CUBIC™ | Transportation Systems

Making Rural Roads Safer

Smart Solutions for Improved Road Network Management

INTRODUCTION

Fuelled by advances in connectivity, open data, and automation, the intelligent mobility industry is growing at a rapid pace. By 2030 it could be worth as much as £1.4 trillion globally.[1] The UK is well placed to capitalise on this huge market potential. Over the past few years, road operators in the UK have stepped up the investment in automated, intelligent infrastructure solutions to improve the effectiveness of transportation networks, combat congestion, raise the safety standards of roads and promote the safety of vehicles and people traveling on the road network across the country. Highways England have pledged to spend £150 million on innovation to further improve safety and tackle congestion on roads between 2016 and 2021 alone — including £35 million on new and emerging technologies and £25 million on data information.[2]

The majority of new technologies and services, including traffic automation, integrated traffic management systems, intelligent traffic light signals, and smart cameras are trialled and installed on flagship projects on the strategic road networks. Equally, a large portion of the investment in transport innovation focuses on improving transportation in cities and densely populated urban areas which generate significant amounts of data that can be harnessed and exploited. According to estimates from think tank IPPR North, more than half of the UK's current total spending on transport networks (£32.7 billion) is invested in London.[3]

The spread of transport innovation is far from democratic. While the most developed urban centres are starting to enjoy intelligent mobility solutions, rural areas often suffer from the lack of adequate transport infrastructure. Given just how much the leading UK cities contribute to the economy, such allocation of capital isn't surprising, but it may soon need rethinking as changing traffic patterns encourage greater investment in rural transport networks. Out of 246,700 miles of roads in Great Britain, 76% of all 'A' roads are rural roads — classified as major or minor roads outside of urban settlements (places with a population of 10,000 or more) and with a speed limit.[4] In the last decade, rural 'A' roads have experienced rapid growth in traffic — an increase of 10.3 per cent, the fastest across all road types. It is a trend that is set to continue.

Following years of successful innovation, collaboration and project delivery with numerous transportation operators in the UK and worldwide, Cubic Transportation Systems remains committed to adding value to the UK road sector and helping address the challenges of our customers. Due to a number of factors, rural roads often require unique technological solutions and out-of-the-box approaches. While investment in rural transport infrastructure can be costly, it is possible to arrive at innovative solutions that increase efficiency gains without being cost prohibitive. In this white paper, we consider several issues specific to rural roads and propose to leverage world-leading technologies and solutions to improve rural road infrastructure, resulting in a more efficient and safer rural road network and a fairer and more balanced economy.

OUT OF 246,700 MILES OF ROADS IN GREAT BRITAIN, 76% OF ALL 'A' ROADS ARE RURAL ROADS — CLASSIFIED AS MAJOR OR MINOR ROADS... ...IN THE LAST DECADE, RURAL 'A' ROADS HAVE EXPERIENCED RAPID GROWTH IN TRAFFIC — AN INCREASE OF 10.3 PER CENT, THE FASTEST ACROSS ALL ROAD TYPES. IT IS A TREND THAT IS SET TO CONTINUE.

[1] Catapult Transport Systems, "Change now to capture £1.4 trillion opportunity" https://ts.catapult.org.uk/news-events-gallery/news/change-now-to-capture-1-4billion-opportunity/

[2] Highways England, "Innovation, Technology and Research Strategy, Our approach" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/513794/S150785_Innovation_Strategy_V6_WEB.PDF

[3] The Guardian, "More than half UK investment in transport is in London, says study" https://www.theguardian.com/uk-news/2017/feb/20/more-than-half-uk-investment-in-transport-is-in-london-says-study

[4] Department for Transport, "Road Lengths in Great Britain 2017" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/722478/road-lengths-in-great-britain-2017.pdf

SOLVING CONNECTIVITY ISSUES

Despite some of the lowest road casualty rates in the world, every year, around 2,000 people die in car accidents on British roads, and nearly 200,000 are injured.[5] Most fatal crashes take place on rural roads — accidents on those roads have a higher severity and are 11 times more deadly than on motorways.[6] Statistics show that rural roads aren't safe for any type of road users; drivers, their passengers, and cyclists are twice as likely to be killed on rural roads than on urban roads, while motorcyclists are nearly three times as likely to suffer a fatal crash while driving through the countryside.[7]

Research doesn't provide conclusive evidence as to why rural roads are more hazardous, but a combination of factors including difficult road conditions, limited visibility and increased speed likely contributes to the severity of incidents on country roads. Crucially, the quality and speed of medical response in remote areas can vary greatly, and since many rural areas suffer from poor connectivity and network signal, the contact with local medical assistance in the critical first 10 minutes after the crash is often hindered.

