

5G: A transformative technology

How the next network upgrade could supercharge your business and the UK economy



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Report highlights

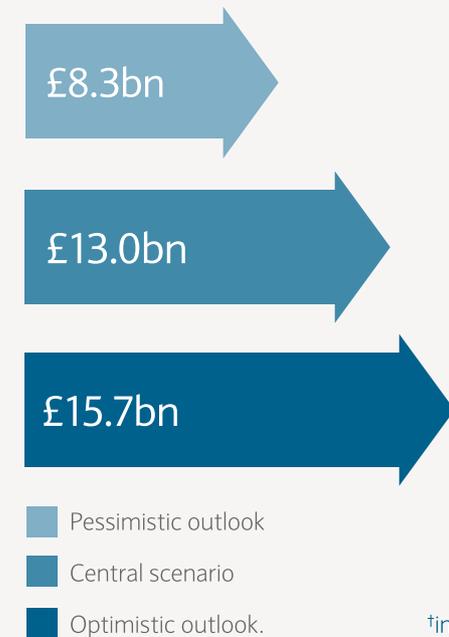
Barclays' latest research has found that 5G will create numerous benefits to UK businesses. But to unlock its full potential, government, mobile providers and businesses themselves must be fully prepared for the change.

- The introduction of a 5G mobile telecommunications network could increase aggregate UK business revenues (in 2018 prices) by between £8.3bn and £15.7bn by 2025, with a 'central' scenario estimate of £13.0bn.* By 2030, the estimated increase in aggregate revenues could be up to £89.6bn, with a central scenario estimate of £64.0bn
- By 2030, the size of the UK economy could be increased by between 0.88% and 1.54% (with a central scenario estimate of 1.09%) compared to a situation where no national 5G network is developed
- However, although awareness of 5G is high, UK businesses are not preparing for its imminent roll-out – only 9% are allocating significant resources in order to take advantage
- Businesses may be distracted by near-term uncertainty around Brexit, but there's also a lack of understanding of what 5G can do for industry. Only 28% of businesses know what 5G is and what it could do on a practical level
- 5G has the capacity to boost the UK economy, keep Britain globally competitive and directly add revenue to businesses, but only if firms act quickly. 5G will enable new and existing technologies such as connected and autonomous vehicles, smart cities and homes, augmented and virtual reality, the Internet of Things (IoT) and Big Data to reach their full potential
- The network upgrade has the power to transform how we use the internet, and is capable of connecting a million devices per square kilometre at speeds of up to 20GB/s
- Other intangible benefits of 5G include improving worker productivity and collaboration, and allowing people with accessibility challenges back into work. This includes home caregivers, people with limited mobility and the elderly – a particularly compelling advantage given the ageing population of Britain.

*see [page 19](#) for more information about the research.

Business benefits

5G could increase aggregate UK business revenues[†] by between £8.3bn and £15.7bn by 2025.



Executive summary

The highly-anticipated rollout of 5G is due to begin in 2019. Businesses that invest in preparing will gain a competitive edge, yet our research suggests few companies are ready for its introduction.

Each time the leap to the next generation of mobile networks has been made, the applications and devices that followed have transformed industries and increased revenues. Alongside the internet itself, mobile telephony has proved to be a game-changing technology for users, businesses and economies. The advent of 5G will further transform these technologies and create a wealth of business advantages. However, it will require British businesses and telecoms providers, with the support of the UK Government, to quickly adapt and adopt to reap these benefits.

How fast is 5G?



Download an HD movie in **10 to 40 seconds**



Upload a 1GB video to YouTube in **under 15 seconds**.

In the pockets of a high percentage of the UK population is a tiny machine that connects them with friends, businesses and the wider world, snaps and edits their photos, provides them with music, reading, games, movies, takes them shopping and so much more. It has only taken a few short decades for the mobile phone to become an almost ubiquitous technology and with each iteration of the networks that support these devices, there has been a step-change in how and when they are used.

“Only 28% of businesses know what 5G is and what it could do on a practical level.”

The very first networks only allowed for analogue voices to be heard, but 2G allowed these voices to go digital or be replaced by text messaging. Mobile data arrived with 3G, but it took 4G networks to fully facilitate widespread mobile internet use as it allowed higher speeds and lower latency. Being on the cusp of the 5G’s arrival means the technology and its capabilities are set to transform once more.

With live trials well and truly underway – at locations including Manchester Airport¹ and the Worcester Bosch factory² (see [page 17](#)) – it is time for UK businesses to tune into the new network’s transformative capabilities.

Higher speeds, more devices

The user experience of mobile internet will be completely different with 5G. Ever-greater speeds and much lower latencies will allow for the download of a HD movie in 10 to 40 seconds, for example, or the upload of a 1GB video to YouTube in under 15 seconds. A 5G network will, at a minimum, support around one million devices in every square kilometre, connecting them all to the internet at the same time. That function will revolutionise the growing IoT, helping anything to get online – an individual’s clothes, smartwatch, healthcare devices and car, for example, or infrastructure such as traffic lights, parcel deliveries and warehousing – the list is almost endless.

IoT isn’t the only technology that will be changed by 5G. More connected devices means more big data to crunch, and 5G will spur innovation in smart homes and smart cities as well as connected and autonomous vehicles. Speed and latency improvements will power technologies such as augmented and virtual reality (AR/VR), 3D video calls and even holograms. It will also support enhanced machine-to-machine communication, which will likely increase developments in artificial intelligence and machine learning.

