example.
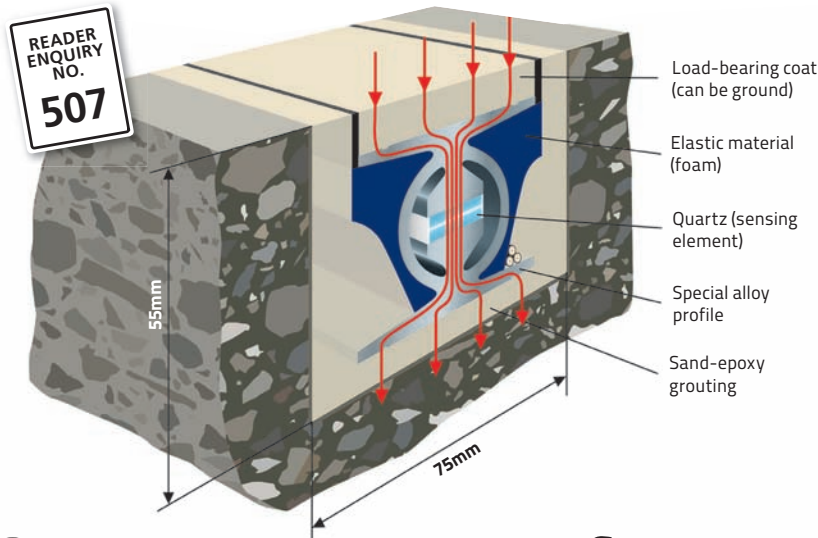
Identifying suspect vehicles

Once the license plate is identified, it can be compared to a 'hot list' of suspect vehicles that was loaded to the officer's in-car computer at the start of a shift. This hot list is a database of suspect vehicles associated with all sorts of infractions and crimes, from unpaid parking tickets and suspended licenses to unregistered vehicles and wanted persons. If license plate number BD51 SMR is found on the hot list, the MPH-900 instantaneously – within milliseconds – sends audible and visual alarms to the officer via the computer. On screen, the officer can see a photo of the suspect vehicle and its plate number, as well as hear the type of illegal activity that is associated with the car. Officers can also see which camera captured the photo, allowing them to quickly find the suspect vehicle and stop it.

The accuracy of the recognition is what makes the system such an appealing tool for law enforcement authorities. It can identify similar-looking

characters in any color combination, day or night, in any weather. When the system alerts an officer that he has just passed a vehicle suspected of being involved in a kidnapping, the officer can depend on that information, saving time and allowing him to prepare safely for the confrontation.

The Elsag Operations Center (EOC) software can help a law enforcement agency's central command center organize their ALPR efforts. By using EOC, an agency's central command center can communicate with all police vehicles equipped with the MPH-900, updating hot lists on the in-car computers and also downloading the data collected by the ALPR system. For each license plate read, the MPH-900 captures a photo of the vehicle and its immediate surroundings along with the date, time, and GPS coordinates associated with the suspect vehicle when the photo was taken. Vast quantities of information are collected quickly. The EOC software saves this information and allows law enforcement to access and review it at a later time. Analysis of this criminal intelligence information can help track suspects, stop crime rings, aid watch list development, help identify a witness, and even place a suspect at a scene.

In working closely with partner agencies, Elsag is still discovering ways its ALPR technology can help with custom solutions to unique law enforcement challenges. Cameras mounted to fixed structures can help monitor important areas such as ports and drug-trafficking corridors. Geofencing technology can keep schools and other sensitive areas safe while there are increasing numbers of covert applications of the MPH-900 in use today. ○

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READER ENQUIRY NO. 507

55mm

75mm

Load-bearing coat (can be ground)

Elastic material (foam)

Quartz (sensing element)

Special alloy profile

Sand-epoxy grouting

Lineas is a quartz sensor to measure the wheel and axle loads and to determine the vehicle gross weight under rolling traffic conditions

Quartz sensors for WIM

Weigh-in-motion (WIM) is the only technology to provide an accurate insight into the weights and axle loads of passing vehicles without disturbing or interrupting the traffic flow. It also provides a great deal of extra information about the vehicles, including the number of axles, length, vehicle class, direction, speed, distance between vehicles, and so on. When combined with digital cameras, an image of the vehicle and its license plate can also be added to the measured data. All in all, WIM has proven to be a powerful technology with applications in many areas.