The availability of a reliable communications network that enables coordination with multiple stakeholders, including emergency services, is key to minimising the risk of death or injury to the general public during an incident. Yet, due to the geographic spread of the motorways, highways, and other roads managed by road operators across the country, there are inevitably areas where communications networks are patchy, non-existent, or contend with commercial traffic. One technology that can make a difference is a temporary LTE communications network.

LTE is increasingly recognised as the preferred international standard for mobile wireless voice and data communications. Exploiting the opportunity afforded by this technology allows road operators to embrace next-generation communications, using the best in LTE radio and antennae technology to deliver a proven, secure, wireless, high-bandwidth network communications bearer. In remote places with no or poor network coverage, pop-up LTE can become a straightforward, cost-effective, and vital tool to support incident management, roadside work, and other operations across the UK road network.

Operating a proprietary LTE platform has significant advantages over existing national cellular (2G, 3G, and 4G) and commercial provision. Apart from offering dependable signal in areas with unreliable network access, a proprietary network can achieve a much higher user count that doesn't suffer a loss of bandwidth at critical times. On a commercial network, prioritisation is in the gift of the operator and perceived capacity is not always a true reflection of the actual network state. This can be particularly troubling during an incident situation, where multiple users share the same bandwidth, reducing the availability of emergency care personnel to share data reliably and in a timely manner.

In addition to increased bandwidth, when designed for proprietary use, LTE can guarantee speeds and data transmission over significantly longer distances (through the private spectrum and non-traditional LTE frequencies), which is particularly handy in remote, hilly areas. Coverage can be dynamically adjusted using additional, temporary assets such as masts, drones and mobile base stations.

> THE AVAILABILITY OF A RELIABLE COMMUNICATIONS NETWORK THAT ENABLES COORDINATION WITH MULTIPLE STAKEHOLDERS, INCLUDING EMERGENCY SERVICES, IS KEY TO MINIMISING THE RISK OF DEATH OR INJURY TO THE GENERAL PUBLIC DURING AN INCIDENT.

A temporary LTE communications network that ensures dedicated and exclusive communications access for all roadside personnel and emergency services can facilitate more efficient coordination of services during a road incident as well as improve the overall incident management. Since, by definition, pop-up LTE communications can be deployed quickly from a patrol or response vehicle, it can become an easy-to-use access point into the LTE infrastructure, improving multi-agency cooperation while an incident is in progress.

With the use of pop-up LTE technology comes the ability to deploy drones for the management of major road incidents and to provide additional support functions beyond what can be achieved on the ground. Advanced, stable, military-grade drones, with long flight times, capable of carrying heavy and multiple payloads can revolutionize accident scene response in rural areas by serving multiple purposes: providing a persistent overhead for LTE access, thus ensuring reliable and powerful communications, securing the integration with the emergency services, and providing persistent CCTV coverage of the incident from variable positions and angles, emergency dynamic floodlighting, and emergency PA systems to relay audible instructions to road users. Both pop-up LTE solutions and drones can help facilitate post-incident analysis and the flow of high-volume intelligent data and information, including high-definition CCTV from multiple sources (e.g., fixed cameras on temporary masts, mobile on drones or personnel), directly to the control room in real-time. Recorded aerial footage of the scene can speed up investigative work, helping road personnel reopen roads more quickly, even after a serious incident, and can be used for incident reconstruction after the event to ascertain fault and for training and accident prevention purposes.

IMPROVING SITE SAFETY AND ROADWORK PLANNING

All roadside working (whether for day-to-day operations and maintenance or during incident management) carries inherent risks and dangers to the safety of the personnel involved. In fact, the average fatality rate for those working on the Highways England road network is one of the highest amongst all employment sectors in the UK.[8] Yet, safety supervisors (both local and remote) are often faced with inefficient working practices; they are unable to suitably monitor the location of personnel and vehicles in relation to roadside work and their communication on the ground is limited to short-range radio, exacerbating existing safety issues.

Portable LTE communications can provide additional value to road operators by promoting the safety of contractors, road users and traffic controllers at road works sites in remote locations. Using a pop-up LTE communications network in conjunction with suitable communications interfaces and GPS devices can help facilitate positional tracking for all roadwork personnel as well as the creation of geofences — virtual geographic boundaries in work zones designed to protect safe or controlled areas where work is being undertaken, monitor vehicle movement, enforce site speed limits, or prevent equipment theft. Site personnel, vehicles, and tools can be equipped with an LTE Communications Interface, which allows for individual identification and tracking on a live map in real-time, locally or remotely from the control centre, further enhancing site safety and traffic management during road works.