Disruption and opportunity

With each progression in mobile technology, businesses have seen a disruption in processes and new competitors. Those who pivot new technologies into innovative ideas have been at the forefront of this disruption, whether by starting up wholly new businesses or transforming their existing company. 5G is expected to be another such transformative technology, not just in ways which can be predicted, but also in ways that are likely to be unforeseen.

“Revenues will increase and the economy will benefit, the UK will remain competitive on the world stage and workforce productivity and employment (both direct and indirect) will rise.”

What is certain is that 5G will accelerate the transition towards [‘Industry 4.0’](#) in the manufacturing sector. Logistics and distribution will change in line with the proliferation of connected devices. The IT, media, professional services, business services, healthcare, retail and entertainment industries are all expected to see changes too.

Based on the experience of previous generations of mobile networks, changes through the introduction of 5G should create significant economic uplift. Revenues will increase and the economy will benefit, the UK will remain competitive on the world stage and workforce productivity and employment (both direct and indirect) will rise.

Business be ready

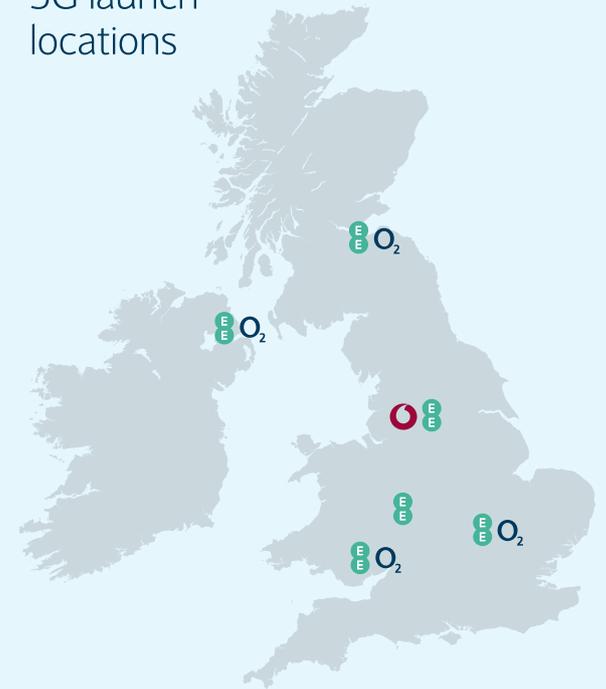
But all of the monetary benefits, innovation and intangible economic boost will only come if business, government and mobile infrastructure providers are ready for the change. In our survey of over 500 medium-sized and larger UK businesses, we found that awareness of 5G was reasonably high, but only 9% of businesses were planning to allocate significant levels of resources to take advantage of the imminent roll-out of a national 5G network.

Brexit has caused a huge amount of near-term uncertainty in the UK economy and it’s only natural that businesses are somewhat distracted from the larger picture with such an event on the horizon. But our economic modelling suggests that the revenue and economic benefits will be much greater if the UK presses ahead quickly with the rollout of 5G networks and if British companies are ready to take up the new services as they arrive.



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5G launch locations



Salford, Manchester.

First company in the UK to carry full 5G over a commercial network, late 2018.



Belfast, Birmingham, Cardiff, Edinburgh, London, Manchester.

First of 16 launch cities, 2019.



Belfast, Cardiff, Edinburgh, London.

Bringing 5G to the UK’s four capital cities, by end 2019.



2,700+ UK sites now have 4G+. £2bn

committed to bring 5G to customers from 2019.

The advent of 5G

The UK Government and mobile infrastructure providers are firmly invested in rolling out 5G from 2019 and device manufacturers have already announced the first phones. The network upgrade will supercharge nascent technologies such as IoT and connected cars, while providing tangible and intangible benefits across the sectors.

There is some ambiguity in the term 5G, which may be part of the reason why businesses are holding off on investment. In fact, there are no internationally agreed specifications or definition for a 5G network yet. Despite that, the first genuinely commercial 5G networks are expected to launch sometime in 2019 and a conservative estimate is for at least 50% coverage within five years.

Improved data rates

5G peak data



5G user experienced*



*Minimum achievable data rate for a user in real network environment.

Although it is not widely known exactly what technologies will power 5G networks across the world, there is awareness of what they will do. The most common attributes, many of which have been agreed by the International Telecommunications Union (ITU), are:

- Peak data rates of 20GB/s – around 20 times faster than 4G
- User experienced* data rate of 100 Mbit/s – around 10 times faster than 4G
- 1 GB/s simultaneously to many workers on the same office floor
- Simultaneous connections for 1 million devices per km²
- Spectral efficiency significantly enhanced compared to 4G
- Latency reduced significantly compared to 4G (e.g. 1m/s)
- Improved energy usage efficiencies.

5G ambitions

The UK Government has repeatedly recognised the importance of connectivity, making full fibre coverage and 5G rollout part of its Industrial Strategy and investing over £1bn in digital infrastructure. These commitments are linked, as full fibre infrastructure is necessary to underpin 5G coverage across the country. The government believes that “driving large-scale commercial investment in fixed and wireless networks is vital for the UK to remain globally competitive in a digital world”.³

The Future Telecoms Infrastructure Review (FTIR), part of the Industrial Strategy, proposes connecting 15 million premises to full fibre broadband by 2025 and providing full fibre broadband coverage across all of the UK by 2033. It also increases access to spectrum for 5G networks and allocates £200m to support the 5G Testbeds and Trials (5GTT) programme, with an additional £35m allocated to joint rail projects with the Local Full Fibre Networks Programme.⁴

In March 2018, the government selected six bids from across the UK as the winners of £25m in the initial phase of the 5GTT programme. In the same month, the world's first end-to-end 5G network, 5GUK, was completed. The network is currently being used to trial further 5G applications and technologies.

