Positioning the UK in the fast lane

Location data opportunities for better UK transport

Geospatial Commission

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Foreword by Commissioner Dr Steve Unger

Data plays a critical role in all our lives, powering many of the services that we expect from a modern digital economy. Nowhere can this be seen more clearly than the transport sector and its use of location data. From the detailed Ordnance Survey maps, which have been used by generations of walkers, to the satellite navigation systems embedded in most modern vehicles, location data has always been fundamental to mobility.

But the transport sector is changing, driven by an urgent need for transport networks to become more efficient, greener, safer and healthier - the sector is responsible for 27% of greenhouse gas emissions[1]. The future of our society depends on us making the transition to new modes of transport, and location data can help spur the innovation required to deliver on this ambition.

Today's publication sets out some of the evidence we have gathered on the opportunities to do so. I have had the privilege to chair a Transport Location Data Taskforce, and a series of roundtables, bringing together a diverse set of industry voices. We have joined up with other relevant parts of the public sector and have run a Transport Location Data Competition, which has provided funding to help develop some of these ideas. And we have reached out to the academic community, interviewing experts in many aspects of transport policy.

I have been enormously encouraged by some of the ideas I have heard. These range from using data to aggregate deliveries to city centres, thereby reducing the environmental impact of existing transport networks, to designing completely new delivery networks based on drones.

A particularly important set of opportunities is created by the transition from internal combustion to electric vehicles. As is well-known, this is central to our ability to hit net zero. Large investments are already being made to achieve this goal, by the automotive industry, and by the various retail and tourism destinations for whom charge-points are now a core offering. Location data can help make these investments more effective.

- It can be used to optimise the location of charge-points, ensuring, for example, that they are readily available to those who are unable to charge vehicles at home.
- It can be used to make the use of charge-points more convenient for drivers, providing them with information on availability, and perhaps even making it possible to reserve a slot.
- It can be used to increase the range of electric vehicles, by enabling satellite navigation systems to select the optimum route, and by maximising the use of 'regenerative braking'.

I am optimistic about what can be achieved with better use of location data. The reason for that optimism is that much of the data required to develop innovative new mobility services already exists. Exploiting it requires us to reduce technical barriers to the sharing of data, and to develop appropriate commercial models: in the world of data, the whole is greater than the sum of the parts. If we can translate that principle into action, then we can shift the UK into the fast lane for a greener, more sustainable transport network.

My special thanks to all of those who have engaged with our policy development process, including members of our transport location data taskforce; government and industry representatives that attended our policy roundtables, including from the Devolved Administrations; the Open Innovation Team and the academics they consulted; and Innovate UK for their partnership in delivering our Transport Location Data Competition.

Dr Steve Unger, Commissioner

Executive Summary

Location data and technologies are critical for the improved operation of transport services and the delivery of new networks and transport corridors. They enable the efficient connection of people with the jobs they need, the goods and services they want, and the places they want to go. Location data is fundamental to delivering new electric vehicle charging infrastructure and enabling drones to navigate their environment. Location data can support our journeys to be safer and more pleasant, whilst minimising the impacts on our environment.

Transport was identified as a key opportunity area within the UK Geospatial Strategy. Geospatial data, products and services play a fundamental and enabling role in the transport sector and, as the sector evolves, the opportunities for location data will continue to grow. Better use of location data in the transport sector could unlock up to £2 billion per annum of economic value[2].

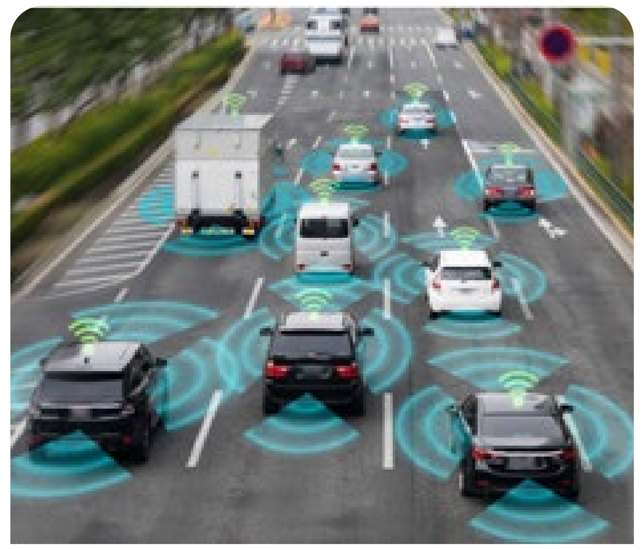
This report summarises the evidence gathered by the Geospatial Commission through extensive engagement across the transport and geospatial ecosystems. The report highlights key common themes and cross-cutting challenges, based on six transport use cases, where geospatial product and services could unlock greatest benefit.

- **Treating mobility as an interconnected system:** We will need to have a common location data framework for defining our transport networks.
- **Data interoperability and standards:** Standards must be implemented in the way that transport location data is collected, stored and managed.
- **Making data more findable and accessible:** Data must be made more discoverable and easier to access.
- **Improving data reuse:** Data is rarely useful for a singular purpose and must be made available for reuse where possible.
- **Enabling greener modes of transport:** We will need to transform the sector in order to meet the UK's commitments around achieving net zero by 2050.
- **Unlocking the potential for data-driven innovation in transport:** Organisations will need access to capital, skills and ideas, as well as a smart and stable regulatory framework to support data-driven innovation.

Unlocking the potential of location data in the transport ecosystem

Themes

1. Treating mobility as an interconnected system
2. Promoting data interoperability and standards
3. Making data more findable and accessible
4. Improving data reuse
5. Enabling greener modes of transport
6. Unlocking the potential for data-driven innovation in transport

Use Cases						
	Roads	Road & Rail haulage	Route optimisation	Electric vehicles	Connected and Autonomous Vehicles	Drones and Unmanned Aircraft Systems
Opportunity Areas	• Improving data reuse and exchange in planning, construction and maintenance • Managing streetworks more effectively • Optimising traffic management systems	• Encouraging adoption of vehicle telematics • Developing common standards of vehicle telematics • Modelling freight networks	• Investing in bespoke operational route planning systems • Supporting the development of strategic route planning systems	• Planning new charging infrastructure • Enabling bespoke electric vehicles routing applications • Managing grid capacity	• Generation and exchange of high definition mapping data • Investing in incremental vehicle-to-everything trials and testing	• Improving navigation and positioning systems • Managing flight paths and airspace • Creating digital testing and simulation environments

01

Introduction

1. The Transport Location Data Opportunity
2. Our Approach

The Transport Location Data Opportunity

Location data has always been fundamental to mobility, whether that is in its most traditional form - maps - as a means of getting from one place to another, or the satellite navigation systems embedded in most modern vehicles. The transport sector is changing rapidly, spurred on by digital and technological developments, as well as changes to our lifestyles and working patterns brought on by the Covid-19 pandemic. New applications for location data will correspondingly help to support the transition to more efficient, greener and safer modes of transport.

Innovate UK have outlined a 2050 vision for UK Transport that demonstrates the scale of change needed across the ecosystem, bringing both challenges and opportunities. The government's 2019 Future of Mobility: Urban strategy[3] highlights the significant opportunities that new technologies offer to accelerate future transport networks - from autonomous transport and zero emission vehicles, to the use of smartphones and the internet to plan journeys. The forthcoming Future of Mobility: Rural strategy[4] will set out the potential to revolutionise travel within our towns, villages and more remote areas.

Change is being driven by an awareness that our approach to economic growth must also protect the environment. The government has committed to achieving net zero by 2050, but the transport sector remains the largest emitting sector in the UK[5]. Actions needed to decarbonise the UK's transport system are set out in the recent Transport Decarbonisation Plan[6]. These changes are also happening at a time when our future need for transport infrastructure is being shaped by the Covid-19 pandemic and our departure from the European Union.

This report seeks to build on the transport strategies the government is implementing, and analyse how transport is changing as a sector, to illustrate the crucial role of location data in enabling and accelerating this change. Smarter mobility solutions, underpinned by location data, will enable us to make the most of our transport networks by boosting capacity, reducing environmental impacts and decreasing travel times.

Our Approach

What is location data?

Location data, or 'geospatial data', is the record of what we do and where we do it. It tells us where people and objects are in relation to a particular geographic location, whether in the air, on the ground, at sea or under our feet.

9 Location Data Opportunities

- Infrastructure
- Housing
- **Transport**
- Public Health
- Emergency response
- Environment
- Finance
- Ocean economy
- Retail

The UK Geospatial Strategy[7] develops a vision for a coherent national location data framework by 2025. Future technologies will be underpinned by data about events occurring at a time and place. Location data will be the unifying connection between things, systems, people and the environment. The Geospatial Commission has been charged with delivering this transformative vision to unlock the power of location data.

The UK Geospatial Strategy outlines four missions to tackle challenges in the geospatial policy landscape and maximise the opportunities. Transport was identified as one of nine opportunity areas on the basis of responses to the Geospatial Commission's Call for Evidence[8], and analysis undertaken in 2017, which found that the better use of location data in the transport sector could realise up to £2 billion of economic value[9]. To deliver Mission 2: Improve access to location data[10], we included a commitment to assess how location data can support the future of mobility and next generation transport networks.

We have already undertaken some work in this space. As part of the Geospatial Commission's Public Sector Geospatial Agreement (PSGA) with Ordnance Survey (OS) we already ensure access to core transport network data to support routing, scheduling and tracking activities. In addition, and following significant user engagement, OS will also be capturing new data which will enhance the transport network data; this will be made available to all OS public and private sector customers as part of the Public Sector Geospatial Agreement from 2022/23.

We identified a need to go further to ensure the power of location data is fully supporting the future of mobility and next generation transport networks in the UK.

Our Engagement

17 Transport Taskforce Organisations

CREATED A TRANSPORT LOCATION DATA TASKFORCE

Launched in August 2020, the Transport Location Data Taskforce brought together a group of 17 geospatial experts across the public and private sectors, as well as the Devolved Administrations, to help shape the Commission's policy towards improving the use of location data in the transport sector. The taskforce concluded with a final meeting to discuss the findings in this report.

28 Feasibility Studies Funded

LAUNCHED A TRANSPORT LOCATION DATA COMPETITION

Technology in the transport sector is developing rapidly and there is a real need to be alert to change, iterate through new ideas and monitor impacts through pilots. The first phase of the Transport Location Data Competition provided 28 projects with funding and the opportunity to develop novel concepts that have provided first hand insight into how transport challenges and opportunities can be navigated. Following the completion of Phase 1 , we reviewed the project closure reports, which identified a spread of benefits, and some overlapping challenges and barriers to innovation.

