

Do Four-to-Three Mobile Mergers Harm Consumers?

A Deep-Dive into the UK Market

25 January 2024

Jorge Padilla

Executive summary

Key points

- Advanced 5G – which unlocks the full potential of 5G technology – can deliver substantial benefits to the UK and support key government policy objectives. However, it requires a step-change in investment compared to previous mobile technologies.
- The current UK market structure of two mobile network operators (MNOs) with scale plus two smaller MNOs is failing to deliver this investment. Compared to 56 of its peers, the UK currently ranks 49th on 5G download speeds and 39th on 5G availability.¹ Without a change in market structure the UK will fall even further behind international leaders in 5G rollout.
- The proposed Vodafone/Three merger will instead create a third MNO with scale that will have the ability and incentive to invest in 5G standalone and Advanced 5G. The merged entity plans to invest over £6 billion during the first five years post-merger, and more than £11 billion across the first ten. This will also increase competitive pressure on BT/EE and VMO2 to invest in their networks, driving improvements in price, quality and choice.
- From Day 1, at least 7 million customers will see improved network speeds and benefit from reduced congestion and less buffering. The merged network will greater density of cell sites and extend high-capacity spectrum coverage to an additional 10 million customers. Together this will deliver a radically improved customer experience. By 2032, more than 86% of the population will receive average speeds of around 800Mbps, with the remaining 14% of the population benefitting from average speeds of around 200Mbps – far greater than either MNO could achieve on a standalone basis. 96% of customers will experience latencies that are five times faster than what Three and Vodafone offer today. Across the network, customers will receive a smooth and consistent experience thanks to negligible congestion.
- The international evidence on four-to-three mobile mergers is mixed and shows that each merger must be assessed on its own merits. The merger- and market-specific factors in this case clearly demonstrate that it will be positive for UK consumers and the economy.

Advanced 5G can deliver substantial benefits to the country, but the UK's investment is already well behind others and the current market structure will not deliver the step-change needed for rollout success

Advanced 5G technology can deliver significant enhancements in network capacity, data transfer speeds, reliability, and latency (the time between sending and receiving data). These quality improvements are crucial for supporting new use cases across multiple sectors such as healthcare, agriculture and transport. As the UK Government recognises, Advanced 5G is pivotal in driving the UK's digital economy, with the potential to benefit consumers, businesses, and the national economy substantially.² It will also support broader government policy objectives such as unlocking investment and growth, positioning the UK as a global innovation hub, promoting regional development and reducing carbon emissions.

However, the UK currently lags behind international comparators in both 5G investment and 5G rollout. As of June 2023, the UK ranked 39th out of 56 countries in terms of active 5G connections and 49th on 5G download speeds.³ Without a step-change in investment, the UK risks slipping even further behind.

¹ 5G download speeds and 5G availability data obtained from OpenSignal.

² A report for the Department for Digital, Culture, Media and Sport estimates that 5G has the potential to increase annual UK Gross Value Added (GVA) by £9.3bn-£37bn by 2035. Cambridge econometrics & Analysys Mason for DCMS, Realising the Benefits of 5G, available at: <https://www.gov.uk/government/publications/realising-the-benefits-of-5g>.

³ 5G download speeds and 5G availability data obtained from OpenSignal.

Advanced 5G requires annual capital expenditure that is significantly higher than the levels observed over the past decades. Many of these costs are fixed – they do not vary with the number of customers. Therefore, compared to previous generations of mobile technology, MNOs need to have greater scale. They need to be able to spread the fixed costs of network deployment over a larger number of customers to make the investment sustainable. MNOs with smaller customer bases will have insufficient scale and will only be able to deploy Advanced 5G on a very limited basis.

Vodafone and Three are sub-scale, with low returns and cash flows. This means neither MNO has the ability or incentive to roll out nationwide Advanced 5G networks. As a consequence, the two larger MNOs (BT/EE and VMO2) face only limited competitive pressure to invest at pace themselves. The UK's current mobile market structure is therefore failing to deliver the investment needed to roll out Advanced 5G. Without a change, rollout will remain slow and geographically limited, and the UK will fall even further behind international comparators.

The proposed Vodafone/Three merger will create a third network with scale and the ability and incentive to invest, increasing quality and price competition in the market

Customers of the merged entity will benefit from the combined network almost immediately after completion, with at least 7 million customers experiencing improved network speeds, reduced network congestion, and less buffering.⁴ Additional changes to the combined network in the near term are also expected to eliminate 25% of 'not spots' (uncovered areas).⁵

In addition to these important short-term benefits, the proposed merger will transform the two sub-scale MNOs into a competitive third network player with sufficient scale and financial ability to sustainably invest in Advanced 5G further and faster than either could achieve on a standalone basis. This is because:

- By merging, they will be able to combine spectrum and assets in a single network, providing scale, increased capacity, higher quality, and merger synergies which are not achievable by either standalone MNO. Together this will lower the incremental cost of upgrading the combined network, and the merged entity will be able to accommodate higher usage of its network at a lower cost;
- The combined customer base of the merged entity also means it can recover the largely fixed costs of upgrading its (single) network over a greater number of customers than either MNO could do on a standalone basis, thereby reducing the upgrade cost per customer; and
- Post-merger, Three and Vodafone will invest billions in the UK to create a leading 5G network in Europe. Investment in a superior network will generate significant revenue benefits without increasing prices, by improving the merged entity's ability to attract and retain mobile customers as well as unlocking new revenue opportunities underpinned by Advanced 5G.

