Local Authority Guide to Emerging Transport Technology

A guide to help Local Authorities plan, specify and procure new systems, make informed decisions, choose the right technology and know the right questions to ask their consultants and suppliers…
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ITS United Kingdom is the UK organisation for all who work in ITS. It is a not-for-profit public/private sector association financed by members’ subscriptions. ITS (UK) provide a forum for all organisations concerned with ITS.

ITS (UK) works to bring the benefits that ITS can offer in terms of economic efficiency, transport safety, and environmental benefits to the United Kingdom. The membership, over 160 organisations, comprises Government Departments, Local Authorities, Police Forces, transport operators, consultants, manufacturing and service companies, and academic institutions.

New members are always welcome and benefit from activities including seminars, workshops and regular news dissemination. ITS United Kingdom encourages discussion on issues such as public/private co-operation, standards, legislation, information provision and new technology.

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Foreword

Local Authorities face a number of challenges to deliver the transport systems that their users need in a demanding financial environment. Recent advances in technology, in the transport domain and elsewhere, offer an opportunity for operators to deliver these services more effectively and efficiently. However, exploitation of new technology is often held back by a number of challenges, ranging from lack of awareness of the art-of-the-possible to the need for new, more flexible procurement models.

The rate of technological change continues to increase, particularly in the telecommunication and computing sectors, and ‘Big Data Analytics’ and ‘Cloud Computing’ are seen as game-changing technologies in a range of sectors. Transport is one of the areas where the explosion in the availability of data and the ubiquitous connectivity of devices can enable new ways to provide service more quickly, efficiently and cost effectively than ever before. Deployed correctly, these technologies present an opportunity to revolutionise the UK transport system much of which is owned and delivered at a local level.

This document is aimed at a Local Authority audience and highlights some of the advantages new technologies can bring in solving existing and future transport problems. It also discusses some of the important issues when implementing these new solutions, including open standards, security/privacy and procurement. The report contains a number of examples, from across the UK and Europe, where new technologies are being used in the real world. These examples illustrate the art of the possible and show that many of the benefits technology can bring are being realised today.

I welcome this document from the IET and ITS(UK) and hope it will act as both an introduction to the potential new technology for local transport, and encourages Local Authorities to consider some of these new approaches when looking at ways to improve their transport systems.

Dr Miles Elsdon
Chief Scientist, Department for Transport
1. Introduction

What are the most important emerging transport technologies and how do they influence current and future infrastructure developments? The purpose of this publication is to enable informed decisions to be made by promoting the capabilities of these new technologies.

This document:
- Identifies the key challenges facing local transport
- Describes how technology that is available now and technology that is becoming available can help to address these challenges
- Discusses business models
- Provides examples of implementation.

Some technologies are the product of research and development whilst others have evolved through implementation, experience and evaluation. In either event these technologies are intended to enhance travel by delivering effective and efficient solutions to transport problems.

Until recently technological solutions to transportation challenges were often inhibited by the inability to process large volumes of data; however, ever-increasing computer processing power (including ‘Cloud Computing’ structures and systems) has virtually removed that problem.

This computing power and the connectivity of everyday technology is a driving force of change and is helping to shape innovative modal options such as ultra low carbon, sustainable transport, connected and autonomous vehicles, High Speed 2 and the ‘Managed Motorways’ programme.

In addition the ubiquity of personal smartphones is further fuelling the demand for 24/7 connectivity. This demand for “real-time” information is a fundamental part of the broader “Smart City” concept.

Demand for these technologies is now global. International, national and local trends are all influential and, as countries emerge from the recent recession, the demand for growth and productivity is being put to the forefront. Budget restraints are necessitating a leaner and fitter approach to traditional systems and “getting more for less” is a widely used phrase.

As countries return to productivity after a period of recession there is often an increased demand for transportation. Capacity is placed under strain as the after effects of lack of investment appear; however, the necessity to exploit the full capacity of the existing transport infrastructure requires a more innovative approach that looks across all modes. Politicians and policy makers need to be aware of the emerging intelligent transport options that can be used to maximise capacity on a finite transportation network.

This report looks at the emerging technology that is being implemented in transport systems currently by some Local Authorities but will become widespread in the next 5 years. For more detail of present day technology, this report should be read in conjunction with the 2014 ITS (UK) “Blue Book”, guide to deployment, business cases and funding.
2. Local level policy challenges to an integrated ITS

Local Authorities are increasingly looking to technology to assist in meeting policy objectives that meet local requirements and are cost effective.

There is a growing understanding among policy makers and engineers that new technologies offer opportunities which extend beyond the traditional ways they have been used in the transport sector. Increasingly, opportunities to transfer technologies from other sectors are being realised to deliver greater benefits through reduced capital and operational costs.

Three key policy areas where new technologies have the potential to change the way services are delivered include:

2.1 More for less

Local Authorities are under continuing budgetary pressure and face an ongoing requirement to reduce their expenditure. Even where grant funding is available to procure and implement new schemes and initiatives (as is often the case), pressure remains to reduce on-going operating costs.