24 Academics Consulted

CONSULTED OVER 20 ACADEMIC EXPERTS

We commissioned the cross-government Open Innovation Team[11] to conduct a review of the challenges and opportunities relating to the use of geospatial data in the transport and mobility sector. For this, they interviewed 24 academics focusing on our six high value use cases.

07 Policy Roundtables

48 Transport Sector Representatives

HELD A SERIES OF STAKEHOLDER ROUNDTABLES

We held seven roundtables with 48 transport sector representatives from across industry, government departments and civil society sectors. The roundtables focused on the high value use cases identified by the Commission.

Transport Location Data Competition

Technology in the transport sector is developing rapidly and there is a real need to be alert to change, iterate through new ideas and monitor impacts.

The Geospatial Commission's Transport Location Data Competition brings together transport data challenges and innovators in order to deliver novel solutions, investing £5 million across two phases and working with Innovate UK[12]. Phase 1 was launched in September 2020 and Phase 2 was launched in May 2021. The Small Business Research Initiative 'SBRI' competition focuses on solutions for four thematic challenge areas:

- **Mobility as a service** - Overcoming siloed transport networks by enabling more seamless and accessible integration of transport modes.
- **Active travel** - Mitigating safety risks to promote active travel.
- **Supply chains** - Tackling logistical challenges, such as planning distribution networks and routing, optimising storage and warehousing, and last-mile delivery to reduce freight transport costs.
- **Increasing capacity** - Managing over-capacity to increase efficiency of our transport networks without compromising safety.

Throughout the competition, the development of innovative ideas has been closely aligned with the future needs of the public sector. Competition entrants have partnered with public sector challenge owners, such as local authorities, regional transport authorities and national bodies, like Network Rail and the General Lighthouse Authority.

The first phase of the Transport Location Data Competition received nearly 200 applications, with 28 projects awarded funding to develop novel concepts through feasibility studies. These studies have provided first hand insight into how transport challenges and opportunities can be navigated.

Following the completion of Phase 1 we reviewed the findings, which identified a spread of benefits and some overlapping challenges and barriers to innovation. Winning the competition and securing funding has provided many benefits for innovators, including close working with public sector partners to hone proposals and demonstrate their ideas. Many of the innovators have successfully grown interest in their proposed products or services through their association with the competition.

Winning projects awarded phase 2 funding

- **Maritime ANalyTics Intelligence System (MANTIS)**, Emu Analytics Ltd: AI visualisation tool to identify evolving ship patterns of movement to inform the planning of future offshore wind farms.
- **Digital Active Travel Augmentation (DATA),** Ngenius Ltd: Software using anonymised location data from CCTV cameras to help Local Authorities manage active travel routes.
- **Optimising Geofencing,** Ricardo UK Ltd: Geofencing optimisation to increase the usage and effectiveness of low emissions zones for air quality improvements.
- **National Freight Model**, City Science Corporation Ltd: Advanced modelling to improve the understanding of freight movements within the UK.
- **ZERO,** Dynamon Ltd: An AI tool to help commercial fleets adopt the optimum zero-emission vehicles and charging infrastructure.
- **Digital twin of the rail network**, Hack Partners Ltd: Using track circuit sensor and location to increase capacity and efficiency of the rail network without compromising safety.
- **Automated Rail Geospatial Observation System (ARGOS),** Thales Ground Transportation Systems UK Ltd: Utilise train location and sensor data to understand track geometry characteristics and detect underlying track faults.

The additional funding awarded in Phase 2 will enable the development and pilot of solutions, supporting innovators to further progress towards bringing these ideas to market.

02

6 Common Themes

1. Treating mobility as an interconnected system
2. Promoting data interoperability and standardisation
3. Making data more findable and accessible
4. Improving data reuse
5. Enabling greener modes of transport
6. Unlocking the potential for data-driven innovation in transport

Common Themes

Our evidence has highlighted a number of common themes and cross-cutting challenges. Many echo our conclusions about location data supporting other sectors, and necessarily call for a system-wide approach. Here, we illustrate how these themes relate to some of the key findings from our evidence.

The Geospatial Commission's Q-FAIR Approach to Geospatial Data

The Geospatial Commission has adopted Quality, Findability, Accessibility, Interoperability and Reusability (Q-FAIR) as principles to define good geospatial data[13]. In the Geospatial Commission's Annual Plan 2021/2022[14], we set out our plans to extend the ambition of this approach as a means of assessing, appraising and implementing options for the improvement of the UK's foundational geospatial data. Many of the themes outlined in this report on transport location data relate to the five principles:

- **Quality:** Data should be fit for its intended purpose, based on appropriate collection and management methods, and should not be materially misleading. There are many factors that can be used to measure data quality, such as its accuracy, precision, timeliness, coherence and completeness[15].
- **Findability:** To be used, data has to be findable. Data should be easy to find for both humans and computers, and able to be integrated easily with other data to draw insights. Findability is crucial in providing users an awareness of what data exists and where, thereby reducing search times and the risk of reproducing data that already exists.
- **Accessibility:** Once found, users should be able to easily access and use that data. This means that the financial cost of accessing that data should be reasonably minimised, and any conditions for access (e.g. licences) should be simplified as far as possible.
- **Interoperability:** Overlaying, linking, or exchanging content from disparate datasets is often required. Ensuring systems can make use of datasets in combination with one another is critical to ensuring their wider impact and value through higher quality insights.
- **(Re)usable:** Data is rarely useful for a singular purpose, and ensuring that datasets are created in a way to both maximise ease of use and reuse is critical to unlocking additional value.

Theme 1: Treating mobility as an interconnected system

Technology is improving our ability to take a systems level view of transport and mobility. The advent of Intelligent Transportation Services (ITS), Mobility as a Service (MaaS), and 5G and Vehicle-to-Everything (V2X) connectivity means we can start assessing journeys considering all possible modes of transport to make the most of existing capacity. However, to fully enable these technologies we need to have a common location data standard or framework for defining different travel options, networks, and the relative positions of key infrastructure and vehicles - whether by land, sea or air.

New data-driven transport technologies

Intelligent Transportation Services (ITS):

ITS is the integration of people, processes and technology to automate and advance transport networks, providing a more cost-effective, reliable and faster service[16]. One example of this is the Split Cycle and Offset Optimisation Technique (SCOOT) system developed in the UK and in use at many traffic lights across the country that uses live vehicle detectors to adjust traffic signal settings, resulting in traffic delay reductions of up to 15%[17].

Mobility as a service (MaaS):

An example of ITS[18], MaaS is the integration of various modes of transport along with information and payment functions into a single platform, creating a single point of transaction for the user. It has the potential to promote the use of mass transit and more sustainable travel, with greater value for money and an improved journey experience for consumers[19].

5G and Vehicle-to-Everything (V2X) connectivity:

The V2X ecosystem, bolstered by future low-latency 5G networks, will enable rapid two-way communication between vehicles and a broad range of transport and traffic-related systems, including vehicle to vehicle (V2V) and vehicle to infrastructure (V2I). It will allow vehicles to make complex manoeuvres and behave as groups rather than individuals[20]. Green Light Optimal Speed Advisory (GLOSA), for instance, is a V2I system that aims to reduce traffic congestion by providing drivers with more detailed traffic light information, such as warning times to traffic light changes and speed recommendations, allowing for a more planned approach to traffic, smoothing traffic flows and improving fuel consumption and journey times. The Department for Transport (DfT) sponsored a project trialling GLOSA on a 6km stretch of the A45 Coventry Road in Birmingham, demonstrating a 7% reduction in journey times[21].

CASE STUDY

Optimising Last Mile Delivery

Last mile delivery[22] could be further optimised by taking a systems approach and considering multiple modes of transport for a journey, including through smarter and innovative use of telematics and fleet management data, local freight consolidation centres, customer pick-up centres and foot or cycling porter services. It could also be optimised by enabling delivery to be grouped from a user perspective: if users chose a single delivery day for all their deliveries, this could significantly reduce the number of trips. The opportunity for financial efficiencies and realising environmental benefits could be significant, because although last-mile distribution accounts for a small percentage of the total distance travelled, it accounts for around 41% of total supply chain costs[23] and is one of the highest polluting segments of the supply chain[24].

The Freight Traffic Control 2050[25] project studied last mile delivery in central London. Using a range of data sources, including delivery manifest data (covering routes and deliveries) from different operators, it observed that:

- There was significant overlap between drivers from the same company and competing operators.
- Vans were stationary on average 65% of the time; whilst drivers walked to make deliveries. Drivers could often walk up to 10km a day.
- The route optimisation softwares commonly used did not account for multi-modal options,

Their research provides support for ideas, such as portering (using foot or cycle delivery staff to collect and deliver packages from a van and deliver across a given area). Consolidation centres, operated by a third party, have been successful in the construction sector[26] and in trials in London[27].

Theme 2: Promoting data interoperability and standardisation

The future of mobility will require technologies and solutions that can scale across the UK. However, currently a great deal of public sector transport data is collected, stored and managed in silos. This siloed approach has led to inconsistencies in the application of existing standards across the mobility system, an issue identified by the DfT[28]. This can make it challenging for innovators to develop scalable solutions without incurring inefficiencies and duplication of effort.

CASE STUDY

Integrating Fleet Telematics Data

During our roundtable engagement, it was noted that for multiple organisations and systems to utilise the same data, technical standards and effective implementation of those standards is critical. The existence of standards does not guarantee their adoption or use; the main challenge for stakeholders is efficiently applying standards in a way that is beneficial to both the wider stakeholder group and end-user.

There are challenges in integrating fleet telematics data - the digital blueprint of every aspect of a vehicle's operation. **Generated by multiple logistics providers in different ways, fleet telematics data can be difficult to integrate due to the use of different routing systems and intervals for time-stamped location data.** Standardising such data could help support better logistics analysis to optimise operations involving multiple operators, such as at a busy port. However, interoperability is further complicated by changing technologies and new ways of working.

Theme 3: Making data more findable and accessible

While there is an abundance of data, especially in the public sector, there is often a lack of awareness of what data exists, where, and for what purpose it can be used. Although the Ordnance Survey, for instance, produces highly detailed geospatial datasets with wide transport applicability, a huge amount of potentially valuable data is collected by DfT and its sponsor agencies, as well as by Local Authorities - data that is often not easily findable or accessible. Where that data is findable, there are often licensing or other accessibility constraints that make it difficult or impossible to access. DfT's Find Transport Data[29] project aims to help address some of these problems and enable the reuse of transport data.