The scale and cost synergies from the merger in combination with the revenue benefits mean the merged entity will accelerate the deployment of Advanced 5G more effectively than either MNO could achieve individually. The merged entity plans to invest over £6 billion during the first five years post-merger, and more than £11 billion across the first ten.

As a result of this investment, customers will benefit from a step-change in experience and reliability with:

- **Faster speeds** – The merged network will extend high-capacity spectrum coverage to around 10 million people in areas that would not otherwise receive that coverage from Three or Vodafone. By 2032, as a consequence of this extended coverage and other network improvements, more than 86% of the

⁴ This occurs because of the implementation of spectrum sharing, which allows certain Vodafone spectrum to be deployed on Three sites (and vice versa).

⁵ By implementing a multi-MNO core network (MOCN), which will provide Three customers with access to Vodafone's sites and vice versa.

population will benefit from average speeds of around 800Mbps – around twice as fast as the Parties could expect to deliver on a standalone basis. The remaining 14% of the population – in mid- and low-traffic areas of the country – will benefit from average speeds of around 200Mbps (around five times as fast as either MNO could achieve standalone), in full support of the Government’s Wireless Infrastructure Strategy ambitions.⁶ Everyday consumer activities, such as participating in HD video calls, streaming HD live video or loading an image-rich webpage (such as the BBC website or on-line shopping sites), will be significantly improved, even in the most remote areas covered by the merged entity’s network.

- **Greater coverage** – The merged entity’s network will provide more than 95% population coverage with a 5G standalone network by 2030, and over 99% population coverage by 2034. This will eliminate the UK’s urban/rural connectivity divide by delivering high-quality coverage to even the most remote parts of the country.
- **More reliable and consistent service** – The merged entity will have a larger network with much greater density of cell sites – 55% greater density in the UK’s six largest cities and 46% greater density in rural areas compared to the standalone networks of Vodafone and Three.⁷ As a result, customers throughout the country will benefit from a much more consistent experience and higher network quality.
- **Lower latency** – for 96% of customers, the time between sending and receiving data will be around five times faster than today’s standalone networks.
- **Reduced congestion** – Absent the merger, both Three and Vodafone expect congestion to be a persistent problem going forward due to the rapidly growing demand for data. By contrast, thanks to its significantly larger capacity, the merged entity’s network is forecast to have negligible congestion into the 2030s.

The merged entity will also have a strong incentive to fill its higher-capacity network, and so will compete aggressively to retain and attract customers. This in turn will increase competitive pressure on BT/EE and VMO2 to invest in their networks, and compete on quality and price to attract and retain customers. Customers will benefit from lower prices when adjusted for quality.

Conclusion

As both Ofcom⁸ and the Government⁹ note, market- and merger-specific factors play a crucial role in determining the effects of any merger, meaning that each merger must be assessed on a case-by-case basis.

By comprehensively considering the evidence on the current and future market conditions in the UK, the financial positions of Vodafone and Three, and the high investment demands of Advanced 5G rollout, the white paper shows that the proposed merger is likely to benefit consumers and competition in the UK, while also unlocking the transformative potential of Advanced 5G.

⁶ UK Wireless Infrastructure Strategy Report.

⁷ London, Liverpool, Birmingham, Glasgow, Manchester and Bristol.

⁸ “The question of whether a particular merger is likely to result in a substantial lessening of competition will turn on the effectiveness of competition that can be expected in the market after the merger, rather than just the number of competitors. Our stance on a potential merger would therefore be informed by the specific circumstances of that particular merger, taking into account how markets are evolving and functioning.” Ofcom, Ofcom’s future approach to mobile markets and spectrum, conclusions paper, paragraph 5.33.

⁹ “The impact of consolidation on the market will be highly contextual and specific and must be assessed on a case-by-case basis”. UK Wireless Infrastructure Strategy; Future Telecoms Infrastructure Review.

1 Introduction

- 1.1 The UK mobile market currently comprises two large MNOs who face a weak competitive challenge from two smaller players who lack the scale to invest. This structure is not conducive to the widespread and timely deployment of 5G – a technology that offers the potential for a fundamental shift in digital infrastructure. This white paper explains why the economics of 5G Standalone and Advanced 5G means that the UK needs a different market structure for rollout success, and why the Vodafone/Three merger will create a third player with scale that will have the ability and incentive to invest in 5G Standalone and Advanced 5G, bringing widespread benefits and increased competition to the country.

Advanced 5G can power the UK’s digital economy, delivering large benefits to the UK

- 1.2 Advanced 5G is the next stage in the evolution of 5G mobile technology. Advanced 5G, of which 5G Standalone is a key component, can deliver the full potential of 5G, including large gains in network capacity, high data transfer speeds, high reliability, low latency (i.e. the time between sending and receiving data), and much higher user density, which are collectively required to support new use cases including smart cities, autonomous vehicles and immersive entertainment.
- 1.3 By transforming existing sectors such as healthcare, agriculture, manufacturing, transport, and public services, and enabling the development of new sectors such as virtual and augmented reality, ultra-high definition video, robotics, and connected vehicles, Advanced 5G has the potential to deliver substantial benefits to consumers, businesses, and the UK economy. A report for the Department for Digital, Culture, Media and Sport estimates that 5G has the potential to increase annual UK Gross Value Added (GVA) by £2.9bn-£11bn in 2030 depending on the level of adoption, rising to £9.3bn-£37bn by 2035.¹⁰ Advanced 5G will support government policy objectives such as unlocking investment and growth, positioning the UK as a global innovation hub, promoting regional development and reducing carbon emissions.