Against this background there are also increasing pressures on Authorities to address issues such as congestion, access to public transport, air quality, infrastructure for electric vehicles and better transport information provision.

Taken together these challenges appear contradictory - the need to address more policy objectives with less funding and staff resource. There is therefore, a strong desire in Local Authorities to better understand the ways in which new and emerging technologies can assist with this.

2.2 Engaging in new media

Increasingly it is becoming the norm for organisations to interact with their clients and customers using new media. Although this has primarily been seen in companies and organisations as a tool to target a younger audience, the growth in the use of smartphones and web enabled devices and increasing adoption of services such as instant messaging and social media is fast spreading this expectation to all social and age groups.

Users do not differentiate between the service they expect to receive from private sector companies from that of a public sector body, and so it is imperative that Local Authorities are able to provide information and promote their services using these tools. However, with limited resources available and (in many cases), limited understanding of new media within Authorities, it is often difficult to know how best to achieve this.

There is a need to inform Local Authorities of how best to utilise new media, how to automate such services and integrate them into existing systems, and how to ensure cost effective and sustainable solutions are used.

2.3 Transport network capacity

In most cases demand for transport, be it highway capacity or public transport, continues to increase. It is also the case that it is not generally possible to provide the increase in transport network capacity that this demand requires.

Authorities are faced with finding new ways of increasing levels of utilisation of the transport networks they already have, whether that is by better use of Urban Traffic Control to improve use of existing road space or better information provision to increase bus patronage.

Technology can play an important part in this and deliver significant improvements for a fraction of the cost of new infrastructure. Advances made in recent years in the use of digital communications to provide better monitoring and control across the network, and the use of data processing to analyse network conditions and suggest intelligent interventions are good examples of this.

There is a need to look more closely at the ways in which technology is being used in other industries and sectors and to identify opportunities where parallels exist and where these technologies can be used to improve the capabilities and efficiency of intelligent transport systems.
3. How technology can help

3.1 Technology as building blocks to services

Technology provides the “building blocks” of products and services that can provide benefits in the transport domain. In essence, technology provides the ability to:

- Collect data/information - from sensors on vehicles and at the roadside, and from communication devices
- Communicate data/information - from/to sensors, personal IT devices and the processing facilities
- Process information - using increasingly capable computing facilities and software
- Disseminate information - rapidly to travellers and to decision makers
- Automate processes - such that rapid, consistent and “intelligent” actions can be taken.

These components have to be engineered together to provide products and services aimed at benefiting transport users.

Advances in technology contribute to better tools to assist in monitoring what is going on in transport networks, predict what might happen in the future and provide the means to manage transport pro-actively and on an area-wide basis.

3.2 Benefits of technology

Increased connectivity has led to a major change in the options available for system-to-system communications. This has created new opportunities for integration and data sharing between various systems, even when they are in different Authorities or geographical locations. It can also address the need to do more for less by allowing different systems to be brought together and automated, or accessed through a single front end, to allow a single operator to handle multiple tasks.

Intelligent Transportation Systems (ITS) aim to integrate different transport modes to form efficient and seamless services that enhance safety, promote a cleaner environment and improve personal and commercial mobility. Using ITS can also help with the delivery of a wide range of policy objectives. It can help improve the environment by reducing the adverse effects of traffic, improve access, increase safety for road users and help meet the transport needs of all social groups.

ITS, when deployed in an integrated way, offer a strategic tool to help promote a more efficient and sustainable transport system. Having an integrated system and utilising information sharing gives:

- Greater coordination from area-wide strategies
- Better integration across modes and sub-systems
- Lower whole-life and operating costs and reduced resource requirements
- Better communication between Authorities and coordination of actions
- Partnerships, which can help reduce costs with public facing benefits.
Transport roadmap showing a selected timeline of transport technology and potential future transport technologies

- **1825**: Steam trains
- **1800s**: Clipper ships
- **321 BC**: Early paved roads (Appian Way, Rome)
- **2000 BC**: Chariots (Indo Iranians)
- **3500 BC**: Wheeled carts (Mesopotamia)
- **4000 BC**: Use of horses for transport
- **1780**: Bicycles
- **1900s**: Motor cars
- **1920s**: Motorcycles
- **1920s**: Electric trains
- **1940s**: Modern buses
- **1940s**: Electric trains
- **1920s**: Motorcycles
- **1940s**: Commercial planes
- **1900s**: Clipper ships
- **1800s**: Steam trains

**Timescale**
- **Previous transport technology**
- **Current transport technology**
- **Recently developed transport technology**
- **Future transport technology 5-15 yrs**
- **Future transport technology 15-40 yrs**

**Transport demand**
- **Transport demand estimated (future)**

**Future transport technology**
- **Self driving vehicles**
- **Autonomous vehicles**
- **Mobility purchasing**
- **National transport management systems**
- **Private space flight**

**Potential future transport technologies**
- **Electronic tolling**
- **Social networks and social media tools**
- **Prepay cards, e.g., Oyster card**
- **2002 - Segway**
- **1970s - Maglev trains**

**Introduction of SmartGrids**
- **Satellite control**
- **Inter-modal systems**
- **New vehicle ownership models**
- **Ageing population (maintaining mobility)**
- **Vehicle to vehicle (V2V)**
- **Vehicle to infrastructure (V2I)"
4. Security and privacy of data

Information systems need to be designed with an appropriate level of security and privacy protection built in - not added as an after-thought. It is important to recognise that addressing the privacy and security aspects of emerging information and communications technologies is key to maintaining public safety and confidence.