CASE STUDY

Competition Findings - Data Access Barriers

Barriers to data access were found by a number of projects in the Geospatial Commission's Transport Location Data Competition, for example, in relation to CCTV footage, maritime data, infrastructure location data and specific rail datasets, such as speed restriction spreadsheets. Barriers included legal barriers and complex data sharing agreements, as well as governance and ownership challenges, such as safety, ethics, and conflicts of interest. In some instances, there were complex and time intensive approval processes which resulted in significant delays to receiving access or no access at all. Access issues were also found in relation to private sector datasets with commercial sensitivities, this was particularly prevalent in the highly competitive EV, e-mobility and CAV sectors where organisations were reluctant to share proprietary data.

In emerging transport modes there is a balance between the mode itself and its use of the transport system. Data exchange between the two is essential. For collective innovation, data on how the transport system is being used could be shared to support advancements and innovation in the wider transport ecosystem.

Data sharing agreements have been established for trailing new modes of transport, such as micro-mobility.

Theme 4: Improving data reuse

The quality of data for reuse was often cited as an issue among stakeholders. Local Authority data, as one example, is often collected and managed on different software, to different standards, for different needs. The result is that while data may be fit for purpose from an operational perspective, it can be a challenge for third parties to aggregate and analyse data from multiple Local Authorities, to provide value add services. This is due to a lack of consistency across local authority systems and approach to standards in digital data management.

CASE STUDY

Local Authority Data and Low Traffic Neighbourhoods

Researchers seeking to understand the impact of Low Traffic Neighbourhoods[30] (LTNs) have highlighted issues with the quality of local authority road data. Longitudinal studies by Westminster University on the impact of LTN implementation in London found that car ownership decreased whilst active travel increased[31]. However, their research was hindered by a number of issues, most notably a lack of ready-made national or regional datasets covering LTNs. Location, boundaries and even the scope of LTNs were poorly recorded, in part due to the individual implementation by local authorities and their rapid rollouts in response to the Covid-19 pandemic.

Theme 5: Enabling greener modes of transport

The transport sector remains the largest emitting sector in the UK, despite reductions in carbon dioxide emissions due to the Covid-19 pandemic[32]. The UK's ambition to be net zero by 2050 means that we must encourage greener and cleaner transport options, such as active travel, electric vehicles (such as scooters, bikes, cars and buses), hydrogen-powered vehicles, and shared mobility schemes and services. Drones and Unmanned Aircraft Systems (UAS) could also play a role in delivery networks, removing the need to send a van to deliver a parcel to a single house, or enable the rapid delivery of medical supplies. Location data will play an important role in enabling our pathway to net zero transport in the UK.

CASE STUDY

Active Travel

Active travel, which is the transport of people or goods by human based physical activity, can improve everyday life for us all, not just through reducing carbon dioxide emissions, but also by improving air quality, health and wellbeing, addressing inequalities, and tackling congestion and noise pollution on our roads[33]. The government is supporting active travel through £2 billion of new funding to deliver its 'Gear Change' vision, which includes a target that half of all journeys in towns and cities will be cycled or walked by 2030[34].

Funded through the Geospatial Commission's Transport Location Data Competition, **the Digital Active Travel Augmentation (DATA) platform has been developed by ngenius.ai[35] to convert local authority CCTV camera data into a network of smart sensors, which can be used to identify cyclist and pedestrian numbers, key paths of movement, and average speed and wait times.** This enables local authorities to make data-driven decisions about planning active travel routes, monitoring the safety of cyclists and informing planning at busy junctions. Ngenius.ai are working closely with ten UK local authorities, including Norfolk County Council, Coventry City Council, Medway Council and Belfast City Council, on this project to ensure the system is designed with local authority needs in mind.

Theme 6: Unlocking the potential for data-driven innovation in transport

There are many barriers to innovation, particularly in the transport sector, and these barriers can be grouped under a few categories: lack of clarity regarding the potential benefits of new technology; lack of funding due to uncertainty on return on investment; resistance to change; and regulatory barriers that prevent the adoption of new technology. Organisations need access to capital, skills and ideas, as well as a smart and stable regulatory framework to support data-driven innovation. Data skills in particular continue to be a persistent gap; according to recent research commissioned by The Department for Digital, Culture, Media and Sport (DCMS), almost half of businesses (48%) are recruiting for roles that require hard or technical data skills, and a similar amount of businesses (46%) have struggled to recruit for these roles over the last two years[36].

CASE STUDY

Barriers to Innovation

Regulatory barriers affected a number of projects developing innovative solutions in our Transport Location Data Competition. The speed of technological innovation has been rapid and regulatory change can be slow to adapt. Some projects from the competition highlighted that this issue was particularly acute in the drone and Connected Autonomous Vehicle (CAV) markets.

Both the drone and CAV markets are seeing a large amount of research, development and innovation, including through the use of location data for applications, such as last-mile delivery and high definition 3D mapping. However, the successful commercialisation of these technologies relies on overcoming current safety risks. We saw examples of these barriers in some of our £5 million Transport Location Data Competition projects:

- **Project on combining various types of location data to determine safe potential landing zones for drones in the context of last mile delivery -** Using drones for last mile delivery will help to reduce emissions from commercial delivery fleets, reduce congestion on our roads, and potentially decrease delivery times for consumers. Whilst the location data solutions and technology exist to enable last mile delivery, safety regulations currently in place for a considerable portion of drone operations do not permit drones to be flown beyond visual line of sight and thereby limit their current use.

- **Multiple projects on CAVs -** Projects focusing on CAVs experienced similar issues when exploring the commercial potential for their innovative solutions. Location data products and services will be fundamental to the safe usage of CAVs, however, innovation is currently hampered by the need for regulations to enable wider usage of CAVs, such as in how liabilities affect self-driving vehicles. In addition, the commercialisation of innovative location data products for the CAV sector will be heavily influenced by the willingness of automotive manufacturers to adopt CAV technology.

03

Deep Dive: Six transport opportunities

01. Roads
02. Road & Rail haulage
03. Route optimisation
04. Electric vehicles
05. Connected and Autonomous Vehicles
06. Drones and Unmanned Aircraft Systems

Transport opportunity 1:

Roads

Regional, as well as national, connectivity is vital to uniting the UK. Roads provide the spine and the arteries of the UK's transport network, and the government has announced significant investment in both strategic and local road networks[37].

Opportunity Areas:

1. Improving the use and exchange of data in planning, design, construction, and maintenance - Geospatial data collected over the course of an infrastructure project lifecycle is often not shared between stakeholders involved at different stages, resulting in inefficiencies where data from site investigations is not being reused. Possible reasons include a lack of interoperable data formats and systems, a liability risk for how data is used by third parties, and there is also a potential duplication of stored data. Local Authorities currently maintain multiple versions of the road network, which are not interoperable, such as the Local Street Gazetteer (LSG) for street works data, and UK Pavement Management System (UKPMS) for road condition data, and Local Authorities can often be inconsistent in their approach to updating local road data.

2. Managing streetworks and maintenance processes more effectively - Roads are dynamic assets, and their usage and condition changes over time. Geospatial data could be more effectively used in the management of streetworks, the communication of said works to road users and SatNav systems, and in routing traffic accordingly. A number of initiatives exist to better plan and manage streetworks, such as DfT's StreetManager[38] and one.network[39].

3. Optimising traffic management systems - A range of Geographic Information System (GIS) solutions exist to monitor road usage and assist with traffic and incident management systems by different providers, such as Esri[40] and Hexagon[41]. Highways England are currently developing a spatial portal to provide a single central view of the road network in order to enable more proactive decision-making and view both real time and near time data and leverage data insights to predict potential pinch points on the network.

The value of our road networks

The Department for Transport has different classification systems for UK roads - the Strategic Road Network (SRN) managed by Highways England, the Primary Route Network (PRN), and roads classification systems managed by local highways authorities[42].

- **Strategic Road Networks:** Made up of motorways and 'trunk roads', the SRN represents 2% of all roads in England by length, but carries one third of all traffic by mileage, and two thirds of all heavy goods vehicle mileage in England[43]. DfT project an increase of 24 - 72% in driving on the SRN by 2040[44], and the government has announced £27.5 billion over this parliament, to ensure that SRNs serve all road users into the future.[45]

- **Local Road Networks:** Local roads make up 98% of the network and are used in almost every journey. They were estimated to be worth over £400 billion in 2013 – making them one of the UK's most valuable public assets[46]. The government is investing £1.7 billion in local roads in 2021-22[47].