However, the UK is already falling behind in 5G investment and without change it will fall further behind

- 1.4 The UK faces a large investment gap in rolling out 5G, which is reflected in its poorer 5G rollout relative to leading 5G countries. These leading countries (such as the US, Finland, Japan, and South Korea) have significantly higher mobile capital expenditure per capita than the UK. The consequence for the UK is lower 5G availability and coverage, download speeds and latency and weaker user experience. This leaves the UK in a poor position to reap the benefits of Advanced 5G and the innovative use cases that it will enable.

Advanced 5G requires a step-change in investment compared to previous technologies

- 1.5 Catching up will be challenging and is not possible with the current market structure. Advanced 5G requires annual capital expenditure levels that are significantly higher than the levels observed over the past decade. Many of these costs are fixed, which means they

¹⁰ Cambridge econometrics & Analysys Mason for DCMS, Realising the Benefits of 5G, available at <https://www.gov.uk/government/publications/realising-the-benefits-of-5g>.

do not vary with the number of customers. MNOs must therefore have sufficiently large subscriber bases to be able to earn sufficient revenue to cover deployment costs. This means that the minimum scale for an MNO to be viable is greater for Advanced 5G than for previous generations of mobile technology. As a result, scale economies favour deployment of Advanced 5G by larger MNOs; MNOs with smaller customer bases will not have the scale to deploy Advanced 5G economically as widely as larger MNOs.

The current UK market structure, with two smaller MNOs, is unable to deliver this investment

- 1.6 The UK has two scale MNOs – BT/EE and VMO2 – and two smaller MNOs – Vodafone and Three. BT/EE and VMO2 lead the market in terms of number of subscribers, profitability, and cash flows. Over the past few years BT/EE and VMO2 have generated almost all of the mobile industry’s cashflows (c90%), earning high returns while the UK falls behind in the global 5G race. Vodafone and Three have smaller gross margins, reduced cash flows, and returns below their cost of capital. This severely limits their ability and incentive to invest – as Ofcom also recognises: *“If an MNO’s financial returns were below the cost of capital for a sustained period of time, this could reduce its incentives to invest.”*¹¹
- 1.7 Vodafone and Three will not be willing or able to roll out nationwide Advanced 5G networks, given their insufficient returns, low cash flows, and inability to recoup the significant fixed rollout costs over their smaller subscriber bases. This will in turn limit their ability to retain existing customers and make it impossible to overcome their scale issues through organic growth.
- 1.8 The UK mobile market will become increasingly bifurcated over time – with BT/EE and VMO2 having strong network advantages over Vodafone and Three. The result will be a softening of competition as many – perhaps most – customers will face a choice of only two networks that can adequately meet their needs. Without an effective investment threat from Vodafone and Three, BT/EE and VMO2 would have little to gain from accelerating their investments in Advanced 5G. The UK will suffer from lower investment and slower rollout of Advanced 5G, to the detriment of consumers, businesses, and the wider economy.

The proposed Vodafone/Three merger will create a viable and competitive third network that will have the ability and incentive to invest

- 1.9 The merger will transform Vodafone and Three from two sub-scale players into a new scale player for whom investment is now financially rational, giving it the ability to deploy 5G Standalone and Advanced 5G further and faster than Vodafone or Three on a standalone basis. This is because:
 - a. Unlike the standalone companies, the merged entity will be able to combine spectrum and assets in a single network, providing scale, increased capacity, merger synergies and a much better quality network than the standalone parties could ever achieve operating independently; and
 - b. Investment in a superior network has the capacity to deliver significant revenue benefits for the merged entity, by sharply improving its ability to attract and retain customers as well as unlocking new revenue opportunities enabled by Advanced 5G.

¹¹ Ofcom’s future approach to mobile markets and spectrum, [Conclusions paper](#).

Taken together, these revenue synergies will provide the merged entity with a greater incentive to invest than either Vodafone or Three would face on a standalone basis.

The merger will deliver quality improvements and drive price competition in retail and wholesale markets

- 1.10 Customers on the merged entity's network will benefit from greater network coverage, faster speeds, a more reliable service, and lower latency 5G services than would be possible for customers of either Vodafone or Three on a standalone basis. The large quality gains will begin to materialize promptly after the completion of the merger and are of direct benefit to customers – they can be expected to result in lower prices when adjusted for quality.
- 1.11 The significant increase in capacity from the merger, combined with the largely fixed/semi-fixed investment costs, mean that the merged entity will also face a strong incentive to fill its network to maximise its returns. As such, it will compete aggressively to retain and attract customers, for example by offering better value and new services.