Road design/maintenance

The magnitude, frequency and distribution of the weights and axle loads of traffic are key factors to determine the lifespan of road pavements and bridges. Engineers are interested in several aspects of the loading spectrum. Road engineers, for instance, are particularly interested in axle loads and lateral distribution, while bridge engineers have an interest in gross vehicle weight and longitudinal distribution. Both rely on detailed and accurate WIM data, which can be used in road maintenance planning, or in the strength assessment of bridges. Over the years, the information provided by WIM

ⓘ | **Need to know?**

The widening scope for weigh-in-motion technologies utilizing quartz-based sensors

> Lineas is a rugged, reliable, maintenance-free quartz sensor, ensuring precision, stability and long life
> Sensor is integrated into the road surface for permanent installation
> Wide measuring range, from slow- to high-speed traffic situations
> Quick and easy installation, as well as being adaptive to different pavement characteristics
> Sensitivity is virtually independent of temperature, time, and speed

When a force is applied to the sensor surface, the quartz disks yield an electric charge proportional to the applied force through the piezoelectric effect

systems has become a standard input in many road pavement and bridge design codes.

Overload enforcement

Overloaded trucks result in considerable extra costs for maintenance of the damaged infrastructure as well as increased traffic risks and unfair competition between transport companies. WIM system data, however, can assist enforcement agencies in achieving the required reduction in overloading. Even without digital cameras, WIM data can be used in the planning of police controls (place and time).

Another well-known application is the preselection of overloaded vehicles. In this case, the WIM system is installed before a regular (static or low-speed) weighing station. The advantage here is that only overloaded trucks are diverted to the control site, which results in more efficient controls and reduced disturbance for the correctly loaded trucks.

Recently, there have also been a number of initiatives in various countries to introduce WIM systems for direct, automatic enforcement of overloading. In this case, a fine is based directly on the measurement of the WIM system and automatically sent to the offender.

Tolling

Toll fees should be based on the vehicle weight and the axle loads. Currently, fees are mostly based on the distance traveled and the vehicle class, generally a combination of the number of axles and vehicle profile. A higher number of axles of a vehicle usually results in a higher fee. But this type of tolling actually stimulates overloading and, consequently, an increase in maintenance costs. As the pavement damage is proportional to the fourth power of the axle load, toll operators are increasingly switching to weight-dependent vehicle classes. This is based on the cost-by-cause principle which is fairer for both the road users and the toll operators.

Sensor technology

All of these applications rely on a constant quality of the WIM data. But high-quality WIM sensors are also essential. The Kistler Lineas WIM sensors are based on quartz technology and provide unparalleled accuracy and stability over time. Small quartz sensing elements are integrated into a compact construction. Wheel loads are accurately measured without being influenced by speed or temperature. The several sensor lengths available (1.5m, 1.75m and 2m) provide full modularity to instrument a traffic lane. The installation can be performed quickly and easily without heavy machinery. These sensors have proved to be rugged and reliable in hundreds of installations in diverse environmental conditions, and stand out due to their fine accuracy, stability, long life and temperature independence. Moreover, they can be installed in all types of pavements and provide accurate weight data at any speed. ○

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READER ENQUIRY NO. **508**

IP trend in modern plate recognition cameras

In order to accurately read a vehicle license plate, it is crucial to have the best possible image of the license plate from which the reader will work. Employing conventional security or surveillance cameras for license plate capturing will provide good results under ideal conditions, such as diffused sunlight. There are, however, conditions that cause a severe degradation of image quality and a subsequent reduction in accuracy. Headlights and/or brake lights can dazzle the camera, for instance – as can strong sunlight, which equally might also place the license plate in the shade. Strong reflections can also result in 'glint', while rain or other environmental conditions can obscure the view entirely.

Several vendors on the market have developed proper license plate recognition (LPR) cameras to ensure that the plate image is clear and bright, even in such adverse conditions. Most LPR cameras are analog and most recognition software still requires a frame grabber card to convert the analog video signal to digital. Regardless, IP LPR cameras have become accepted by the security industry now that some vendors are able to offer networked ALPR cameras.

