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5G'S IMPACT ON TRANSPORT AND LOGISTICS: $280BN OF BENEFITS IN 2030

5G connectivity can make travelling by road faster and more efficient. This can drive productivity around the world and help the struggling transport and logistics industry to overcome its challenges.

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Preface

This document has been authored by STL Partners, an independent research and consulting firm. It is based on extensive research into the impact of 5G on the transport and logistics industry, including 10 interviews with enterprises and telco executives and an industry survey with more than 100 participants in both developed and developing markets. The research programme has kindly been supported by Huawei.

Mentions of companies in this document are intended as illustrations of market evolution and are not intended as endorsements or product/service recommendations.

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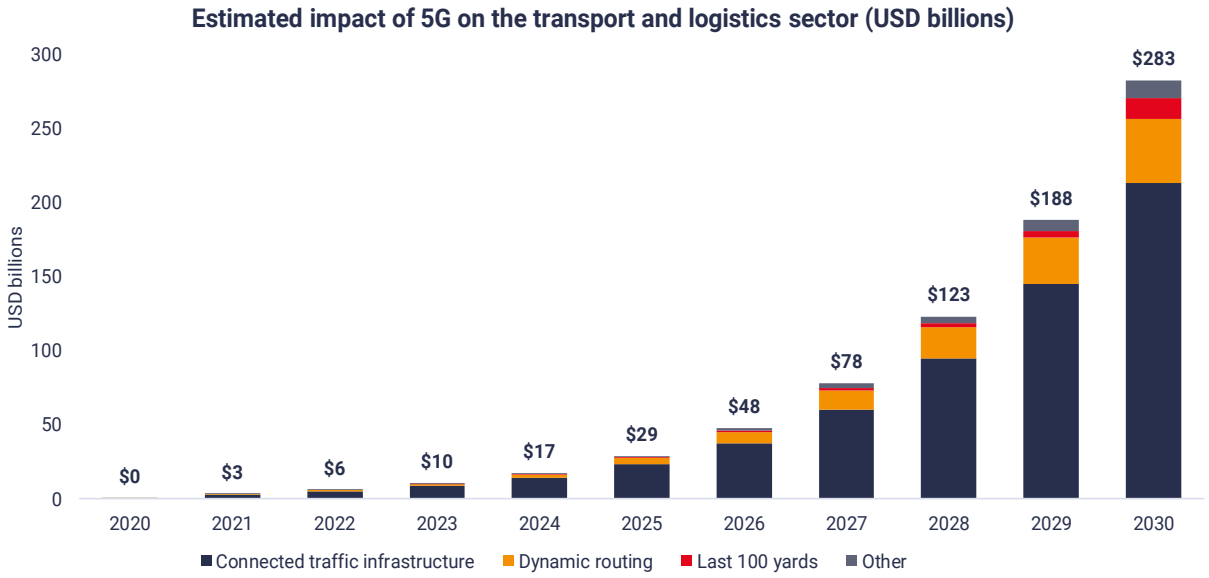
Executive Summary

5G can provide $280Bn of benefits to the transport and logistics industry

This forecast is driven by new use cases and improvements in existing applications that 5G uniquely brings compared to other technologies, and their impact on productivity. The assumptions and analysis were informed by interviews with transport and logistics and telecoms industry representatives, as well as a survey of more than 100 practitioners worldwide to validate the benefits of 5G. This gives an indication of the potential benefits that 5G could bring, but there will still be challenges to overcome (e.g. how the use cases are funded, licensed and operated) that will impact how these benefits are realised.

Figure 1: Connected traffic infrastructure drives the $280Bn of benefits to global GDP in 2030



Source: STL Partners

The use case delivering the biggest economic benefit is connected traffic infrastructure, in which smart devices are integrated into traffic infrastructure to trigger real-time actions. This opportunity reaches across multiple verticals, though transport and logistics will be heavy beneficiaries. Although it stands out as a promising use case that deserves investment and action since the combined impact across industries is large, its value to individual verticals is not big enough for companies to invest on their own, so for it to truly take off will depend on cross-sector collaboration or government funding.

5G's unique capabilities enable new and enhanced use cases

The logistics industry has been a relative laggard when it comes to digital transformation. However, it is now facing low margins, high operating costs and increasingly stringent customer demands. 5G-

enabled use cases can play a part in addressing these pain points because of several unique capabilities:

- The ability to support thousands of devices or sensors in a small area;
- The ability to handle high bandwidth applications such as streaming HD video through a connection that supports mobility;
- The ability to reduce latency to ultra-low levels of below 10 milliseconds so that data is captured real-time.

In this report, we focus on three use cases that we expect to bring significant value to the industry:

- **Real-time routing and optimisation:** Sensors collect data throughout the supply chain to improve visibility and optimise processes through real-time dynamic routing and scheduling;
- **Automated last 100 yards delivery:** Using drones or automated delivery vehicles for the last 'hundred yards' of delivery, where the delivery van acts as a mobile final distribution point;
- **Connected traffic infrastructure:** Smart sensors or cameras are integrated into traffic infrastructure to collect data about oncoming traffic and trigger real-time actions such as rerouting vehicles or changing traffic lights.

Benefits from these use cases include fewer traffic jams, more efficient supply chains, less fuel required and fewer accidents on the roads.

However, there are challenges to adopting 5G

Although mobile operators have already started to launch 5G, this does not imply 5G will be ready for transport and logistics companies to use widely. Certain features of 5G that are relevant to transport and logistics use cases may not be available for 2-3 years at least and coverage in remote areas will be an issue.

What should the transport and logistics industry do?

1. Build an understanding of 5G and its benefits (and limitations) and how it will integrate with other technologies you are using;
2. Input into the development of 5G standards and regulation so the technology is developed to meet your needs;
3. Collaborate with telecoms operators now to influence how they commercially deploy 5G in your market and ensure that you are part of the developing ecosystem.

What should the governments do?

1. COVID-19 has demonstrated the importance of reliable, high speed connectivity across national territories. Governments, aware of these prevailing attitudes, should consider investment in 5G

infrastructure that can benefit wider society – for example by becoming an anchor tenant that can drive cross-sector collaboration for 5G corridors along major road routes.

2. Regulators should also consider how they can adapt roaming regulations, licensing terms, or their approach to private networks development to help telecoms operators collectively overcome the challenge of delivering 100% coverage across transport networks.

What should operators do?

1. Operators need to prove their pedigree as good ecosystem players and enablers in order to succeed in the transport and logistics sector. For example, to add value to the ecosystem, operators could seek to enable data sharing across supply chains and mediate relationships between private companies and the public sector.

    1.1. One of the key challenges for operators here will be finding the right balance between competition and collaboration to deliver 100% coverage across roads and other infrastructure, within regulatory constraints. This may require exploring new types of roaming technology and agreements which fall beyond the scope of this report.

2. Operators should work closely with enterprises and solution providers to ensure technology is aligned with customer needs, and in order to overcome key barriers – for example, the regulation surrounding autonomous cars/drones.

3. To successfully address points one and two, we believe telcos will need to choose transport and logistics as a key vertical to specialise in. We will explore B2B2X business models and vertical strategies in an upcoming report.

Table of Contents

Table of Figures

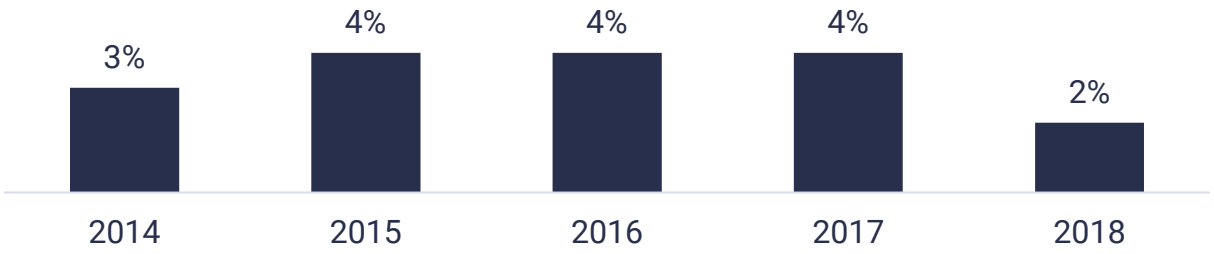
Introduction: A major industry under increasing pressure

The challenges facing the transport and logistics industry

The transport and logistics industry is a fundamental sector that acts as the backbone to a country's economy, and plays an essential role underpinning other core sectors such as manufacturing and retail. Challenges and opportunities facing the transport and logistics industry are also closely tracked and influenced by national and local governments, who are often responsible for investments in supporting transport infrastructure (e.g. roads, rail networks etc.).

As the movement of people and goods across the world increases, the industry is evolving to meet these demands. However, it faces challenges in doing so. The logistics industry[1] has been under significant pressure for some time. Capital and fixed operating costs are high, and companies are struggling to differentiate. Despite growing demand, many firms are suffering from eroding margins. The UK market exemplifies these issues, with revenue growth across the industry low or negative (Figure 2). The COVID-19 pandemic has exacerbated these issues and thrown up unforeseen challenges, with the airline industry being particularly badly hit.

Figure 2: UK top 100 hauliers reported operating margin



Source: FTA Logistics Report 2019

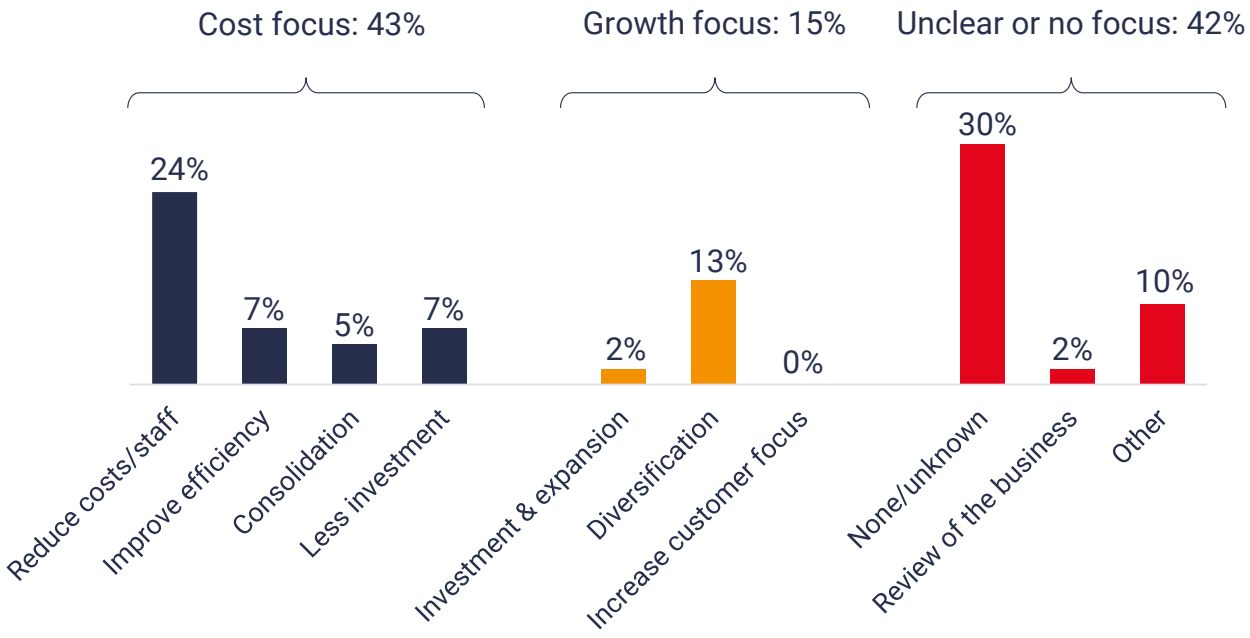
Although the rise in online retail and growing international trade have helped to stimulate the industry, there are still pain-points that are hindering growth. These include volatile diesel prices, driver shortages, and increasing pressure from governments and the general public to be more environmentally friendly.