From a privacy perspective care needs to be taken in the way that information is released or used, particularly where it potentially includes personally identifiable information.

Some personally identifiable information is easy to recognise as it clearly identifies the individuals, however there is also a risk that release of poorly or partially anonymised data may lead to identification of an individual when data from multiple sources is combined. Failure to adequately address the protection of personally identifiable information undermines the trust of citizens and transport users, resulting in reduced uptake of services or an unwillingness to provide information.

From a security perspective the procurement of systems and services must address security in a holistic fashion. This should include appropriate measures to address the following system security attributes: confidentiality; possession and/or control; integrity; authenticity; availability; utility, and safety.

4.1 Difference between raw and processed data

When releasing data sets for public or commercial use, it is important to consider the nature and form of the released data. For example with travel cards, such as the Oyster card, the potential data sets include: raw, processed and summary data. Raw data is the detailed transaction data, i.e. a specific card touched in or out of the transport system on a date at a time.

Processed data may relate to a specific card or may be anonymous and likely covers a single journey. Typically this data set might comprise the date, start and end times, the journey (start and end points), the charge, and the location of the interchange - where the journey involves a transition between, say, over ground and underground.

Summary data is similar to processed data, but includes more detail for example, a count of the number of journeys and the start and end times. Raw data, and to a lesser degree processed data, have privacy implications as they may enable regular journeys undertaken by individuals to be identified.

For transport planning and route congestion monitoring the use of summary data is likely to be sufficient, with a sampling period of say 15 minutes during peak times, and 30 or 60 minutes outside peak times. The summary data would allow aggregated travel patterns to be assessed without compromising the security or privacy of individuals or groups.

4.2 Licensing and use of data

Release of Local Authority data as open data should be governed by a simple licence which clearly states the rights and responsibilities of the data provider and the data user. The licence agreement should be short (e.g. no more than 2 sides of A4) and in plain English. Topics to be covered in the agreement include use of data, rights, requirements, exemptions, non-endorsement, non-warranty and governing law.

An example of a requirement is placing a limit on the maximum number of data requests so that only a set number of data units are released per unit of time. The proposed licence may also stipulate to limit the feed access so that the authority has the right to manage the flow of data. This helps maintain service availability and minimises the service degradation. Another requirement from the data owner may be for data users to clearly acknowledge the source of the data in any outputs generated using it.

4.3 Benefits of open data provision

The benefits of adopting open standards as well as open source software cannot be overstated. Such approaches can typically lead to rapid innovation, reduce costs of ownership, and give significant business benefits from not having to install custom software for differing user platforms and avoiding supplier lock-in. However, it is important that good engineering and business practice is maintained in order to maximise benefits.

As with any modern information service, security is vital. This means systems are designed to:

- Prevent un-authorised access both from the client (user) end and the system administrator
- Communication protocols should be industry standard using secure protocol (such as SSL), where sensitive or authenticated data is being communicated
- Data generally available to the public should not contain sensitive or personal data
- Care should be taken to ensure any anonymised data cannot be used in conjunction with other publically available data to identify personal information or individuals.
5. Business models

Background

One of the major benefits of new technology is the ability to move away from traditional procurement and ownership models. In the past, it was necessary to undertake a capital purchase of the hardware required, acquire the necessary software licences and ensure sufficient on-going revenue (operational) funding was in place for future maintenance, licensing and asset renewal. This often placed a heavy burden on Local Authorities and could result in systems being operated well beyond their economic life due to the inability to fund their replacement.

As travel and transport systems become increasingly based around internet technologies, these traditional methods of ownership and operation become less relevant. As the traffic and transport technology industry adopts the approaches found in the internet and telecommunications industries; there is now the opportunity to buy systems as services, use remote hosting or ‘cloud’ solutions and rely on cheap communications media.

Procurement models

Where once it was necessary to buy technology as a capital procurement it is now common to see technology as a service that can almost be bought on a pay-per-use basis. Many suppliers can offer systems remotely hosted in secure, highly resilient data centres that rely on the availability of cheap, reliable Internet Protocol (IP) communications links. Systems can be procured through various business models;

- Revenue Only - many systems can be procured with no capital outlay and be fully financed through regular revenue payments. This allows systems to be procured based on a ‘Service Level Agreement’ (SLA) rather than a detailed technical specification. Through this method the responsibility for ensuring sufficient hardware is provided, maintained, renewed and operated reliably and efficiently, rests with the service provider. This model suits applications where the owner has access to revenue funding but not capital.

- Capital/Revenue Split - Many public bodies find access to capital somewhat easier through grant funding. This can be used to fund the ‘one-off’ set up costs of a new system and reduce the ongoing costs. The benefit of this solution is that by retaining an element of ongoing revenue commitment, systems can still be governed by a SLA, with future maintenance and upgrade costs built in.