Roads:
The data landscape

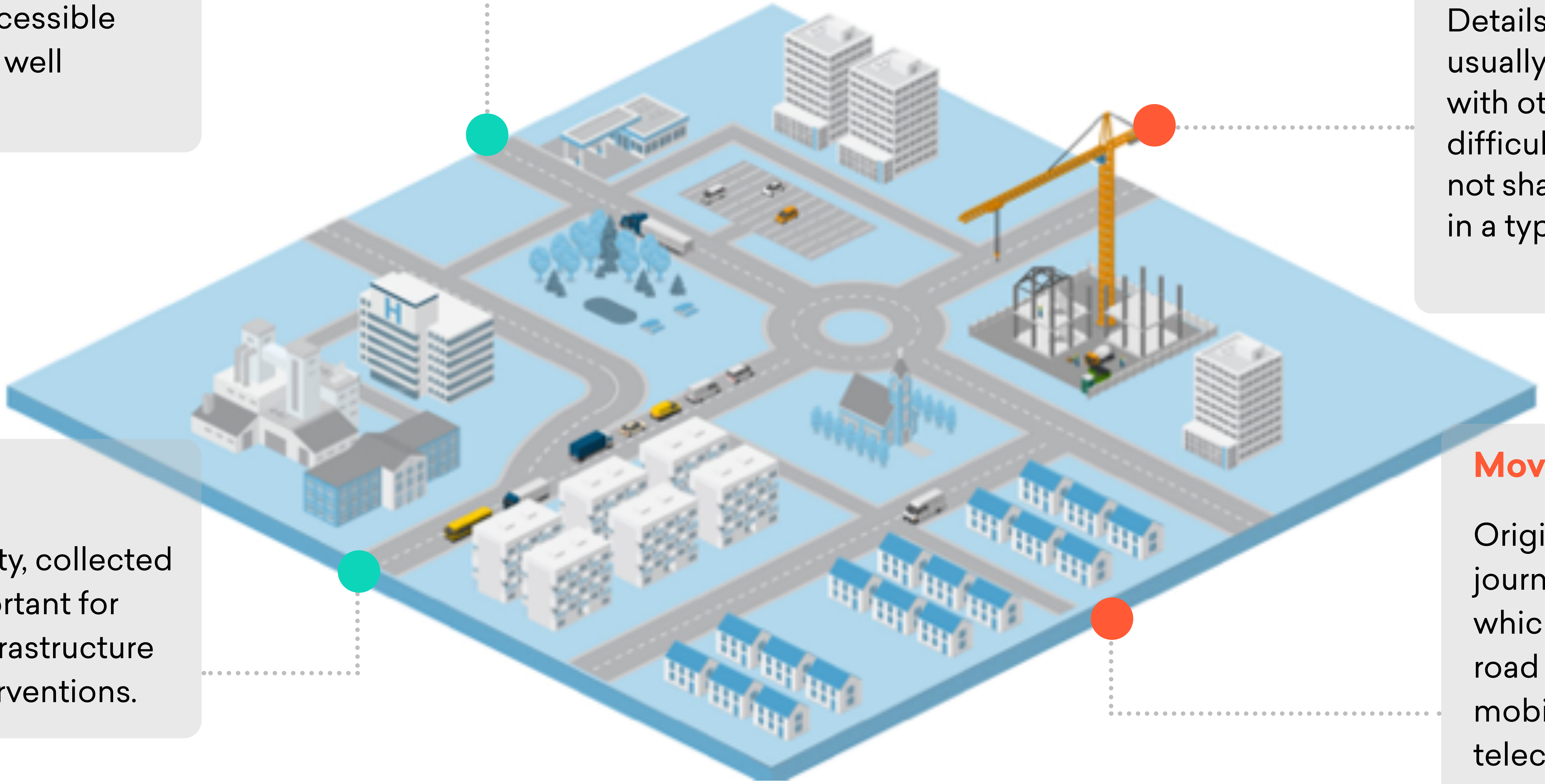
Good data is generally available on

National road networks:

This is well mapped and is accessible from the Ordnance Survey, as well as other open sources.

Traffic flows:

Data on traffic flow and density, collected by Highways England, is important for assessing where new road infrastructure is needed and modelling interventions.



We generally lack good geospatial data on

Planning and construction:

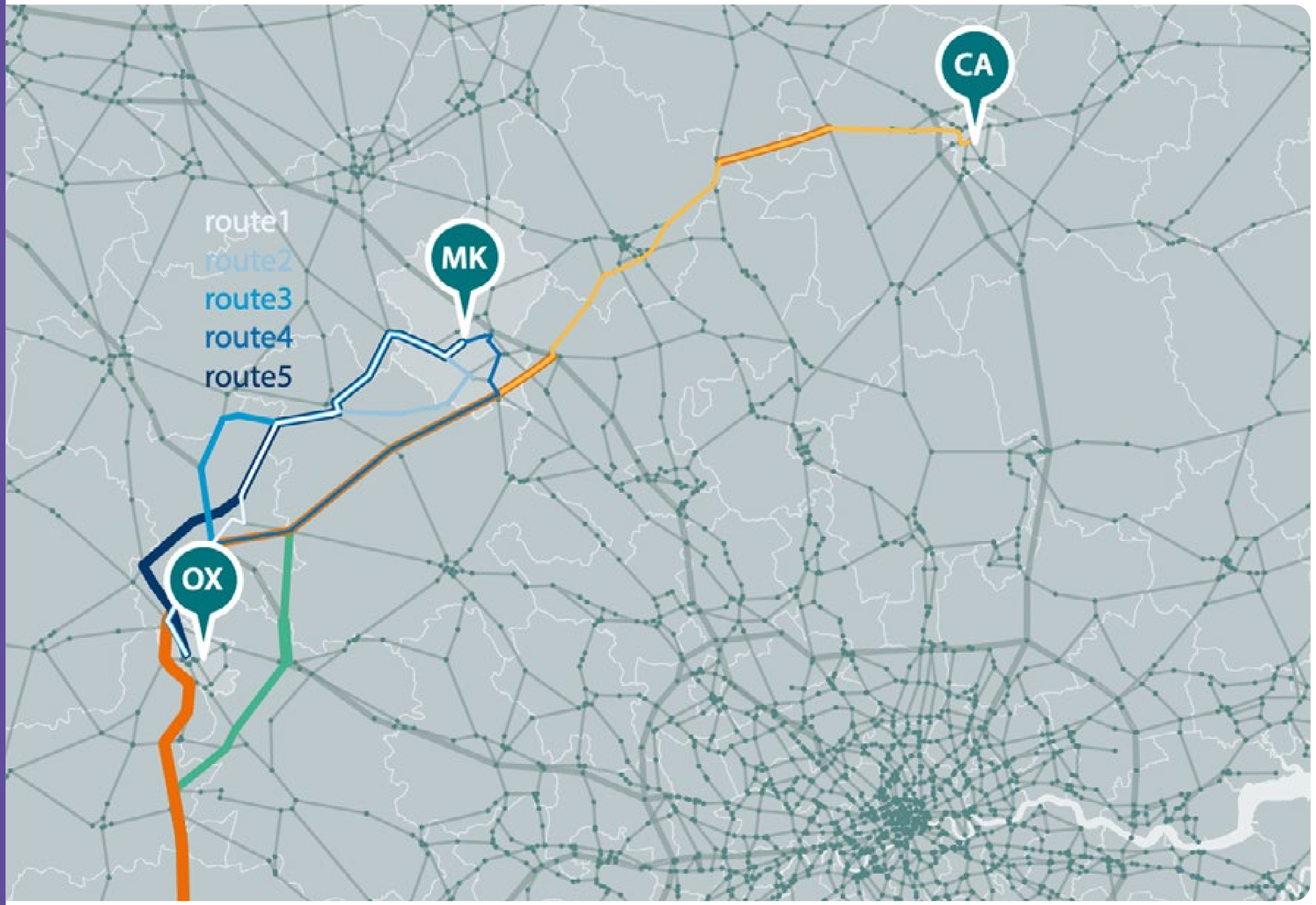
Details of new developments are not usually available in formats compatible with other GIS spatial data, making it difficult to use. Additionally, data is often not shared between stakeholders involved in a typical infrastructure project.

Movement of people and goods:

Origin/destination data on these journeys can be difficult to access, which can make planning or updating road infrastructure challenging. Some mobility data may be available from telecommunication and mobile application providers.

CASE STUDY

Modelling Road Networks



Results from the NISMOD road transport model, showing route sets for fastest trips between the centres of Milton Keynes and Oxford (blue), and Cambridge and Oxford (yellow). It shows that the new proposed expressway (brown) gives the fastest route between Oxford and Cambridge - traffic no longer has to negotiate roads in and around Milton Keynes, and travel times are reduced by 15-20 minutes compared with Baseline journeys. However, for journeys between central Milton Keynes and Oxford, there are several existing routes which provide similar or faster travel times in uncongested conditions.

Improvements in the modelling of transport networks can help us understand the impact of improving, changing or building road infrastructure.

Modelling road networks is important for helping to plan and maintain infrastructure. The Infrastructure Transition Research Consortium (ITRC)[48], a collaboration between seven UK universities, developed a model (NISMOD), which has been used in collaboration with the National Infrastructure Commission and relevant local authorities in projects, such as the Oxford/Cambridge Arc.

They took a two-tiered approach to modelling. One part focused on modelling national travel patterns to help forecast demand for new road infrastructure and simulate traffic on major roads. A different approach was used to understand requirements for maintenance and road upgrades at the local level.

Multiple spatial referencing systems used in different datasets made integration difficult — much of the data they relied on had to be converted and checked before it could be layered. This is a laborious and time-consuming process that could be tackled through standardisation and implementing a universal database, which would allow cross-referencing of classification systems.

Transport opportunity 2:

Road & Rail haulage

The UK's logistics networks represent a significant contributor to the UK economy, ensuring both consumers and businesses have access to the goods and services they need. Location data is widely used in the logistics sector to manage fleets, plan routes and provide up to date traffic information[49].

Opportunity Areas:

1. Encouraging greater adoption of vehicle telematics systems - Vehicle telematics systems are a useful way to plan and manage delivery fleets, saving journey times, reducing fuel emissions and promoting safe driving. However, such systems are under-utilised by many companies, particularly SMEs.

2. Developing common standards for telematics routing systems - Data collected from vehicle telematics systems is often not standardised, generating time-stamped location data at differing intervals. This can make the integration of data across multiple telematics systems difficult and time consuming, for example to analyse traffic patterns at a busy port or transport hub. Further vehicle data communication standards, such as SAE J1939[50], which is used widely along diesel-powered vehicles, could be developed and adopted further.

3. Modelling freight networks - Although there is generally good data available on freight moving in and out of the country (such as at ports and key terminals), there is little data available on how freight moves within the UK, such as its location, type and path of cargo, and across multiple modes of freight transportation. Better data about the UK's freight network could enable a range of policy and planning interventions, such as enabling freight consolidation and modal shift away from road-based transport. DfT has recently completed a freight data hub discoverability project[51] to explore the potential to improve freight data accessibility and use.

Rail Freight

With the right access to data, e-commerce and delivery companies could be helped to make better use of the rail network, reducing pressure on congested roads. Large quantities of goods are transported long-distance across the road network in the UK. Much of this travels across similar and predictable routes, which could be rationalised and transferred to the rail network with the right combination of data, facilities and brokers.

At present, individual e-commerce and grocery companies generally do not transport enough to make efficient use of entire trains, requiring greater coordination between companies. **Competition law may limit direct data sharing between the e-commerce firms,** preventing them from making optimal use of less congested and environmentally friendly railways.

However, with the right access to data, third-party companies could identify popular common road haulage routes and offer affordable and efficient consolidated rail freight alternatives, while remaining within competition law.