Infrastructure, devices and applications at the ready

All of the major mobile network infrastructure providers in Britain have announced plans to trial and then roll out 5G networks in the near future. In many cases, the 5G networks will initially rely on existing technologies to work, leading to them being branded by some as "5G lite". However, experts expect the full networks to quickly follow, using new technologies such as Massive MIMO (multiple-input multiple-output), small cell, beamforming, Li-Fi (light fidelity) and millimetre waves.

“Vodafone was the first company in the UK to carry full 5G over a commercial network in Salford, Manchester, using its converged fibre nationwide network.”

Current announcements include:

- Two Massive MIMO trials in Kings Cross and Marble Arch in London. These are run by O2 and Nokia and aimed at enhancing connectivity and paving the way for the future deployment of 5G across the capital⁵
- O2 has also committed to supporting the design of Europe's largest fibre-connected small cell network in the Midlands⁶
- EE is launching 5G within 16 UK cities in 2019, beginning with London, Cardiff, Edinburgh, Belfast, Birmingham and Manchester as phase one of their launch⁷
- In late 2018, Vodafone became the first company in the UK to carry full 5G over a commercial network in Salford, Manchester, using its converged fibre nationwide network⁸
- Three UK has committed to spending more than £2bn to bring 5G to customers from 2019, including buying spectrum, new 5G radio equipment and cell site upgrades and the world's first end-to-end cloud-based core network.⁹

Of course, the networks are nothing without devices and applications to run on them. But here too, there is evidence of ample investment. Manufacturers such as Samsung, Huawei and OnePlus have all confirmed 5G phone models for launch in 2019. And Qualcomm president Cristiano Amon has said that every Android vendor is working on 5G right now.¹⁰

The journey to 5G



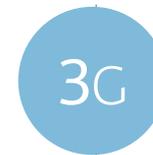
2019 – rollout begins

Higher capacity, faster, 3D video calls and holograms, possible alternative to home broadband



2008

Widespread mobile internet use, high speeds and real-time streaming, ultra broadband



1998

Digital broadband, multimedia features and video call



1991

Digital version of 1G, voice and data, narrowband



1980s

The first wireless communication, voice only, analogue.

What can 5G really do?

5G will enable a much wider range of applications than previous iterations of mobile networks. It will also be a vital component to spread and support the use of other new technologies that are currently in their infancy, including IoT and AR/VR. A comprehensive list of what 5G can do is impossible to put together, not just because of how long it would be, but because there will be unexpected consequences, disruptive technologies and killer apps that can't be imagined until the network has been fully introduced.

5G transport industry benefits



Connected vehicles that allow data collection will reduce congestion, improving journey times and environmental outcomes.

There is an expectation that 5G will support a wide variety of applications, including:

- Large-scale machine-to-machine communications such as sensors on a production line
- Innovative augmented and virtual reality applications
- Connected and autonomous vehicles for both individual and corporate use, including transportation and distribution
- New services such as 3D video calls and even holograms
- Innovations in artificial intelligence and robotics
- Smart home and city tools
- Healthcare applications including personal fitness and health monitors, drug dispensing devices and expanding telemedicine appointments
- Accelerated transition to 'Industry 4.0' manufacturing technologies
- Applications in agriculture, e.g. more targeted application of fertiliser, pesticides, nutrition and other inputs, leading to cost savings and enhanced environmental outcomes.

Which industries benefit?

The evolution from 2G to 3G and then from 3G to 4G both hint that almost every industry will benefit from 5G, with increased revenues, more productive workers and the boost to the wider economy. While more money will trickle through to each sector, there are some verticals that will see a wider range of benefits, including:

Smart cities and homes

- The ability to reliably connect ever-more devices to the internet simultaneously is a key component of the IoT, which in turn will help fuel the innovation needed to create smart cities and homes
- As urban areas grow into so-called megacities with swelling populations, the ability to intelligently manage resources, improve public safety, provide services such as rubbish collection and reduce traffic congestion and associated environmental impacts will grow in importance
- Smart energy grids, which have been emerging over the last decade, will have an enhanced ability to adjust to supply and demand as more machines and devices come onto the network.

Transportation

Connected vehicles that allow data collection from the surrounding environment, such as traffic lights, other vehicles or roadside sensors, will:

- Improve the efficiency and economy of road transportation (including freight) by platooning road vehicles (i.e. road vehicles travelling in close proximity at speed)
- Reduce traffic congestion leading to improved journey times and reliability (with implications for productivity for sectors such as manufacturing and retailing) and improve environmental outcomes (e.g. lower emissions)
- Improve data collection to enhance transport system efficiency and capacity (including traffic analytics, fleet analytics and improved transport system modelling)
- Create intelligent fleet and logistics management for logistics and distribution, as well as postal services and emergency services.

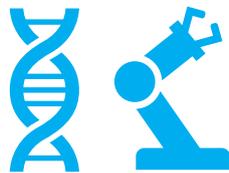
Autonomous cars that can self-drive with little or no help from humans, will:

- Allow increased mobility by, for example, enabling elderly or disabled people who can't drive themselves to get around
- Improve road safety by reducing human error.

Healthcare

- While we are already seeing the deployment of healthcare devices for personal fitness, 5G will accelerate the development and expansion of these monitors. Trackers will be able to monitor health as well as fitness, coming into use for monitoring medication response or chronically ill patients, for example
- 5G will also support big data analytics in the sector, which will have particular benefits in helping to speed up the time-to-market for new treatments and reducing the often vast costs of pharmaceutical R&D
- Improved communications will help to create and spread telemedicine programmes, where patients with non-life-threatening ailments can get appointments by video call or even 3D video at a clarity that will allow for more accurate diagnosis
- Longer-term, 5G could help spur innovation in other medical technologies, such as the use of robotics in surgery.