- Shared Services - There is increasing pressure on public bodies to merge services and work together to generate savings. Through the use of IP and relaying datagrams across network boundaries, hosting systems far away from their users makes it possible for one authority to provide services for others. The move to virtualised servers, (where systems can be spread and balanced across numerous physical computers), means that it is practical for one organisation to provide the hardware to offer an agreed level of service to others. Such arrangements are becoming common in joint payroll and finance systems and are now possible for transport systems such as Urban Traffic Management & Control services.

- Guaranteed Income - there are some transport systems where an income can be identified to assist in operating costs. For example:
  - systems that generate revenue (website and mobile apps from which advertising revenue can be earned)
  - systems that have a revenue ‘through-put’ that can be utilised (car parking or smart ticketing solutions)
  - systems that generate valuable data (traffic monitoring systems that can provide data to commercial travel information providers).

This can result in systems becoming ‘self-funded’ with operating costs met from income. Also a ‘cap and collar’ arrangement can be used where levels of income below an agreed level require the short-fall to be shared between supplier and client and above an agreed level result in a profit sharing mechanism being triggered. This arrangement forms a strong link between system performance and profitability and can increases the impetus on suppliers to innovate to maximise income and ensure efficiency.

With any of these models it is essential that systems are procured based on a realistic SLA and an ‘outcome’ basis where the technical details can be left to the suppliers to decide. An outcome based procurement can free clients from the need to fully specify the technical details and can potentially encourage innovation from suppliers. However, it does mean that it is critical to ensure that the parts of the system that do need to be specified in detail, (interfaces with other systems, fixed data input and output requirements) are clearly identified.

Risk management

Risk is related to incentive, and the various methods of procuring systems incentivise suppliers differently and result in differing levels of risk being borne by each party. It is often sensible to procure emerging technologies as services with a defined contract duration rather than as an ‘up front’ capital investment and so it is important to ensure a procurement model is used that sufficiently incentivises the supplier to sustain support and maintenance throughout the lifetime of the system. Although buying a system with a single capital payment might seem an attractive and cheap way to proceed, it can result in a supplier that is less incentivised to continue to support and develop the system. A supplier who receives regular SLA based payments through the life of the contract, even though this approach might appear more expensive when tender costs are compared will be likely to deliver innovation and better long-term performance.

It is also important to ensure the expectations of the SLA used to manage the delivery of the service are realistic. Although it may appear attractive to write highly onerous requirements of the supplier into an SLA, delivery and operating costs will rise as a result. An example would be requiring 24 hour availability for a system only used during office hours.

By taking advantage of the opportunities offered by new technologies (remote hosting, hardware virtualisation, pay-per-use, etc), it is possible to reduce costs of operation or deliver far more innovative, versatile and ambitious systems than would otherwise be possible. However the risks involved in ensuring effective long-term support must be understood and suitable measures built into the procurement model.
6. Case studies

6.1 Use of RFID technology to help disabled crossing users

Background

For many disabled people, fear of crossing the road is a major factor that deters them from walking. At controlled crossings, people with disabilities can experience difficulty in locating and/or using the pedestrian push button unit and then crossing the road in the available crossing time.

In these situations there can be a benefit from equipping crossings with communications technology to detect vulnerable pedestrians and call the green man without requiring that they press any buttons.

Application of emerging technology

On-street trials at signalised crossings in Edinburgh have explored these types of emerging technology including the RNIB “React” system that use Radio Frequency Identification Device (RFID) communications and smartphone apps and Bluetooth.

On approaching a signalised crossing, an audible signal informs the user that they are approaching a crossing. The user then requests to cross remotely using the hand held device (i.e. trigger fob or smartphone). A confirmation message that the green man had been requested can be sent directly from the traffic signal or to the smartphone and earpiece.

Benefits

The technology was generally well received by participants. The equipment appeared to be readily understandable and easy to use.

The insertion of the pedestrian demand by the trigger fob and by the smartphone was very reliable and users reported that they were confident when using the crossing. Once the green man was called they crossed the road in a calm unhurried manner. Equally, the confirmation messages were very reliable. Most of the participants appeared to react positively to these features. The trial showed that such systems can improve disabled pedestrian’s experience of using signalised road crossings.

6.2 Using smartphones and tablets to better manage traffic technology in Dublin

Background

Dublin City Council is the largest Local Authority in Ireland. One in four of the Irish population live in or around Dublin, necessitating the need for an effective transport infrastructure. Dublin has invested significantly in ITS over many years, including the installation of Sydney Co-ordinated Adaptive Traffic System (SCATS) in 1989, through a comprehensive programme of CCTV, automatic number plate recognition, vehicle detection, emergency telephones, access and lane control and variable message signing installations. Data from various sources in the city can be utilised to create an effective traffic management system that will improve transport efficiency in the city.