The focus for the majority of the industry is therefore on cost-cutting and improving operating efficiency. For many companies, investing in new technologies provides an opportunity to transform their operations and drive efficiencies. There is significant scope to do this since the industry as a whole is generally not as digitised as other verticals, and because there is room to make improvements to currently under-utilised assets. For example, in the UK, 30% of goods vehicles on

[1] The logistics industry can be thought of as responsible for the movement of goods, while transport is about moving people. We will focus mainly on logistics going forward since that is where we see the main 5G benefits.

roads are running completely empty, and the freight vehicles that are carrying goods carry an average of 60% of their potential capacity.[2]

Figure 3: UK logistics industry focus is cost-cutting and efficiency



Source: FTA Logistics Report 2019

As well as looking to improve efficiencies, safety and environmental impact are key areas of focus for the transport and logistics industry and government stakeholders:

- **Safety**: enhancing safety of transport, particularly road transport, which is the most widely used, is an ongoing goal for the industry. Doing so benefits society as a whole, with fewer casualties due to road traffic accidents, for example, but also directly benefits transport and logistics companies through a positive impact on their branding and a decrease in insurance premiums. The industry is adopting new innovations and technologies such as 'black box' driver monitoring and/or alerts to improve safety.
- **Environmental impact**: the drive to become greener is increasingly paramount. The industry is currently responsible for almost a quarter of the world's CO_2 emissions[3], and 14%[4] of overall emissions. Road vehicles are responsible for the majority of this, contributing to nearly three-quarters[5] of global transport

Why governments are key stakeholders in transport and logistics:

- The impact on public safety and the environment
- They are often responsible for investing in critical road and rail infrastructure

[2] Department for Transport, Gov.UK
[3] International Energy Agency, 2019: CO2 emissions from fuel combustion
[4] IPCC, 2014: AR5 Climate Change 2014: Mitigation of Climate Change
[5] Ibid

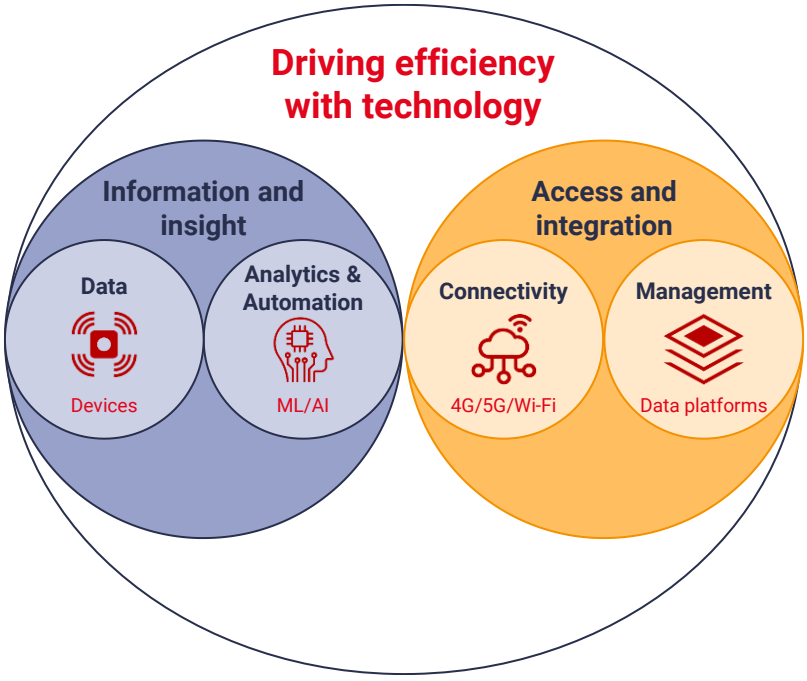
emissions. As the population becomes more environmentally conscious, governments are passing regulations and setting sustainability targets to try to reduce emissions and consumption of non-renewable energy sources. For example, the United Nations has adopted 17 Sustainable Development Goals (SDGs) that aim to reduce inequality while tackling climate change. The industry must adapt to these regulations, and large players are taking steps to improve their practices. Logistics heavyweight DHL has committed to zero emissions by 2050[6] and in the shipping industry, the International Maritime Organisation (IMO) have declared they will halve carbon emissions[7] in this time period.

The role of technology in driving efficiency

For the industry to address these challenges and achieve efficiencies, it will need to adopt new technologies.

The catalyst for digital transformation will be data – in particular the generation of richer and more comprehensive data and the analysis of this data to produce insights to better inform decision making. Figure 4 shows the four pillars of technology that will drive improvements in efficiency.

Figure 4: The four pillars of technology that will help in driving efficiency



Source: STL Partners

[6] DHL Mission 2050
[7] IMO GHG Strategy

Information and insight

- **Data**: Tracking of global movement of people and goods results in huge quantities of data. The logistics industry is becoming increasingly data-driven as it realises the potential for big data to improve operations. Logistics companies and traffic agencies are increasingly using sensors to collect data on vehicles, travel behaviours, fleets, warehouses, and the wider supply chain. This data (if effectively converted into insights) can increase visibility of operations, optimise processes, improve a company's customer service and aid with automation of the supply chain.

- **Analytics and automation**: Although collection of data in its raw form can in itself provide insight, more value can be derived from data through more sophisticated analysis, paired with automation. Artificial intelligence (AI) and machine learning (ML) can be powerful tools to process data and draw insights from it on a much larger scale than we can do manually. AI/ML will be particularly important to enable the move towards greater autonomy, whether that be for autonomous vehicles or warehouse automation. These technologies can also enable predictive analytics, which is useful for the industry as it can be used to forecast demand and plan resource allocation, or for predictive maintenance. These capabilities can address enterprises' wider efficiency aims (see Figure 3).

Access and integration

As much as data can provide valuable insights, if users are not able to access the data at the time they need it, they will not be able to capture the full benefit. This is why data management and connectivity are also important:

- **Management**: Data is collected through a multitude of different devices, then processed and stored on different systems across the supply chain. There are often multiple stakeholders who have ownership of the data in these siloes. In order to gain valuable insight about the entire ecosystem the data must be converted into a common format and integrated into existing systems, so it is accessible to the right people. Ideally all data would be processed on the same platform to prevent data siloes and enable full, real-time visibility of the required data and secure storage of the rest.

- **Connectivity**: (Mobile) connectivity must underpin the digital transformation of the transport and logistics industry as it enables the sharing of data in a secure, reliable and real-time way throughout a dynamic ecosystem comprised of many moving parts. Connectivity solutions such as Wi-Fi, and particularly mobile solutions like 4G or 5G, are important to ensure the necessary speed, latency and bandwidth is delivered to application performance requirements.

Digital transformation: Transport and logistics lags behind

The need to digitise is not only driven by internal ambitions for greater efficiency in operations, but also by external pressures as customer expectations change. Requirements for last mile experiences in particular are evolving, as customers become accustomed to shorter and more flexible delivery times and greater visibility of the delivery process. Their cost expectations are also changing, with these improvements being expected for a smaller fee or even for free.

Despite the impetus to transform, the logistics industry lags behind other industries when it comes to digital transformation. There are two core reasons for this:

- **The degree of automation is limited**: Although there are some fast adopters of technology, many companies (particularly smaller ones or those in developing markets) are still heavily reliant on manual processes, particularly paper, phone or email based operations. As a result, they are losing manpower in manual tasks and the customer experience is diminished, since they expect to be able to access this information through an online system, which isn't possible unless it is digitised. This lack of automation also results in large quantities of unstructured data. One logistics executive highlighted the "hundreds of thousands of emails pouring into the industry"[8] from which information is not currently being extracted. Good data management structures are required so that this data can be analysed using ML/AI and its full value can be captured.

"Even if technology could facilitate the vision of data sharing, one of the main things holding back this 'utopic vision of data science' is the challenge of connecting the data between parties who don't, for legal or commercial reasons, collaborate."

- **There is a reluctance to share information**: The logistics industry is highly fragmented, with the top four companies holding less than 15% share of the market.[9] This competitive landscape makes many reticent to share anything with potential competitors, even if for the mutual gain of both parties. This problem extends across the whole supply chain, from manufacturers' production schedules to retailers' sales forecasts. The result is a lack of transparency that hinders the industry's ability to transform. One logistics strategy director said that even if technology could facilitate the vision of data sharing, one of the main things holding back this "utopic vision of data science" is the challenge of "connecting the data between parties who don't, for legal or commercial reasons, collaborate".[10] Even if attitudes were to shift, data sharing would be difficult as each company has their own systems and methods of reporting. Even within a company, there are often proprietary systems and data siloes that make it difficult to gain full visibility of operations. We discuss how digital twins offer a potential solutions to data siloes and interoperability challenges in our reports on the Internet of Things and digital twins.

The role of 5G networks in digital transformation

5G especially holds the potential to help drive digitalisation and address some of these challenges, both through enabling new and improved use cases and in its role in helping to catalyse the digital transformation journey. As 5G is rolled out, it could have a significant effect on supply chains, the wider transport industry and society more generally. This report will explore the benefit of 5G to the

[8] STL interview programme – Executive Chairman, European Logistics Service Provider
[9] Supply management – Logistics industry fragmentation
[10] STL interview programme – EMEA Strategy Director, Global Logistics Company

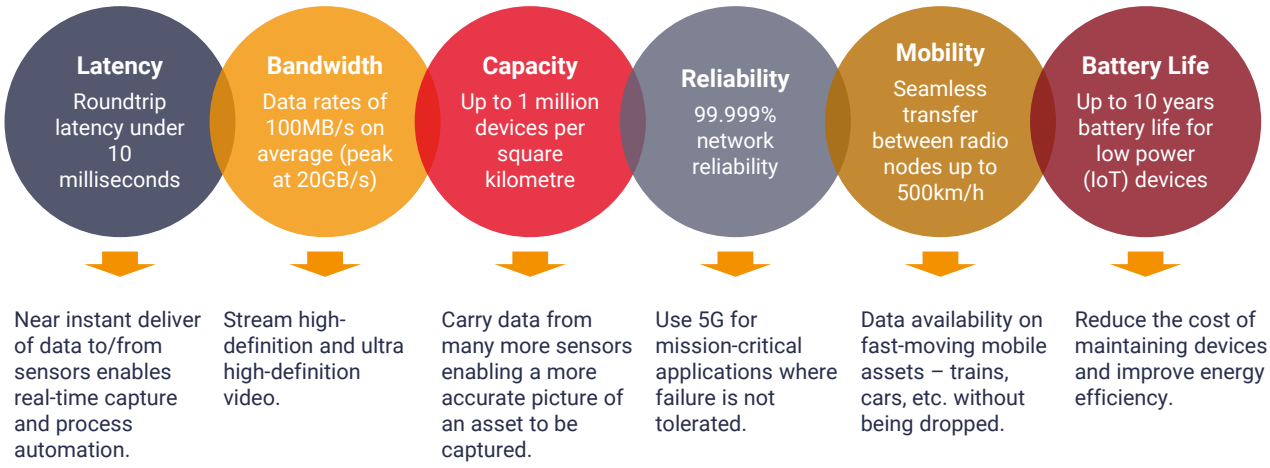
industry and consider the actions that need to be taken by the industry, by governments, and by telecoms operators to reap the benefits.

The impact of 5G on the transport and logistics industry

What is 5G?

