Assembly

A report for Huawei

Regional and consumer impact of a delayed 5G roll-out

28 October 2020

An independent report by Assembly Research, commissioned by Huawei.

Contents

The UK Government has promised to 'level up' every part of the UK with the ambition of repositioning the UK economy away from London and the South East. Whether it's through the Northern Powerhouse Strategy, the Midlands Engine or the Western Gateway to form a 'new powerhouse', the Government wants to facilitate a 'rebalancing' of the UK economy. World-class connectivity and leadership in 5G is crucial for the realisation of these objectives and was laid out in the Government's 5G strategy of 2017 which estimated benefits to the economy of more than £173bn by 2030.

The UK mobile industry has made significant progress in deploying 5G infrastructure, arguably sooner than was anticipated. With support from the Government, the UK is already positioned as a global leader in the deployment of 5G with networks already available across more than 300 towns and cities with more than 50 capable 5G devices for consumers to choose from. However this pace of deployment and the benefits consumers can expect are at risk of not being fully realised in line with the Government's own prior expectations.

After continued pressure from the US over security fears, the UK Government recently announced further restrictions on Huawei and their participation in the UK's 5G networks, such that no new Huawei 5G equipment is to be bought from January 2021, and 5G networks must be Huawei free by the end of 2027. In announcing the further restrictions, the Government concluded it would delay 5G roll-out by a further year, meaning a cumulative delay of two to three years. In our recent report 'Macroeconomic impact of a delayed 5G roll-out in the UK', we calculated the cost to the UK economy of a 3 year delay in 5G roll-out to be as much as £18.2bn.

Huawei asked us to consider how this impact might be felt regionally across the UK and in light of policy to rebalance the economy. Using the same data and methodology for our previous report, we looked to distribute the potential economic benefits of 5G across the UK. We found that outside London and the South East, 5G has the potential to give a £108bn economic uplift, and create more than 350,000 jobs.
As mobile operators come to terms with the impact of the telecom supply chain restrictions, they are set to manage the vendor swap-out at the same time as pushing ahead with their 5G roll-out. Any delay to roll-out, in the parts of Britain away from London and the South East, puts at risk the very idea of 'leveling up', and would increase the risk of widening the digital divide – condemning parts of Britain to the slow lane for years to come.

Introduction

In light of further US pressure and restrictions we recently revisited previous analysis to assess the impact on the UK economy of a more severe restriction and further delayed roll-out of 5G as envisaged by the Secretary of State for Digital, Culture, Media and Sport. In our report ‘Macroeconomic impact of a delayed 5G roll-out in the UK’ we calculated that the cost to the UK economy of a 3 year delay in 5G roll-out stands at £18.2bn.

This report considers how the impact of the change in UK policy that sees further restrictions in the telecoms supply chain could affect the different cities and regions of the UK. It highlights the potential economic benefit 5G is set to provide to the regions, what that equates to on a household level, and how many jobs could be created in the regions as a result of the UK being a leader in 5G.

Key Findings

Belfast[24]

Potential 5G benefit 2020-2030
£2.64bn

Potential jobs created by 5G
9,214

4G 97% | 5G

Glasgow[23]

Potential 5G benefit 2020-2030
£3.97bn

Potential jobs created by 5G
13,853

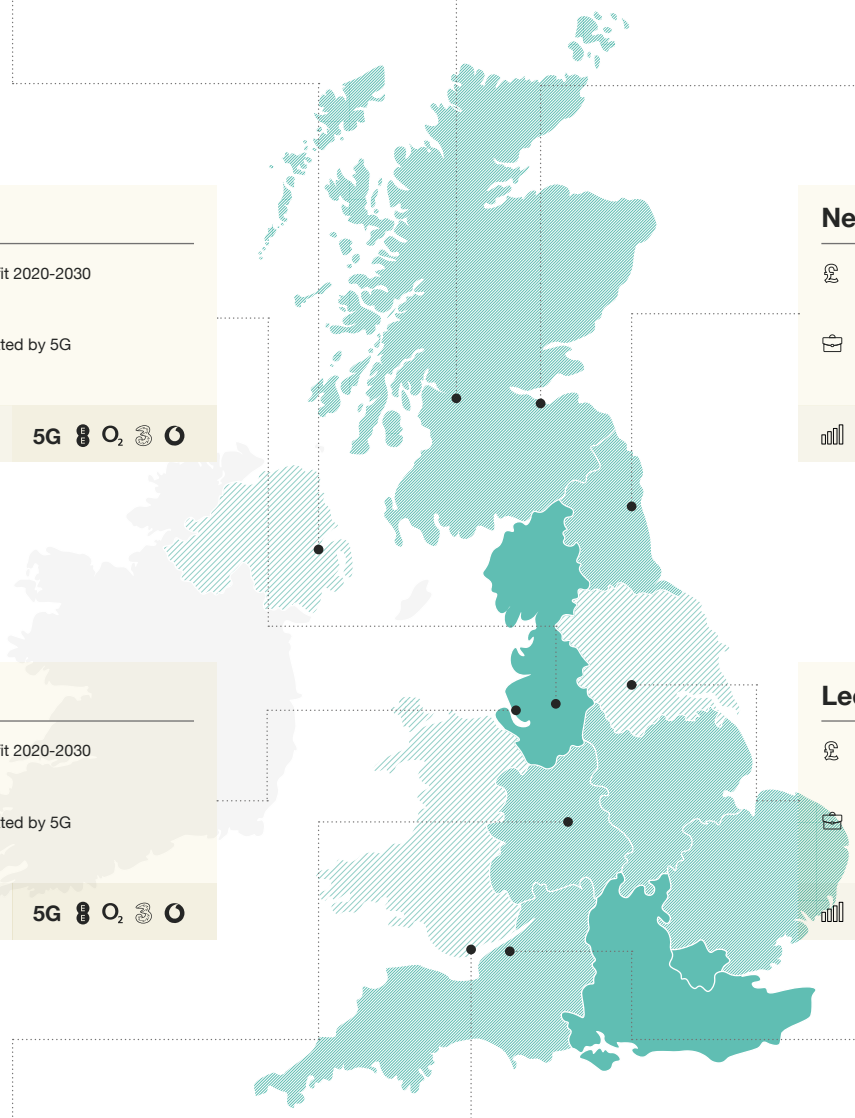
4G 86% | 5G

Edinburgh

Potential 5G benefit 2020-2030
£2.17bn

Potential jobs created by 5G
7,564

4G 91% | 5G



Manchester[21]