Application of emerging technology

Dublin City Council has recently installed a new web-based system for the improved management of the fault life-cycle of traffic equipment. This is maintained by in-house staff and third party contractors throughout the region, including the use of smartphone apps and tablets that enables significantly improved service delivery at a lower cost. The web access is configured and encrypted for secure web access using multiple browsers. Access to the system is available from smartphones to allow field engineers to view and enter all necessary information directly from the roadside, with managers having a more and complete overview of the real-time performance of their technologies.

Benefits

By using standard smartphone technologies, the Authority is not only able to reduce the costs of hardware provision but is also able to take advantage of new smartphone features to continually improve the quality of service throughout the City. The system delivers an effective management service covering all forms of traffic technologies across the region and delivers services to multiple client staff, contractors and other stakeholders as part of a fully integrated online service.

By detecting, logging and notifying users and companies of faulty technical infrastructure, action can be quickly taken to rectify problems and minimise equipment downtime. The system enables the Authority and its contractors to effectively plan all routine maintenance tasks, whether recurring or one-off, and enables real-time completion of inspection reports, improving the health of the infrastructure, staff utilisation and operational efficiency.
6.3 Providing free traffic information in Sweden to stimulate the take up of new technology

Background

The Swedish Transport Administration's traffic information is based on information that is collected from the national public road network together with different actors such as road maintenance contractors, public safety authorities, organised road reporters and the Swedish Meteorological and Hydrological Institute (SMHI). They provide this information as a free service as the overall benefits to society have been calculated to significantly outweigh the potential revenue from the sale of the data. Data is available through push and pull services and covers detailed information.

Application of emerging technology

The Swedish Transport Administration manages its national transport network through a comprehensive national traffic management system. It recognises the significance played by third party service providers to deliver additional and complementary traffic and travel services using new smartphone apps and in-vehicle systems, and has established a free and open source set of quality-assured traffic information that can be used directly by these third parties to inform private motorists and commercial drivers.

Benefits

This programme brings great benefit to the industry as it encourages new revenues in the development of travel services. There are also significant benefits for drivers and road users. Through utilising data, accidents, queues, traffic messages, roadworks, road conditions, ferry timetable changes and frost damage to roads can all be broadcast to vehicle users. Estimated travel times, weather data service, traffic measurements and the general condition of the roads in general are all information that can be generated from the release of data.

6.4 Sunderland integrated transport and weather information pilot

Background

A 2014 project has been developed in partnership with Sunderland Software City, the Met Office, Connected Digital Economy Catapult and Transport Systems Catapult in the North East to support the fast delivery of third party applications to improved traffic and travel throughout the region.

Application of emerging technology

Data from the Met Office, Tyne and Wear Integrated Transport Authority and many other sources is now being gathered, cleansed and opened up via application programme interfaces. This data will be presented to industry as part of an ‘Innovation Challenge’ which will be the start of a 6 month pilot in which all of the data will continue to be freely accessible.

Benefits

Solutions using this new data could: reduce delays on public transport by predictive routing; reduce insurance premiums through identifying fraud; increase crime prevention by modelling crime occurrences and supporting proactive policing; and much more. Beyond this pilot the Met Office and other data providers want to build mutually beneficial business models in which their data can be accessed and used under Service Level Agreements. It is hoped software companies can forge relationships with buyers and build great solutions with the data.
6.5 eCall

Background

eCall is a cooperative ITS service that automatically summons emergency assistance in the event of a severe vehicle crash (such as would cause air-bag deployment). eCall also creates a voice/audio link which may be of benefit for passengers and rescue authorities.

Application of emerging technology

Trials of eCall are underway in several European countries coordinated through the European HeERO project.

There are three key parts to an eCall system:

- The in-vehicle units which are integrated into the vehicle; these may either be installed during manufacture or by after-market fitment
- The cellular radio network which carries the voice and data as an emergency message
- The Public Safety Answering Point which receives, decodes and acts on the emergency message by dispatching appropriate rescue services.

Even if no passenger is able to speak, e.g. due to injuries, a Minimum Set of Data (MSD) with relevant information about the incident is sent automatically via the cellular communications network, to the most appropriate Public Safety Answering Point (PSAP). The MSD includes information needed to handle the emergency situation, such as time stamp, accurate location (through satellite positioning) and direction of driving, Vehicle Identification Number (VIN), and other information essential to the rescue services.

Benefits

By helping to achieve an efficient and rapid response to crashes, eCall can save lives and public resources by reducing the severity of injuries, rehabilitation needs and hospital admission/permanence. The reduction in fatalities is difficult to estimate and depends not only on eCall but the performance of the whole rescue and health system.

In Europe, estimates of benefits of between 1% and 5% in fatality reductions have been made. eCall can be installed on trucks and would be particularly beneficial for those with dangerous goods. eCall for powered two wheelers is also possible.

6.6 Using a smartphone to determine road and cycle path condition status

Background

Authorities around the world need to understand the detailed condition of their transport networks. However, the costs associated with the detailed measurement of the condition of roads and the identification of areas for repair is significant.

A new smartphone app - Roadroid - has been created to help Authorities more quickly identify potholes and the roughness of their roads and cycle paths in a simple and cost-effective manner.