The merger will also increase pressure on BT/EE and VMO2 to invest in their networks and price competitively

- 1.12 At the moment, both BT/EE and VMO2 have the ability to invest, but they lack sufficient competitive incentive to do so. The merger changes that by combining Vodafone's and Three's spectrum and sites to create a superior network, and giving the merged entity the ability and incentive to invest. BT/EE and VMO2 risk losing substantial numbers of customers to the merged entity unless they invest in 5G roll-out as quickly as they can. The merged entity's incentive to price competitively to fill its new capacity will put further pressure on BT/EE and VMO2 to price competitively to attract and retain customers.

Critics claim that the merger will lead to higher prices without increasing investment, but this is not supported by the empirical evidence

- 1.13 Critics of the proposed merger argue that it will increase prices while not increasing investment. However, these claims are based on a limited and selective assessments of the economics literature. Instead, a robust meta-study of the academic literature shows that there is no sound basis for a presumption that four-to-three mobile mergers are likely to harm consumers.¹²
- 1.14 This highlights the importance of market-specific and merger-specific factors when assessing the likely effects of any merger. This will involve taking into account prevailing and future market conditions, the market positions and financial performance of the merging parties, the significantly higher investment required to roll out Advanced 5G, and the competitive impact of the merger on existing rivals. As this white paper shows, a careful consideration of these factors shows that the proposed merger will benefit consumers and competition in the UK.

¹² Padilla et al (2023), [Do four-to-three mobile mergers harm consumers?](#)

2 Advanced 5G can power the UK’s digital economy, delivering large benefits to the UK

- 2.1 5G, the current generation of mobile technology, offers the potential for innovative information and communication services as well as the transformation of manufacturing, transport, commerce, and public services. As such, it can deliver large consumer welfare gains and wider economic benefits. New 5G use cases underpin multiple government policy objectives including unlocking investment and growth, positioning the UK as a global innovation hub, promoting regional development, and reducing carbon emissions.

Realising the full potential of 5G requires combining 5G radio access and core technology with the deployment of low, mid and c-band spectrum across a dense site network

- 2.2 5G is the latest mobile telecommunications technology. While 5G offers the potential for a large advance in quality and functionality over 4G, realising this potential also depends on the spectrum bands deployed, the landmass and population covered and the cell-site density of the network.
- 2.3 5G can be categorised into different forms reflecting the different ways in which it can be deployed. **Non-standalone 5G** (“Basic 5G”), is the form of 5G that has been rolled out in the UK to date and involves deploying 5G radio equipment alongside existing 4G. **5G Standalone** (“5G SA”) is an implementation of 5G that uses a 5G standalone (SA) core network. **Advanced 5G** requires much greater investment including in the widespread deployment of high-capacity c-band spectrum and is needed to realise full 5G functionality on mobile networks. Box 1 shows the different forms of 5G compared to 4G.
- 2.4 While the deployment of 5G networks using Basic 5G technology – which has been the focus of mobile network MNOs (MNOs) in the UK – delivers greater capacity, helping in reducing congestion in urban areas, it does not support the full range of capabilities that Advanced 5G can ultimately enable and which will be critical to the success of the most advanced economics. As the UK Government explained in its April 2023 Wireless Infrastructure Strategy: *“We want to move beyond the basic 5G that is being deployed now over 4G networks to build higher quality, standalone 5G networks that do not rely on older infrastructure.”*¹³

¹³ UK Wireless Infrastructure Strategy, page 12.

Box 1: Forms of 5G

4G:

- Fourth generation of cellular networks. In comparison to 3G, 4G networks offer significantly faster data rates through aggregation of different radio frequency spectrum bands and more efficient use of the radio frequency spectrum.
- Technology standard: 3GPP 4G.

5G:

- Fifth generation of cellular networks. In comparison to 4G, 5G networks have enabled access to increased bandwidth and more efficient use of radio spectrum, resulting in faster download speeds and lower latency.
- Technology standard: 3GPP 5G.

Basic 5G:

- A 4G-like service delivered using 5G radio technology. Deploying Basic 5G involves incorporating 5G radio equipment into an existing 4G radio network (using a 4G core network). Basic 5G can provide some improvement in speeds and/or capacity. However, it does not deliver the advanced capabilities typically associated with the large expected benefits of 5G (e.g., network slicing). Basic 5G can be deployed using a range of different spectrum bands, including low and mid-band spectrum as well as C-band spectrum.
- Technology standard: 3GPP 5G Non-Standalone (NSA).

5G Standalone (5G SA):