Potential 5G benefit 2020-2030
£6.44bn

Potential jobs created by 5G
22,475

4G 99% | 5G

Newcastle

Potential 5G benefit 2020-2030
£806m

Potential jobs created by 5G
2,814

4G 100% | 5G

Liverpool[22]

Potential 5G benefit 2020-2030
£3.10bn

Potential jobs created by 5G
10,810

4G 100% | 5G

Leeds

Potential 5G benefit 2020-2030
£2.35bn

Potential jobs created by 5G
8,203

4G 97% | 5G

Birmingham

Potential 5G benefit 2020-2030
£2.60bn

Potential jobs created by 5G
9,091

4G 98% | 5G

Cardiff

Potential 5G benefit 2020-2030
£1.06bn

Potential jobs created by 5G
3,695

4G 96% | 5G

Bristol

Potential 5G benefit 2020-2030
£1.30bn

Potential jobs created by 5G
4,542

4G 100% | 5G

Potential regional benefit (£) 0 - 5bn | 6 - 15bn | 16bn +

1

Policy Background

The Government's 'levelling up' agenda

The Conservative party won the General Election of December 2019 with a clear majority. In part, this was achieved by winning over voters in areas of the country that traditionally would not elect Conservative MPs, such as the so-called 'red wall' in the North of England. The promise of 'levelling up' every part of the UK was crucial to obtain the trust of those voters, and was repeatedly stated in the Conservative manifesto ahead of the election[1]. The party pledged to invest 'in the infrastructure that can make a difference', and in training workers for 'the jobs and the industries of the future'[2].

The manifesto promised the creation of 20 Institutes of Technology, and a target of 2.4% GDP being spent in R&D across the economy. The Queen's Speech of December 2019 (through which the Government took office), confirmed that target and planned to prioritise investment in 'industries of the future' where the UK can take a commanding lead – such as life sciences, clean energy, space, design, computing, robotics and artificial intelligence[3]. World-class connectivity and leadership in 5G is crucial for the realisation of these objectives.

The Government's objective of 'levelling up' is also reflected in its broader vision for the country's connectivity. In their 2019 election manifesto, the Conservative party promised to bring gigabit-capable broadband to every home and business across the UK by 2025. In the Queen's speech, the Government confirmed its commitment to invest £5bn to help the roll-out of gigabit-capable broadband in the hardest to reach 20% of the country, and announced a £400m Digital Infrastructure Investment Fund, as well as a £200m Rural Gigabit Connectivity Programme and a £200m Local Full Fibre Networks Programme[4].

Renewed importance for the regions when it comes to industrial strategy

2014

Previous Governments have shown the ambition of repositioning the UK economy away from London and the South East. In August 2014, the Coalition Government set out a vision to better connect the North for it to become 'one Northern Powerhouse'.

2015

The Autumn Statement of 2015 defined a range of investments in the North, mainly based on science and business, to facilitate a 'rebalancing' of the UK economy.

2016

A year later, the Government set out a fully fledged Northern Powerhouse Strategy[5] as part of the Autumn Statement 2016.

2017

Shortly after, in March 2017, the Government set out a similar vision for the Midlands Engine, to reduce the fragmentation of the Midlands' economy and address its shortage of skilled workers and economic dynamism[6].

Infrastructure is one of the five foundations of the Government's industrial strategy, published in November 2017[7]. At the time, the Government committed to building a Britain that lives on the digital frontier, 'with full-fibre broadband, new 5G networks and smart technologies'. The Government pledged over £1bn of public investment in digital infrastructure, including £176m for 5G, recognising that its investment decisions need to be more geographically balanced and include more local voices.

2019

In November 2019, the Government promoted the creation of the Western Gateway, a strategic partnership across south Wales and the west of England with a view to form a 'new powerhouse' in the UK economy[8].

In the December 2019 Queen's Speech, the Government reaffirmed its commitment to those strategies to foster local and regional development, and to strengthen the dynamics of devolution. The Conservative election manifesto pledged to use the respective bodies to attract greater foreign investment into the UK, and invited other local areas to propose the creation of similar bodies for other parts of the country. The Government sees these bodies as an essential part of the industrial strategy. Central to these regional strategies is the enhancement of digital connectivity and, in turn, the reaping of associated productivity benefits.

2020

The Government is also trying to level up research and innovation across the UK. As part of the pledge to achieve 2.4% of GDP spent on R&D, the Government is doubling the public R&D budget over the next five years. In January 2020, Science Minister Chris Skidmore noted that investments must benefit the country as a whole, not just parts of it[9], and referred to data from the UK Research and Innovation Institute (UKRI) showing that 52% of the national gross expenditure on R&D is spent in London, the South East, and the East of England[10]. Northern Ireland and Wales each get 2% of the total, whereas 7% is spent in Scotland. In May 2020, a report published by Nesta found that areas including North England, the English Midlands, and South West of England, together with Wales and Northern Ireland, have been missing out on £4bn a year due to underinvestment in R&D[11]. In turn, this means losing an £8bn private sector multiplier per year.

5G Testbeds and Trials Programme

First phase

Off the back of the industrial strategy, in October 2017 the Government launched the initial phase of the 5G Testbeds and Trials Programme (5GTT). £200m from the National Productivity Investment Fund (NPIF) was allocated to 5GTT, and the winners of the first phase were announced in March 2018[12]. These included projects in the Midlands, West and Northern England, Wales and Scotland. All the projects came to an end between September 2019 and March 2020.