5G healthcare industry benefits



5G will accelerate the development of healthcare devices to monitor medication response, for example.

The new world of work

As well as the aforementioned sector-specific advantages, there are also a number of intangible or indirect benefits that the arrival of 5G will bring across the British economy, many of which were outlined in a document¹¹ produced by the UK's Department for Digital, Culture, Media and Sport. It's worth highlighting two key changes to the country's workforce from that report:

- **Productivity:** 5G will promote productivity growth in businesses and their workers. Employees will be able to collaborate more effectively within an organisation and with partnering firms, while services to customers will be improved. Better and more reliable connectivity will increase the likelihood that staff can work effectively from home, saving commuting time and consequently reducing the burden on road and rail travel.
- **Labour participation:** Not only will workers do their jobs more effectively and on the move, but enhanced communications will also remove some of the barriers to work for those that are home-based carers or have impaired mobility, and older workers. This factor is hugely important as the population in the UK rises and retirement age increases, and because some areas of the country, particularly in the South East, are nearing full employment.

Act fast to boost benefits

It's difficult for businesses to anticipate the disruption and opportunities a new technology can bring. When mobile networks upgrade, there are always early adopters, but it's the killer apps and the incredible new devices that bring everyone else on board. The introduction of 5G could, and should, be different though.

The lessons learned by upgrading to first 3G and then 4G have taught us that network improvements increase revenues and employment and contribute to economic growth. Experts predict that the improved level of service on 5G networks will have a whole host of indirect benefits across different industries. However, Barclays' survey of 526 senior managers at medium-sized and large enterprises, conducted by YouGov, found that few British firms are preparing for 5G.

“Just 15% of UK firms are discussing plans to take advantage of the rollout of 5G networks.”

5G awareness low

Nearly two-thirds (62%) of the managers reported that they knew what 5G was, even if over half that number were unsure about how it would work practically. But 14% of British businesses are not even aware of 5G. And just 15% of UK firms are discussing plans to take advantage of the rollout of 5G networks.

Despite the UK Government's well-publicised support of 5G and a host of announcements of trial programmes and launches from mobile networks, most British firms don't know that 5G will arrive in the next 12 to 18 months. This blind spot is not just concentrated in certain regions, as might be expected. Only 14% of companies in London were aware of plans to roll out 5G in the city and 55% said they didn't know of any plans. Those figures are only slightly different to the rest of the country, with 76% of Scottish firms, 70% of Welsh businesses and 60% of companies across the North East, North West and Midlands reporting no knowledge of 5G rollout in their region.

The business case

Nearly half of companies reported that they didn't expect to see an increase in business revenues from the advent of 5G and only 12% are looking forward to a significant improvement to their bottom line. It appears that the majority of managers don't know that experts are predicting economic benefits across the board for the British economy once mobile networks upgrade.

However, of those that do expect some business growth from 5G – perhaps managers that are generally tech-savvy or that tend to be early adopters of new technologies – their ideas of what 5G will enable them to do seem to match expert opinions. The most commonly cited reasons for a 5G boost were:

- Increased business efficiency (31% agreed with this reason)
- Ability to utilise/exploit the IoT (27%)
- Facilitate communication with more customers (19%) or potential customers (18%)
- Reduced business costs (18%)
- Increased business output (14%)
- Expanded geographic reach/coverage (14%)
- Enhanced opportunities for international trade (14%).

Sector by sector

Although 5G will benefit the majority of businesses, there are some industries that will see specific changes. The natural assumption is that these verticals would be more aware of the imminent rollout of 5G and its advantages, but that was not always the case.