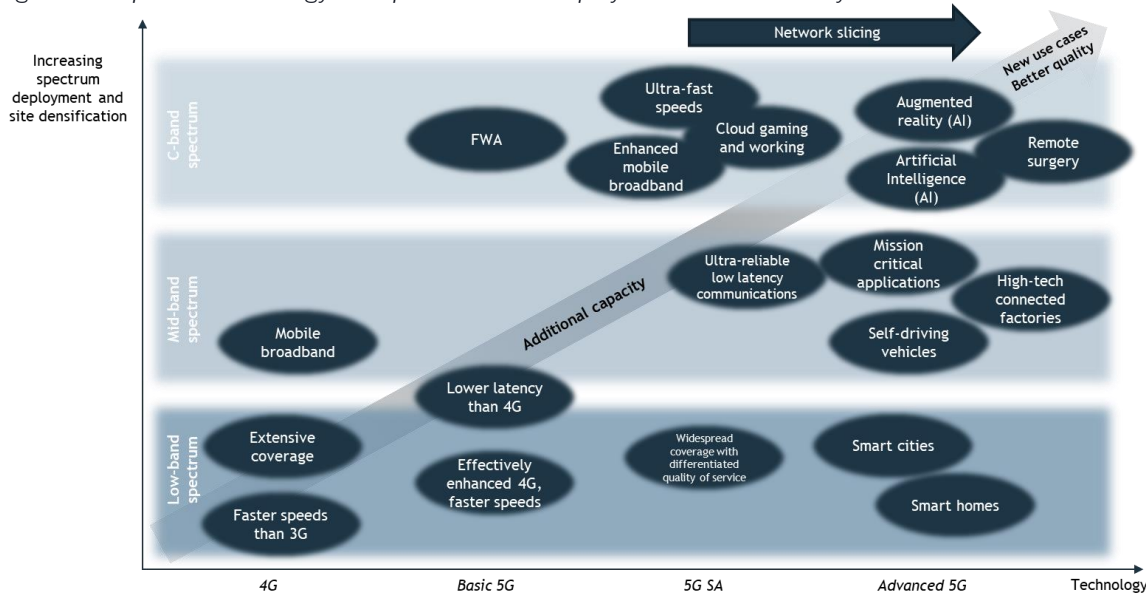
- An implementation of 5G that uses a 5G standalone (SA) core network and is required as a key element towards full 5G functionality on mobile networks, compared to the Basic / 5G NSA networks of today which use the existing 4G core network. 5G SA can be deployed using a range of different spectrum bands, including low and mid-band spectrum as well as C-band spectrum.
- Technology standard: 3GPP 5G Standalone (SA).

Advanced 5G:

- A 5G network with enhanced capabilities beyond connectivity achieved through a combination of the following: 5G SA, widespread deployment of C-band spectrum, high-bandwidth backhaul and a low latency network architecture (including a 5G core network) enabling a wider set of advanced use cases via the introduction of AI and machine learning for improved performance, reliability, network optimisation, and energy efficiency. While Advanced 5G can, in theory, be deployed using a range of different spectrum bands, widespread use of C-band spectrum is an essential prerequisite to support advanced use cases.
- Technology standard: 3GPP 5G Advanced.

2.5 Figure 1 shows how quality, functionality and potential use cases depend on the form/technology of 5G and the spectrum that is deployed (i.e., C-band, mid-band, and low-band).

Figure 1: Impact of technology and spectrum/sites deployment on functionality and use cases



Advanced 5G will underpin multiple government objectives

2.6 The Government’s Wireless Infrastructure Strategy recognises that Advanced 5G is essential for harnessing enterprise and innovation to grow the economy and drive forward the delivery of the government’s policy objectives, including the following:¹⁴

- a. **Unlocking investment and growth** – Together, Advanced 5G and its associated new use cases are forecast to deliver large gains in productivity, consumer welfare and economy-wide economic benefits:
 - i. A report for the Department for Digital, Culture, Media and Sport¹⁵ estimated potential economic benefits of 5G in the UK, measured as Gross Value Added (GVA).¹⁶ The report estimates the potential annual GVA impact of 5G to be £2.9bn-£11bn in 2030 depending on the level of adoption, rising to £9.3bn-£37bn in 2035.¹⁷

¹⁴ The Growth Plan 2022. See <https://www.gov.uk/government/publications/the-growth-plan-2022-documents>, last accessed 20 October 2022.

¹⁵ Cambridge econometrics & Analysys Mason for DCMS, Realising the Benefits of 5G, available at: <https://www.gov.uk/government/publications/realising-the-benefits-of-5g>.

¹⁶ GVA is equal to the total remuneration to households (via salaries and wages) plus the total surplus of businesses (including profits) plus net taxes to governments from production.

¹⁷ Specifically, the DCMS report considers two scenarios, based on whether 5G will be a) a general-purpose technology (“GPT”), that could be adopted by nearly all firms, like the internet currently; or b) an advanced digital technology (“ADT”) in which adoption is more limited and taken up by only some consumer groups and firms based on trends in uptake of advanced digital technologies. The lower bound figures are estimated for the ADT scenario and the upper bound figures are estimated for the GPT scenario. See Figure 8-2 of the DCMS report.

PwC estimates an increase in annual UK GDP of £43bn by 2030 from 5G use in five key sectors (see Table [x]).¹⁸

Table 1: Estimated potential GDP increase by 2030 from 5G

Sector	Amount sector will add to UK GDP by 2030
Healthcare	£15.0bn
Consumer and Media	£9.4bn
Smart Utilities	£9.4bn
Manufacturing	£6.1bn
Financial services	£3.1bn
Total	£43.0bn

Source: PwC, 2021, “Adoption of 5G technology to add £43bn to the UK GDP by 2030 – new PwC analysis shows”, Press release 2. February. Available at <https://www.pwc.co.uk/press-room/press-releases/5g-technology-to-add-43bn-to-uk-gdp-by-2030.html>. Last accessed on 1 September 2022.