Table 1: First phase projects of the 5GTT Programme

	Location	Funding	Description
5G RuralFirst	Orkney, Shropshire, Somerset	£4.1m	Rural trials for 5G wireless connectivity and spectrum sharing
5G Smart Tourism	Bath, Bristol	£5.2m	AR and VR to enhance tourist experience in major attractions
Worcestershire 5G Consortium	Worcestershire	£7.2m	Industrial productivity enhancements through robotics, big data, AR
Liverpool 5G Testbed	Liverpool	£3.7m	Health and social care, reduction of digital divide in deprived communities
AutoAir	Millbrook, Bedford	£5.8m	Connected and autonomous vehicles
5G Rural Integrated Testbed (5GRIT)	Cumbria, Northumberland, North Yorkshire, Inverness-shire, Perthshire and Monmouthshire	£3.3m	Tourism, precision farming, drones, rural broadband

Source: DCMS

The Government also invested in other projects, including 5G applications and deployments on roads and railways across the country. In particular, £35m from the NPIF was invested to explore ways to improve mobile communications for rail passengers. This has been used to install trackside infrastructure along part of the Trans Pennine route and support the roll-out of full-fibre and 5G networks. The Trans-Pennine Initiative (TPI) has delivered gigabit-capable infrastructure along the existing rail route between Manchester and York. The project offers a range of connectivity services to telecoms operators and internet service providers seeking to deliver gigabit-capable connectivity to local communities along the route. It also offers connections at data centres in Manchester and Leeds, or breakout from initial points of presence along the route[13].

Urban Connected Communities Project

Shortly after the first-phase project, the Government announced more initiatives for urban areas, industrial testbeds and trials, and rural communities. The West Midlands Combined Authority was selected to run the Urban Connected Communities Project, which started in October 2018[14], to develop a large-scale 5G pilot across the region with hubs in Birmingham, Coventry and Wolverhampton. The project is now known as West Midlands 5G (WM5G) and will run until March 2022, with £21m funds available from the Department for Digital, Culture, Media & Sport (DCMS). This is matched by local public investment, and private investment is expected to match the total public investment.

The purpose of WM5G is to demonstrate the value of 5G technology across a number of verticals. The programme includes different types of projects, such as an 'Infrastructure Acceleration' project (to remove barriers to 5G deployment); a '5G Applications Accelerator' (for organisations to develop innovative services); and testbeds for 5G use cases (for example in mobility).

Second phase

In February 2020, the DCMS announced the nine projects receiving a share of £35m funding from its rural and industrial 5G competitions[15], and launched the 5G Create competition for new uses of 5G in a variety of industries, including creative sectors such as film, TV, and video games.

Table 2: Second phase projects of the 5GTT programme

	Location	Funding	Description
Mobile Access North Yorkshire (MANY)	North Yorkshire	£4.4m	Development of rural connectivity. Focus on tourism, mental health, coverage for emergency services and environmental management
West Mercia Rural 5G	Shropshire, Worcestershire	£3.3m	Exploring infrastructure challenges in operating a rural 5G network, and health/social care applications
5G Connected Forest	Sherwood Forest, Nottinghamshire	£5m	Robotic environmental management and live monitoring of the health of the forest
Multi Operator Neutral Host (MONeH)	South West Wiltshire, Buckinghamshire, Bath	£2.4m	Network slicing on small-cell networks
5G RuralDorset	Dorset	£4.3m	Coastal public services, agri-tech, commercial connectivity, and a 5G innovation hub
5G New Thinking	Orkney Islands, Borderlands, Scotland, Northern Ireland, rural England	£5m	Mobile connectivity over shared spectrum and local spectrum
Connected Communities in the Rural Economy (CoCoRE)	Monmouthshire, South Wales	£5m	Focus on 'immersive tourism' and farming security
5GEM - 5G Enabled Manufacture	Dunton, Bedfordshire and Cambridge	£1.9m	Use of 5G in manufacturing
5G ENCODE	Bristol	£3.8m	New business models for private mobile networks in manufacturing

Source: DCMS

In July 2020, the DCMS announced the winners of 5G Create, which obtained a share of £30m funding[16]. Six projects in Sunderland, Preston, Liverpool, Manchester, Brighton and Suffolk commenced in August 2020 and will test 5G use cases such as AI-controlled traffic lights to reduce pollution, the potential for remote music festivals, aircraft manufacturing, remote healthcare, autonomous trucks, and VR applied to live sporting events.

At the time of announcing these projects, the DCMS noted that none of the winning projects in these initiatives would use equipment from so-called high-risk vendors. This led to the exclusion of Huawei equipment from the second phase of 5GTT and from 5G Create. The decision followed the conclusion of the Telecoms Supply Chain Review in January 2020.

Vendor diversity

In July 2020, the Government decided that UK mobile operators will have to stop buying Huawei 5G equipment from January 2021, and remove Huawei entirely from their 5G networks by 2027. A Telecoms Security Bill will be introduced to turn the Government's decision into law. The Secretary of State for Digital, Culture, Media and Sport estimated that the decision will result in a delay of up to three years in 5G roll-out, and costs of up to £2bn for the operators, and admitted that the decision "will have real consequences for the connections on which all of our constituents rely"[17]. We have previously estimated that the economic impact of a three-year delay will be £18.2bn[18].

The exclusion of Huawei results in a weakened supply chain, relying on two vendors and on the emerging OpenRAN solution which will require some time before operators can deploy it at scale. Reduced choice in the market for vendors could also result in higher equipment prices (potentially as much as 20–25% higher than the current prices), and a slower pace of innovation based on our discussions with operators.

The Government is aware of the importance of a diverse telecoms supply chain. On 23 September 2020, to addressed the perceived market failure in the choice of vendors, the DCMS created a Telecoms Diversification Task Force with a view to publish a Telecoms Diversification Strategy by the end of 2020[19]. Excluding any one of the main vendors from the market is likely to be at odds with the objective of diversifying, and operators could suffer from reduced competition in the market for network equipment Overall, this will result in 5G being delayed, and likely deployed at higher costs across the country. This could become a significant obstacle in the effort to 'level up', which is at the heart of the current Government's policy, and will slow down the benefits that the UK regions could reap if the country remains a leader in 5G.

> "Excluding any one of the main vendors from the market is likely to be at odds with the objective of diversifying, and operators could suffer from reduced competition in the market for network equipment."

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Regional Impact

The risk of widening the digital divide

The economic benefit associated with 5G will be spread throughout the various regions of the country. While London is set to realise the greatest share in terms of benefit and job creation, more than three quarters of the total expected benefit and opportunity comes from the regions. Outside London and the South East, 5G has the potential to give a £108bn economic uplift, and create more than 350,000 jobs.