5G is the latest generation of mobile communication technology. It is different from previous generations because 5G offers more than just an improvement in speed compared to 4G. It is more flexible than previous generations due to its software-based nature and has been designed to consolidate the requirements from multiple use cases, whether this be for ultra-low latency or high bandwidth. Customers can therefore use its different characteristics to meet different and new application's needs. 5G's key capabilities are summarised below:

Figure 5: 5G's technological capabilities and their implications for users



Source: ITU, STL Partners

5G's relevance in transport and logistics

The industry is built upon the movement of assets, therefore the ability to maintain a stable connection on a fast-moving asset such as a vehicle or a train is crucial to enable solutions requiring connectivity to function smoothly and successfully. 5G is the most capable technology to date to do this.

Interviews with industry representatives highlighted three further 5G capabilities that are particularly important for transport and logistics, as shown in Figure 6:

- **Device density and data volume**: 5G increases the volume of data that can be collected and carried through the network. This allows you to increase the number of sensors in a single place that are collecting data and monitor more data points for more variables. For example, instead of simply sharing a vehicle's location every ten seconds, with 5G you can share its location every second as well as its speed, internal temperature, condition of the vehicle, and the status of goods onboard. The increased bandwidth of 5G is also important for solutions that rely on streaming of data-intensive applications such as HD video.

- **Low latency**: 5G enables near real-time transmission of data. This is crucial for mission-critical applications that require actions to be triggered in near real-time and therefore have extremely low latency requirements of 10 milliseconds or less (e.g. autonomous driving systems or high speed processes).

- **Network slicing**: There are a broad range of connectivity requirements in transport and logistics. 5G enables network slicing,[11] which may be able to meet the different connectivity needs e.g. of autonomous driving vs. asset monitoring. For this to happen the industry must overcome significant technical (there is a need for more automation in telco operations for this to be a reality) and regulatory hurdles. More information on network slicing can be found in 5G network slicing: How to secure the opportunity.

Figure 6: Key benefits of 5G according to the transport and logistics industry

Device density and data volume

> 5G will offer the high definition, high quality, raw data streaming capability which you can't do very well on 4G at the moment
> *– Programme Director, 5G Testbed*

> More complex use cases with better latency of response for many, many more assets – that's where your 5G will start playing off
> *– Digital Services for T&L, European operator*

Low latency

> If you want to be proactive towards customers, it needs to be real time
> *– Strategy Director, Package delivery services*

> The latency on 4G is almost okay, but when you've got heavy traffic the latency gets worse and worse – 5G is a potential way around this challenge
> *– COO, Traffic insights start-up*

Network slicing

> Network slicing is a strong benefit… If you've got a critical infrastructure you want to be able to allocate the connectivity SLA to it, which 5G enables
> *– Digital Services for T&L, European operator*

> One key benefit of 5G is that there's this slicing under the guaranteed service levels
> *– Chief Advisor, Transport and Communications Agency*

Source: STL Partners

[11] Network slices are separate (virtual) networks that run on the same physical network infrastructure and are designed in unique ways to meet different needs, e.g. low latency/ultra-reliability vs. support for massive number of devices.

New and improved use cases and applications enabled by 5G

Figure 7 shows some of the key use cases that 5G will enable, and maps the 5G capabilities that are most relevant to each use case. Although some of these use cases already exist today, 5G will be able to enhance them and increase the value added. For example, there are various logistics routing and scheduling solutions currently available on the market that can calculate the optimal route for a vehicle to follow, but the addition of 5G will enable more dynamic solutions that can change in real-time to reflect the shifting status and demands of the ecosystem.

In this report we deep dive into three of these use cases and explore the benefits they could bring to the industry. The most dominant form of transportation worldwide is road transport, with three quarters of passengers globally travelling by private car,[12] and over three quarters of inland freight in the EU being transported by road.[13] We have therefore chosen to explore two use cases that will benefit the road freight industry. For the third use case, we will take a wider look at how a road transport use case can have benefits beyond just the transport and logistics sector.

[12] Sustainable Mobility for All, 2017: Global Mobility Report 2017
[13] Eurostat: Freight transport statistics

Figure 7: Use cases in the transport and logistics industry enabled by 5G

Use case		Benefits	Why 5G?
	**Connected traffic infrastructure**	Smart sensors or cameras are integrated into traffic infrastructure to collect data about oncoming traffic and and trigger real-time actions	Reduce congestion Reduce accidents Increase efficiency	Device density Low latency
	**Real-time routing and optimisation**	Sensors collect data throughput the supply chain to improve visibility and optimise processes through real-time dynamic routing and scheduling	Increase supply chain visibility Increase efficiency Increase throughput	Device density Low latency
	**Automated last 100 yards delivery**	Using drones or automated delivery vehicles for the last 'hundred yards' of delivery, where the delivery van acts as a mobile final distribution point	Reduce time for delivery Reduce distance driven by van	Low latency Reliability Location-awareness
	**Predictive maintenance of fleets**	Using dozens of sensors to give an accurate, real-time representation of the status of a vehicle to perform predictive and preventative maintenance	Reduce downtime Reduce spend on maintenance Reduce vehicle replacement rate	Device density Reliability Device costs
	**Advanced driver assistance**	Using cameras to monitor behaviour of the driver and the external surroundings to detect and alert driver to any potential risks	Reduce accidents Reduce damage to vehicle Lower insurance costs	Bandwidth (video data) Low latency
	**Infotainment for public transport**	Better connectivity on public transport to deliver information and entertainment services to travellers e.g. HD video streaming, gaming, video calls	Improve passenger experience Stimulate use of public transport	Bandwidth (video or AR/VR applications)
	**Automatic vehicle software updates**	Vehicles with embedded 5G modules receive over-the-air updates to applications and software systems	Increase efficiency Enable more frequent updates	Bandwidth

Source: STL Partners

Real-time routing and optimisation

The road freight industry, like other industries, suffers from inefficient practises (e.g. with routing, loading and unloading) and long wait times. Poor supply chain visibility is also a major issue, with only 6%[14] of companies having complete visibility of their end to end supply chains.

In order for companies to drive efficiencies and strengthen their supply chain they need to improve end to end visibility. This can be done by using multiple sensors to collect data across the entire supply chain:

- **For warehouses / the point of collection:** Sensors gather data on the goods to be transported e.g. on stock levels, delivery time and destination, requirements for shipment (e.g. temperature)
- **For vehicles and their loads:** Sensors on the vehicle can track pertinent information such as location, speed, quality of driving (e.g. sharp braking), loading factor,[15] number of hours on the road and number of stops taken. Collecting data on the goods can help to track their journey and adherence to storage specifications e.g. temperature limits.
- **For the customer / the point of delivery:** Data can be gathered on retail demand e.g. purchase orders or sales forecasts.

The data can then be streamed to an analytics platform, where an AI engine extracts insights and trends and provides real-time automated recommendations to optimise the supply chain. Data is also stored for longer term analysis to identify areas for improvement and help to plan better cargo routes. Two key ways that the supply chain can be optimised is through enhanced route planning and dynamic scheduling:

- **Enhanced route planning** – Route planning algorithms can analyse historical data to identify the most efficient route to take. With the addition of incoming real-time data, the route can be continually optimised to take into account variable factors that may have an impact e.g. unfavourable traffic or weather conditions. These algorithms are distinct from generic route planning applications like Google Maps, since they must consider fleet-specific requirements such as the need avoid low bridges or the need to ensure driver breaks are taken at suitable intervals without needing to divert off route.
- **Dynamic scheduling** – Most logistics companies today give each driver a set schedule of deliveries and pickups, and once they leave the central distribution hub this can't be updated automatically (though their progress may be monitored). If logistics schedules are centralised, then with 5G they can be continuously updated in real-time to ensure the most efficient schedule is being used by each driver at any given time. Changes to the schedule will take into account factors from across the entire supply chain, from changes in stock levels in the warehouse, potential delays within transit due to traffic or regulatory requirements for the driver to take a

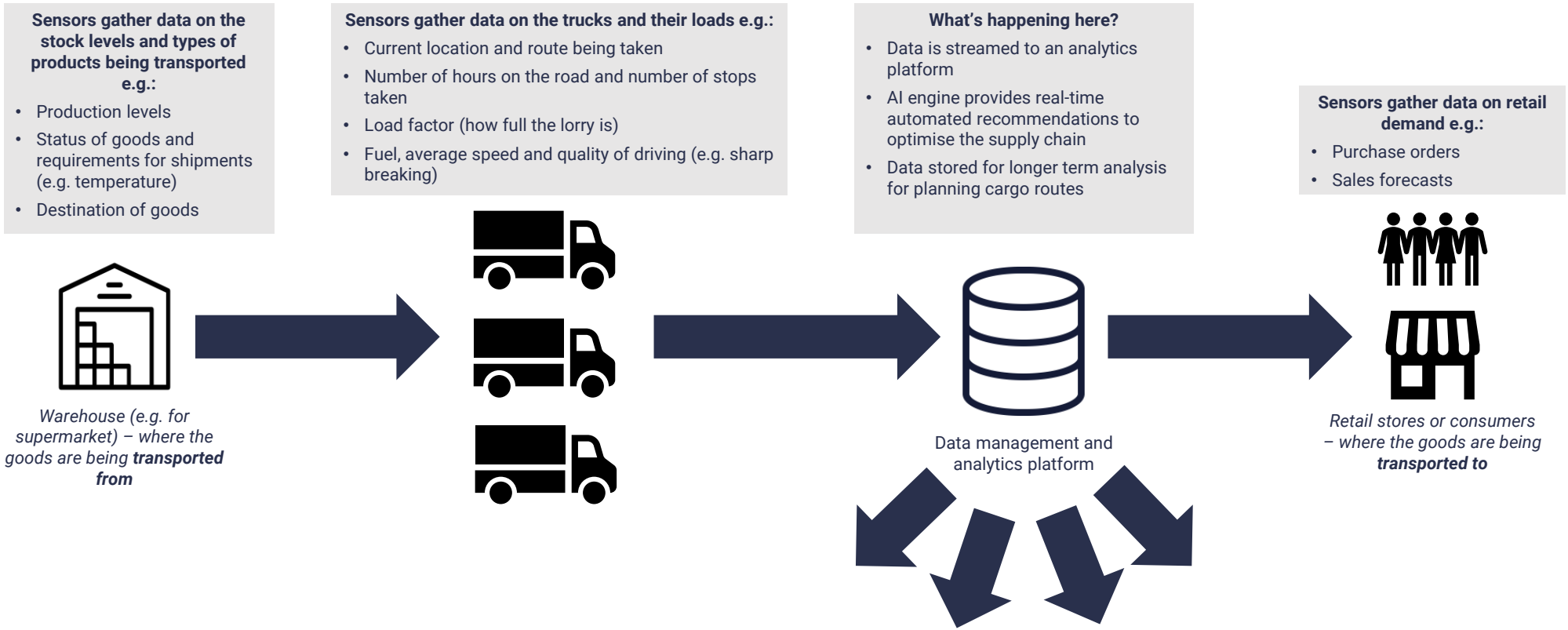
[14] GEODIS, 2017: Supply chain worldwide survey
[15] The amount of goods that were moved by a vehicle, as a proportion of the total amount of goods that could have been moved if when the vehicle was loaded it was always fully laden.

break, the need to pick up new goods and the status of other deliveries. This means that if a high priority order comes in and a driver is close by to the pickup point, it can be added to their route. Conversely, if a driver is running late, another driver can be assigned one of their pickups to ease their load and prevent the company from missing a deadline. The volume of data required to manage this in real-time makes 5G's bandwidth and latency capabilities crucial to enabling this use case at scale – potentially in conjunction with edge computing in order to reduce data transport costs by running analytics closer to the drivers.

The industry is beginning to embrace digitised logistics solutions, with companies like ClearMetal[16] and Shippeo[17] providing customers with visibility into goods delivery, but existing solutions tend to be more tailored, addressing either routing or scheduling or predictive analytics, but not all of these things together. This is likely due to the huge quantity of data required to address all these issues through one platform.