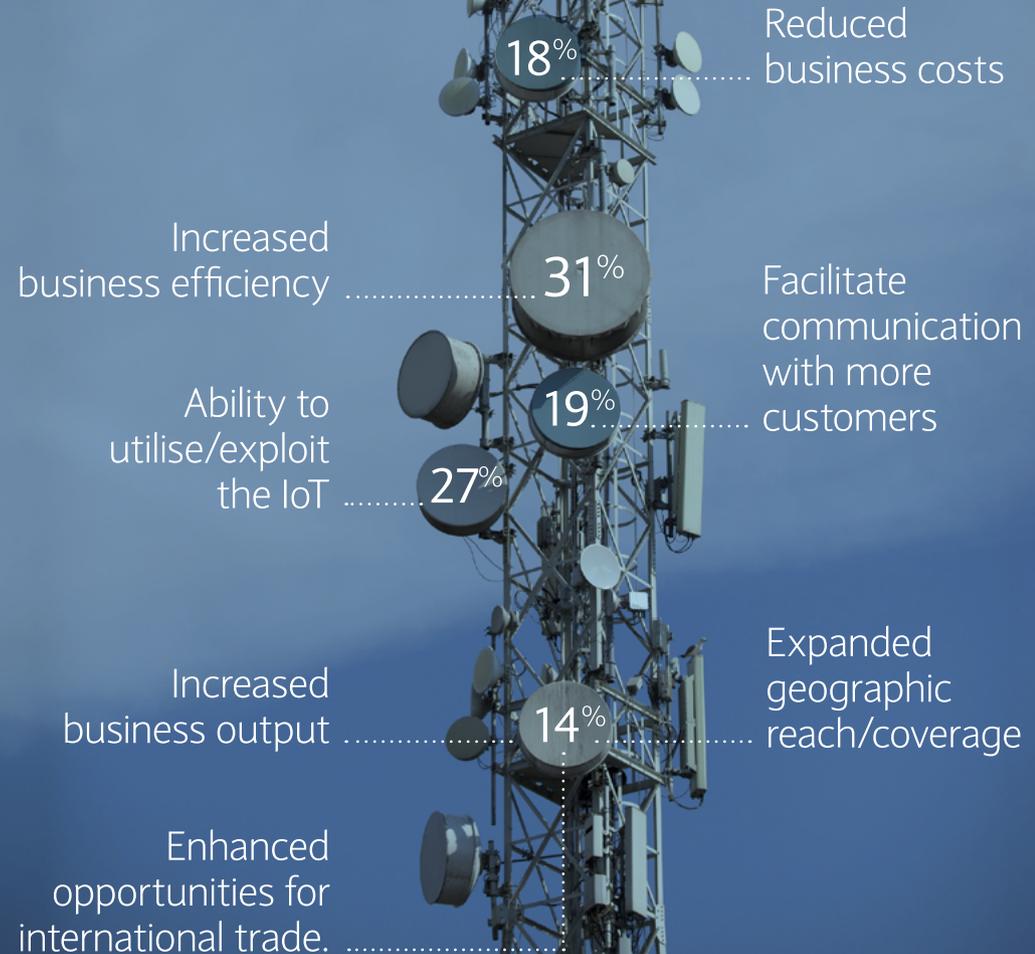
Again, those that believe their business will grow when 5G arrives are more aware of what it can do in their sector. Over half of respondents working in Healthcare (54%) anticipate growth from efficiency improvements, while Business Services (40%) and Logistics (38%) are especially enthusiastic about opportunities from an increased use of the IoT. But it doesn't follow that these industries are more aware of 5G benefits in general. Only 7% of managers in the Healthcare industry are expecting a significant increase in revenue compared to the highest reported figure of 26% of Logistics businesses.

Short-term vs long-term investment

The impact that near-term uncertainty may be having on the investment plans of UK businesses, particularly in light of Brexit, cannot be ignored. Indeed, it's often difficult for businesses to look beyond their short-term challenges and allocate the funds they need now to long-term investment. So, it's not surprising that only 9% of managers plan to invest significantly in enabling 5G operations over the next five years. Most managers see 5G as a long-term issue, with 14% planning to invest significantly over a timescale longer than five years and another 17% looking at minimal investment for now because they don't see it as an immediate enabler for business growth.

Expected business benefits

Of those who do expect business growth from 5G, the most common reasons were:



The mobile imperative

UK companies understand how fast mobile internet has supported and enhanced their businesses' abilities, but they don't always connect this knowledge with the potential benefits of 5G. Business increasingly needs mobile technology to connect with customers and staff, while improving efficiency. Future demand forecasts are predicting that mobile internet will become ever-more important.

Almost every potential customer and employee now has a smartphone in their hand, taking the need for mobile from a best-case scenario to a clear requirement for every business. UK managers are well aware of how important internet access is for their company, with 35% saying their business requires access to a fast and dependable network, while for 29%, access to such a network is rated as beneficial. Only 7% of firms said that the availability of internet access is unnecessary for their business.



of businesses say that access to a fast and dependable network is either required or important.

How 5G will become mission-critical

When firms report needing access to fast, reliable broadband or mobile networks to operate, their rationale clearly show how 5G will benefit their business. Surveyed UK managers explained the need to connect many different devices and how reliable access enables time-critical business decisions. From a multiple-choice list, those UK managers also highlighted their reliance on mobile and broadband because:

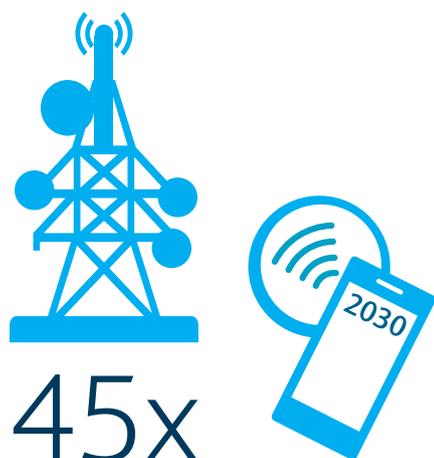
- 59% of companies operate across disparate locations and need to communicate in real time
- 49% need to communicate with customers and fulfil customer orders online
- 48% have to connect multiple machines together in order to run their business
- 43% say that customers expect it.



It's obvious that 5G's projected increase in speed and reliability will greatly benefit British firms. However, factor in the forecasts for future demand for mobile internet, particularly in the context of IoT, and issues such as connecting multiple devices and customer expectations leap to the fore.

Appetite for connectivity

Exactly how much traffic will be generated by the IoT is still up for debate. Networking giant Cisco famously predicted that 500 billion devices will be connected to the internet by 2030.¹² Multinational telecoms firm Ericsson is predicting around 29 billion connected devices by 2022, of which around 18 billion will be related to IoT. And research firm IDC forecasts global spending on IoT¹³ to hit \$1.2trn by 2022.



demand for mobile data by 2030.

Regardless of the exact number, it is clear that future demand for internet connectivity will experience phenomenal growth. A 2016 report from the Real Wireless Consultancy for the UK's National Infrastructure Commission (NIC) found a variety of representative use cases for future mobile telecommunications,¹⁴ including:

- **Automotive** – the connected car is expected to have three main use cases: entertainment services, driver assistance and vehicle management
- **Railway** – passenger broadband needs, command and control management and telemetry services
- **Utility** – smart metering and smart grids
- **Healthcare** – assisted living, remote healthcare and preventative health
- **Supply chain** – road haulage and drone delivery
- **Media and cloud** – 4K content, immersive gaming and mobile office applications.