It's too soon to say precisely where and how the expected delay to 5G roll-out will be felt, but publicly, the operators have framed the potential impact of restricting Huawei in terms of coverage and widespread availability of 5G services. It's likely that network deployments are prioritised and focused in more populated, urban areas at the expense of more rural and remote regions and that it will take longer for these parts of the country to benefit from the same levels of 5G coverage as major towns and cities.

Regional level

Table 3: Regional benefit of 5G and job creation

	Potential 5G benefit 2020-2030 (£m):	Potential 5G benefit per household 2020-2030 (£/household)	Potential jobs created by 5G (#)
South East	25,383	6,992	88,656
North West	16,916	5,498	59,081
London	39,722	12,090	138,735
East of England	15,204	5,908	53,103
North East	5,108	4,475	17,841
West Midlands	13,033	5,623	45,519
East Midlands	10,164	5,094	35,499
Yorkshire and The Humber	11,554	4,998	40,355
South West	12,890	5,455	45,021
Wales	6,108	4,602	21,333
Scotland	13,152	5,444	45,936
Northern Ireland	3,986	5,045	13,923
Total	**173,219**	**6,362**	**605,000**

Source: Assembly calculations

Jobs

The Government (in its election manifesto), stated that “improving our trains, roads and broadband helps local businesses grow and create more jobs and opportunities”. It has been estimated that the global 5G value chain will support 22 million jobs in 2035[20], more than 600,000 of which could be in the UK. These are not only jobs for those who assist in network roll-out, but also from the use cases and applications that 5G will enable – for instance from smart grid analysts and robotics engineers to telehealth support and diagnostic staff. Crucially, jobs won’t be limited to the tech sector or confined to tech hubs, but rather the jobs created will mostly benefit regions that rely on both a white collar and blue collar workforce. The improved connectivity that 5G gives will also help non-tech businesses grow and create more jobs and opportunities. As we have seen during the course of the pandemic, there has been a shift away from urban centres to the regions, with more people working at home and staying local.

“It has been estimated that the global 5G value chain will support 22 million jobs in 2035[20], more than 600,000 of which could be in the UK.”

Regional Impact

City level

Manchester[21]

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£6.44bn	22,475	99%	EE O2 3 Vodafone

Birmingham

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£2.60bn	9,091	98%	EE O2 3 Vodafone

Liverpool[22]

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£3.10bn	10,810	100%	EE O2 3 Vodafone

Glasgow[23]

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£3.97bn	13,853	86%	EE O2 3 Vodafone

Newcastle

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£806m	2,814	100%	EE O2

Leeds

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£2.35bn	8,203	97%	EE O2 3 Vodafone

Edinburgh

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£2.17bn	7,564	91%	EE O2 Vodafone

Cardiff

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£1.06bn	3,695	96%	EE O2 3 Vodafone

Bristol

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£1.30bn	4,542	100%	EE O2 3 Vodafone

Belfast[24]

Potential 5G benefit 2020-2030	Potential jobs created by 5G	4G coverage	5G availability
£2.64bn	9,214	97%	EE O2 Vodafone

3

Consumer Impact

Industries benefiting from 5G

The industrial applications of 5G will be highly impactful on the UK economy, leading to significant productivity gains and consequent creation of jobs. In its 5G Strategy of March 2017, the Government set out the ambition to adopt 5G early to enjoy 'valuable services from connected cars to smart factories' and 'more high-paid, high-skilled jobs'[25]. In the Future Telecoms Infrastructure Review of July 2018, the Government highlighted the potential of 5G to generate significant economic benefits from the digital transformation of many sectors[26]. 5G will enable the development of new use cases across a range of sectors where, to date, the provision of connectivity has not been a part of the business model, such as advanced manufacturing and robotics, health and social care, transport and logistics, and smart agriculture.

At a global level, 5G applications for industrial IoT are expected to have a compound annual growth rate of 464% between 2022 and 2026, since 5G will overcome the limitations of wireless connectivity in manufacturing[27]. The Worcestershire 5G Consortium (as part of the first-phase 5GTT projects), explored a range of 5G use cases including increased productivity in manufacturing, machinery fault detection, and remote training[28], among other uses. The results show productivity improvements of about 2%, which could mean a £3.6bn increase in annual output for the UK manufacturing sector[29]. In farming and agriculture, 5G will allow farmers to make faster, better decisions leading to improvement in the yields and in management of livestock. The results of the 5GRIT trial programme suggest that farmers can improve their revenue margins by applying 5G to those use cases[30]. The 5G RuralFirst programme showed the potential of precision grazing, aquaculture health monitoring, drone soil analysis, and remote care for animals[31].

5G will also bring about environmental benefits and greater efficiency and cost savings. The Government expects smart grids to bring £13bn of productivity benefits to the UK economy between 2014 and 2050, and export earnings of £5bn. Jobs could be boosted by an average of 8,000 during the 2020s rising to 9,000 during the 2030s if sufficient investment is made[32]. A testbed in the Island of Orkney is showcasing the potential of a new smart energy system for the island[33].

> "At a global level, 5G applications for industrial IoT are expected to have a compound annual growth rate of 464% between 2022 and 2026, since 5G will overcome the limitations of wireless connectivity in manufacturing[27]."

Expected consumer benefits from 5G

Mobile as an alternative to fixed broadband

Fixed-wireless access (FWA) technologies have already been in use to provide home broadband like services using the mobile network. This has proved popular in places that can't be easily served through fixed broadband. However, current mobile technology has meant that FWA's performance has not been able to fully rival full-fibre. With 5G, performance of FWA is expected to be more similar to that of full-fibre, thereby allowing operators, consumers, and policymakers to consider it as a viable option for the parts of the country where deploying a fixed solution would be inconvenient or too costly. In particular, FWA has three clear advantages:

- It is capable of reaching gigabit speed. In Switzerland, for instance operators have been able to offer speeds close to 2Gbps;
- It can be rolled out quickly. As operators can use their existing mobile sites, at a lower cost of capital compared to fibre. It is estimated that, for suburban areas in countries such as Germany and the UK, 5G FWA can have a cost per line between five and six times lower than full fibre;
- Consumers can set it up easily. It requires a plug-and-play device, which can often be delivered on the same day of ordering and they take it with them when they move home.