[16] ClearMetal
[17] Shippeo

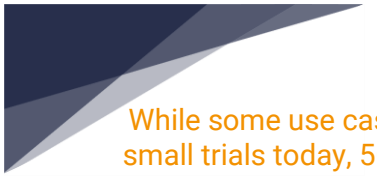
Figure 8: Real-time routing and optimisation – how it works and benefits



Source: STL Partners

Why 5G?

5G increases the number of sensors that can be connected, so a greater wealth of data can be collected. This is important as the more data you can collect, the more granular visibility you can get of the supply chain and the more accurate your predictions can be. The frequency with which data is collected is also important. Reactions to changes in the supply chain may need to happen very quickly, meaning that data streaming needs to be almost constant.



While some use cases exist in small trials today, 5G is crucial to scale these use cases across a whole country or region. This is critical for widespread adoption since logistics companies do not want solutions fail when their vehicles are in congested areas.

Assuming one truck needs 15 sensors, when providing coverage for a medium-sized fleet of 100 vehicles the total number of sensors grows to 1,500. On major routes in particular, where large numbers of logistics vehicles travel each day, 5G's bandwidth, latency and reliability will be necessary to ensure the solution can cope at scale.

Another benefit of 5G is that it reduces the cost of sensors. Due to the fast connection, analytics can be offloaded to the cloud so the device itself can be dumber and therefore cheaper. It also has a longer battery life since 5G is more energy efficient than 4G.

Impact of the use case on the industry

This use case will increase the throughput of goods carried by road freight in three ways:

1. **Decrease in distance driven**: By constantly updating the route and schedule in real-time to ensure it is the most efficient, the total distance driven by each vehicle would decrease by an estimated 5%[18] on average.

2. **Decreased waiting times**: By enhancing visibility of the supply chain, journey and arrival times can be better predicted to ensure goods are transferred just as they are needed, which reduces wait times. For example, if a lorry's arrival time at a warehouse is known accurately, the necessary stock can be pre-prepared so it can be loaded immediately once the lorry arrives. This is especially important for refrigerated stock that cannot be left sitting around.

   For international deliveries, maintaining visibility of goods across the supply chain can improve efficiency at border crossings, since it is possible to guarantee where the cargo has come from and that it has not been tampered with. This could reduce the need for certain border checks and decrease the time taken for those that are essential.

2. **Increased efficiency (loading factor and empty running)**: Dynamic scheduling can increase the average load factor of vehicles and decrease the number of vehicles that are running empty (i.e. not carrying any goods). This is because companies can maximise the loading of each truck. This can be done on a regional or national scale. For example, instead of a truck driving out to deliver a load then driving back to the hub empty, AI/ML can analyse the overall fleet status and

[18] Based on results from STL Partners survey with 200 logistics industry professionals globally, June 2020

set of orders, and dynamically update the route to add in nearby pickups. Logistics industry professionals believe that with a mature dynamic loading solution, average load factors could increase in the UK from 61% to 65%, while empty running could decrease from 29% to 27%.[19]

Assuming that real-time routing was used for all heavy goods vehicles (HGVs)[20] in the UK, the total throughput of goods carried in a year could increase by 251 million tonnes (a 17% increase). The use case could also be used by light goods vehicles[21] e.g. vans, therefore the true impact on throughput is likely to be greater than this.

Beyond increasing throughput of goods transported, real-time routing and optimisation would have additional benefits.

- **Increase in real-time reporting** – Logistics companies are able to gain greater visibility of their fleet and its status. Customers also gain more awareness of the status and location of their shipments. Delivery slots can be predicted more accurately, and any potential issues or delays are communicated faster.

- **Decrease in theft** – Theft of goods is a serious and growing problem faced by the industry, that can be costly; in 2018 the average value of goods stolen per incident in Europe was $63,996.[22] Comprehensive tracking of goods and vehicles would improve their security and reduce theft, both by acting as a deterrent to criminals and by notifying management if abnormal activity is detected so they can react quickly. This would not only save companies the lost cost of goods but would also lower insurance costs and improve conviction rates.

- **Decreased food waste** – Data collection improves the traceability of food supply chains. If any incident occurs (e.g. certain pallets of fruit becoming too warm) it is easier to quickly identify the source of the issue and respond promptly in order to mitigate the consequences, and an informed plan can be developed to try to prevent future waste. This can be particularly useful for cold chain[23] monitoring, where gaining insights at the product or pallet level can significantly improve quality control and adherence to temperature requirements. Supply chain data can also be useful to provide accurate information on when a product was harvested, so that sell-by dates can be forecast in a more precise and reliable way. Finally, simply reducing the amount of time perishable goods spend in transit minimises the amount of time in which damage can occur (e.g. fruit getting bumped and bruised).

Dependencies

The success of this use case is not only limited by the quality of connection that is available. Widespread adoption will also depend on the availability of sensors to collect the data – these will need to be cheap, have a long battery life, and be able to withstand variable operating conditions.

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[19] Ibid.
[20] An HGV is any truck with a gross combination mass of over 3.5 tonnes.
[21] Light goods vehicles, or light commercial vehicles, are commercial carrier vehicles with a gross combination mass of 3.5 tonnes or under.
[22] Supply chain cargo theft
[23] A cold chain is a temperature-controlled supply chain.

The other key element in enabling this use case is the data platforms and architectures that are required to manage the data and analyse it. These structures must be in place in order to extract insights from the data using AI/ML.

Automated last 100 yards delivery

Last mile deliveries consist of the final stage of delivery, from the final distribution point to the end consumer. Although this is only a small portion of the total journey, it dominates in terms of cost, comprising 53%[24] of the overall shipping cost. The market is growing rapidly - more parcels are being delivered due to a rise in e-commerce, and demands are becoming more complex, with more customers expecting next day or on-demand delivery, and increasingly expecting deliveries to be free.

Companies are experimenting with automation in an attempt to cut costs in last mile deliveries. Automated guided vehicles (AGVs) and unmanned aerial vehicles (UAVs) are being activity tested by companies, such as UPS's Flight Forward efforts.[25] However there are significant limitations in terms of their capacity and battery life, with a typical delivery drone carrying around five pounds, and only being able to cover a distance of up to 15 miles. An AGV can carry a slightly higher payload but it is still considerably diminished compared to a delivery van or truck.

For this reason, initial adoption of automated vehicles in the last mile of delivery is expected to focus on higher-value deliveries, such as medical supplies, organs or cash deposits. Automation of delivery of regular B2C parcels will be slower to roll-out as the limitations make the business case harder to justify.

Automating just the final 'hundred yards' of delivery helps to address this problem. We will demonstrate how this can work using drones as an example. Instead of the drones carrying the parcels all the way from the warehouse to the customers' doorsteps, the delivery van carries the parcels and drones, then when it is within 100 yards of the drop-off point the van stops, and the drone flies out and carries the parcel for the final stretch. While the drone is engaged the driver can deliver a parcel by hand, or can continue driving to the next stop, at which point the drone (which has been to the house and dropped off the parcel), can return and redock.

The degree of complexity and automation of this solution can vary. In its simplest form there is only one drone involved and the driver gets out of the van at each stop, manually selects the next package to be delivered, loads up the drone and sets its next destination. Once the delivery has been made, the drone redocks and can be charged. In a more advanced form, multiple drones can be used, and they operate fully autonomously with no external input needed for them to load and reload, or to set each destination. Workhorse have even developed a delivery van that is tailored so its roof can open automatically to release the drone.

The option to use both UAVs or AGVs to automate the final stretch of delivery is valuable since the vehicles can cater to different environments. While drones can travel fast through the air and deliver

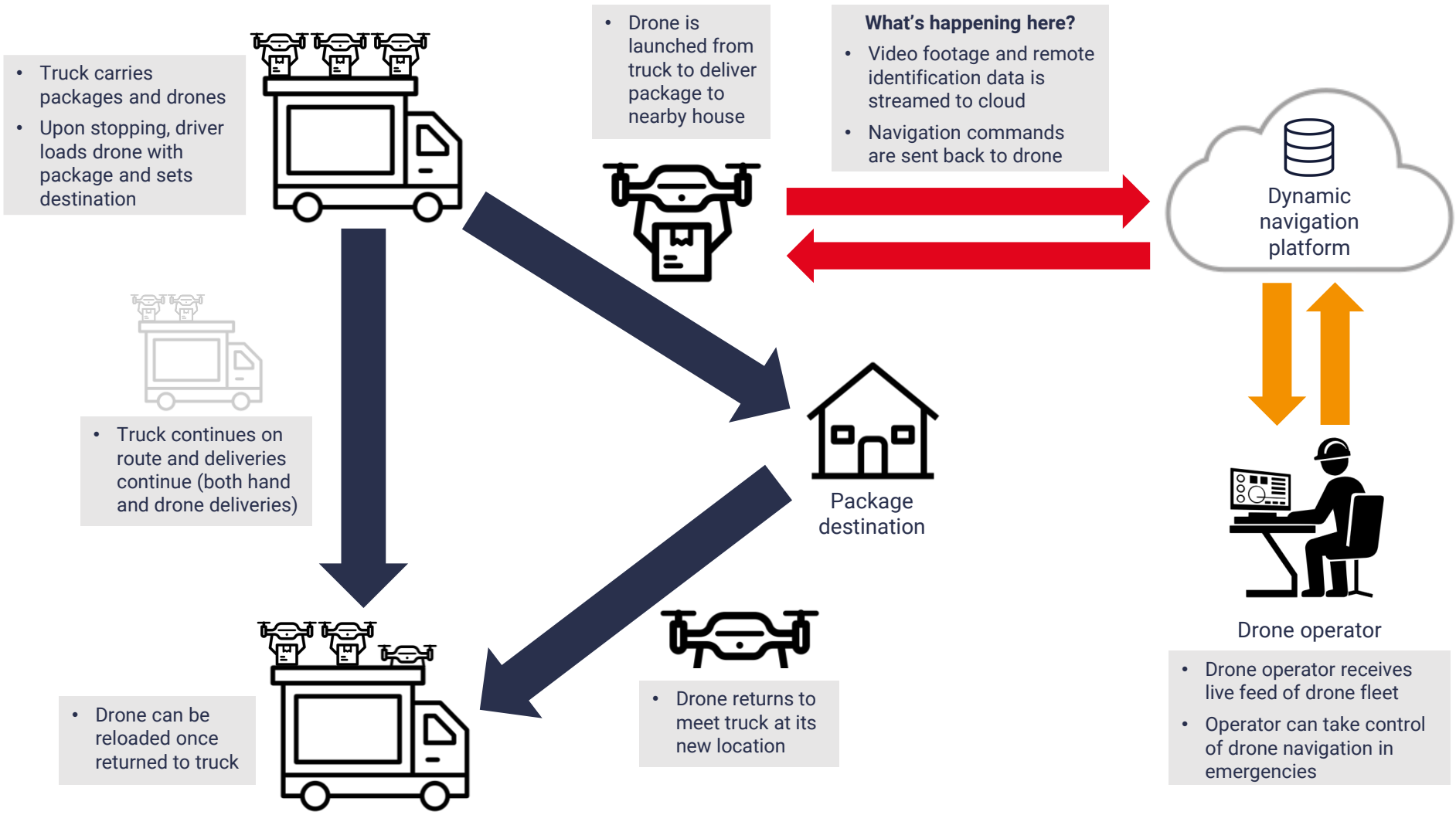
[24] Last mile delivery costs
[25] UPS Flight Forward drone delivery

packages efficiently in rural and suburban environments, their need to travel through the sky can be problematic in dense urban environments. Conversely, AGVs are well suited to cities but less efficient than drones over longer distances.