What exactly this means for the British appetite for mobile data is again debatable, but the trajectory is definitely climbing. A UK-specific forecast published by the UK Spectrum Policy Forum suggested that overall demand for data usage will rise 22-fold between 2015 and 2030.¹⁵ Ofcom's consultation document on the potential release of the 700 MHz band provides forecasts by consultants Analysys Mason focusing on the demand for mobile data in 2030. The forecast estimates that demand could be 45 times higher than the level in 2014, with the traffic carried on mobile networks (after allowing for traffic offloaded to Wi-Fi networks) increasing 25 times.¹⁶



If UK business is ready, 5G will supercharge revenues

Being an early adopter of new technology can carry risks as well as benefits. In most cases, it's difficult to predict how industries will respond or where the profit will lie. But with 5G, the lessons of the past and the expectations for the future are clearer, which is why companies should prepare now.

The current forecasts all predict that the rollout of 5G will have a positive effect on the UK economy. But how big that boost will be and whether the country can remain competitive on a global stage and spread the benefits geographically are down to the speed of both the network upgrade and the uptake from British businesses.

In analysing how 5G will impact the economy, three main scenarios have been outlined: an optimistic one, a central scenario and a pessimistic outlook. (Each scenario's benefits have been weighted against a reference base case of expected economic growth if there was no rollout of 5G and the listed increases are on top of this level of growth.)

“Current forecasts predict that the rollout of 5G will have a positive effect on the UK economy. But how big that boost will be is down to the speed of both the network upgrade and the uptake from British businesses.”



The central scenario

- Under this scenario, it is assumed that pilot projects for 5G are in place by 2020, with coverage of London and other major cities achieved by 2021
- It is also assumed that a 5G network would be available across the remainder of the country, with 75% population coverage achieved by 2025, rising to at least 95% by 2030
- The take-up rate by the covered residential and business population would be expected to reach 56% by the end of 2025 and 81% by 2030
- If the development of a national 5G network proceeds at this orderly pace, by 2025, an extra £13bn will be added to annual business revenues. By 2030, the figure will reach £64bn
- Although indirect employment benefits are difficult to judge, the direct impact on employment will equate to 124,000 additional jobs by 2030
- While every UK region is expected to receive a boost, the anticipated increase in this scenario is expected to be weighted in favour of London and the South East. By 2025 the 'Greater South East' (consisting of London, the East of England and the standard South East region) is expected to account for 54% of net additional job growth and 52% of the turnover that is attributable to the rollout of 5G
- Moreover, by 2030, this 'super region' is expected to account for 57% of overall net additional job growth and 55% of net income and output growth.

The optimistic outlook

- This scenario is predicated on an accelerated roll-out of 5G infrastructure and also faster take-up of the service by the residential and business population. It is assumed that coverage reaches 86% and take-up 65% by the end of 2025
- Under this scenario, businesses are also assumed to respond more quickly to the opportunities to develop service and user applications targeting households and business users
- With businesses and consumers reacting faster, turnover accelerates to reach £15.7bn by 2025 and £89.6bn by 2030. The latter figure is an increase of over £25.5bn per annum when compared to the equivalent increase in the central scenario
- Nearly 172,000 new jobs will be created by 2030, amounting to an incremental increase of about 47,500 jobs compared to the central scenario
- This scenario helps to spread the benefits of 5G across the country. While under the central scenario, around 32% of the extra direct jobs occurring by 2030 are expected to be located in London, under the more optimistic outlook this proportion falls to about 30.5%
- On the one hand, faster deployment and greater usage favours some sectors such as Professional Services and IT/Communications that have an above-average concentration in London and adjacent regions