Unsurprisingly, these upsides are ensuring 5G FWA is becoming popular in many countries. For example, in Finland, Telia was the first operator to offer 5G FWA, and all other mobile operators soon followed in order to avoid losing ground. Finnish customers are now enjoying 1Gbps speeds with unlimited data from all operators. While this is still rare, some operators are even offering a speed guarantee over 5G FWA (e.g. Optus in Australia). As the technology becomes more popular, it is likely other operators will guarantee minimum performance levels.

5G will dramatically enhance entertainment whether live, at home, or on the go

5G supports a whole new set of capabilities for the provision of entertainment and content, spanning across live virtual reality (VR) video streaming, enhancement of existing live streaming services, gaming/animation, and delivery of on-demand content. In countries where 5G is already widely adopted and VR is popular, VR live events with tens of thousands of active users at one time are taking place (e.g. VR concerts). With regard to audiovisual content, the shift from linear to on-demand content will require infrastructure that supports on-demand high-definition video streaming for both private and public service broadcasters, especially if the BBC ends up adopting a Netflix-like subscription model, as has been suggested in recent debates.

Live and social events outside the home will also be transformed by the potential of virtual and augmented reality (AR). The gaming industry is already gearing up for 5G, and will soon offer experiences that require AR and that 4G cannot support. Perhaps unsurprisingly, EE partnered with game maker Niantic for its 5G launch in 2019, and offered a special version of the AR game Harry Potter: Wizards Unite. Sport stadiums equipped with 5G are already offering an AR experience to their fans, and those going to an event will be able to benefit from a wealth of real-time information. Finally, the experience of sharing on social media could reach new levels. Immersive video recordings are expected to be adopted enthusiastically by avid social network sharers, such as extreme sport athletes. Video streaming platforms will be able to support 4K video and VR, and in-person video content will become more common.

Connected cars

The automotive sector is widely recognised as one of the key verticals in which 5G will have a significant impact. For the consumer, this will mean enhanced safety inside and outside a vehicle, due to better interaction between vehicles and within the vehicle. Drivers will be able to 'see the invisible' due to real-time traffic navigation technology, including objects that would normally be visible only to other vehicles ahead. Inside the vehicle, AR windshields will display real-time data and provide safety instructions. Virtual assistants could even take the form of avatars next to drivers, providing directions and other information.

The entertainment and retail experiences inside the car will also be enriched by new functionalities such as mixed-reality maps and city guides, in-car retail and holographic personal shoppers, VR movies, and vehicle-to-vehicle gaming.

The UK is already testing 5G use cases related to connected cars. AutoAir was one of the first-phase 5GTT projects, aiming to make 5G technologies available for the validation and development of Connected and Autonomous Vehicles (CAVs) at the UK's premiere vehicle proving ground at Millbrook[34]. In February 2019, the project showcased their 5G connected McLaren supercar at the Mobile World Congress in Barcelona, and launched its 5G test network at Millbrook Proving Ground in Bedfordshire. The launch event allowed AutoAir to demonstrate the UK's only independent 5G-enabled infrastructure for CAVs, including the transmission of live 4K video at 1Gbps from fast-moving vehicles, to a screen on a bus. This was powered by 23 small cells that were installed on the site. In September 2019, a low-carbon vehicle and a connected ambulance were showcased.

The University of Warwick is also carrying out extensive research into CAVs. In May 2020, it started working on the 300km Midlands Future Mobility test environment, spanning from Coventry to Birmingham, which will see autonomous vehicles trialled on urban, rural, suburban and highway roads[37]. The University also collaborated with a Coventry-based company, Aurrigo, in developing driverless pods that can follow each other without supervision, helping each other to drive and navigate through pedestrian areas around people. The project alone has already resulted in the creation of 10 new jobs[36].

Learning inside and outside of the classroom

The COVID-19 pandemic has highlighted the importance of adequate instruments for remote learning in situations where students have to be away from their school. 5G will enhance the potential of remote learning tools. Faster, more reliable connectivity, together with AR/VR experiences will facilitate learning based on direct experience rather than depending on a 'lectured environment'. Even inside the classroom, 5G will provide new possibilities – especially in closing the gap between rural areas and cities, addressing the shortage of teachers. Due to learning materials being all in the cloud, students will be able to access them remotely at all times, and will likely rely on less expensive devices.

In the UK, some schools have already reaped the benefits of 5G. One example is the Hudson Road Primary School in Sunderland, which saw its internet speeds improve by 70 times due to 5G[37]. The school can now interact more easily with other schools, and plans to start using educational games and both VR and AR in the near future.

Healthcare will see significant improvements with 5G

5G has the potential to transform healthcare both at home and in hospitals. 5G-enabled wearable devices for remote care will result in improvements in the regular monitoring of a patient's health, improved diagnosis, and remote administering of medication. Remote consultations through 5G will be possible through high video quality and doctors being able to observe patients by means of specific devices (e.g. a projection on their glasses). This will result in better care for the elderly, while bringing care to the home or closer to it. Unnecessary A&E admissions will be reduced, and doctors will be able to access patient records immediately. Remote surgery will also become a viable option, due to the reliable and low-latency nature of 5G. This will make sure a patient can access a specialist even when they live in areas where there is shortage of them, without having to travel.

Connected ambulances will have a similarly transformative impact. This use case was part of the testbeds and trials hosted in the West Midlands during 2019[38]. BT and the NHS partnered up to showcase an ambulance in which HD cameras send a real-time view to a clinician's workstation; through a joystick, the clinician operates a robotic glove worn by a paramedic in the ambulance. This speeds up the diagnosis, reduces the number of ambulance journeys, and results in fewer emergency department visits.