Road & Rail Haulage:
The data landscape

Good data is generally available on

Railway mapping and timetables:

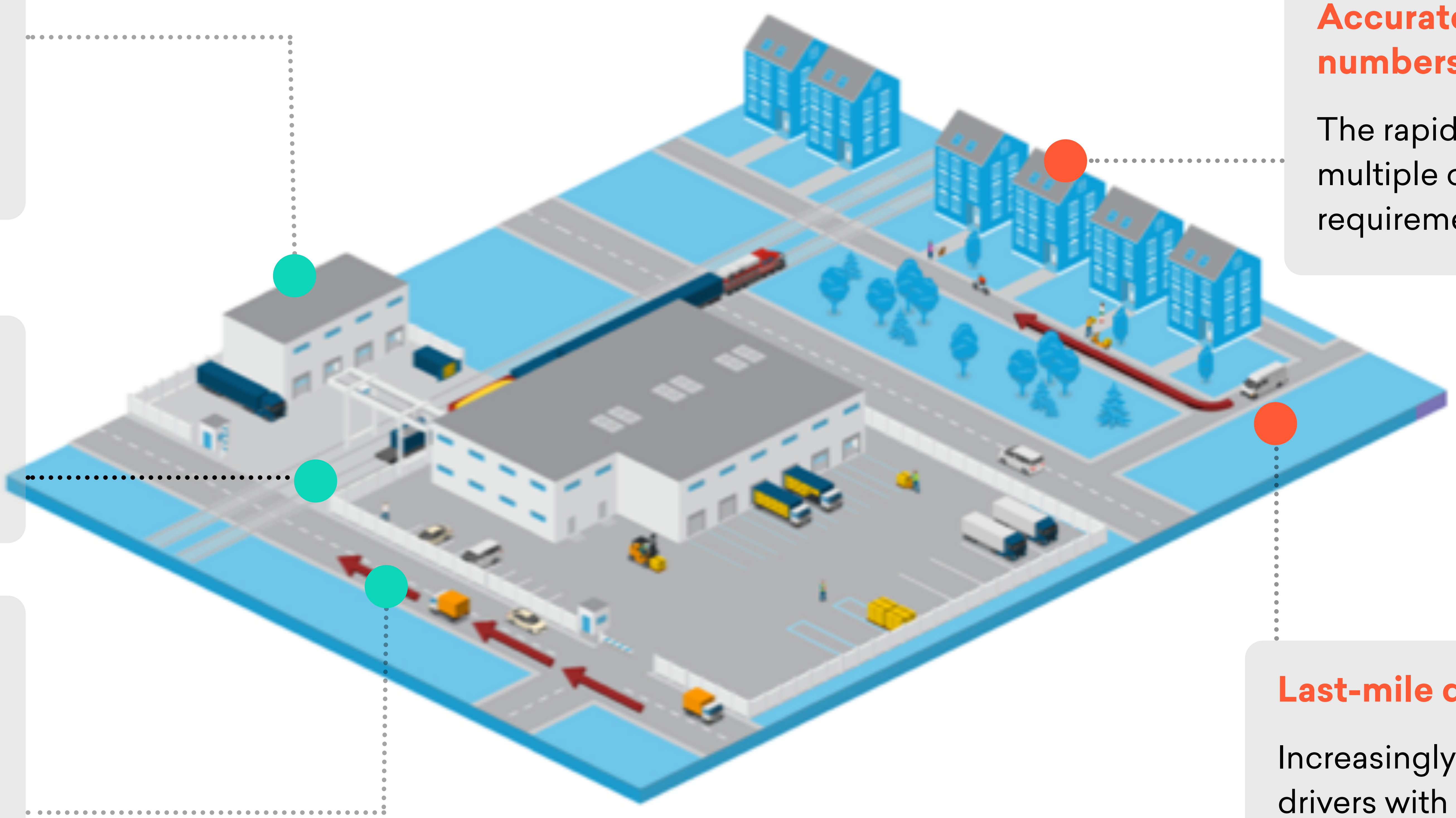
This is well mapped and is accessible from the Ordnance Survey, as well as other open sources.

Distribution centre locations:

These tend to be published by large distribution companies.

National delivery route data:

Delivery route data is generally held by the operator and/or external monitoring companies, such as Microlise.



We generally lack good geospatial data on

Accurate aggregated delivery numbers:

The rapid increase in e-commerce and multiple operators means logistics requirements are underestimated.

Last-mile delivery:

Increasingly performed by gig-economy drivers with their own or rented vans.

CASE STUDY

Freight Modelling

Through our Transport Location Data Competition, the Geospatial Commission is funding the development of a National Freight Model by City Science. **Bringing together geospatial data and models from a wide range of sources, the National Freight Model aims to enable analysis at sufficient scale to provide a range of insights.** By making freight data accessible and available through APIs, the model makes this data findable and usable. Enabling users to make data-driven decisions will ultimately improve the efficiency and sustainability of the UK's freight network.

The model aims to **improve the efficiency of freight** movement through consolidation, enable last mile delivery services and support the identification of local alternative suppliers. It could also be used to understand the carbon impact of freight and support customer information, such as through carbon footprinting or enable pricing strategies based on carbon emissions. Infrastructure planning could benefit through the identification of charge points, facilities and warehousing space.

City Science are working in collaboration with Somerset County Council, England's Economic Heartland, and Transport for the North on this project.

Transport opportunity 3:

Route optimisation

Better location data can help determine the most cost-efficient route, taking into account all the relevant factors. This might include consideration of:

- **Multi-modal travel:** such as public transport routes with multiple changes.
- **Speed, cost** or **emissions** of the trip.
- **User needs:** for example, wheelchair users might require a dropped curb.
- **Scheduling:** the time dimension of route planning also needs to be considered.

Both operational and strategic route optimisation would benefit from more real-time, dynamic data on events like traffic jams and roadworks.

Opportunity Areas:

1. Investing in more bespoke operational route planning systems - Most current route planning systems are designed to enable users to get from one point to another using the shortest, quickest, and/or cheapest route possible. However, there is considerable scope to develop more bespoke route planning systems to reflect additional user preferences. Examples include pedestrian or cycling routing systems given local crime statistics and the presence of street lighting, pavements/cycle lanes and other infrastructure, and including carbon footprint estimates to identify clean modes of travel.

2. Supporting the development of strategic route planning tools - Geospatial solutions can help support the development of strategic planning tools to determine the optimal routes for certain types of traffic, such as school bus routes, and to support the development of new infrastructure.

Route optimisation can be divided into two distinct categories:

1. Operational: the route planning an individual or company would use to determine how to get between two places, or deliver goods or services, most efficiently. This usually draws on mapping data (local and national maps) and real time or historic data about traffic conditions.

2. Strategic: this is about better understanding optimal routes at the strategic level, often for planning purposes, for example, where a local authority should build cyclepaths for optimal use. This relies on usage data (such as historic traffic flows), multi-model travel data and sometimes very detailed map data, such as the exact width of roads.

Route Optimisation:
The data landscape

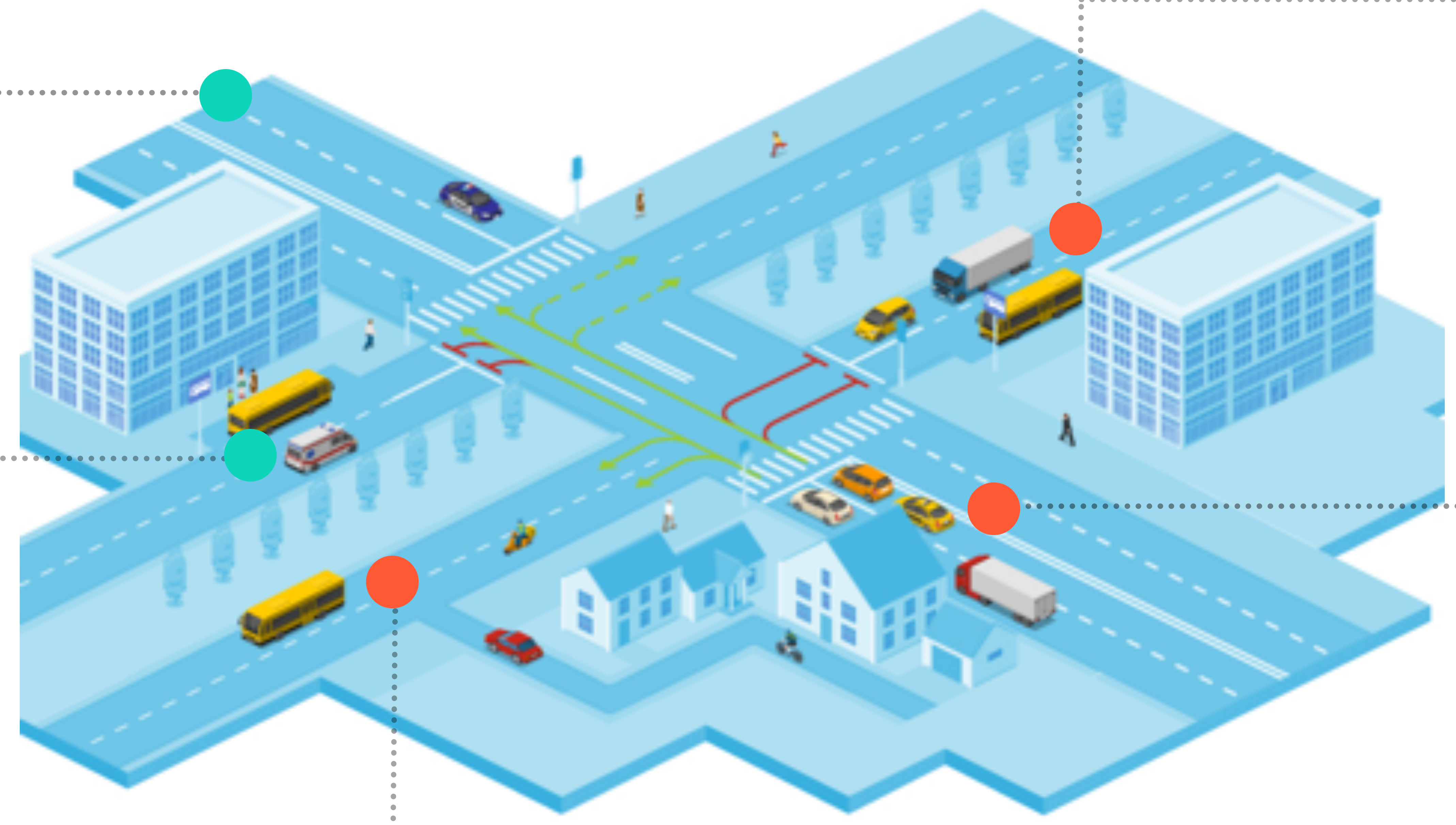
Good data is generally available on

National road networks:

This is well mapped and is accessible from the Ordnance Survey, as well as other open sources.

Average traffic flows:

For time-specific route planning.



We generally lack good geospatial data on

Origin/Destination data:

About regular trips (e.g. commuting habits) is often out-of-date, highly aggregated, or prohibitively expensive. Some mobility data may be available from telecommunication and mobile application providers.

Traffic speeds:

Ordnance Survey is intending to make road speed data available through the PSGA from April 2023. DfT also publish data in stats series form on average speeds along the Strategic Road Network and A roads by month.

Dynamic road conditions:

Real time data on traffic conditions, including jams and collisions.