Application of emerging technology

The app that gathers the necessary data using standard features within the smartphone and uses sophisticated algorithms to provide dynamic, quantified and geographic data of potholes and frost damage. Roughness can more easily be monitored over time and be presented through a website to provide the Authority and drivers with details on the quality of the road surface through a red, amber and green comfort factor as part of any route planning. Roadroid is currently being operated in 6 cities and 2 regional authority road districts around the world. Pilots and research projects are also being undertaken in New Zealand, South Africa, Spain, Brazil, Kenya, Canada and Czech Republic.

Benefits

The app will not replace detailed measurements, but can be used as a complementary service to help Authorities more quickly identify problem areas, particularly in rural areas where current measurements are often undertaken sporadically. Authority and other probe vehicles, such as Royal Mail or delivery companies, and cycles can be equipped with the app so that they can gather data from the routes they regularly use.
6.7 Milton Keynes electric bus programme

**Background**

Milton Keynes Council is the 54th largest authority in England based on population of around the 250,000 and estimated to rise to 350,000 by 2026. Milton Keynes is the UK’s fastest growing city and will continue to grow with the planned expansion areas to the north, south, east and west of the city. As part of its programme to improve air quality in the city centre, Milton Keynes council have commissioned a fleet of electric buses.

**Application of emerging technology**

From December 2014 one route in Milton Keynes will replace its existing diesel buses with a new fleet of electric buses that will run seven days a week. Uniquely, the new buses will be able to recharge their batteries wirelessly through the day, which means that for the first time, electric buses will be capable of the equivalent load of a diesel bus. The trial was planned and will be managed by Mitsui-Arup joint venture MBK Arup Sustainable Projects (MASP). MASP’s ultimate aim is use the data collected by the Milton Keynes trial to demonstrate the economic viability of low-carbon public transport. This data could be used to kick-start electric bus projects in other towns and cities worldwide.

**Benefits**

The Milton Keynes buses will be able to cover a heavily-used urban route because they are able to charge for 10 minutes at the beginning and end of each cycle without interrupting the timetable. This means that for the first time, an electric bus will effectively be able to do everything a diesel bus can do, which is a significant step forwards to a cleaner, quieter, public transport system. The trial aims to remove approximately 500 tonnes of tailpipe CO$_2$ emissions per year from the city’s streets as well as 5 tonnes of other particulates and noxious tailpipe emissions.

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6.8 Air quality monitoring and carbon reduction targets

**Background**

Governing Authorities in the UK have major targets to reduce carbon emissions, but carbon is just a part of the environmental problem. It is estimated that across the EU there are some 400,000 premature deaths due to poor air quality, with 20,000 to 50,000 in the UK alone, with transport being the major contributor. Poor air quality reduces the life expectancy of everyone in the UK by an average of seven to eight months. The financial implication is estimated at some £20 billion annually.

**Application of emerging technology**

Technical developments have enabled the monitoring of air quality for a number of years, but these solutions are costly to implement. Significant advances in new computing and sensing technology has enabled the development of new low cost units that can be deployed on a much wider scale to collect significant data on the air in which we live and breathe. A small company in North East England, Envirowatch has successfully achieved the trade-off between the highly precise and indicative monitoring solutions, with a new pervasive air quality monitor called the E-MOTE.

Equipment is already installed at sites in towns and cities such as Newcastle-upon-Tyne and Stockport, as well as inter-urban routes such as the A2 in Rainham Medway Council, and on Network Rail’s premises in England, delivering high quality data from which these Authorities can take informed decisions to make their contribution to help save lives and meet our air quality targets.

**Benefits**

These devices are designed to record multiple pollutants in a minute by minute basis and deliver the data to the internet in real time. E-MOTES are small, unobtrusive and easy to deploy across any city and have been demonstrated to be a viable and accurate means of monitoring the micro-scale trends in key air pollutants created by our city road and motorway networks.
There are approximately 7.4 million street lights in operation in the UK alone and Local Authorities spend over £300 million each year powering them. There is a growing focus throughout Europe on reducing energy consumption and councils are under increasing pressure to cut costs and reduce carbon emissions.

In the last five years, the move to install LED outdoor lighting has gathered pace but this does not solve the core issue of how to save the vast amounts of energy used to fully illuminate roads at times when there is very little or no traffic and lighting streets and public areas when there are no pedestrians around.

**Application of emerging technology**

AGD Systems has developed a radar-enabled dynamic street lighting solution to help Local Authorities and lighting manufacturers reduce the energy consumption of street lighting systems. The system provides traffic-adaptive, dynamic street lighting control which ensures that lighting levels are adjusted safely and reliably, depending on specific traffic volumes at particular times.

The result is a fully interactive, intelligent lighting solution in which, at certain key times, when the radars detect consistently high volumes of traffic or congestion, the streetlights are deployed on full brightness but then are programmed to dim to established safe levels by the local management system when traffic flow is lighter.

**Benefits**

Dimming the street lights at quieter periods during the night or in the early hours of the morning when traffic flow is at a minimum will considerably reduce energy consumption and costs - without any compromise on safety levels. It has been estimated that a dynamic lighting system can increase energy savings by up to 20%.