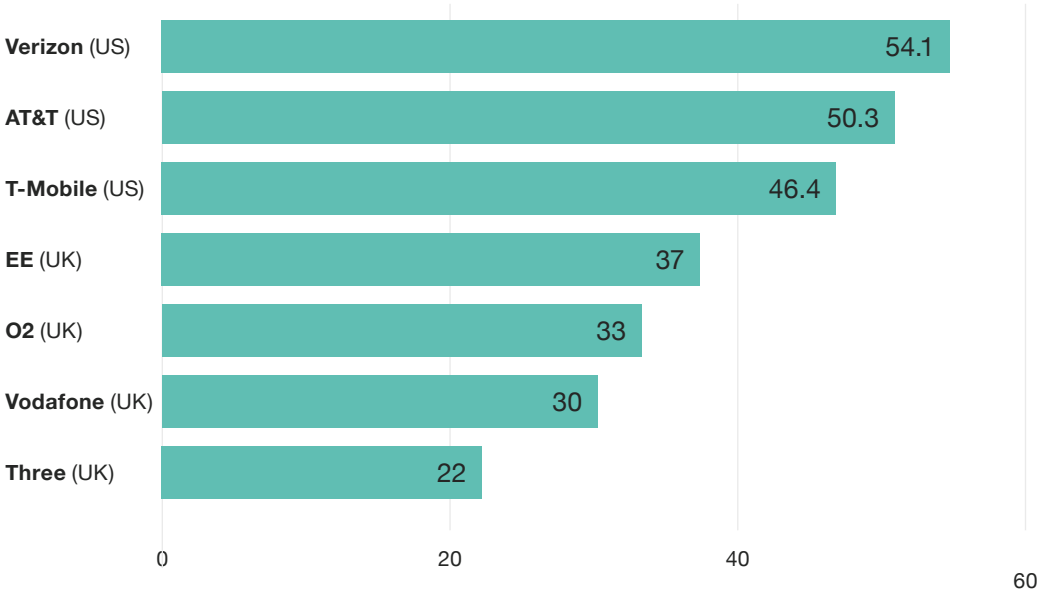
Benefit consumers get from a competitive ecosystem

A diverse telecoms supply chain contributes to a competitive mobile market, where operators offer increasingly attractive packages and often compete on price. The UK mobile market is widely regarded as being one of the most competitive in the world, and this has resulted in relatively low prices for consumers. By contrast, in the US, where competition among vendors is less intense than in the UK, prices have been considerably higher for years. This has been the case despite the US market being made up of four operators until recently (In April 2020 the T-Mobile/ Sprint merger reduced it to a three player market).

For the last three years, Ofcom has compared prices of standalone mobile services in the UK and Europe with the US[39]. It found that US prices were the highest throughout this period of time, whereas the UK has always been the cheapest, or second cheapest. Retaining competitiveness in the telecoms supply chain would contribute to UK consumers continuing to take advantage of affordable mobile services.

A direct comparison of current mobile prices in the UK and in the US shows the difference between the two markets. As of October 2020, the average price of the cheapest SIM-only plan with unlimited data available from US operators was £50.3 per month ($65), compared to £30.5 in the UK. Figure 1 shows that UK operator's lowest-priced unlimited data plans vary between £22 and £37 per month, whereas in the US it's between £46.4 ($60) and £54.1 ($70) per month.

Figure 1: Monthly price of the lowest priced unlimited data plan by operator, October 2020 (£)



Source: Assembly

Impact on consumer 5G applications and use cases

The reduction in the number of vendors in the telecoms supply chain, and the requirement to remove Huawei from UK 5G networks by 2027 is likely to have an impact on consumers. The enormous potential for 5G to increase capacity means that a delay in the widespread availability is likely to mean the UK falls behind other countries in terms of quality of experience of mobile services – consumers would miss out on the benefits that come from the ability to use extra capacity especially in highly congested areas, such as stadiums or stations.

The loss of benefit would not be limited to those places, but could be even greater outside urban areas, considering the huge potential of 5G FWA in providing gigabit-capable connectivity where fibre is not viable. Delaying the roll-out of 5G will therefore continue to leave rural areas behind, potentially exacerbating the digital divide. The parts of the country that currently suffer from poor broadband could continue to grapple with this problem for many years.

While the precise time frame for 5G use cases becoming mainstream remains uncertain, a delay in widespread availability of 5G would inevitably affect when consumers will be able to take advantage of the possibilities it brings about. In particular, high-quality remote learning and remote healthcare can be considered ‘social equalisers’ as they help address shortages of teachers and doctors in underserved areas. Failing to seize these opportunities would therefore be at odds with the ‘levelling up’ agenda of the current Government. The increasing importance placed on remote working and learning further highlights the need for a quick roll-out of 5G. On the entertainment front, UK consumers would miss out on the newest experiences and ways to enjoy live shows and content, and on the new services on which these industries will focus their future investments.

> “Delaying the roll-out of 5G will therefore continue to leave rural areas behind, potentially exacerbating the digital divide. The parts of the country that currently suffer from poor broadband could continue to grapple with this problem for many years.”

Methodology

Independence

- Our study is an independent study and Huawei has not had any input with regards to the regional impact assessment
- Our baseline scenario remains unchanged and is informed by estimates announced by the Secretary of State for Digital, Culture, Media and Sport

Quantitative assessment

- We estimate the potential total benefit of 5G to the different regions of the UK. This is to show what is at stake for the different regions, it is not an estimate of what they will miss out on as we do not make an assumption on which regions will have delays and how long those delays will be
- We calculate the total potential 5G benefit consistent with our methodology in our previous report 'Macroeconomic impact of a delayed 5G roll-out in the UK'. We have broken this down regionally by distributing based on latest levels of GDP by regions (ONS 2017). This is a reasonable allocation because much of the benefits associated with 5G are related to boosting the economic activity that already exists
- To calculate the economic benefit per household by region, we have taken the GDP benefits by region and distributed them by the number of households by region (ONS 2017)
- To estimate the number of jobs 5G is likely to create by region we reviewed existing literature that assumes 5G will contribute 605,000 jobs to the UK economy. We use this number as our base and distribute this regionally based on GDP (ONS 2017). This is a fair assumption, although the actual distribution of jobs may not follow the pattern of GDP it is indicative of the increased economic activity
- We have also estimated the potential total benefit of 5G and employment at the city level. We use the same methodology as described above. We break down the total potential 5G benefit by distributing based on latest levels of GDP by city (ONS 2017). This is from the same dataset as the regional GDP statistics ensuring consistency with our regional approach
- 4G coverage in each city is the population coverage (percentage of premises) by all four mobile networks in the respective city local authority, as reported in Ofcom's Connected Nations update Summer 2020: Interactive report