CASE STUDY

Propensity to Cycle Tool

The Propensity to Cycle Tool, built by a team of UK academics[52], allows local authorities and DfT to test different cycling uptake scenarios and plan cycle infrastructure.

It identifies potential cycle lane routes by combining data about levels of cycling by area with data on roads and other infrastructure, and topographical data. The data has been available for some time, but effective integration and visualisation in an easy-to-use tool was needed to make it usable.

The current approach has limitations due to available data. Commuting data is largely drawn from the 2011 census and the routes PCT identify may sometimes be out-of-date. Other data which is not easily accessible to the researchers but would improve such a model include:

- **Detailed origin-destination data:** this would help identify where cycle lanes could have the greatest impact.
- **Speed limits:** speeds of vehicles in practice would help identify safe and less safe routes.
- **Road width data:** can be used to determine whether a road is wide enough to install a cycle lane.

Transport opportunity 4:

Electric vehicles

Accelerating the shift to electric vehicles (EVs) is important to achieving net zero and the UK government's ambition to end the sale of petrol and diesel vehicles by 2030. Cars and vans were responsible for almost a fifth (19%) of the UK's total domestic greenhouse gas emissions in 2019[53]. The Society of Motor Manufacturers and Traders (SMMT) responded to the government's 2030 target by stressing vehicle manufacturers' willingness to "work with government on the detail of this plan, which must be delivered at pace to achieve a rapid transition that benefits all of society, and safeguards UK automotive manufacturing and jobs."[54]

While the market for electric vehicles is immature, it is growing and a number of vehicle manufacturers have announced changes to the types of vehicles that they will produce to meet the 2030 target.[55] Tesla continues to produce record numbers of EVs, announcing over 200,000 vehicles built and delivered in the second quarter of 2021, and $1.1 billion in net income for the first time.[56]

Opportunity Areas:

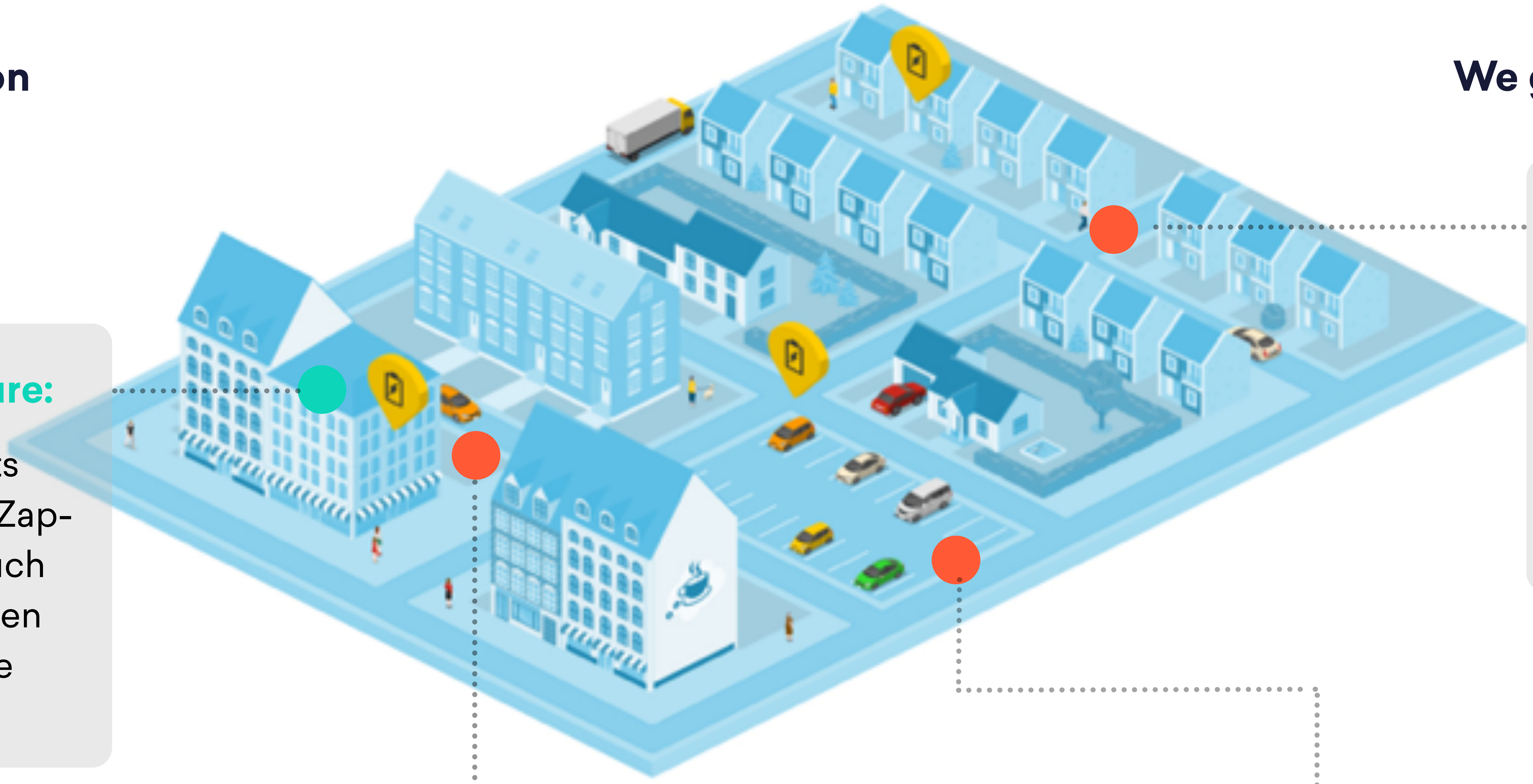
1. Planning new charging infrastructure - To inform where to build new EV chargepoint infrastructure, a range of location-based information is often considered. Knowing exactly where the nearest electricity line is can help to minimise connection costs. Location data on parking spaces, shopping outlets, leisure centres, and other areas where users are likely to leave their car unattended for a portion of time can also provide insight into where best to build a charge point. Critically, however, the data needed to support EV charging infrastructure must be made interoperable; and there is currently no authoritative data on EV usage and infrastructure nationally.

2. Enabling bespoke EV routing applications - EV users will have bespoke requirements when it comes to planning routes of travel. As well as information about the type, speed and availability of the nearest chargepoint, road gradient and outside temperature can have a significant impact on the effective battery range of an EV. Some steps are being taken to develop bespoke EV routing solutions; for example, Zap-Map's Route Planner takes into account EV model and chargepoint accessibility[57].

3. Managing grid capacity - The UK's electricity transmission network is expected to cope with an influx of EVs, however, localised distribution networks are at risk of being overwhelmed in the short-medium term. Increasing population levels and EV uptake mean that energy demand could increase by 9 - 26% from 2018 to 2030[58], although this may be offset somewhat by continued efficiency improvements to the UK's electricity networks. Geospatial data about the UK's electricity networks could be used to identify stress points in the network, enable targeted investment, and support the development of smart charging schemes. In February 2021, the Energy Networks Association announced its intention to develop a digital proof of concept of the UK's energy system, including network assets, generators and energy-intensive users, in collaboration with the Ordnance Survey and 1Spatial, to increase visibility of the Energy System infrastructure and assets, enable optimisation of investment and inform the creation of new markets[59].

Electric Vehicles: The data landscape

Good data is generally available on



We generally lack good geospatial data on

Existing EV charging infrastructure:

The location of existing charge points data is available via services such as Zap-Map. However more granular data, such as their availability / reliability at a given time, is difficult to obtain from charge point operators.

Latent demand:

We do not currently have good, granular data on who and where people are buying / using EVs (other than DVLA data on where the vehicles are registered), which could help local councils anticipate charging demand.

Electricity grid:

Data about the underlying grid connection, such as the location of existing electricity networks, low voltage networks, and substations, is often needed to minimise connection costs and manage electrical capacity but this data is often difficult to obtain.

Parking:

There is limited data on home parking access (for example, on-street versus shared carparks versus driveways) — particularly important for planning where public EV and on-street residential charging points should go, where home charging will not be possible.

CASE STUDY

Electric Vehicle Chargepoint Data: Creating a pan-London view

Heatmap showing chargepoint utilisation in London, GLA Dashboard 2021

Location data can facilitate insight into the optimal locations for new charge points to help support the rollout of electric vehicles (EVs), however, there are data challenges that must be overcome on this journey - as was found by the London Office of Technology and Innovation (LOTI).

LOTI[60], in collaboration with London Councils, the Greater London Authority (GLA), and other partners, has developed a dynamic dashboard showing the location and patterns of usage for EV charge points in London, for use by highway and transport officers. **This project is intended to enable informed strategic infrastructure planning decisions on future EV deployments locally, by bringing together data on usage and location of EV charge points across boroughs to show a pan-London view.**

To build this dashboard, their starting point was data generated by EV points implemented by the boroughs via the TfL Electric Vehicle Charging Infrastructure Framework, funded through Go Ultra Low City Scheme (GULCS) or On-Street Residential Charging point Scheme (ORCS), accounting for approximately two-thirds of London's EV infrastructure. Dynamic EV charge point usage data, as well as location, was already provided by GULCS charge point operators, but there were two main barriers to a transparent pan-London picture:

1. Varying data quality and different datasets provided by operators made cross-borough analysis a time-consuming process; and

2. Differing mechanisms used for providing data by different operators meant that analysis was largely a manual process, involving the combining of multiple spreadsheets every quarter.

To fix the barriers, LOTI used the London Datastore[61] as a central point for sharing all EV charge point data, and developed common data and API standards to automate and improve this process.

Transport opportunity 5:

Connected and Autonomous Vehicles

Connected and Autonomous Vehicles (CAVs) represent a significant step for the future of mobility. The UK CAV market is expected to be worth £41.7 billion and employ 49,000 people by 2035, with 80% of jobs expected to be in software-related industries[62]. **High resolution location data, either from vehicle mounted sensors or high definition maps, will be critical to supporting navigation and obstacle avoidance in Autonomous Vehicles.**

Opportunity Areas:

1. Enabling the generation and exchange of HD mapping data - In order to be able to navigate the road environment autonomously and safely, CAVs will need to be able to understand and interpret this environment. There are broadly two schools of thought to achieving this:

- High definition maps; and
- Vehicle-mounted sensors.