A smarter street lighting system used by Hampshire County Council on over 100,000 lights and signs has brought significant carbon and cost savings. It has reduced Hampshire’s CO₂ emissions by 4,000 tonnes - the equivalent to the CO₂ emitted from 1,600 cars per year.

A significant advantage for road authorities is that radars already are in deployment in road networks and can therefore serve a dual purpose - both as a means of vehicle, cycle or pedestrian detection and traffic flow monitoring, and to control lighting levels.
7. Technology examples

7.1 Data and apps

INRIX

INrix are an innovative provider of traffic data based on fusing data from many sources, such as Floating Vehicle Data (FVD) from fleets, and FVD from new vehicle manufacturers. The background algorithms are based on Bayesian Statistical Pattern matching, and flexible enough to add new sources of data to predict the effect of stimulus, such as weather, accidents, roadworks, etc on traffic flow. INrix also produce an app that can run on iOS, Android and Windows operating systems. The app can predict journey times for users, but also warn a user when they need to set off for a journey. The app will also act as an additional source of FVD and feed the data back to central servers.

CityMapper

CityMapper is an app that was originally built as a multimodal journey planner for London, but has been developed also for New York and Paris, and other major cities. This demonstrates its strong design and flexibility. Two things make this an award winning app. Firstly, is the ability to access accurate and real-time data from the TfL transport system, and secondly, is the very simple and intuitive user interface. This allows it to really provide a user with the information they need. In London, you can either plan a point to point journey, or a “from here” to a destination journey. Every journey provides options based on mode, mixed modes, amount of walking or favourite travel methods, as well as the cost. The recommendations take into account the time of day and the real time status of the whole of the transport network.

Pothole notification

Many smartphone have GPS and accelerometers on board. This has been exploited by developers - including http://www.roadroid.com - to read and analyse the accelerometer data from smartphone and to match that with the GPS position. This allows the data to be analysed to produce a picture of the road network with details of where pot holes (sharp vibrations) are regularly spotted. It also allows a user to press the screen to indicate a pothole.

This system is similar to projects developed by the cycling community and the DfT, as well as back office systems like http://www.fixmystreet.org that can be used to crowd source the condition of transport assets and to notify the correct responsible Authority.

Weather

Projects have been completed internationally to gather data from vehicles that can be used to provide weather based information. An example of how this could be completed would be to take the information available from a vehicle, such as temperature, headlights, fog lights, wiper speed, location, skidding, acceleration/exhaust waste details, etc, and to transfer the data from the vehicle to a central store. This can be done directly from the vehicle if it is fully connected, or via an OBD2 interface using Bluetooth (£12 interface dongle from eBay) and a smartphone. The data can then be analysed in real-time and non-real-time to show areas prone to fog, frost, or identify cloud bursts very accurately and quickly. The data can be fed into traffic management systems, meteorological systems or open sourced weather tools to provide information that is taken from the road and transport systems.

7.2 ibeacons

Ibeacons are devices that use Bluetooth Low Energy (BLE) technology to allow smart devices to locate their position. The term iBeacon is an Apple Trademark, but the technology can be used by other smart devices as long as they support the BLE technology. These devices, and other Bluetooth detection devices can be used to identify congestion and to allow navigation in areas where GPS signals are weak or non-existent.

Standard Bluetooth devices read the unique identifier from a smartphone or other device and send the data to a central server that can then calculate how many devices are in the detection zone. This method has been successfully used at the 2012 Olympics and other large festivals (including Glastonbury) around the world to warn administrators of situations where there are too many people in a confined space, or even just for simple counting.

The iBeacon works slightly differently in that it is a relatively dumb device that only sends out its unique identifier and has no other communications paths. The smartphone can read this unique code and communicate to a central server using an app to find its general location (as this will be stored centrally).

This method could be used to monitor congestion by counting the number of devices making requests about a unique iBeacon, but the initial uses have been largely based on marketing, including by supermarkets and sports stadia. There is however no reason why these low power (battery powered even) devices cannot be placed in travel stations to help travellers move around with more information of their position. This could include knowledge of platforms or even guidance to help move people to a carriage on a train that has seats available.

7.3 Bluetooth

Bluetooth systems offer transport operators and planners the ability to analyse journeys across multiple transport modes in near real-time. This allows the user to see the effect of changes to their Traffic Signal cycles or signage very quickly. There is also the ability to measure complex journey times, including across multiple modes, and from a single capture node it is possible to detect speed and congestion. Having a flexible and open system can lead to many innovative uses being made of the technology and link multiple systems, especially across transport modes, to create a truly powerful data acquisition system that can influence planning, operations and even measure the effectiveness of interventions in almost real-time.