A UAV/AGV can either deposit the package on a front doorstep, or it can send a message to the customer to come and collect the package, and only deposit the package once the customer has scanned a code with their phone. A drone also has the advantage of being able to drop off packages in back gardens, which is safer than leaving them on a doorstep. Alternatively, they can be used in combination with smart lockers or mailboxes, where the mailbox acts as a landing pad for the drone and signals from the drone trigger it to open, providing a secure location to hold the package.[26] This solution should widen the number of locations where the solution is viable, to include multitenancy buildings, apartment blocks, terraced houses and those with no front or back garden. Deliveries where neither direct delivery to the front door nor a smart locker/mailbox solution is possible will still need to be dealt with by a human on foot.

[26] Valqari - Smart drone delivery mailbox

Figure 9: Drones for last 100 yards delivery



Source: STL Partners

Why 5G?

Automated operations where the UAV/AGV follows a pre-defined route can function with 4G. However, if adoption of UAVs were to become widespread and the number of drones in the sky reached the thousands, the drones would need to be able to communicate with one another in order to be aware of each other's locations and not crash. This inter-drone communication would need to be real-time, therefore would require 5G.

In order to progress to more autonomous movement of UAVs/AGVs (where the route has not been pre-planned), real-time streaming of video footage is required, sometimes from multiple cameras. Navigation commands must also be communicated back in real time. 5G enables this transfer of information due to its low latency and high bandwidth.

Impact of the use case on the industry

Automating the 'final hundred yards' of delivery could increase the throughput of parcels delivered, by decreasing the total distance driven by last-mile vans and decreasing their dwell time:

- **Decreased distance driven** – With traditional deliveries, the driver parks as close as possible to the drop-off point in order to minimise the distance that must be travelled on foot. However, a drone or AGV is significantly faster, therefore they can cover a greater distance and the distance that the van travels can decrease. For example, instead of driving up to three individual houses it may be more efficient to stop at a location within 100 yards of all three delivery points, so three drones can be released and travel concurrently to their respective destinations. The industry professionals surveyed estimated the total distance driven per shift could decrease by 7%,[27] which for a shift length of 100 miles translates to 7 miles saved. This translates into reduced fuel costs as well as reduced maintenance costs over time.

- **Decreased dwell time** – The time that is spent at each stop decreases, since the time that was previously spent walking to the customers' doorstep, waiting, delivering the parcel, then returning to the van is now eliminated for all parcels light enough to be delivered by drone/AGV. There will be some time required to load the drone and set its destination, but this will be minimal in comparison. The number of stops that the van must make also decreases, since the van does not have to drive as close to each delivery point. This decreases the total dwell time as it eliminates some of the parking time.

The benefits in terms of distance and time saved would translate to an estimated increase in throughput for last mile deliveries of 29%[28] (assuming 100% adoption of the use case), which in the UK is equivalent to an additional 490 million packages delivered each year.

[27] Based on results from STL Partners survey with 200 logistics industry professionals globally, June 2020
[28] Ibid.

Dependencies

Regulation will play a significant role in the adoption of this use case. Since AGVs and drones are relatively new technologies, many countries do not have comprehensive legislation surrounding their use, and the legislation that does exist is very limiting on where and how they can be used. This will significantly slow the rate of adoption of automation in deliveries.

The immaturity of these technologies also has an impact on their cost, which is currently relatively high. Until they are produced on a wider scale and become cheaper, it will be more challenging to justify the business case for automating the last hundred yards, particularly in countries with low labour costs.

Connected traffic infrastructure

Connected traffic infrastructure can increase global productivity, decrease traffic accidents and reduce the amount of fuel consumed globally.

There are an estimated 1.2 billion cars on the roads today, and this is set to double by 2050.[29] Even with new roads being built, the ever-increasing levels of traffic will place pressure on existing road networks. Connected traffic infrastructure could play an important role in easing this pressure.

Connected IoT devices such as sensors or video cameras are integrated into traffic infrastructure (e.g. attached to traffic lights or embedded in roads). These devices collect data about oncoming traffic and the surrounding environment and stream it to a central analytics platform. In the future, connected cars will also be able to receive and share this information. Aggregated data points can be compared against historical data, which can lead to real-time actions being triggered, or in the longer term the information can be leveraged to identify improvements to traffic networks. This form of data collection and analysis can be used in the following ways:

- **For smart traffic lights** – Smart control of traffic lights can optimise traffic flow and minimise waiting times for vehicles by adjusting their timing according to real-time conditions, and by advising drivers on the ideal speed to maintain in order to avoid a red light. It is also possible to prioritise more sustainable transport options such as buses or cyclists, or emergency vehicles such as ambulances. Traffic lights can also be used to slow down cars that are speeding (e.g. by turning red when they approach and forcing the car to stop).

- **For smart road signs** – Signs conveying speed limits can be changed dynamically to reduce build-up of traffic (by lowering the limit at busier times); hard shoulders can be opened on highways to accommodate increased demand; and road signs can change to encourage drivers to take alternative routes when the regular route is becoming overwhelmed, e.g. to reroute traffic in the event of a crash.

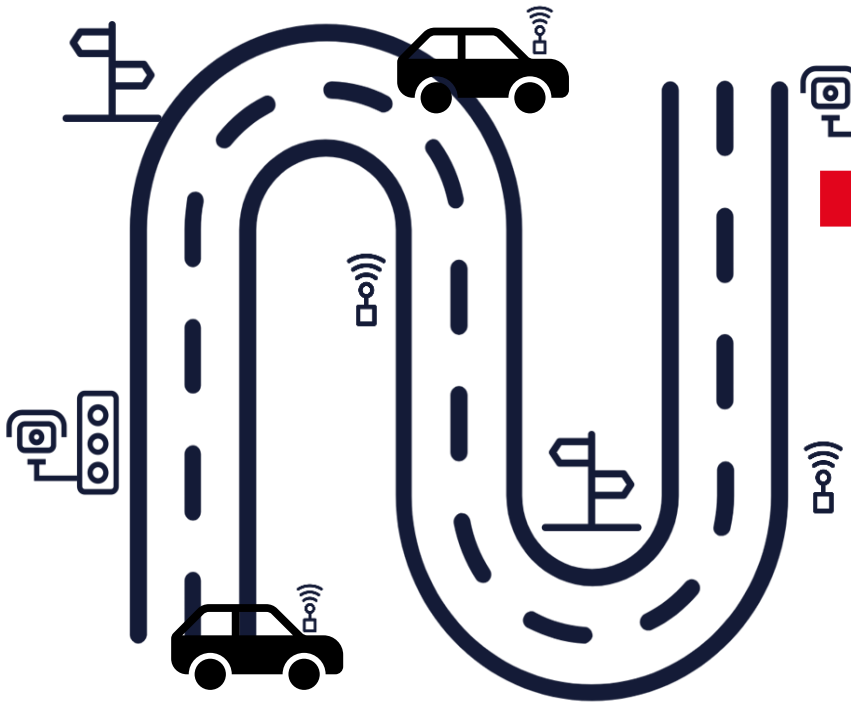
[29] Sustainable Mobility for All, 2017: Global Mobility Report 2017

- **To help deal with accidents** – In the event of abnormal activity such as an accident, the emergency services can be alerted immediately, and other road users can also be notified to alert them of the potential hazard. Since devices with cameras can record footage from new vantage points, they can help identify the causes of accidents, which could potentially help prevent future accidents and would be valuable to insurance companies.
- **For public transport** – Data can be used to help public transport to run on time. Factors such as weather, accidents, or level of traffic can be considered and measures taken to ensure public transport schedules are adhered to as closely as possible (e.g. holding buses to spread them out or rerouting services). This data can also be used to predict arrival times more accurately.
- **For longer term analysis of road networks** – Analysis of routes can determine which are most heavily used and how they are used (type of vehicle, average speed etc.). This information can help to identify improvements e.g. areas with heavy speeding may need action to be taken to mitigate speeding, or areas with heavy usage may require more frequent maintenance. Cameras can also identify specific problem areas that require more immediate intervention (e.g. blocked train tracks, potholes).

Figure 10: Connected traffic infrastructure – how it works and benefits

Sensors/video cameras gather data on:

- Condition of roads (e.g. potholes)
- Types of vehicles using the roads
- Traffic conditions
- Accidents



What's happening here?

- Data is streamed to video analytics platform
- Aggregated data points are compared against historical and "normal" data
- Real-time alerts triggered for abnormal activity e.g. emergency services called for crash or changes to infrastructure made e.g. speed limit adjusted or lane opened to ease traffic

Data management platform

Drivers

- Depending on car model but could also come to phones/radio:
- Real-time updates/alerts on road conditions, accidents etc.
- Car automated responses (in the future)

Emergency services

- Immediate notification of accidents
- Real-time insights in fastest route to accident incl. traffic lights giving priority to emergency vehicles

Public transport providers

- Analysis of routes to maximise usage
- Faster information on need to provide additional services, reroute services, hold buses to spread out service etc.

Local authority / infrastructure mgmt.

- Reduced air pollution from queuing traffic
- Better insights into road conditions
- Fewer accidents

Source: STL Partners

Why 5G?

This is a massive IoT use case with a huge number of sensors that constantly stream data. Although 4G has sufficient latency and bandwidth requirements when a small number of sensors are being used, the performance provided by 4G will decrease as the number of devices increases. This is problematic as the need to drive efficiencies in road networks is most important when traffic is building up, but when areas are congested and many cars or phones are connecting to the local network, 4G begins to struggle with transmitting the data in real-time. 5G is therefore required as it has the capacity to deal with the increase in sensors and ensures a reliable connection. It also has high bandwidth so can cope with streaming HD video. This is increasingly important for multi-modal transport, since other sensors like radar or inductive loops can identify a vehicle's presence, but with video it's possible to identify the specific type of vehicle (e.g. bike versus car versus truck).

Fibre could also meet the performance requirements for this use case, but deploying fibre is a costly and disruptive task that requires roads to be dug up, whereas 5G sensors are expected to be very simple and – once they reach scale – low-cost to deploy therefore are a much more practical option for non-fibre rich areas.

Impact of the use case on the industry

Connected traffic infrastructure will impact three key metrics:

1. **Decrease in congestion resulting in increased productivity.** Connected traffic infrastructure could optimise traffic flow on road networks and decrease congestion. If all major roads in South Korea were equipped with 5G smart traffic infrastructure, this could reduce time spent in the car by an average of 12 minutes each day for urban road users.[30] Assuming that on weekdays just over a quarter of this extra time is used to do additional work, this equates to an extra 15 or so minutes every working week. If these benefits were captured by all workers with access to a car, this would have a 0.21% uplift to South Korea GDP. There would also be an additional GDP uplift tied to the rest of the time saved (including on weekends), which would result in more time spent in activities that stimulate the local economy, but this is difficult to quantify accurately.

3. **Decrease in accidents.** 20-50 million people are injured each year in road traffic crashes across the world.[31] With the aid of connected traffic infrastructure, this number could decrease. This is because real-time information can inform drivers of potential risks, encourage them not to speed, and help traffic agencies to regulate traffic in congested or higher risk areas. It is estimated that the number of road traffic accidents would reduce by roughly 12,000 accidents per year in the UK (which is approximately 8%).[32] There would also be a faster response to any accidents that did occur, with emergency services being notified immediately and given priority on roads, which would lead to faster treatment of any injuries sustained.

Decrease in fuel consumption and emissions. Traffic congestion results in a significant increase in fuel consumption and carbon emissions. By spending less time at a standstill and less time stopping

[30] Based on results from STL Partners survey with 200 logistics industry professionals globally, June 2020
[31] WHO – Road traffic injuries
[32] Based on results from STL Partners survey with 200 logistics industry professionals globally, June 2020

and starting, vehicles would experience a decrease in fuel consumption that UK road users estimated could save them £5 per month in fuel. It would also provide the environmental benefit of reducing consumption of non-renewable resources and decreasing emissions of greenhouse gases.