An IP camera is one that digitizes and processes analog images, encodes them internally and then transmits the video

ⓘ | Need to know?

Top tips to transition from analog to a digital IP-based network ALPR system

> Combines latest camera, optics, illumination, and filter technology to provide clear images of license plates during day and night
> IP LPR cameras offer the ability to use an existing network wiring infrastructure to support a recognition system
> WalzCAM comprises a high-resolution monochrome CCD camera with high sensitivity in the infrared, surrounded by 240 IR LEDs

BT 478LX

information digitally over an Ethernet connection to a computer. IP cameras are equipped with an embedded web server and can be accessed and controlled over any IP network, such as a WAN, LAN, intranet or internet. By utilizing a standard web browser or client software, users can view an IP camera's video output from any local or remote location.

Most ALPR software managers can only be interfaced to analog cameras. So when and how do you make the transition to IP plate recognition software? Is it a quick changeover? When does a security manager or system integrator know when to make such a move? Knowing how to execute and navigate the transition from analog to network plate recognition cameras is a critical business decision. But the following key strategic points could help smooth such an evolution, as well as shape the timing and execution of transition tactics.

A first strategic point
The larger the area upon which the license plate recognition cameras are secured, the more valuable an immediate transition to IP ALPR cameras will be. As a result of the intrinsic limitations of coaxial cable, when the area or the facilities in which the cameras have been installed become too large, the costs of

system installation increase dramatically. To illustrate this point, consider large parking lots or extended restricted areas to enforcement, such as campuses, municipalities, and military bases. Low-cost coaxial cable runs could not solve the problem. For medium- and large-scale projects, you can save US$1,000 to US$4,000 per camera relative to analog long-distance transmission systems. Moreover, if you can eliminate trenching, the cost-savings are even more. Another advantage of IP plate recognition cameras is the capability to use an existing network wiring infrastructure to support a plate recognition system.

Strategic point number two
Another important advantage of using IP-based plate recognition cameras is that each single camera outputs 25 frames per second (fps). Although for modern plate recognition software, more frames means a greater number of chances to come up with an automatic plate reading (especially for high-speed traffic), attaining such a level of frame numbers per channel by using a frame grabber card is still possible – but more expensive.

There are in fact plenty of cost-effective four-channel PCI grabber cards available on the market that capture 25fps. Nevertheless, when four

Intertraff has developed WalzCAM to ensure that ALPR images are clear and bright, even in adverse conditions

cameras are connected to those grabber cards, the number of frames per second each camera moves to the recognition engine through the frame grabber is not greater than 2-3fps. Such a low number of frames may still be suitable for access-control applications in which the speed of the car is pretty low, but this is not applicable for high-speed traffic scenarios.

A third strategic point

In the event that the plate recognition system must be integrated within a Digital Video Recorder (DVR) system, proper IP-based ALPR cameras can really make the integration process easy and achievable.

For IP-based cameras with embedded plate recognizers, the number of such cameras that can be interfaced to a DVR system is unlimited as **all of the** processing resources necessary to extract the license plates from the flow of images is located within the plate recognition camera itself. By doing this, the workstation processing power in the DVR will not be jeopardized by the 'integrated' plate recognition subsystem. ○
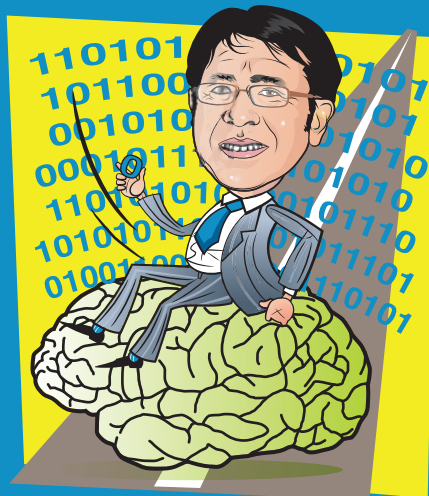
misener@path.berkeley.edu

And you may find yourself behind the wheel of a large automobile…
And you may ask yourself
How do I work this?
(Lyrics from *Once in a Lifetime*, Talking Heads, 1984.) I've been ruminating the purported subject of this column, the Smart Car. (Note the reverent proper noun.) When I began writing this column a number of years ago, the primary definition of a Smart Car was rather clear to me and most readers of this magazine. The Smart Car was loaded with gadgets and gizmos, all aimed at making driving safer and convenient. Ergo, the Smart Car was, um, smart. And safe.