- b. **The UK being a 5G world leader and a leader in innovation more generally** – Advanced 5G will be pivotal to the development of new sectors and new use cases, including in healthcare, manufacturing, transport, energy, and agriculture.
 - i. Recognising this potential, the UK Government has created ten ‘5G Innovation Regions’ to promote innovation and growth through investment in, and scaled adoption of, 5G technologies by business and public services.¹⁹
 - ii. Early deployment and adoption of new technologies, such as Advanced 5G, is crucial for technological leadership. Countries with more investment in 5G are likely to capture more of the 5G value chain: “Countries that engage in continual and aggressive investment, especially in R&D, will increase the likelihood of establishing robust 5G value chains capable of serving both domestic and global markets.”²⁰ For example, McKinsey estimates that 60 to 65 per cent of the global GDP increase from 5G could be captured by pioneer markets and China.²¹
- c. **Promoting regional growth throughout the UK** – 5G connectivity can play a significant role in supporting families and local communities and narrowing the digital divide.
 - i. Rural communities stand to benefit significantly from the application of Advanced 5G in sectors such as agriculture, healthcare, and education. For

¹⁸ PwC, 2021, “[Adoption of 5G technology to add £43bn to the UK GDP by 2030 – new PwC analysis shows](https://www.pwc.co.uk/press-room/press-releases/5g-technology-to-add-43bn-to-uk-gdp-by-2030.html)”, Press release 2. February. Last accessed on 21 September 2022.

¹⁹ Gov.uk: <https://www.gov.uk/government/publications/5g-innovation-regions-successful-regions/5g-innovation-regions-successful-regions>

²⁰IHS Markit, 2020, “*The 5G Economy in a Post-COVID-19 Era*”.

²¹McKinsey, *Connected world: an evolution in connectivity beyond the 5G revolution: Discussion paper*, 20 February 2020.

example, virtual classrooms could enable pupils to undertake specialist qualifications and therefore increase the number of opportunities available to them, without having to travel long distances. Vodafone’s partnership with Coventry University explored the possibilities of using 5G SA in bespoke, subject-specific teaching opportunities, with students enjoying real-time Augmented Reality and Virtual Reality tours of the human body.

- ii. However, 5G connectivity is currently almost completely absent across all rural areas of Great Britain: there are complete or partial 5G not-spots in 99.4% of rural constituencies in comparison to 66.2% of urban constituencies.²² Rural constituencies will benefit the most from a widespread roll-out of 5G technology since they also tend to be where higher economic deprivation levels and lower connectivity coincide.²³
- d. **Helping to reduce greenhouse gas emissions** – 5G is up to 90% more efficient than 4G in terms of energy consumption per unit of traffic.²⁴ Moreover, 5G can help reduce energy consumption more widely through IoT solutions applied to automatic meters, optimise energy consumption in offices, homes, cities and agriculture, and through smart transport solutions.²⁵
- e. **Efficient public service delivery** – Advanced 5G has significant benefits for improving public services, supporting smart cities which are cleaner and less congested and delivering connectivity to schools and hospitals that will provide better, more interactive lessons and personalised healthcare.
- i. Smart cities are made possible by the collection and analysis of vast quantities of real-time data through 5G technology, together with IoT. Advanced 5G’s network slicing capability means that more devices can be connected simultaneously, vastly increasing the quantity of data that can be captured at once and the speed and reliability with which it can be transmitted, analysed and used, with benefits to local government, businesses and citizens. Analysis commissioned by DSIT suggests that with high levels of adoption, 5G applications within smart cities and public services could account for £100 billion in additional GVA between now and 2035.²⁶
 - ii. In particular, cost savings are expected for public services (principally health and social care) as a result of healthier lifestyles, remote provisioning and remote monitoring (e.g. medication monitoring).²⁷ Analysis by consultancy WPI shows that 5G-enabled remote patient care could save the NHS up to £1

²² WPI, [“Connecting the Countryside”](#), 2023, page 4.

²³ According to WPI Economics’ Coverage/Deprivation Index, which charts the relationship between mobile connectivity and economic deprivation, rural constituencies account for the vast majority (92.8%) of the 20% worst performing constituencies on the index

²⁴ Ericsson, [“Achieving sustainability with energy efficiency in 5G networks”](#), 2021.

²⁵ HM Government, October 2020, [“The Government Response to the Committee on Climate Change’s 2020 Progress Report to Parliament”](#), p. 127.

²⁶ UK Wireless Infrastructure Strategy, page 62.

²⁷ Analysys Mason and Cambridge Econometrics, Realising the benefits of 5G, page 41.

billion per year, equivalent to 15,400 full time nursing posts, while councils could reduce spending on social care by up to 5%.²⁸

The potential benefits of Advanced 5G for consumers, industry, and the economy are substantial