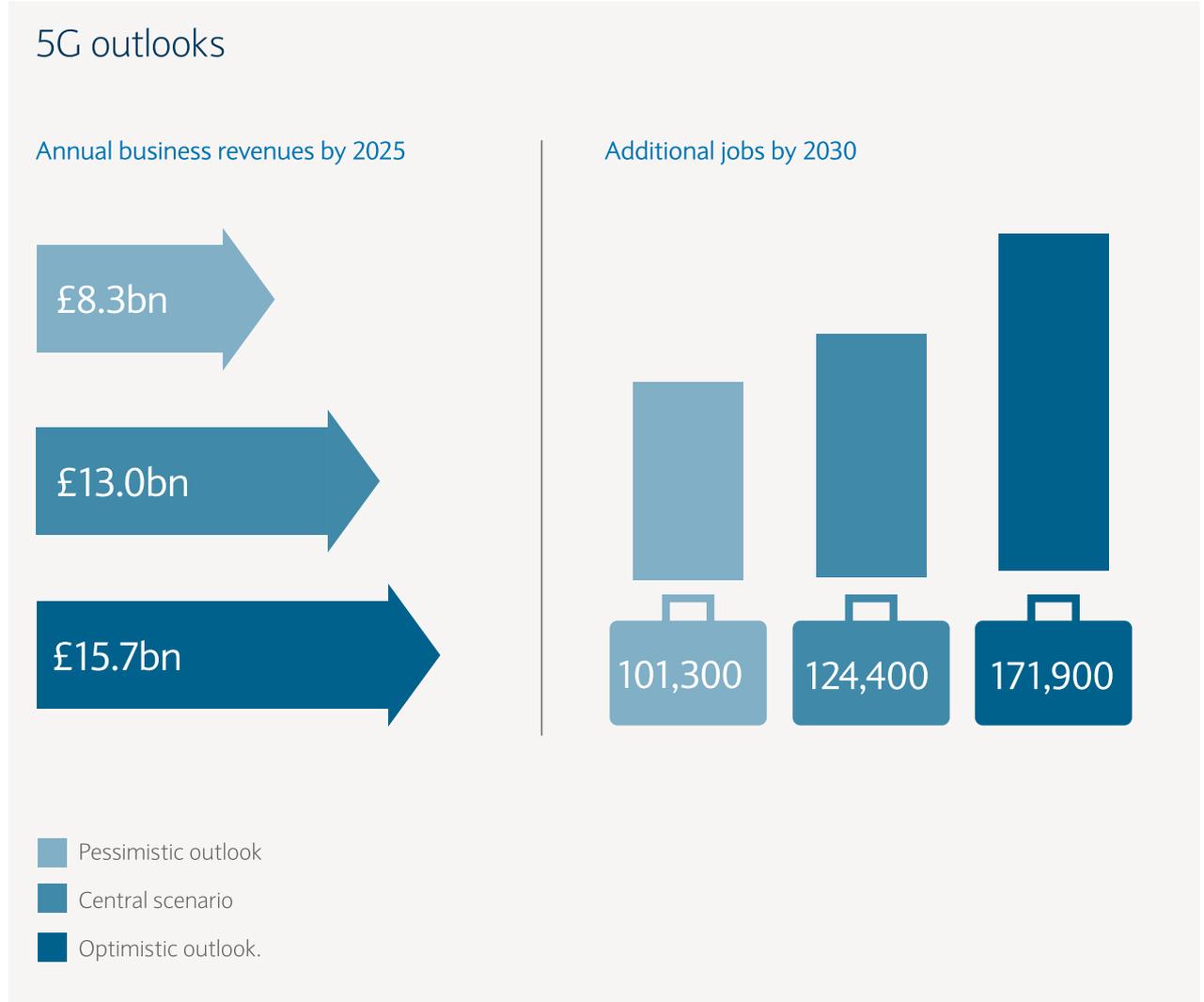
- But on the other hand, faster growth in the regions helps to offset some displacement of business activity and associated revenues from the other nine UK regions that would otherwise be expected to occur to either the Greater South East or to non-UK territories.

The pessimistic outlook

- This third scenario assumes a slower pace of infrastructure coverage and weaker demand for services by users. By the end of 2025, it is assumed that coverage reaches just 60% and take-up 42%
- The key difference here is a slower rate of network development and a less vigorous customer response to the availability of services. This could be because killer apps that encourage fast take-up are slower to emerge or that a higher proportion of customers remain happy with the service they get from 4G and are slower to switch over
- While 5G will still bring growth, much additional revenue and jobs will be lost. Annual business revenues would increase by £8.3bn by 2025 and £51.9bn by 2030, while new jobs would amount to 101,300 by 2030
- Business revenues will therefore lose out on nearly 42% of the increases they would gain under the optimistic outlook
- As with the central scenario, what growth there is would be concentrated in London and the surrounding region.

The final analysis

- Two things are important to note about these scenarios. The first is that regardless of the level of pessimism, 5G is still expected to grow the economy and business revenues. While it would clearly be beneficial to add £89.6bn to annual business revenues by 2030, as per the optimistic outlook, adding £51.9bn would still be significant. Even if the rollout of the network upgrade is held up and companies and consumers are slow to respond, the benefits will trickle down
- Secondly, while the uptake from business is a somewhat unknown factor, we expect that the support from government and the commitment from mobile infrastructure providers is such that a more optimistic outlook for the speed of 5G rollout across the country is far more likely. All four major infrastructure providers have announced plans to start their 5G networks in 2019. As outlined above, the government has financial commitments and trial programmes in place to help boost nationwide 5G coverage. Device and application vendors are also getting ready for 5G, bringing the machines and software that will entice users to take up 5G services
- To create the greatest increase in revenues, employment and the economy, it is clear that firms across the business spectrum must work together with 5G networks to ensure they are strongly prepared for the implementation of 5G technologies.



Case studies

Across the UK, 5G trials and preparations are already well underway.

Case study 1

Capital investment

As the introduction of 5G gathers pace, two tech giants are laying the foundations for the next generation of mobile connectivity.

In preparation for the roll-out of 5G technology in London, O2 and Nokia are running trials of Massive MIMO (Multiple-Input, Multiple-Output) technology.

According to Ofcom, in 2017 the average mobile user consumed 1.9 GB a month.¹⁷ With the demand for data in the capital expected to keep increasing once 5G has been rolled out, the purpose of the tests is to boost capacity, performance and enable more people to connect concurrently.

The trials are being conducted in Kings Cross and Marble Arch and will use O2's additional 2.3GHz capacity¹⁸ and Nokia's Massive MIMO expertise to enable an increase in transceiver antenna elements which is greater than the number of devices being served.

Case study 2

5G prepares for take off

Vodafone's trials at Manchester Airport have proved a hit with passengers due to 4x faster download speeds.

With mobile connection speeds and reliability being a must-have for holidaymakers and commuters alike, Vodafone has taken the first steps to bring 5G technology to the country's airports. Passengers at Manchester Airport's Terminal One have been testing it out by downloading episodes of their favourite shows and boxsets with a free NOW TV entertainment pass. The 5G speeds were four times faster than those of 4G.¹⁹

Because the first 5G-enabled handsets have still to come to market, the company has deployed its 5G blast pod – a giant mobile router – to conduct the trials. Manchester is the UK's first airport to be connected to 5G and Vodafone has plans to bring it to more major UK airports and railway stations as soon as possible.