However, the confluence of public awareness, product rollout, and research over the past several years has morphed my hitherto clear understanding and definition of Smart Cars. And certainly, my potpourri of editorials addressing the topic du jour has blurred my personal definition. To recount, topics covered in this editorial have included product innovations in safety, 'active safety', the role of communications from the roadside in our Smart Car ecosystem, automated and cooperative vehicle-roadside systems versus autonomous vehicles, the growth and use of nomadic devices before and during driving trips, increased awareness of vexing problems in driver distraction, the burgeoning eco-driving movement,

the virtues of transit and the complexity of software in our vehicles, family vacations and, of course, random song lyrics. That's a broad range of topics, delivered in admittedly sometimes sugary and sub-500 word chunks.

These topics were and are topical. (Yes, I drive and write circularly.) It is noteworthy that a number of years ago, many of these subjects would not have hit the mark as Smart Car topics. My point? As reflected by the evolution of my column, the transportation world is also and clearly evolving. The interface between the car and the road used to be the rubber tire and the road. Now it's complex and involves wireless communication and the ever-growing need to capture the driver and his/her brain in light of all those smart gadgets.

Similarly, the interface between the car and the driver used to be the primary (driving) controls. There were some Smart Car autonomous sensors providing warning and in the background some ancillary and seemingly innocuous controls for climate and audio entertainment. Now that interface is so very complex because it involves communication and the roadside – and of course, the driver's brain. Yes, there's more to a Smart Car for sure: more gizmos, more services, more complexity, more interfaces and more competition for cognition and attention.

So for good or bad, those interfaces and our collective understanding of them have broadened, and the Smart Car has become more than a philosophical and iconic symbol of our connected-by-transportation world. It's now part and parcel part of that world, and that world has in turn entered our Smart Car.

What does this bode for our future? I only wish I knew. I am but a not-so-smart editorialist, writing about an oh-very-Smart Car. I leave you with some more lyrics, again from the Talking Heads' 1984 melody, from *Once in a Lifetime*,
And You May Ask Yourself
Where Does That Highway Go?

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" The confluence of public awareness, product rollout, and research over the past several years has morphed my hitherto clear understanding and definition of Smart Cars

Jim Misener, executive director, California PATH, UC Berkeley, USA

LEDs take to the streets

READER ENQUIRY NO. **509**

Today's LED-based lighting systems are a step ahead in terms of quality

Over the past few years, LED-based lighting has become popular in the traffic community due to superior performance when compared to traditional light sources such as incandescent and fluorescent technologies.

When considering whether to install LED lighting systems – or even to replace traditional lighting with LED – there are several considerations to be taken into account. The first question to ask is why choose LED lighting? A common reason is its long operating life. Today's LEDs last for around 20 years in real-life conditions without requiring regular maintenance, which is in contrast to high-pressure sodium (HPS) lamps that require scheduled regular bulb changes, usually every five years or so. The cost savings in this regard are evident. Secondly, LED-based systems are able to achieve the same or better illumination performance as HPS lamps, while consuming up to 50% less energy. Finally, LED light sources emit white light, which a recent study[1] indicates can double a driver's peripheral vision and increase braking reaction time by 25%.

Such features combined make LEDs a very attractive alternative for roadway illumination. The ability to provide energy savings while potentially also increasing road safety are pretty compelling arguments in favor of LEDs.

Telegra, however, believes it has moved a step ahead in the design of LED lamps. Its new Lightway IQ range is tailored to meet customer needs in every aspect – from their scalable size to the advanced features on offer. A range of improvements have been incorporated to create a complete LED lighting system that truly requires less power than the best available High Intensity Discharge (HID) lamp lighting systems.

ⓘ | Need to know?