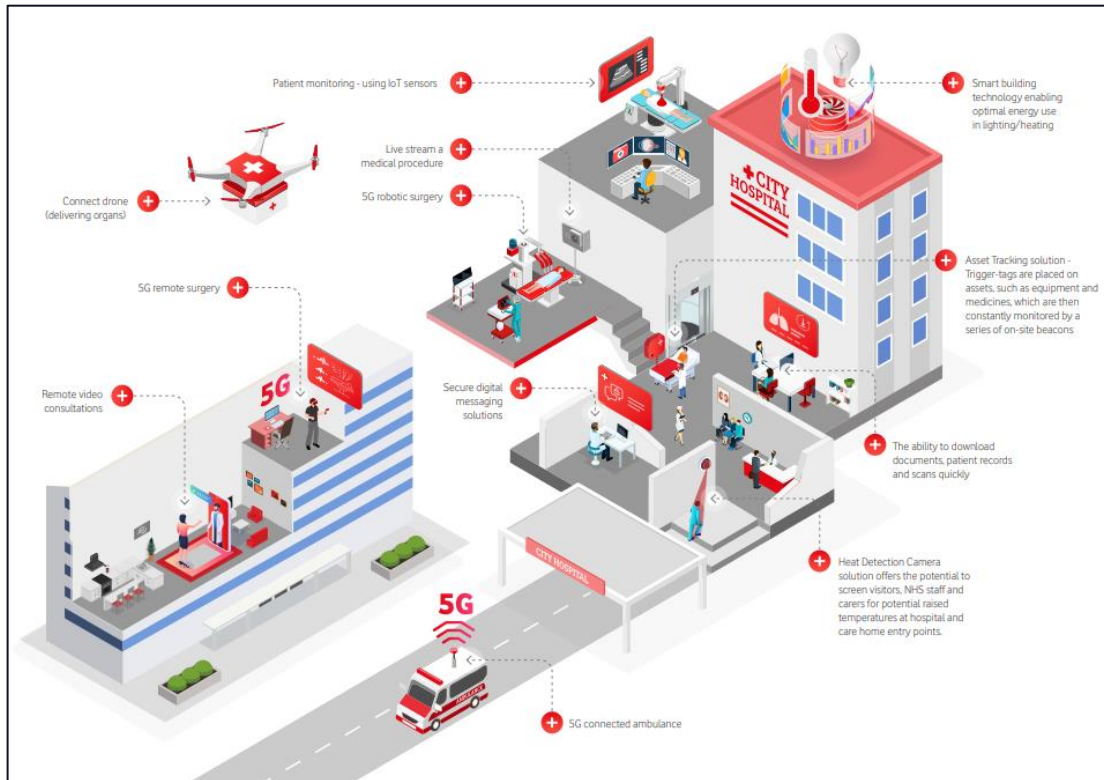
- 2.7 The Government has rightly described 5G as something that “*will be the cornerstone of our digital economy*”, driving growth in the industries of today and tomorrow.²⁹ Advanced 5G can connect many more types of devices than smartphones and will be able support new uses (beyond existing consumer applications) that need high network capacity, high data transfer speeds, high reliability, low latency, and much higher user density.
- 2.8 These capabilities mean that Advanced 5G will be pivotal to the development of new sectors using virtual and augmented reality, ultra-high definition video, robotics, connected vehicles, drones and smart cities and factories. By unlocking new applications, Advanced 5G will deliver material benefits to both consumers and businesses. For example³⁰:
- **Healthcare:** in 5G-connected hospitals, doctors will be able to provide remote expert guidance on medical procedures (e.g. surgeries) through augmented reality without the need to be on site. For instance, 5G-connected ambulances can link paramedics working with an emergency patient in transit with a hospital clinician using high-resolution video and tools that share the patient’s medical records as well as live clinical data such as heart rate. This will improve patients’ experiences and outcomes.

²⁸ WPI, [5G: Building a Digital Society](#), November 2023

²⁹ UK Wireless Infrastructure Strategy, page 3.

³⁰ WPI, Digital Ambition 2030 – A WPI Strategy report for Vodafone UK, June 2022, available at [Digital-Ambition-Report-220622-Hi-Res.pdf \(vodafone.co.uk\)](#)

Figure 2: A visual illustration of the benefits that full 5G and IoT technology will bring to staff and patients in hospitals of the future