An equally critical issue for road operators is the ability to track all road works that are being carried out on the road network. Currently, road operators do not possess a holistic picture of all road works taking place on the network. The limited visibility of road work planning becomes most apparent across regional boundaries — major road

> IN REMOTE PLACES WITH NO OR POOR NETWORK COVERAGE, POP-UP LTE CAN BECOME A STRAIGHTFORWARD, COST-EFFECTIVE, AND VITAL TOOL TO SUPPORT INCIDENT MANAGEMENT, ROADSIDE WORK, AND OTHER OPERATIONS ACROSS THE UK ROAD NETWORK.

[5] Department for Transport, "Reported road casualties in Great Britain: 2017 annual report" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/744077/reported-road-casualties-annual-report-2017.pdf

[5] BBC, "Country roads '11 times more deadly than motorways'" https://www.bbc.com/news/uk-29550811

[5] Heritage Insurance, "Rural roads are the most dangerous in Britain" https://www.heritagecarinsurance.co.uk/newsroom/news-and-articles/rural-roads-are-the-most-dangerous-in-britain/

[8] RoW SaF, "RowSaF Strategy 2015" http://www.rowsaf.org.uk

operators have no visibility into works being carried out on local authority roads, while in turn, local authorities have no visibility into road works planned on major highways. This means that motorists often end up driving through multiple road work zones or even being rerouted from one road work zone directly onto another. The resulting traffic and delays increase the chance of driver inattention and frustration, often leading to abuse of road personnel and increases the risk of incidents in work zones. Highways England estimates that between 2007 and 2017, 12 road workers, including two traffic officers, have lost their lives on the network — in three of the cases the victims were knocked down by members of the public, whereas in the same time period, workers have been injured by motorists on more than 50 occasions.[9]

To combat that, while at the same time increasing road work effectiveness, road operators should explore investing in road work management tools, either as standalone solutions or as modules in transport management systems such as Highways England's new CHARM system. Such solutions can give road operators improved visibility into their transport networks and provide them with better situational awareness, enabling smarter planning and more efficient roadwork management. Further, if linked with geolocation element of a pop-up LTE solution, such tools can provide real-time information about works taking place across all road networks, helping road operators quickly identify all road work personnel deployed on the entire transport network, including rural roads.

Other technologies that can improve site safety include equipping road work sites with CCTV to film lawbreaking drivers and using overhead gantries or Variable Message Signs (VMS) instructing motorists of upcoming work areas or lane closures. Providing advice and warnings to drivers via roadside VMS is a long-established practice on motorways and major roads across the UK; VMS are generally perceived as useful and informative, can reduce drivers' stress and can help limit congestion and shorten driving times. However, as with any infrastructure, deploying roadside message signs is expensive and time-consuming, often being effectively limited to critical locations on strategic roads where the cost can be justified. Yet, road users perceive deficiencies in signage to be a safety hazard as well as adding unnecessary stress to a journey[10] while research indicates that no guide signs or incorrect positions for guide signs of road works increase crash probability by over 200 per cent.[11]

> THERE ARE OTHER SOLUTIONS THAT ARE LESS COST PROHIBITIVE AND COULD WORK EQUALLY WELL. THE ADVANCEMENTS IN ARTIFICIAL INTELLIGENCE (AI) AND MACHINE LEARNING (ML) HAVE OPENED UP THE DOORS FOR AN ENTIRE HOST OF AUTOMATED, ANALYTICS-BASED SOLUTIONS THAT CAN BE INTEGRATED INTO EXISTING INFRASTRUCTURE AND PLUGGED INTO THE CONGESTION AND TRAFFIC MANAGEMENT PLATFORMS.

To make VMS systems smarter and more prevalent while controlling the cost of deployment, road operators should consider delivering in-vehicle, virtual VMS that communicate directly with in-car infotainment systems. Providing driver guidance directly in the car extends the existing delivery of information and warnings to drivers via physical roadside VMS and increases the safety of both drivers and roadside workers in rural areas. Currently, trials of such systems are being undertaken by Cubic Transportation Systems and Transport Scotland, across a vast network of rural roads. The trialled virtual VMS system requires no investment in infrastructure or additional equipment in cars as it relies on existing 3G/4G communications. By using limited bandwidth capacity and ensuring only low levels of mobile cell data service are required for the system to operate, virtual VMS are quickly becoming a reliable solution for even the most remote areas of the road network.