Sources

- Conservative Party, Conservative Manifesto 2019
- HM Government, Queen's Speech, December 2019
- Department for Business, Energy & Industrial Strategy, Industrial Strategy, November 2017
- HM Treasury, Northern Powerhouse Strategy, November 2016
- Department for Business, Energy & Industrial Strategy, Midlands Engine Strategy, March 2017
- Ministry, of Housing, Communities & Local Government, Cross-border Western Gateway will form new 'powerhouse' in UK economy, November 2019
- Department for Business, Energy & Industrial Strategy, Levelling up research and innovation right across the United Kingdom, January 2020
- UK Research and Innovation, Regional distribution of funding for research and business
- Nesta, The Missing £4 Million, May 2020
- Department for Digital, Culture, Media & Sport, 5G Testbeds and Trials Programme, July 2018
- Western Gateway, Propelling a Greener, Fairer, Stronger Britain
- Department for Digital, Culture, Media & Sport, Urban Connected Communities, July 2018
- Department for Digital, Culture, Media & Sport, Funding boost for UK tech innovators to seize opportunities of 5G technology, July 2020
- Department for Digital, Culture, Media & Sport, Ex-BT boss leads task force to attract new vendors to UK telecoms, September 2020
- Digital, Culture, Media and Sport Secretary's statement on telecoms, July 2020
- Department for Digital, Culture, Media & Sport, Next Generation Mobile Technologies: A 5G Strategy for the UK, March 2017
- Department for Digital, Culture, Media & Sport, Future Telecoms Infrastructure Review, July 2018
- Huawei, 5G Unlocks A World of Opportunities, 2017
- UK 5G Innovation Network, 5G: The Driver For UK Productivity, January 2020
- 5G Rural Integrated Testbed, Interim Final Report, July 2019
- Department of Energy & Climate Change, Smart Grid Vision and Routemap, February 2014
- UK 5G Innovation Network, 5G-powered digital twin for Orkney, May 2020
- Department for Digital, Culture, Media & Sport, AutoAir: 5G Testbed for Connected and Autonomous Vehicles, July 2018
- Warwick University, Work begins on autonomous vehicle trial route, May 2020
- Centre for Connected and Autonomous Vehicles, Aurrigo makes breakthrough in driverless pods technology, September 2020
- UK strategy and plan for 5G & Digitisation - driving economic growth and productivity, January 2017
- Office for National Statistics - Regional economic activity by gross domestic product, UK: 1998 to 2018
- Labour Force Survey (LFS), Office for National Statistics
- The 5G economy: How 5G technology will contribute to the global economy, IHS, January 2017
- Ofcom, Connected Nations update Summer 2020: Interactive report
- Ofcom, Pricing Trends for Communications Services

UK towns and cities covered with 5G, by operator[40]

EE (112)

Aberdeen, Aldershot, Altrincham, Ashford, Ashton-under-Lyne, Barrhead, Bath, Belfast, Belshill, Birkenhead, Birmingham, Blackpool, Borehamwood, Bransholme, Brentwood, Bristol, Bury, Cardiff, Castleford, Castlereagh, Chatham, Chelmsford, Cheshunt, Chester-le-Street, Chesterfield, Chorley, Clevedon, Clifton (Notts), Clydebank, Coventry, Crawley, Cumbernauld, Dartford, Dinnington, Doncaster, Dudley, Edinburgh, Epsom, Gillingham, Glasgow, Grays, Guildford, Hamilton, Harlow, Hoddesdon, Huddersfield, Hull, Ilkeston, Inchinnan, Jarrow, Kimberley, Kingston-upon-Thames, Leeds, Leicester, Lichfield, Lisburn, Liverpool, London, Loughborough, Loughton, Maidstone, Manchester, Mirfield, Milnrow, Minster, Motherwell, Newcastle, Newton-le-Willows, North Shields, Northampton, Nottingham, Nuneaton, Oxford, Oldham, Paisley, Plymouth, Pontefract, Porthcawl, Potters Bar, Rochdale, Rochester, Romford, Rotherham, Rugeley (West Midlands), Salford, Sheffield, Shipley, Solihull, South Shields, Southend-on-Sea, Staines-upon-Thames, Stafford, Stevenage, Stirling, Sunderland, Sutton Coldfield, Swadlincote, Sydenham, Wakefield, Walsall, Waltham Abbey, Waltham Cross, Walton-on-Thames, Warwick, Washington, Watford, West Bromwich, Westhoughton, Weston-Super-Mare, Weybridge, Wickford, Wolverhampton.

O2 (108)

Aberdeen, Ashford, Aughton, Aylesbury, Banstead, Basildon, Beaconsfield, Bedford, Belfast, Birmingham, Blaydon, Bradford, Bridge of Don, Brighton, Bristol, Bury St Edmunds, Byfleet, Cambridge, Cardiff, Chadwell St Mary, Chatham, Chelmsford, Chesterfield, Chipstead, Colchester, Coventry, Dartford, Derby, Dewsbury, Doncaster, Dundee, Durham, Dyce, Eastbourne, Edinburgh, Epsom, Esher, Eton and Windsor, Gateshead, Gatton Bottom, Gillingham, Glasgow, Gravesend, Grays, Great Yarmouth, Halifax, Harlington, Harlow, Hemel Hempstead, Hextable, High Wycombe, Hove, How Wood, Huddersfield, Hull, Ipswich, Jarrow, Leeds, Leicester, Lincoln, Lisburn, Liverpool, London, Longford, Loughborough, Lowestoft, Luton, Manchester, Mansfield, Middlesbrough, Milton Keynes, Morley, Newcastle Upon Tyne, Newtownabbey, North Shields, Northampton, Norwich, Nottingham, Nuneaton, Orpington, Oxford, Peterborough, Plymouth, Rainham, Redhill, Rotherham, Royal Tunbridge Wells, Rugby, Sheffield, Shepperton Green, Slough, South Shields, Southend-On-Sea, Staines, Stevenage, Stockton, Stoke-on-Trent, Sunbury, Sunderland, Thundersley, Tynemouth, Warrington, Washington, Weybridge, Whickham, Whitley Bay, Worthing, York.