Beyond these three benefits, connected traffic infrastructure acts as an important stepping-stone on the road to smart cities and autonomous driving. Investing in sensors and the connectivity infrastructure now will facilitate and accelerate the move towards a fully connected city. By using 5G, local councils can be sure the solution will be future proofed for these eventualities.

Connected traffic infrastructure requires an ecosystem of players contributing different data types from different sources. AI can understand the relationship between these data sets, model the consequences of a change and inform all impacted parties in near real-time.

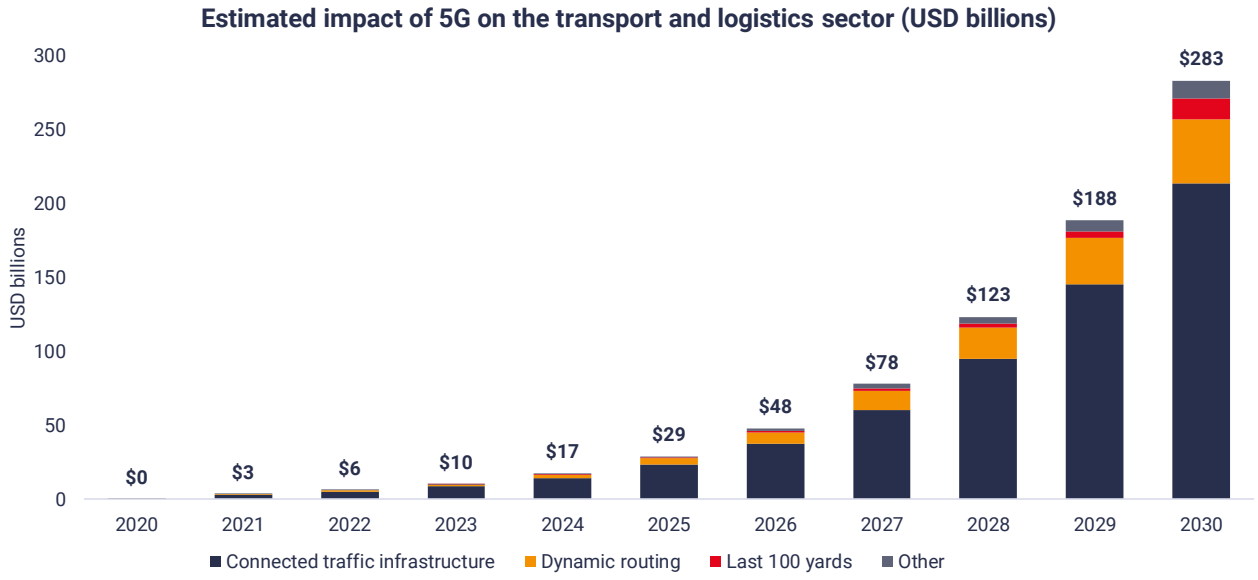
Dependencies

This use case is highly dependent on the coordination of a vast range of stakeholders across the ecosystem, including those using road infrastructure and potentially contributing valuable data, and those that are collecting and analysing the data. Until coordination is achieved, wide scale adoption will be difficult.

There are also issues with privacy that need to be resolved, since a system in which the data from every vehicle on the road is streamed in real time and uploaded to a central data platform (that would likely be orchestrated by the government) would raise issues in terms of data privacy and ownership.

5G impact: Increased productivity to drive $280bn rise in GDP

Figure 11: Connected traffic infrastructure delivers the biggest GDP impact

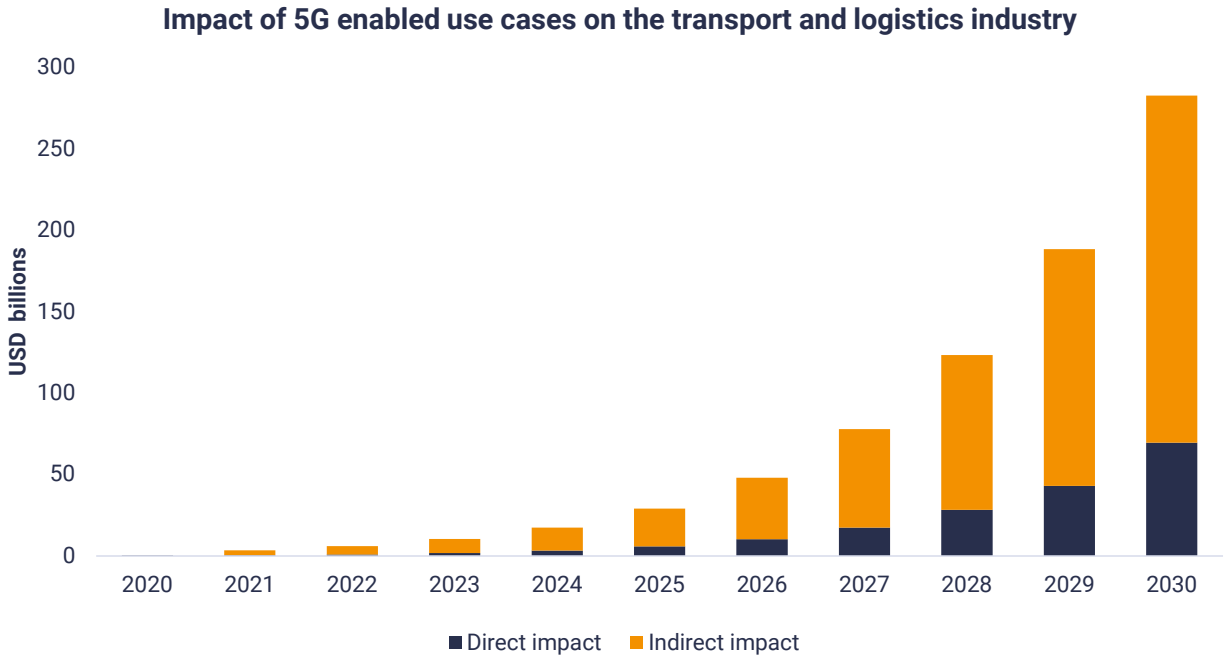


Source: STL Partners

The use case with the largest economic impact for the transport and logistics industry is connected traffic infrastructure. As heavy users of road infrastructure, the transport and logistics industry will benefit significantly from this use case being implemented. It is also likely to see additional benefit in the form of revenues since companies within the transport and logistics industry, such as smarty city solution providers, are likely to play a major part in implementing such a solution.

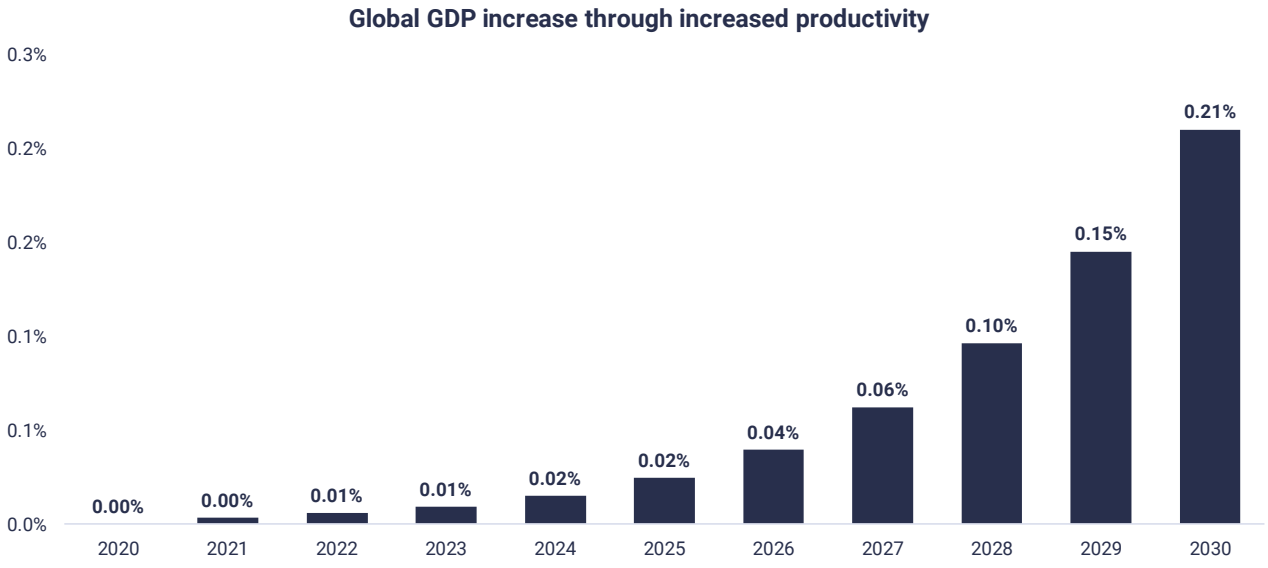
However, not all benefits from the use case will be directly recouped only by transport and logistics. In fact, any industry and indeed any person that uses road infrastructure (be that driving themselves, being a passenger in a car, cycling, using buses etc.) will benefit from this use case.

Figure 12: Almost 80% of the benefits of 5G within transport and logistics in 2030 are indirect benefits that will be shared across all industries from increased productivity



Source: STL Partners

Figure 13: Global GDP increase through increased productivity



Source: STL Partners

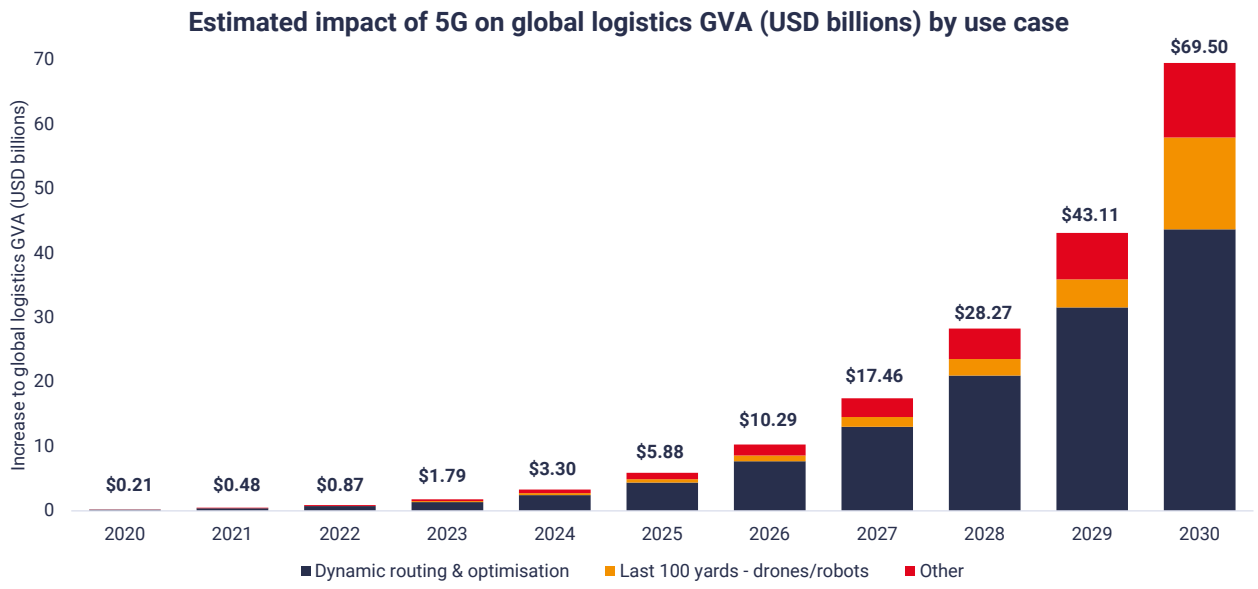
This assumes that only certain road networks will upgrade their infrastructure, as rural roads that are used less heavily are unlikely to experience issues with congestion, therefore connected traffic solutions will have minimal impact.