Our engagement has highlighted that requirements amongst CAV developers are likely to differ, although sensor technology is likely to become the cheaper and more accessible technology in the long term. Nonetheless, connected mapping data beyond line of sight of the sensor, and that needs to be shared with multiple vehicles, is likely to represent an additional corroborative source of data. Furthermore, there is considerable potential for location data crowdsourced from these sensors to produce a high-quality, dynamic and real-time view of the road environment, update existing maps, and automate manual traffic and highway surveys. Ordnance Survey recently led the E-CAVE project[63], funded under the Industrial Strategy Challenge Fund. It successfully demonstrated the value of a data hub to facilitate the neutral exchange of dynamic information between CAVs and roadside infrastructure. Data hosting and exchange platforms, such as ConvEx[64], are likely to be critical to enable the wide-scale commercial exchange of this data, however, standards to describe objects in the road environment consistently are likely to be necessary[65].

2.Investing in incremental V2X testing and trials - CAVs are still some years away from being a wide-scale, commercially viable mobility option. Over the course of our engagement, stakeholders have emphasised undertaking incremental initiatives that can be achieved contemporaneously, with a specific focus on addressing safety considerations of CAVs. Working with the Centre for Connected and Autonomous Vehicles (CCAV), the British Standards Institution (BSI) is developing a set of standards (PAS 1882) for the collection, storage and sharing of data by automated vehicles during CAV trials and advanced trials in the UK for the purpose of assisting in accident and incident investigation[66]. Examples of such initiatives now include Green Light Optimal Speed Advisory (GLOSA) trials, improving 4G and 5G coverage, and digitisation of Traffic Regulation Orders.

Connected and Autonomous Vehicles: The data landscape

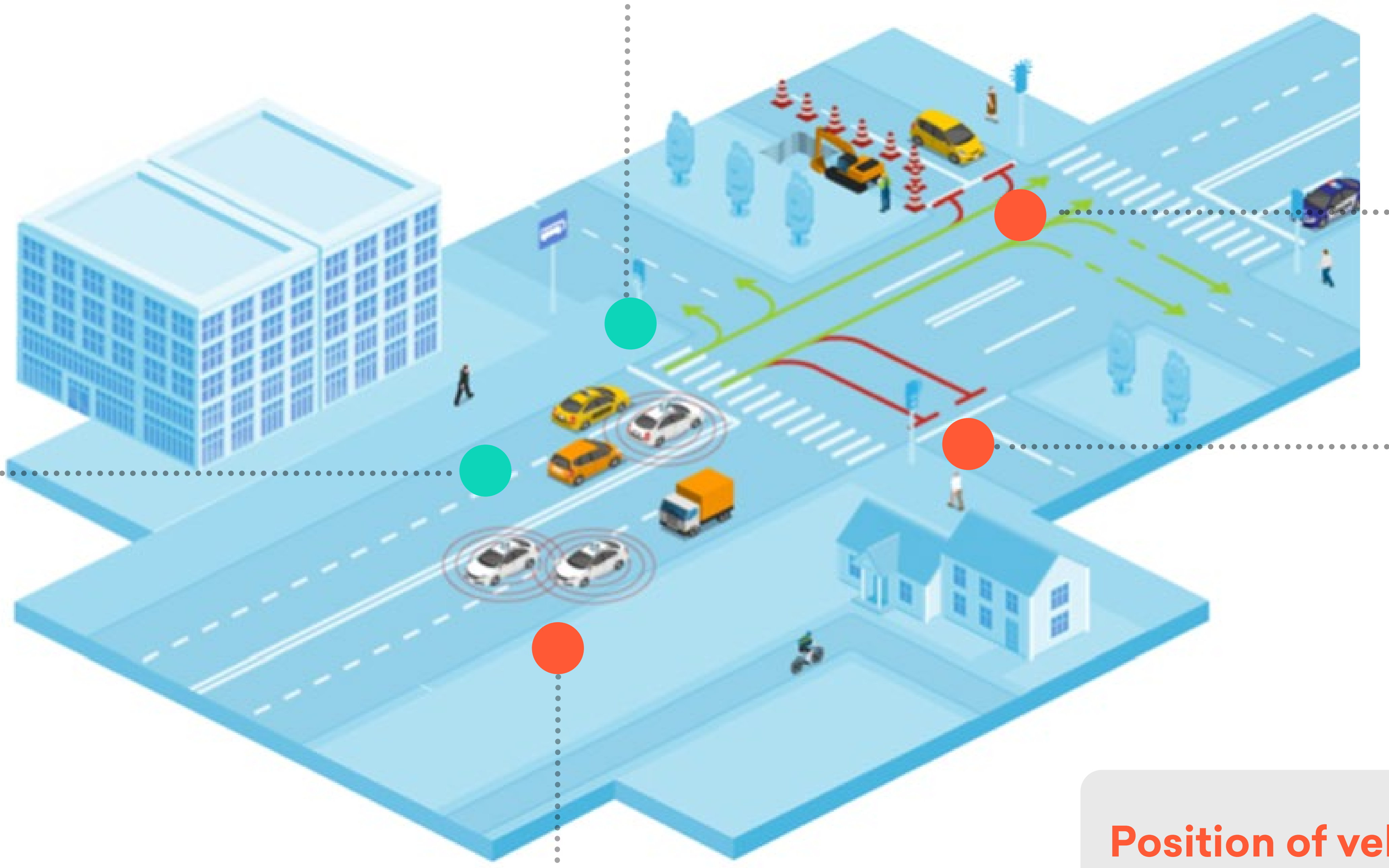
Good data is generally available on

Getting CAVs to navigate themselves from point to point:

Data to support CAV navigation is provided by Global Navigation Satellite Systems and sensors on the vehicles.

Average traffic flows and density:

This data is available to train which can be used to train CAV machine learning algorithms to understand normal traffic conditions.



We generally lack good geospatial data on

Dynamic road conditions:

Particularly temporary hazards, such as road works, lane closures, congestion and meteorological / environment data. Vehicles will need to rely on sensors, as well as information about the road, because road conditions can change quickly.

High resolution information on lanes and other road information:

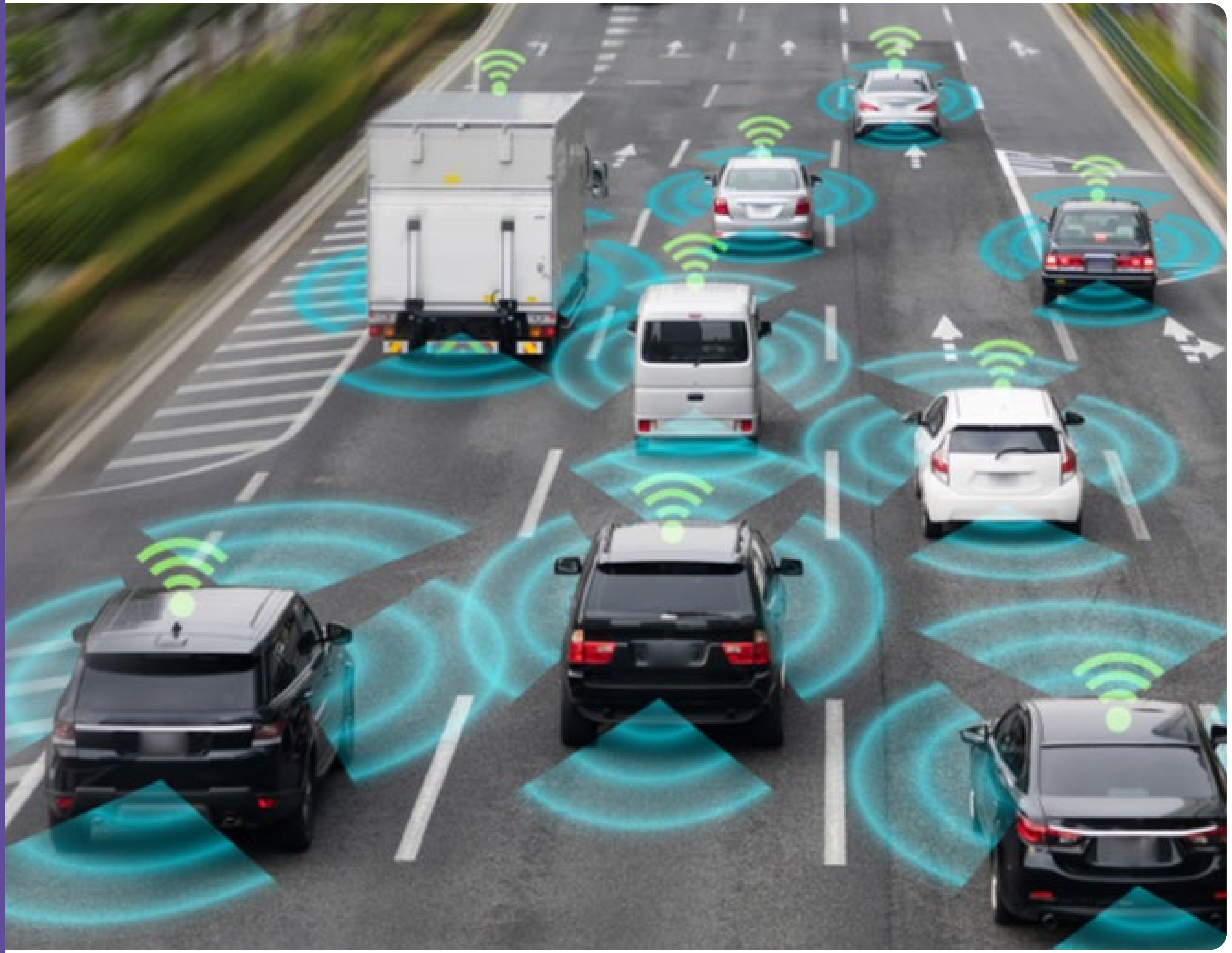
This data needs to be made available in standardised machine-readable formats.

Position of vehicles relative to each other:

Regular communication between close communication between CAVs is necessary for safe operation. IP, commercial advantage and data protection issues generally limit data sharing.

CASE STUDY

Modelling CAVs



By simulating how CAVs might drive and interact on roads, researchers are identifying areas where more detailed road data could improve safety.

The impact of CAVs under real-world conditions is still largely unclear, so researchers are currently using traffic microsimulations to try and predict what risks will need to be mitigated in practice. This has highlighted the potential significance of geospatial data in CAV safety.

Through simulations, researchers at Loughborough University have identified situations where CAVs are likely to struggle without additional data:

1. Roadworks: how CAVs will identify and navigate around them.

2. Road markings: how well CAVs can detect them accurately in practice, and whether this information can be encoded in digital maps.

While CAVs will rely heavily on real time sensor data, there is potential for high fidelity maps which have very detailed data encoded into them, such as exact road dimensions, markings and features, to improve safety by acting as a corroborative layer of information. This data will also need to be provided according to similar standards and formats across the UK, where currently local authority datasets exhibit significant variations; however, generating this data at the required level of fidelity for the entire UK road network represents a challenge.