When deciding the best light source to use for roadside projects, it pays to consider LEDs

> Issues to consider when deciding the most appropriate lighting source for your project
> The benefits of LED-based lighting systems compared to alternative light sources
> Range of LED lamps designed to save money and maintenance
> Improved illumination, lifecycle and intensity

Return on investment

Another important aspect to consider is the cost of running LED-based lighting. Telegra's lamps are designed to save money via their energy-saving features and low maintenance costs. Maximum light intensity or shut down is achieved instantly, without any delay for warm-up, which subsequently allows for flexible intensity regulation and savings.

The company's calculations show that after an HPS lamp bulb has first been replaced (after approximately five years of operation), the initial investment in a Telegra LED lamp may already have been returned, while after the second replacement (after 10 years), the

user may not only have had his investment returned but have earned around an extra US$500 per lamp. Easy maintenance is achieved by quick plug-and-play electrical module replacement without needing special tools.

Furthermore, Lightway IQ lamps are compliant with the Restriction of Hazardous Substances (RoHS) directive, are free from mercury and lead, less attractive to insects as they emit less UV light, and also produce less light pollution on the surroundings.

With all of these factors considered, ultimately you want to know whether or not it's worth choosing LED-based lighting. Telegra believes the answer is now yes. Even high-power HPS lamps (up to 400W) can be replaced with Telegra's lamps, which offer twice as much power than standard LED lamps. Lightway IQ lamps are also built to last, with the light engine designed to preserve a minimum of 70% of initial intensity after 70,000 operating hours on full intensity, even at 25°C. In average ambient temperatures of below 10°C – and with intensity regulation in use – this figure can increase to more than 100,000 hours.

High-efficacy LEDs are used that come with a manufacturer-guaranteed minimum efficacy of 140 lm/W – around 20-30% more than other LEDs presently used in luminaires.

Another important value that can be achieved is an additional

reduction in operating costs via flexible dimming algorithms, which are integrated with ATMS through topXview, Telegra's software platform. Adjustable intensity based on traffic and environmental data increases driver safety by providing the necessary intensity in cases of higher traffic volumes, incidents, bad weather, etc, while decreasing intensity when the maximum is not needed, such as late at night when there is less traffic.

A wireless communication option is offered as a precise alternative to control via the power line. This communicates to the control device using the wireless ZigBee interface, providing a reliable and flexible connection. A wireless-enabled control device is installed in the field cabinet and can control a group of lamps up to 1,000m. The control device can be connected to Telegra's control system or act as a standalone controller equipped with a clock and illumination meter. ○

[1] Bullough J, Rea MS and Akashi Y, *Several views of metal halide and high pressure sodium lighting for outdoor applications*, Lighting Research and Technology, 2009

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The future of vehicle identification for law enforcement

License plates have been the primary means of identifying vehicles for more than 100 years. In most current systems, only once a vehicle is stopped can law enforcers determine if the plate belongs to a vehicle by checking the licence disc and the VIN, and subsequently referring to a central database. There is no reliable means of determining solely from the face of a plate if it was legitimately issued.

The increasing use of cameras to detect traffic infringements, and criminal activity involving vehicles, relies heavily on the license plate to provide identification for apprehension and prosecution of offenders. Government jurisdictions can benefit significantly with the introduction of a passive RFID component (RFID tag) on a vehicle license plate. This is not the tag of science fiction – containing personal information and owners' DNA profile – but rather an ingenious use of technology that many people aren't even aware is already deeply entrenched in our lives, posing no risk to individuals.

An embedded RFID tag allows for immediate off-line

Secure sequence of vehicle identification

Secure manufacture (secure electronic plate) → Secure issuance (plate trust center) → Field verification (stationary and mobile)

Secure database
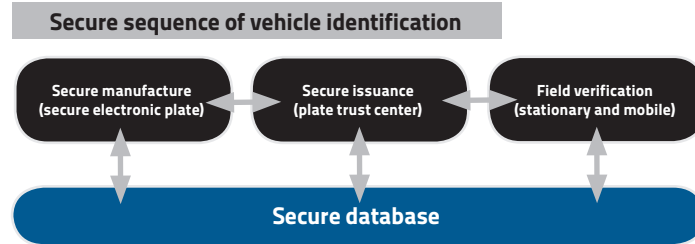
verification and authentication of plate issuance, making the plate once again a highly reliable vehicle identifier.