When a purchaser is considering the use of Bluetooth, it is essential that they understand the benefits and limitations, and that they clearly specify the design so that the solution meets their requirements. It is also important to ensure that the system is not standalone, and that it can be added to in the future, or expand an existing system.
7.4 ARMAS

CGI have worked with Skysoft in Portugal on the ARMAS (Active Road Management Assisted by Satellite) project, a concept involving using EGNOS (European Geostationary Navigation Overlay Service), which enhances the data provided by the US GPS system. The ARMAS project was funded by the European Space Agency with the developed application having been tested on Portugal's Vasco Da Gama Bridge. One of the most beneficial facilities being developed is an early warning system for drivers who may be about to enter a hazardous area. Drivers can receive notification of incidents they are likely to encounter on their journey, with the problem highlighted on an in-car display screen and through sound messages.

The ARMAS system also allows an individual vehicle to send back information to a centralised control centre. An S.O.S. alarm can be sent in an emergency, for example. Personnel in the control centre are then able to send assistance immediately as the system tells them the exact location of the vehicle. It is also possible for an individual driver involved in an accident to alert nearby motorists to slow down.

7.5 Thermal imaging cameras for traffic applications

Traditional CCTV cameras have proven their use for video monitoring. Although CCTV cameras are reliable tools for video analysis, they need additional algorithms to overcome their limitations. In order to work at night, scene illumination needs to be installed. CCTV cameras can also be blinded by light from the sun.

Vehicles or pedestrians that are moving in shadows are sometimes not detected.

Thermal imaging cameras do not have these issues. A thermal imaging camera creates a crisp image based on subtle temperature differences. They do not need any visible light. They are also not affected by direct sunlight. FLIR’s high-performance thermal imaging cameras give uninterrupted 24-hour detection of vehicles, pedestrians and cyclist regardless of the amount of light available.
8. Final remarks

This report is intended to give a snap-shot of the Emerging Transport Technology that is gradually being used by Local Authorities and also provide an insight into those which will emerge in the near future.

The growing prominence of the smart cities agenda clearly leads to the conclusion that in many cases, transport must be considered as part of a broader integrated system that encourages the merging of disciplines, the potential to share systems, and the need to join policies together. New means of monitoring, measuring and managing transport now exist that were unthinkable a few years ago, bringing the potential to use technology that was previously not necessarily designed for transport into the fold.

The case studies and examples in this report highlight where technology has enhanced local transport and widened the horizon for Local Authorities who are looking to develop innovation solutions to local transport issues. Additionally emerging technology has the potential to introduce new procurement and cost models, and reduce overall spend (doing more for less, in Local Authority parlance). However, this list is not exhaustive. New technologies exist in a wide breadth of transport systems with good practice and lessons to be learnt, not just from the UK case studies we present here, but from exemplar schemes worldwide. For example, in the US there is the RITA database which charts the costs and benefits of scheme implications across the country. In Europe an ITS Observatory is about to be established to record and provide impacts and benefit information on a wide breadth of ITS-based transport schemes.

We hope this first attempt to bring together information on a sample of the successful schemes that utilise new technologies will be helpful in raising the profile of intelligent transport systems. Moreover, we very much hope a more coordinated approach from government and the funding bodies, will support Local Authorities in moving this agenda forward. As the technology horizon expands, IET and ITS(UK) will continue to push the case for utilising developments in technology to enhance local transport and support stakeholders to obtain the information they need to make informed decisions on whether such technology is the right option for them.

9. Links

Various resources are available that can be used as a source of information to help procurers maintain up-to-date knowledge of this fast paced industry.

Below is a list of links that direct the reader to impartial sources of information. The links are intended to be a source of information and will be updated in the future when necessary. We would also be interested to hear about any further examples of technology that have enhanced local transport in your region:

- The Institution of Engineering and Technology
  http://www.theiet.org
- IET Transport Key Topics
  http://www.theiet.org/policy/key-topics/transport/index.cfm
- ITS-UK
  http://www.its-uk.org.uk
- IET Journals
  http://www.theiet.org/resources/journals/
- IET Digital Library
  http://digital-library.theiet.org/
- UK data protection act
- European data protection directive and guidance
- Information security measures from the Information Commissioner's Office
  http://ico.org.uk/for_organisations/data_protection/security_measures
- ICO - Privacy in mobile apps
- HeERO - Harmonised eCall European Pilot
- United States Department of Transportation, Research and Innovative Technology Administration
  http://www.rita.dot.gov/

This report can be downloaded from the IET website

- http://www.theiet.org/policy/key-topics/transport/index.cfm
- http://www.its-uk.org.uk/publications
10. Endnotes


2. For further information on this topic, refer to the joint IET ITS UK 2011 factfile “Can we really do more at less cost with the UK road network?” which illustrates some examples of how technology can deliver real and compelling returns on investment for Local Authorities. http://www.theiet.org/factfiles/transport/more-for-less-page.cfm

3. The IET has published guidance on cyber security in the built environment which explains how a risk-based strategic approach can be used to reduce security threats. http://www.cpni.gov.uk/

4. An example of a licence agreement is the one employed by TfL which can be found at: http://www.tfl.gov.uk/corporate/terms-and-conditions/transport-data-service

5. For further information on the benefits in the adoption of Open Source software solutions see the IET Factfile at http://www.theiet.org/factfiles/it/open-source-page.cfm


7. http://www.localgov.co.uk/Smarter-street-lighting/36491