With use cases that deliver benefits that are widespread across the economy (such as connected traffic infrastructure), it becomes even clearer that governments must play a key enabling role.

Countries that have a higher urban population and a high number of road users will consequently derive a greater benefit from this use case. For example, Monaco has both of these characteristics so could experience up to a 0.5% uptick to its GDP whereas Bolivia has a lower urban population and number of road users so will have a more modest GDP increase of 0.04%.

If we focus just on use cases with a direct impact on the transport and logistics sector, we see that 5G-enabled use cases could deliver a GVA (gross value add) uplift of $70 billion in 2030. In order to determine this economic impact, the benefits of the three use cases were quantified based on the survey and other UK data. The benefits were then extrapolated globally based on GDP, population, and logistics performance index, then forecast over the next ten years by considering the rate of adoption of each use case, and country growth in GDP. There is also an assumption that other 5G-enabled use cases that apply to the transport and logistics industry (which we have not modelled in detail) will make up circa 20% of total benefit.

Figure 14: Estimated impact of 5G on global logistics GVA (USD billions) by use case

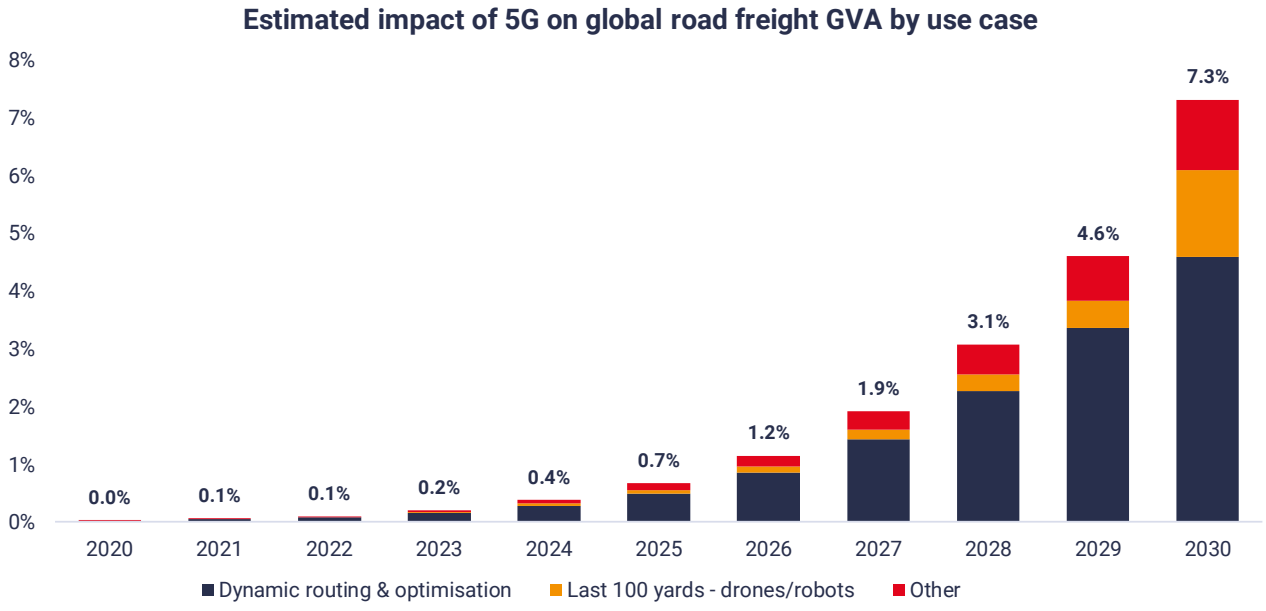


Source: STL Partners

The majority of this increase is attributable to real-time routing and optimisation, because this use case is likely to be adopted by the industry at a much faster rate than UAVs/AGVs, which will need to overcome regulatory constraints before use becomes widespread. Additionally, the high cost of drones prevents them from being a feasible solution in developing markets, and until the technology is developed at a larger scale, the cost is unlikely to reduce dramatically.

Looking specifically at the road freight industry (rather than transport and logistics as a whole), 5G could have a transformative impact of 7% increase to GVA in 2030.

Figure 15: Estimated impact of 5G on global road freight GVA by use case



Source: STL Partners

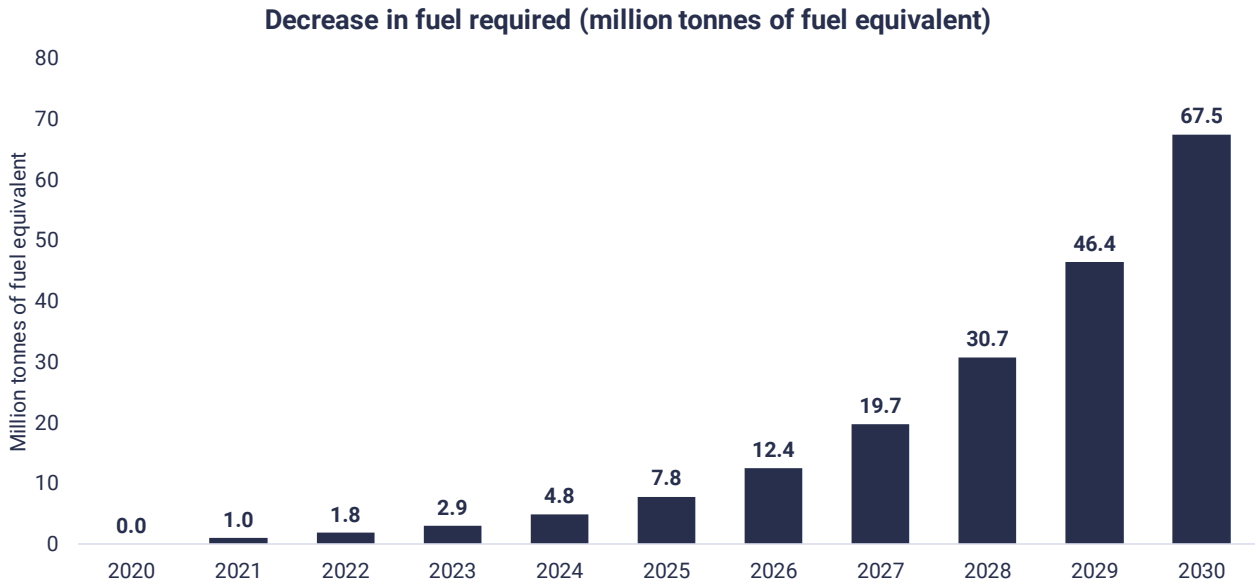
It's not just about money: 5G's socio-economic benefits

5G's ability to enable new use cases and increase efficiency of vehicle usage has effects that extend beyond simply monetary benefits – it also has a strong socio-economic impact.

1. Improve use of resources

By decreasing the distance that vehicles drive and minimising the amount of time they spend in traffic, the amount of fuel consumed is decreased. Connected traffic infrastructure alone could save 67 million tonnes of fuel in 2030 globally. For comparison, this is the same amount of fuel that Thailand consumes in an entire year.

Figure 16: Decrease in fuel required (million tonnes of fuel equivalent)



Source: STL Partners

In addition, collecting more information throughout the supply chain can help to protect perishable goods and reduce waste in food supply chains. With 1.3 billion tonnes of wasted food each year, and 30-40% of food production lost before it even reaches the market,[33] any reduction in waste that can be achieved could have a large impact on conserving valuable resources.

2. Decrease emissions

Road transport is a huge contributor to greenhouse gas (GHG) and air pollutant emissions. This is inflicting long-lasting environmental damage to the planet and accelerating climate change. Air pollution can also have devastating consequences for health. Seven million people die each year because of polluted air, and over half a million of these are children under five. This then has an economic impact on countries. In the 15 countries with the highest GHG emissions, treating health conditions related to air pollution is estimated to cost over 4% of their GDP.[34] The role of 5G in limiting emissions is therefore very significant – any improvements to congestion or distance driven can reduce vehicle emissions and play a part in limiting damage to the environment and premature loss of life.

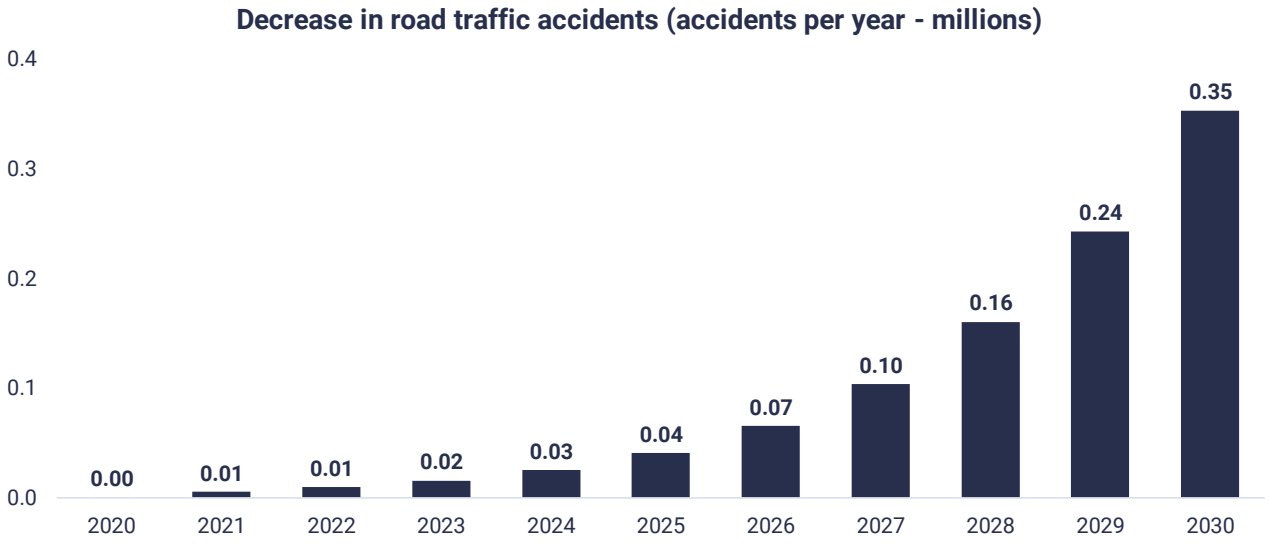
3. Reduce accidents

Although cars and roads are becoming safer and the overall road accidents are decreasing, 1.35 million people still die each year because of road traffic crashes.[35] 5G-enabled connected traffic

[33] UN Food and Agriculture Organisation – Production chain food waste
[34] WHO – Air Pollution
[35] WHO – Road traffic injuries

infrastructure could improve the safety of roads and aid the emergency response to accidents, thereby preventing 350,000 accidents[36] in the year 2030 (see Connected traffic infrastructure).

Figure 17: Decrease in road traffic accidents (accidents per year – millions)



Source: STL Partners

4. Accelerate adoption of electric vehicles

Beyond how 5G can change the way that vehicles are used, it can also play a role in accelerating the adoption of electric vehicles (EVs). The move to electric vehicles is critical as the world strives to reduce carbon emissions. This is because, as electric grids become cleaner and powered by renewable energy, electricity becomes a significantly more environmentally friendly fuel compared to petrol. We will explore the factors around this move to electricity in an upcoming report evaluating the impact of 5G on the renewable energy industry.

However, electric vehicles are not yet widely adopted. In Norway, one of the world leaders, only 10% of all passenger vehicles were electric in 2018. Government incentives and reducing the price of vehicles are two important factors, although 5G has a limited role to play in changing these. Nonetheless, our survey with experts and practitioners in the energy industry found that there were other factors (see Figure 18) that were posing significant barriers and which 5G could make an impact on.