The RFID tag acts as an enabler of a secure electronic system which allows for critical non-personalized plate information, such as a unique identifier UID, manufacturer's details, plate number, expiry date, and validation date.

This information is securely stored on the license plate and be easily accessed by law enforcement and other authorized agents. The integrity and authenticity of the information on the plate is secured with Digital Signatures, which in turn enable simple low-cost law enforcement access and use.

An additional benefit of the inclusion of the RFID tag is that it enables the tight management of the plate manufacture and

issuance process. This is particularly relevant in jurisdictions where plate manufacture is available through multiple sources or there are compliance issues with a vehicle class for example heavy vehicles.

License plate issuance is often not regulated allowing for the production of duplicate or false plates. Number plate issuers will no longer be able

to operate with invisibility and impunity, and will be held liable for transgressions whether intended or not.

By shifting the law enforcement process from a visual process to one of captured electronic data, any irregularities in the process of law enforcement of plates is made transparent, in doing so significantly reducing unintended or intended abuse of the system from within. This also enables measurement of performance in the field.

The application of RFID technology to the manufacture, issuance and identification of license plates greatly enhances the security and validity of the plate as the primary vehicle identifier. This technology automates the digital validation process for law enforcement agencies, which results in a far more effective and secure identification capture process for non-compliant vehicles.

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Assessing the impacts of speed enforcement programs

Speed camera technology has evolved greatly in recent years. So how many lives have the cameras saved and what has the economic impact been?

Redflex Traffic Systems is a global player in traffic enforcement technologies and has seen the deployment of its systems change driver behavior.

Redflex is not alone in its theory on the effectiveness of speed cameras in lowering crash rates and reducing fatalities. It is backed by research conducted by a range of international studies.

For example, an evaluation of speed camera effectiveness in the UK in 2005 showed that cameras were saving around 100 lives a year.

Cameras reduce speed, which helps to reduce crashes. This was demonstrated in Maryland, USA, where the proportion of vehicles going more than 10mph faster than posted limits fell by 70% on roads where cameras were operational, and by 39% on roads with signs warning of enforcement. Redflex believes its systems offer constant enforcement of high incident areas and promote a long-term change in behavior.

The revenue received from cameras is a fraction of the overall cost of speed-related crashes. In Victoria, Australia,

speed camera and on-the-spot fines amounted to around A$400 million (US$392 million) in 2008-2009. The cost of road trauma amounts to around A$3.8 billion (US$3.7 billion) per year. Redflex believes the economic impact of its systems is giving back billions of dollars to tax-payers by reducing accidents.