Three (66)
Aberdeen, Abingdon-on-Thames, Aldershot, Balloch, Barrow-in-Furness, Basildon, Bath, Bedford, Birkenhead, Birmingham, Blackpool, Borehamwood, Bradford, Brighton, Bristol, Brookmans Park, Cannock, Cardiff, Chatham, Clayton-le-Woods, Coventry, Crawley, Cullingworth, Doncaster, Dundee, Glasgow, Gorebridge, Grimsby, Guildford, Heanor, Hedge End, Hemel Hempstead, Huddersfield, Inchinnan, Ipswich, Leeds, Leicester, Leyland, Liverpool, London, Lower Stondon, Luton, Maidstone, Manchester, Motherwell, Neston, Newquay, Nottingham, Nuneaton, Peterborough, Plymouth, Preston, Reading, Redcar, Royston, Sheffield, Shelly Green, Slough, St Albans, Sunderland, Swadlincote, Swansea/Abertawe, Swindon, Westhoughton, Wickford, Wigan.

Vodafone (54)
Ambleside, Bebington, Belfast, Birkenhead, Birmingham, Bishopbriggs, Bolton, Bootle, Bournemouth, Bristol, Bristol Airport, Cardiff, Cheadle and Gatley, Cheltenham, Crosby, Droylsden, Dunbarton, Eccles, Edinburgh, Glasgow, Guildford, Horwich, Huyton-with-Roby, Inner London, Isles of Scilly, Kingswood (Bristol), Lancaster, Leeds, Liverpool, Llandudno, Manchester, Mangotsfield, Newbury, Oldbury/Smethwick, Paisley, Penarth, Plymouth, Portsmouth, Prestwich, Reading, Rochdale, Salford, Solihull, Southampton, Stockport, Stoke-on-Trent, Stretford, Sutton Coldfield, Swansea, Swinton and Pendlebury, Urmston, Wallasey, Warrington, Wolverhampton.

References

1. https://www.conservatives.com/our-plan
2. https://assets-global.website-files.com/5da42e2cae7ebd3f8bde353c/5dda924905da587992a064ba_Conservative%202019%20Manifesto.pdf, p. 25
3. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853886/Queen_s_Speech_December_2019_-_background_briefing_notes.pdf, p. 106
4. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/853886/Queen_s_Speech_December_2019_-_background_briefing_notes.pdf, p. 93
5. https://www.gov.uk/government/publications/northern-powerhouse-strategy
6. https://www.gov.uk/government/publications/midlands-engine-strategy
7. https://www.gov.uk/government/publications/industrial-strategy-the-foundations/industrial-strategy-the-5-foundations#infrastructure
8. https://www.gov.uk/government/news/cross-border-western-gateway-will-form-new-powerhouse-in-uk-economy
9. https://www.gov.uk/government/speeches/levelling-up-research-and-innovation-right-across-the-united-kingdom
10. https://www.ukri.org/funding/funding-data/regional-distribution-of-funding-for-research-and-business/
11. https://media.nesta.org.uk/documents/The_Missing_4_Billion_Making_RD_work_for_the_whole_UK_v4.pdf
12. https://www.gov.uk/government/collections/5g-testbeds-and-trials-programme
13. https://www.gov.uk/guidance/building-digital-uk
14. https://www.gov.uk/government/case-studies/urban-connected-communities
15. https://www.gov.uk/government/news/new-65-million-package-for-5g-trials
16. https://www.gov.uk/government/news/funding-boost-for-uk-tech-innovators-to-seize-opportunities-of-5g-technology
17. https://www.gov.uk/government/speeches/digital-culture-media-and-sport-secretarys-statement-on-telecoms
18. https://www.assemblyresearch.co.uk/press-comments/uk-5g-delay
19. https://www.gov.uk/government/news/ex-bt-boss-leads-task-force-to-attract-new-vendors-to-uk-telecoms
20. https://cdn.ihs.com/www/pdf/IHS-Technology-5G-Economic-Impact-Study.pdf

21. Greater Manchester Combined Authority

22. Liverpool City Region Combined Authority

23. Glasgow City Region

24. Belfast City Region

25. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/597421/07.03.17_5G_strategy_-_for_publication.pdf, p. 4.

26. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/732496/Future_Telecoms_Infrastructure_Review.pdf, p. 53.

27. https://www-file.huawei.com/-/media/corporate/pdf/mbb/5g-unlocks-a-world-of-opportunities-v5.pdf, p. 10.

28. https://uk5g.org/discover/testbeds-and-trials/worcestershire-5g-consortium/

29. https://uk5g.org/media/uploads/files/Mark_Stansfeld_5G_ACIA_21.01.20_v2.pdf, p 13.

30. https://uk5g.org/media/uploads/resource_files/D7.7_D7.13_Interim_Final_Report_-_Monitoring_and_Evaluation_V2.pdf

31. https://www.5gruralfirst.org/project/agritech/

32. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/285417/Smart_Grid_Vision_and_RoutemapFINAL.pdf, p. 10.

33. https://uk5g.org/5g-updates/read-articles/5g-powered-digital-twin-orkney/

34. https://www.gov.uk/government/case-studies/autoair-5g-testbed-for-connected-and-autonomous-vehicles

35. https://warwick.ac.uk/newsandevents/pressreleases/work_begins_on_autonomous_vehicle_trial_route1/

36. https://www.gov.uk/government/case-studies/aurrigo-makes-breakthrough-in-driverless-pods-technology

37. https://www.sunderlandoursmartcity.com/casestudies/opening-up-a-world-of-opportunities-at-local-primary-school/

38. https://newsroom.bt.com/uhb-and-bt-demonstrate-uks-first-remote-diagnostic-procedure-using-a-5g-connected-ambulance/

39. https://www.ofcom.org.uk/research-and-data/multi-sector-research/general-communications/pricing

40. Correct as of 22 October 2020

Assembly

Unit 41
Gossamer Gardens
London E2 9FN
United Kingdom

+44(0) 7786 625 456
info@assemblyresearch.co.uk