[36] Figure extrapolated from decrease in accidents estimated by transport and logistics executives in our 2020 survey

Figure 18: Main barriers hindering adoption of EVs and those which 5G can influence

Rank	Barriers to adopting electric vehicles
1	Cost of electric vehicle
2	Ability to access EV charging points
3	Battery limitations
4	Fuel costs
5	The time it takes to charge an electric vehicle
6	Lack of choice (vehicles)
7	Lack of education
8	Government incentives

Source: STL Partners' survey with 100+ energy experts

For example, having highly connected vehicle and road infrastructure can allow ease of access to EV charging points and partially help to overcome electric vehicles' battery limitations. Knowing where the next EV charging point/battery replacement station is in advance and automatically determining the stops during a journey will provide a more seamless experience compared to today, as well as ensuring there is enough supply to meet demand. Second, mobile smart charging systems connected by 5G can reduce the cost of electricity used to fuel the car. By optimising when charging happens during the day, consumers would be able to access lower off-peak rates, when supply of energy is high.

5G and the sustainable development goals

These socio-economic benefits map to the sustainable development goals established by the UN. Although there is no goal to address transport exclusively, targets SDG 3.6 and SDG 11.2 focus on transport, and the benefits from improving the industry have a positive impact on achieving other goals (SDGs 8 and 12).

Figure 19: How 5G in transport and logistics benefits UN SDGs

Source: United Nations. STL Partners

Next steps for the T&L industry

The role of governments

Government funding

Governments are often key stakeholders in decision making about public transport infrastructure. For example, in the UK it is local governments in combination with Highways England (a government-owned company) that pay for road upgrades. The government therefore plays a pivotal role in the digital transformation of a country's transport industry, as the transformation of public infrastructure is often heavily reliant on public funding.

When talking to public sector stakeholders there is a need to prove a strong and rapid return on investment, as the budget holders may find it hard to justify the investment if they do not understand the digital solution and the benefits that could be derived. It is therefore important that the value of 5G solutions is clearly demonstrated, and that transport bodies are able to understand the language used when discussing technological benefits of new solutions and use cases. It is also important to be flexible with the engagement model, as some bodies will have the budget for a larger capex investment but will have tight opex constraints, whereas other will be happy with an ongoing opex.

The importance of reliable, high speed connectivity across the nation has been exemplified by COVID-19. Operators should use these prevailing attitudes to engage with governments about investment in 5G infrastructure that can benefit wider society – e.g. through 5G corridors along major road routes.

Regulation

Regulations surrounding autonomous delivery vehicles in most regions are limited. Companies looking to roll out solutions are hindered by a variety of regional and national laws that don't reflect the current technological landscape and are often designed with passenger vehicles in mind, not goods carriers.

Drone regulations are similarly problematic. There are currently 15[37] countries in the world where drones are completely banned (in many cases simply because they have yet to figure out appropriate guidelines so are banning them as an intermediary measure). Even within countries that do permit drone use, today most countries require the drone to be flown within visual line of sight (VLOS) which limits their range, or only allow usage beyond VLOS if you apply for an exception. In order for drone adoption to become widespread, regulations will need to be established that set forth a safe way for drones to be integrated into society for use in delivery operations, beyond their use exclusively in rural areas or on set routes (e.g. between two hospitals). The same need applies to automated delivery vehicles that run on pavements.

[37] Drone bans

Collaboration with the telecommunications industry

Capturing the value of 5G in the transport and logistics industry requires the collaboration of parties across different sectors, that may have limited visibility and understanding of one another's sectors. Telcos will need to prove their pedigree as good ecosystem players and enablers in order to succeed in the transport and logistics sector. They will need to enable data sharing across supply chains and be able to mediate relationships between private companies and the public sector. While this is in some ways challenging, it also plays into some key strengths for telcos – e.g. their relationship with the public sector, their reputation as an entity that can be trusted to store data, their strong national plays etc.

Cross-industry organisations or initiatives can also help cultivate these ecosystems, by bringing together experts from the two sectors in order to marry together their knowledge, align their understanding, and ensure they are working towards a common goal. Some organisations that are carrying out notable research and trials to recognise the value of 5G in transport and logistics include:

- Traficom: 5G momentum ecosystem – Promoting development of 5G services for sectors including transport (Finland)
- 5G-Blueprint – Investigating how real-time data exchange can improve supply chain efficiency (EU)
- WM5G: Mobility project – Trialing 5G opportunities to ease urban congestion and improve access (UK)
- 5G Strategic Deployment Agenda (SDA) for Connected and Automated Mobility (CAM) – Strategy to accelerate 5G rollout and develop 5G highways corridors (EU)

Operators will also need to collaborate with one another to address the challenge of connecting road networks seamlessly, since this will potentially require some sort of roaming agreement between them to allow traffic to move between networks - the alternative being that all networks provide 100% coverage, which is an ambitious ask.

Challenges with meeting necessary 5G standards

Although 5G could have a significant impact on transport and logistics, the industry will face challenges in leveraging its capabilities. Some of these challenges are not specifically tied to 5G, such as the issues with data siloes and the lack of standardisation in data collection and formatting.

With regards to the 5G itself, telecoms operators generally understand the value in 5G and the potential it holds within other industries, but although it has been launched in more developed markets it is not yet ready to be used by the industry at large. This is because there are still barriers preventing its full value from being leveraged:

- **Hindered roll-out** – Building 5G networks is extremely costly which can make it hard for operators to justify the investment. The current market of stagnant revenue growth makes this especially difficult, therefore operators may delay their rollout of 5G until the business drive

becomes more compelling, or until they have more flexibility to make large capital expenditures. COVID-19 poses additional challenges that both delay rollout in the short-term, and could hinder rollout in the longer term by negatively impacting market conditions.

- **Coverage** – Coverage in remote areas is not guaranteed. As 5G networks are rolled out, the priority will be to establish coverage in densely populated urban areas as this is where the majority of consumers will be. As such, there will be a delay in rolling out coverage across more rural areas. For transport and logistics use cases, coverage will need to be widespread, particularly for drones which will be operating in rural areas. It is therefore important to encourage fast roll-out of 5G.

- **Standards are still being set** – 5G is still evolving; with each new release, additional capabilities are added. Although the full 3GPP 5G standards were recently completed in Release 16, further enhancements will continue to follow that could have an impact on industry 5G use cases. For example, the next release (Release 17)[38] will feature 5G enhancement for UAVs, enhanced V2X services, and the second phase of network slicing. The exact standards for the next release have not yet been defined.

If industry players engage in influencing the standards for 5G by informing the 3GPP standards forum of the technological requirements of their use cases, they can help to ensure that 5G meets their needs in terms of which use cases they would like to address, and how they need 5G to perform for these use cases. 3GPP is interested in accommodating these views and invites "Market Representation Partners" to share their view of market requirements. Existing partners include the 5G Automotive Association and the Automotive Edge Computing Consortium. Collaborating in this way can help to speed up the process of defining standards, which will help to accelerate 5G roll-out.

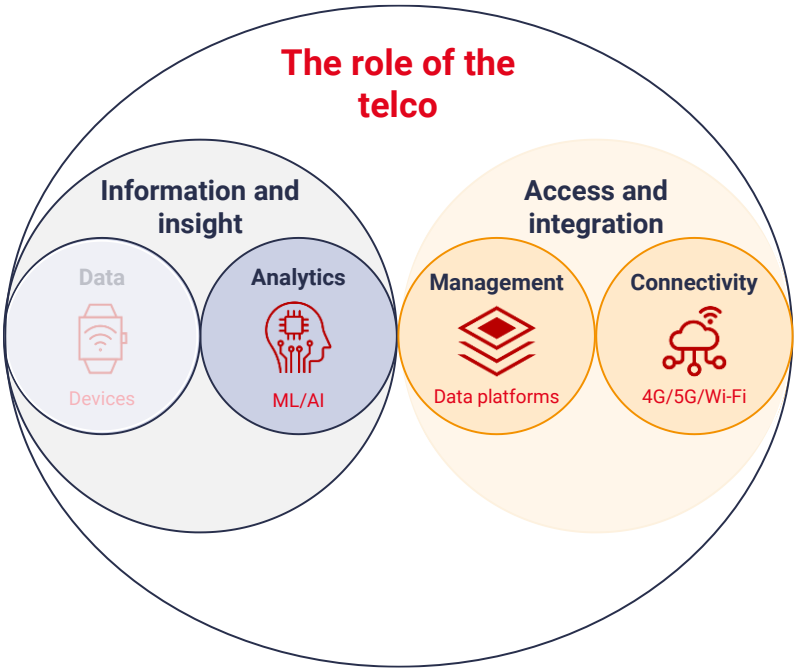
Collaboration with telecoms operators

Telecoms operators are well known for their role in providing connectivity[39], but not for offering solutions or applications beyond this, particularly in other industries such as transport and logistics. However, operators are experiencing diminishing revenues with their pay-per-megabyte business model, so are trying to stimulate revenue growth by breaking out of the confines of their traditional role of connectivity provider and adopting new business models.

[38] 3GPP Release 17

[39] It should be noted that telecoms operators may not be the only players deploying 5G – it is possible that new players could enter the space and operate 5G as a slice or a private network. However for the wide area use cases discussed in this report, operators will play the primary role in providing 5G connectivity.

Figure 20: Telcos will have a role beyond connectivity



Source: STL Partners

Telcos are targeting specific sectors and developing the necessary skills to address their needs and deliver tailored solutions. Broadly speaking, there are three layers of the value chain in which telcos can play. We have outlined these in Figure 21 and given three examples of telcos that have made a play in each domain. An upcoming report will discuss these new telco business models in more detail and explore how enterprises can drive technology adoption by partnering with telcos.

Figure 21: Telco 5G business models

Solutions and Applications	Provide custom end-to-end solutions for customers, includes consulting and advisory services, systems integration and applications	verizon
Application Enablement	Aggregate applications and data from multiple partners to multiple users e.g. data management & sharing, billing / transactions, app marketplace	verizon
Networks-as-a-Service	Manage custom networks in a cloud-like way, i.e. ability for customer to scale up and down, define parameters (e.g. latency), and add other functionality	vodafone

Source: STL Partners

Conclusion

- In this report we have demonstrated how the capabilities of 5G can impact the evolution and transformation of the transport and logistics industry, through enabling new and enhanced use cases that can drive efficiencies and improve consumption of resources.
- The key characteristics that 5G brings are increased bandwidth and device density, and reduced latency. This expands the volume and quality of information that can be collected throughout the ecosystem and enables actions to be triggered in real time.
- Three use cases that leverage these characteristics are:
  - **Real-time routing and optimisation**: Collecting data across the supply chain to improve visibility and optimise processes through real-time dynamic routing and scheduling
  - **Automated last 100 yards delivery**: Using a delivery van as a mobile final distribution point from which drones or automated delivery vehicles are launched to carry out the last 'hundred yards' of delivery
  - **Connected traffic infrastructure**: Integrating smart sensors or cameras into traffic infrastructure to collect data about oncoming traffic and optimise use of road networks
- Globally, the impact of 5G road freight use cases on global GDP is forecasted to be $280 billion by 2030. Increased productivity from connected traffic infrastructure makes up the majority of this.
- 5G will also have a positive socio-economic impact. It will benefit the environment by reducing consumption of fuel and release of emissions. There will also be a benefit to safety and wellbeing, with a reduction in accidents and fewer illnesses related to air pollution.
- In order to take advantage of the benefits that 5G can offer, the industry will need to take an active role in the acceleration of 5G roll-out and the adoption of new use cases. This includes:
  - Building an understanding of 5G and its benefits
  - Inputting into the development of 5G standards and regulation
  - Collaborating with telecoms operators and industry specific partners

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