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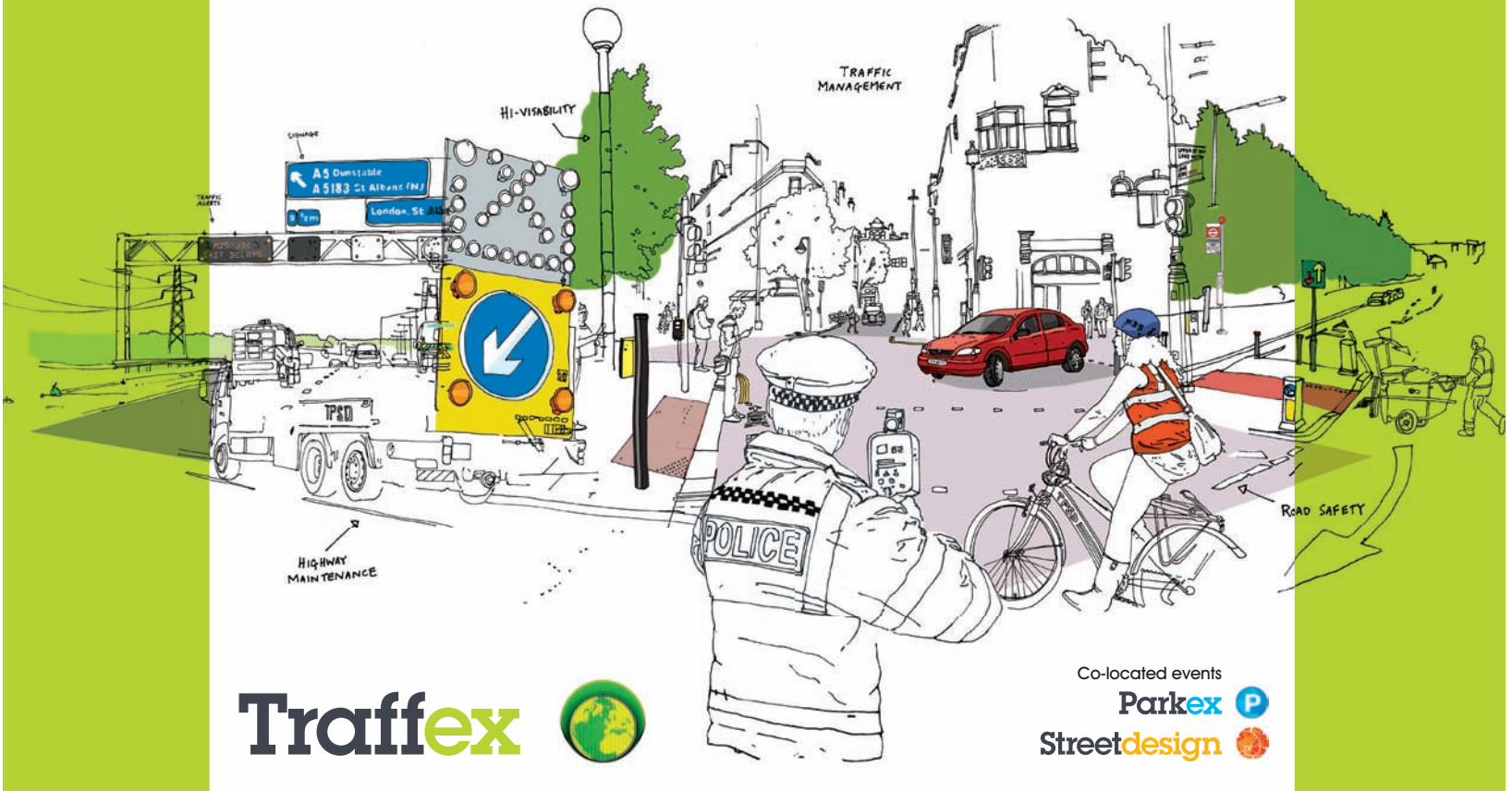tabitham@redflex.com.au
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What road weather management strategies can we put in place to lessen the impact of severe weather on mobility?

A "We need to analyze how severe weather affected the roads in years gone by to help understand what was and wasn't avoidable. Was the VMS used properly? Did radio inform about the weather forecast? Also, integrating meteorological sensors with advanced warnings through ITS is essential. Effective road markings are also key. In the future, though, we can expect that real-time GPS information integrated with next-gen vehicle systems communicated by WAVE will prevent many accidents."

Enrique Gómez González
SICE, Spain

A "We need to provide improved road and atmospheric hazard products to road maintenance operators and the traveling public. With funding and support from the USDOT RITA IntelliDrive initiative and direction from the FHWA Road Weather Management Program, we're conducting research to develop a Vehicle Data Translator (VDT) that incorporates vehicle-based measurements of the road and surrounding atmosphere with other, more traditional weather data sources."

Sheldon Drobot
NCAR, USA

A "MDSS is one of the biggest things we've seen emerge in road weather management – a computer-based program that combines weather forecast, road weather forecast and rules of practice to present a recommended action. It doesn't make decisions for you but it takes weather information and presents it in a transportation context. It puts the forecast into a treatment action – i.e. you should put down this amount of material on this route. What it also includes is the ability to enter 'what-if' scenarios, so if you're not sure about the advice, you can pose alternatives and plot out the projected outcome if you took one course of action over another. It gives maintenance crews the ability to compare alternatives and make the best decision based on that. With maintenance you've got to be conservative – you've got to err on the side of caution as you don't want to create an unsafe driving environment. But with limited resources, this is a very challenging position to be in. MDSS helps them get through the process better."