Case study 3

Industry 4.0 and 5G

13 February 2019 was a landmark date for UK industry with Worcester Bosch commencing a trial of the new technology in its factory in a bid to boost productivity.

The Worcestershire 5G Consortium has resulted in 5G factory trials commencing at Worcester Bosch. The tests will cover a range of processes including factory floor production, real-time analysis and also the ability to control the movements of machinery remotely.²⁰

It is hoped the roll-out of 5G will herald the beginning of 'smart factories' in the UK and a new manufacturing era – Industry 4.0. The factory which produces a range of hot water and heating products will have a number of 5G factors monitored including speed and latency.²¹

Strategies for success

What steps can you take now to make your company 5G-ready?

Get the information you need

There are a number of ways to educate yourself about 5G. The UK5G innovation network, for example, endorsed and funded by the Department for Digital, Culture, Media and Sport, shares the knowledge and lessons of emerging 5G R&D activities. Industry regulator Ofcom has also published plans for enabling 5G in the UK²² and supporting industry innovation around wireless networks.²³ It hopes to encourage businesses, trade bodies and other parties to help it to ensure the regulatory regime enables industry to access the benefits of wireless connectivity.

Grow your network

The first practical step is to audit your IT system. When 5G arrives, companies have to be ready to scale up their networks quickly to maximise the benefits. The exact solution will be different for each company, but you should be identifying opportunities to change your business network. These include virtualising your network, scaling up your cloud computing provision and assessing how you will handle the security concerns of growing access to your network.



Use your existing resources

Your technology providers and partners are a valuable resource. Companies may not be preparing for 5G, but technology solution vendors, cloud providers and network builders are and they are aware that their customers need help to migrate to this new environment. They are investing in 5G and that's why they will be promoting it at industry tradeshows, conferences and events and will be keen to show you how the technology can work for your business.



Put 5G on the radar

Your business can't be prepared for 5G if your staff aren't aware of the challenges and opportunities it will bring. With staff education and training, not only will employees be primed for how business operations might change, they'll also be a potential source for innovative use cases. The intangible benefits of 5G – boosting workforce productivity and collaboration – will be faster and more fully realised when staff are on board from the beginning.



Start on your 5G strategy

Regardless of whether you're willing or able to start financially investing in technological solutions for 5G right now, you should plan for a 5G future. Developing short-term, mid-term and long-term goals for your business and identifying areas of opportunity in light of superfast speeds, low latency and growing device traffic should be a priority. This includes looking at current business models and day-to-day operations, as well as assessing how processes and products might change in response to 5G applications.

Find out more

Visit [gov.uk/government/news/creating-the-5g-network-apply-for-funding](https://www.gov.uk/government/news/creating-the-5g-network-apply-for-funding) to learn whether you might be eligible for funding, or read more about 5G at:

- [uk5g.org](https://www.uk5g.org)
- [ofcom.org.uk](https://www.ofcom.org.uk) (e.g. 'Enabling 5G in the UK' and 'Supporting the role of wireless innovation for UK industry')
- [gov.uk](https://www.gov.uk) (e.g. 'Updates to 5G Testbeds and Trials' and 'The impacts of mobile broadband and 5G').

About the report

This report is based on economic modelling and desk research conducted by Development Economics and survey research* undertaken by YouGov.

YouGov carried out 526 online interviews with senior board level respondents and their direct reports at medium and large UK firms. The respondents came from the Manufacturing, Retail, Technology, Media and Telecoms, Business Services, Healthcare, Education, Hospitality and Leisure, Logistics and Charitable sectors. The fieldwork was carried out between 16 January and 4 February 2019.

The evidence accumulated through desk-based research and YouGov's business survey was then used to produce a socio-economic assessment of the potential future benefits that would be associated with the future development of a 5G network of mobile telecommunications in the UK.



Cross-sectoral analysis, 16 January – 4 February 2019.

The assessment considered four potential scenarios for investment in the UK's communications networks, as follows:

- **Scenario 0:** Reference case (Do-minimum). The first scenario assumes that the mobile network provided continues to improve 3G and 4G network coverage and service quality but there is no investment in a 5th generation of mobile infrastructure in the UK. This is not considered to be a realistic option, but it provides a necessary benchmark or baseline against which the potential effects of future investment in 5G can be undertaken in the other 'do something' scenarios described below.
- **Scenario 1:** 5G at expected pace of roll-out and take-up (central scenario). Under this scenario it is assumed that pilot projects for 5G are in place by 2020, with coverage of London and other major cities achieved by 2021, and that a 5G network would be available across the remainder of the country (with 75% population coverage) achieved by 2025, rising to at least 95% by 2030. The take-up rate by the covered residential and business population under this scenario is assumed to reach 56% by 2026 and 81% by 2030.

- **Scenario 2:** 5G accelerated (optimistic outcome). The third scenario assumes an accelerated roll-out of 5G infrastructure accompanied by a faster take-up of the service by the residential and business population. For example, by the end of 2025 it is assumed that coverage reaches 86% and take-up 65%.
- **Scenario 3:** Slower pace of investment in 5G (pessimistic outcome). The fourth scenario by contrast assumes a slower pace of infrastructure coverage and take-up of services by users. By the end of 2025 under this scenario it is assumed that coverage reaches 60% and take-up 42%.

* All results are based on a sample and are therefore subject to statistical errors normally associated with sample-based information.

About the author

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