[9] gov.uk. "Highways England highlights dangers faced by road workers" https://www.gov.uk/government/news/highways-england-highlights-dangers-faced-by-road-workers

[10] Transport Focus, "Road users' priorities for the Road Investment Strategy, 2020-25" http://d3cez36w5wymxj.cloudfront.net/wp-content/uploads/2017/06/28081709/Road-users'-priorities-for-the-Road-Investment-Strategy-2020-25-FINAL.pdf

[11] Science Direct, "Influence of deficiencies in traffic control devices in crashes on two-lane rural roads" https://www.sciencedirect.com/science/article/abs/pii/S000145751630286X?via%3Dihub

DETECTING STOPPED VEHICLES

Stopped vehicles are one of the major causes of accidents on highways. A stopped vehicle poses an immediate safety risk to the occupants of that vehicle and other vehicles traveling on the carriageway. Even with advanced solutions, detecting stopped vehicles can be a real challenge. To avoid false alarms and bring tangible efficiencies, the technology must be able to differentiate between vehicles stopped in traffic and vehicles stopped due to an emergency. Without a suitable automated means of detecting the hazard, the control room remains unaware of the problem until it is reported directly to them by road users or in the unlikely event of being spotted on CCTV. Highways England, in conjunction with a number of suppliers including Cubic Transportation Systems) is currently trialling

a solution that uses radar technology to detect stopped vehicles, or those traveling in the wrong direction. The solution, which takes advantage of high-resolution radar technology that when spaced up to 500 meters apart, can detect stopped vehicles on both sides of a highway has impressed the transport industry, winning the "Best Use of New Technology" category during the 15th Highways Awards in London, and the "Forward Thinking Innovation" award in the ITS (UK) Awards, both in 2018. One of its greatest advantages is that it can perform well even in harsh weather conditions, including rain, fog, smoke and darkness and maintains a very low false alarm rate. Its key disadvantage, however, is the high cost of deployment.

There are other solutions that are less cost prohibitive and could work equally well. The advancements in Artificial Intelligence (AI) and Machine Learning (ML) have opened up the doors for an entire host of automated, analytics-based solutions that can be integrated into existing infrastructure and plugged into the congestion and traffic management platforms. For instance, by adding suitable analytics software to video feeds from existing CCTV cameras or detection loops, or by performing additional processing on the data received continually from existing on-road detection devices, such as magnetic loops, the control room would be able to receive alerts of stopped or wrong-way vehicles quickly, and without the need to roll out new types of hardware with the specific purpose of looking out for one type of hazard. Such automated detection of stopped vehicles would dramatically reduce the time before these hazards are known to the control room, while the relatively low cost of deployment would enable road operators to roll out the solution across the entire transport network, including rural roads, rather than having to focus just on the most congested areas.

CONCLUSIONS

While rural 'A' roads constitute only nine percent of the entire transportation network in the UK, they carry 30 percent of all traffic — a figure that is set to grow in the coming years.[12] The steady rise of traffic on rural roads calls for more investment in intelligent mobility solutions as well as smart infrastructure to ensure rural roads remain safe for drivers, passengers, and roadside workers, connect more people and businesses to opportunities and help rural areas contribute to the overall growth of the economy. While the focus

on urban centres dominates advancements in mobility innovation and sets the tone for investment decisions, road operators in the UK must focus on improving rural road networks as part of their efforts to monetise the opportunities brought about by intelligent mobility. There are numerous existing technological innovations or those still under development, including pop-up LTE communications, drones, virtual VMS and automated analytics solutions that can address the issues pertaining to rural roads in the UK and abroad. Those solutions need not be expensive – Cubic can assist road operators in identifying technologies with the most promise and harness the power of transport innovation to make rural roads safer and more efficient, making a positive difference in rural communities and helping deliver a stronger, more balanced economy.

[12] Department for Transport, "Road Lengths in Great Britain 2017" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/722478/road-lengths-in-great-britain-2017.pdf

CUBIC™ | Transportation Systems

CUBIC – A LEADER IN INTELLIGENT TRAVEL SOLUTIONS

At Cubic, we believe our identity is intrinsically linked with our customers, and the people our customers serve. How they get from one place to the next – how that impacts their lives, their fellow travelers and their cities – and how it feels along the way.

That's why we're passionate about developing transportation solutions that improve the way we move throughout cities. Innovation is in our culture, and our history speaks for itself. In our 45-year history, we've delivered public transport fare collection systems to over 450 operators, including 20 regional back office systems, and traffic and transportation management systems for major cities and regions on four continents.

Cubic Transportation Systems (ITMS) Ltd.
Cavendish House
Clearwater Park Prince's Wharf
Stockton-On-Tees,
TS17 6QY
UK
TEL: +44-1642-636700
ctsinfo@cubic.com
cubic.com/transportation

CTS-WP-MRRS-V1-19APR