Paul Pisano
Road Weather Management Program, FHWA, USA

A "Optimizing the salt supply is key. It makes sense to have lots of stores around the counties so you can get to it quickly. If a snow event suddenly comes in during in rush-hour (it's the snow events that are most problematic), getting your gritters from A to B in a lot of traffic while snow is falling is a nightmare. You need to be out there actually tackling the problem there and then, but if you're continually going from one side of the county to the other, you've got a problem. Logistically it makes a lot of sense. But snow is often forecast with such bad probability; you can a level of confidence in a forecast, but there's no guarantee snow will fall. I feel like I should say the Highways Agency and Local Authorities in the UK are more geared up for it this year. But they should have been more geared up for it last winter because they'd been through it the year before. Also there's less money knocking around. It's really difficult and it's not anybody's fault, they do a great job out there but their hands are tied. The main thing is getting salt down in the first place – getting it down and hoping it stays down and does the job."

Dr Lee Chapman
University of Birmingham, UK

A "You can't have the same safety and mobility in the winter as in summer unless you use salt. That's the bottom line. But because salt is cheap, it's never really regarded as strategic. So what happens is nobody builds any infrastructure to be able to store it close to where it's going to be used. Road authorities have depended too much on the salt companies' infrastructure for salt storage. In the middle of winter, it's the hardest possible time to be able to get a quick delivery when you need it. We're advising people to start putting some money into infrastructure. You'll ultimately save from being gouged by agents in the middle of winter who happen to have a stockpile and are going to charge you double or triple. You have to make the investment because it's your responsibility to keep the roads clear. We've had a couple of really bad winters here in the USA, so we've noticed there's more and more storage being built closer to the scene of the action – and that's really good. It helps our producers as they're able to run deliveries throughout the season so that when winter begins all of the stocks are full. That's the ideal situation and we can thus have a rational delivery schedule. Anti-icing is also really taking off in North America, which is a much more efficient use of the resource."

Morton Satin
vice president, Science & Research, Salt Institute, USA

Readers are invited to answer the Burning Question for the January 2010 issue:

With distrust on the user side – and perhaps caution on the operator side – what more can be done to fully utilize the potential of our deployed VMS systems?

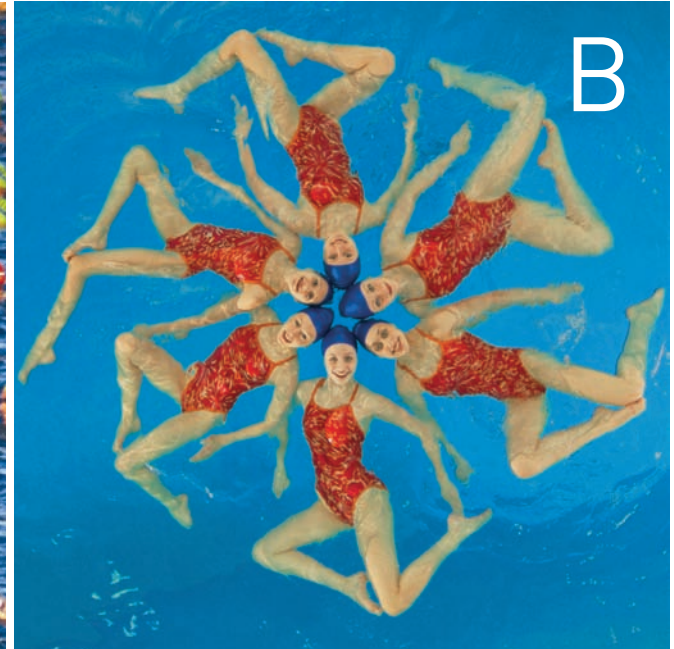**email answers to:**
l.smyth@ukipme.com

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A — Swimming. A healthy sport...in this case a little bit too chaotic. There are too many disorganized swimmers and a danger of injuries is present.

B — Swimmers. Synchronized. Executing harmonic figure. A circle, the complete one.

COMPLETE?

Q: It is quite obvious where the harmony and swimmers' complete coherence are present. When it comes to more complex systems, like ITS, the real question is: how to achieve needed ultimate synchronization of all subsystems and to provide the complete solution for all your needs?

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