Transport opportunity 6:

Drones and Unmanned Aircraft Systems

Drones and Unmanned Aircraft Systems (UAS) could transform our future logistics and supply chain networks by making better use of one of our most under-utilised assets - the space above us. UAS are expected to add £42 billion to the UK economy and create 628,000 new jobs by 2030[67]. A regulatory framework for managing drones in the UK exists, but **better geospatial data will be a key enabler for safely flying long distances in mixed airspace, alongside greater industry-led innovation to mitigate the current risks of UAS flight.**

Opportunity Areas:

1. Improving navigation and positioning systems - The provision of spatial data in three dimensions, such as building height, topography and land use and cover, may be crucial in enabling to UAS navigate their environments safely and efficiently. The Civil Aviation Authority (CAA) are proactively working with industry, though their Innovation Sandbox[68], to explore solutions that will enable integration where drones can operate in the same airspace as other traffic.

2. Managing flight paths and airspace - The expected proliferation of UAS means non-segregated airspace will need to manage between competing uses to minimise collision risks and manage ethical, privacy, noise and security concerns. In particular, there is a need for defining authorised UAS landing / take-off sites, flight routes at the lower altitudes expected for drone flights, and charging / refuelling points in order to enable the successful scale of autonomous drone and UAS 'highway' networks. In addition to this, there could be a requirement to accurately predict and measure air traffic densities in a given region.

3. Creating digital testing and simulation environments - The representation of geospatial data in simulated 'digital twin' environments represents a safe way to simulate UAS flight prior to conducting real world trials.

Drones:
The data landscape

Good data is generally available on

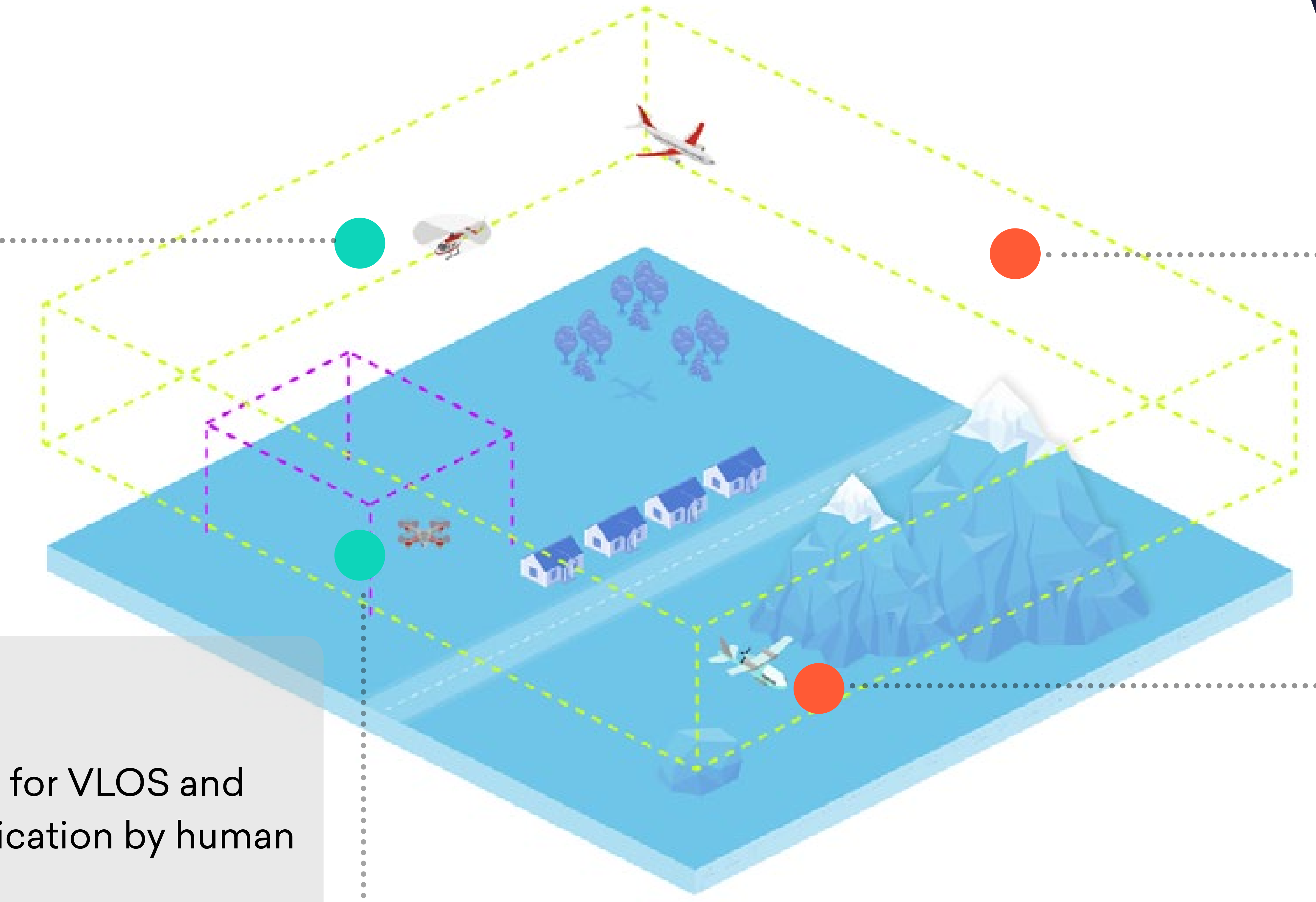
Mapped and tracked airspaces:

Along with GNSS data, currently a requirement for CAA-approved BVLOS drone trials in segregated airspace (usually a specific temporary airspace granted under a Temporary Danger Area order by the CAA).

Drone locations:

GNSS can provide good data on drone locations for VLOS and Extended VLOS flights, supported by visual verification by human operators and spotters.

However, BVLOS flights will likely require other navigation systems to support them when satellite navigation and communication links are lost, and Unmanned Traffic Management (UTM) systems to coordinate this data.



We generally lack good geospatial data on

Conducting drone trials in non-segregated target airspace:

In addition to requiring mapped airspaces, GNSS data and geofenced area data, there is a need for ground risk assessments and other arrangements discussed and agreed with the CAA.

Operating fully non-segregated BVLOS operations:

In addition to the above, this might require realtime or near realtime ground risk assessment data, and precise 3D maps of the area of operation — the CAA have outlined possible approaches in their BVLOS Roadmap[69].

CASE STUDY

Drone navigation

Helping drones navigate autonomously over long distances, and around structures, will require technologies beyond the Global Navigation Satellite System (GNSS).

Drone operations are regulated by the Civil Aviation Authority (CAA), which categorise these operations based on how well the remote pilot can maintain safe flight. In recent years, the CAA have granted approvals for drones to operate in special 'segregated airspace', where the risk of drones colliding with other aircraft is reduced. In 2020 for instance, Innovate UK awarded funding to an international consortium to trial the delivery of medical devices in the Midlands[70]. Similarly, the Department for Transport has funded drone delivery trials of medical devices to the Isle of Wight[71].

GNSS systems are sufficient for locating and navigating drones today, but other systems will be needed to help drones navigate Beyond Visual Line of Sight (BVLOS) operations. In particular, GNSS accuracy can fall in poor weather conditions, and lost signals and dropouts are common. Solutions have been found for particular tasks, such as surveying, but a number of limitations also make them impractical for BVLOS operations.

New approaches might end the reliance on the GNSS, and instead focus on computer vision techniques. This would enable drones to recognise and navigate by landmarks in the way that a human might. The Civil Aviation Authority (CAA) has recently noted that high fidelity digital maps will be necessary to support this.

Obstacle data (which can include permanent or temporary structures, such as cranes) is another significant issue. There is a system in place for notifying pilots of ground obstacles, such as cranes. These are broadcast through Notification to Airmen (NOTAM) and more permanent structures are typically mapped on aviation charts. Drone operators must routinely refer to these sources for their awareness of obstacles.

04

Acknowledgements

My special thanks to all those who have engaged with our policy development process over the past few months:

01. Transport Location Data Taskforce

02. Roundtable participants

03. Academic engagement

04. Transport Location Data Competition

01. Transport Location Data Taskforce

1Spatial	Department for Transport	EMU Analytics
Esri	Gaist	Geoplace
Here Technologies	Hexagon Geospatial	Knowledge Transfer Network
Northern Ireland Executive	One.Network	Ordnance Survey
Satellite Applications Catapult	Improvement Service	Steer
Transport Research Laboratory	Transport Scotland	

02. Roundtable participants

Addison Lee	ARPAS	Atkins
BEIS	BP Chargemaster	British Ports Association
British Standards Institution	Centre for Connected and Autonomous Vehicles	CGI
CILT UK	Civil Aviation Authority	Connected Places Catapult
Deliveroo	ESB	Field Dynamics
Frazer Nash Consultancy	Highways England	Informed Solutions
Infrastructure and Projects Authority	Institute for Transport Studies (Leeds)	Institute of Engineering and Technology
Intel	Intelligent Transport Systems UK	Kier
Living Map	Logistics UK	Miralis Data
Mitsubishi	Office for Zero Emissions Vehicles	Oxfordshire County Council
Pod Point	QRoutes	RAC Foundation
REA	Road Haulage Association	Sees AI
Skanska	SMMT	Sopra Steria
Strava	Streetworks UK	TechUK
Tesla	Uber	Vivacity Labs
Wayve	Zap-Map	Zenzic

03. Academic engagement

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Oliver O'Brien, Visualising transport data, University College London	Robin Lovelace, Transport Data Science, University of Leeds	Sarah Wise, Advanced Spatial Analysis, University College London
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04. Transport Location Data Competition

Special thanks to Innovate UK, our partners in the design and implementation of our £5m Transport Location Data Competition, and all of the following winners to Phase 1:

Addresscloud Limited	CGA Simulation Limited	City Science Corporation Limited
Comms365	Dynamon Limited	Emu Analytics Limited
Flock Limited	Hack Partners Limited	Hydrosurv Unmanned Survey UK Limited
Iconic Blockchain Limited	Marine South East Limited	Modal Limited
Mott MacDonald Limited	Movement Strategies Limited	Ngenius Limited
Openspace Group Limited	Pelation Limited	Pragmatex Limited
Prospective Labs Limited	R4Dartech Limited	Reliable Data Systems International Limited
Ricardo UK Limited	Rural Technologies Limited	Slingshot Simulations Limited
Space Syntax Limited	Thales Transport and Security Limited	Travelai Limited

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