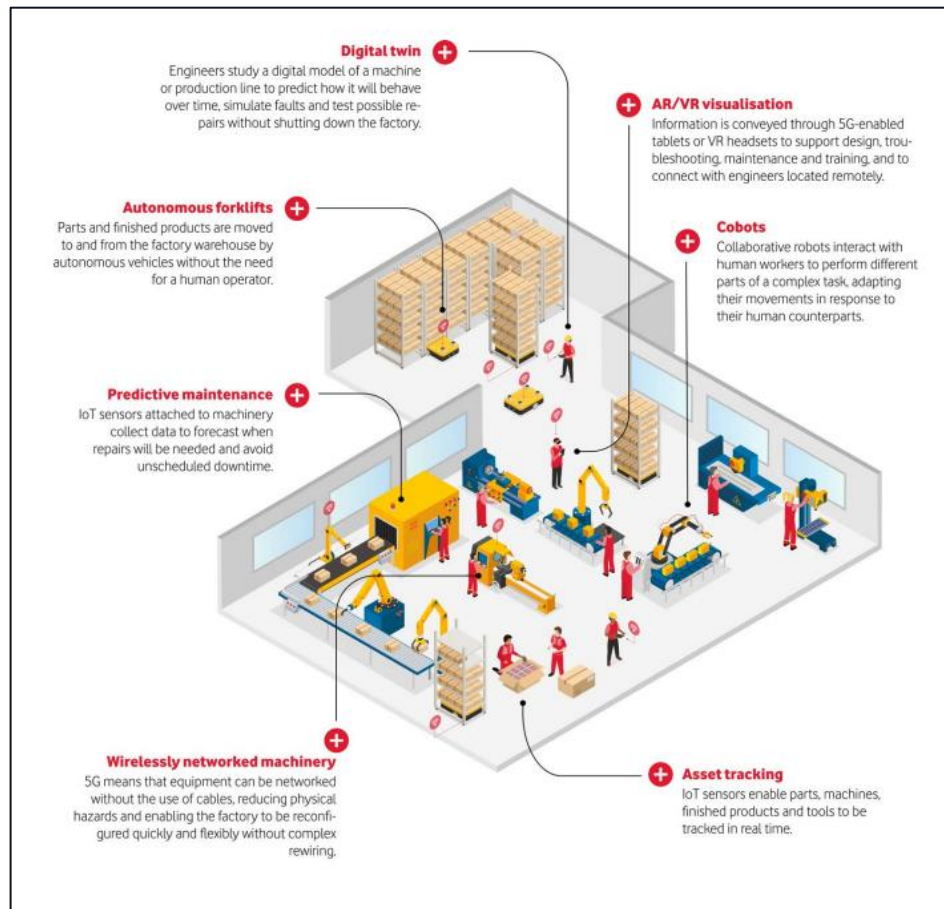


Source: WPI (2022): *Digital Ambition 2030 – A WPI Strategy report for Vodafone UK*.

- Manufacturing:** Advanced 5G will allow the transfer of large quantities of data from multiple IoT-connected devices in real time, enabling faster decision making and improving processes to maximise productivity. For instance, factories will be able to carry out real-time monitoring of safety parameters (heat, vibration, sound level, gas, etc.) to enable predictive maintenance and avoid costly unscheduled downtime. Analysis by Analysys Mason and Cambridge Econometrics suggests that high levels of 5G adoption in the manufacturing and logistics sectors could add £15 billion in additional GVA to the UK economy between now and 2035.³¹

³¹ UK Wireless Infrastructure Strategy, page 68.

Figure 3: A visual illustration of a “smart-factory” – where 5G capacity and speed will favour the integration of AR and VR with human workers



Source: WPI (2022): *Digital Ambition 2030 – A WPI Strategy report for Vodafone UK*

- **Transport:** Autonomous vehicles, including driverless cars, will in the future rely on Advanced 5G connectivity to enable rapid decision-making and response to changing road conditions and other road users. For example, the Connected Automotive Logistics project funded by the UK Government’s 5G Testbeds and Trials (5GTT) programme demonstrated a self-driving truck distributing parts and assemblies across the Nissan plant in Sunderland. The vehicle’s teleoperations system used next generation technology connected to a private 5G network to facilitate remote teleoperations.³²
- **Energy:** Advanced 5G can allow energy and utilities companies to improve their monitoring and understanding of energy use, enabling them to adjust the production and distribution of electricity, reducing overall levels of demand and better matching that demand to the supply of renewable energy (which is more decentralised and more variable at a substation level than traditional fossil-fuel based centralised grids). 5G-enabled smart grids can perform this monitoring and analysis and respond dynamically to rapidly changing patterns of demand and supply remotely and in real time.
- **Agriculture:**³³ Powered by high-speed 5G connectivity, precision agriculture enables IoT and robotic devices to perform a wide array of time- and labour-intensive farming

³² UK Wireless Infrastructure Strategy, page 53.

³³ Ericsson, 2022, “[Making the 5G precision agriculture connection](#)”. Last accessed on 21 September 2022.

activities in real-time, around the clock, even in harsh conditions. For example, Advanced 5G enables unmanned tractors to plough farmland autonomously using GPS and computer vision for guidance to respond to obstacles. 5G-enabled sensors can provide huge amounts of data, allowing for constant monitoring of crops and their environment, improving both yields and crop quality. On a testbed farm, these sensors enabled the farm to reduce its chemical usage by 30% and improve efficiency by 15%. Similarly, a 5G-connected weather station on a farm provided 92% prediction accuracy which in turn helped farmers plan irrigation schedules, leading to an approximately 30% fall in the farm's water consumption.³⁴

³⁴ Ibid, p.15

3 The UK is already falling behind in 5G investment and without change this gap will continue to widen

The UK currently faces a large investment gap in rolling out 5G

3.1 A recent report by Frontier Economics for the Digital Connectivity Forum³⁵ found that the UK MNOs were projected to invest £9bn on 5G by 2030, but this level of investment is far below what will be required for full 5G functionality. The report found that this investment could deliver additional capacity in high traffic urban areas, but that there was an investment gap even to provide basic 5G coverage to 95% of the population (see Table [2]). There was an even larger investment gap if enhanced 5G services³⁶ were to be provided to semi-rural areas and/or to provide full 5G, low latency services in urban and suburban areas, with a shortfall estimated at over £23bn.

Table 2: Estimated capital expenditure requirements for 5G

#	Scenario	Capital expenditure
(1)	5G rollout in high traffic urban areas	£5bn - £7bn
(2)	(1) + basic 5G in remaining current network footprints	£12bn - £14bn
(3)	(2) + enhanced 5G quality and semi-rural coverage	£22bn - £24bn
(4)	(3) + advanced use cases in urban/suburban areas	£32bn - £34bn

Source: Frontier Economics, 2022, "[The Investment Gap to Full 5G Rollout](#)". Last accessed on 21 September 2022.

The UK is falling behind leading 5G countries in both 5G investment and 5G rollout

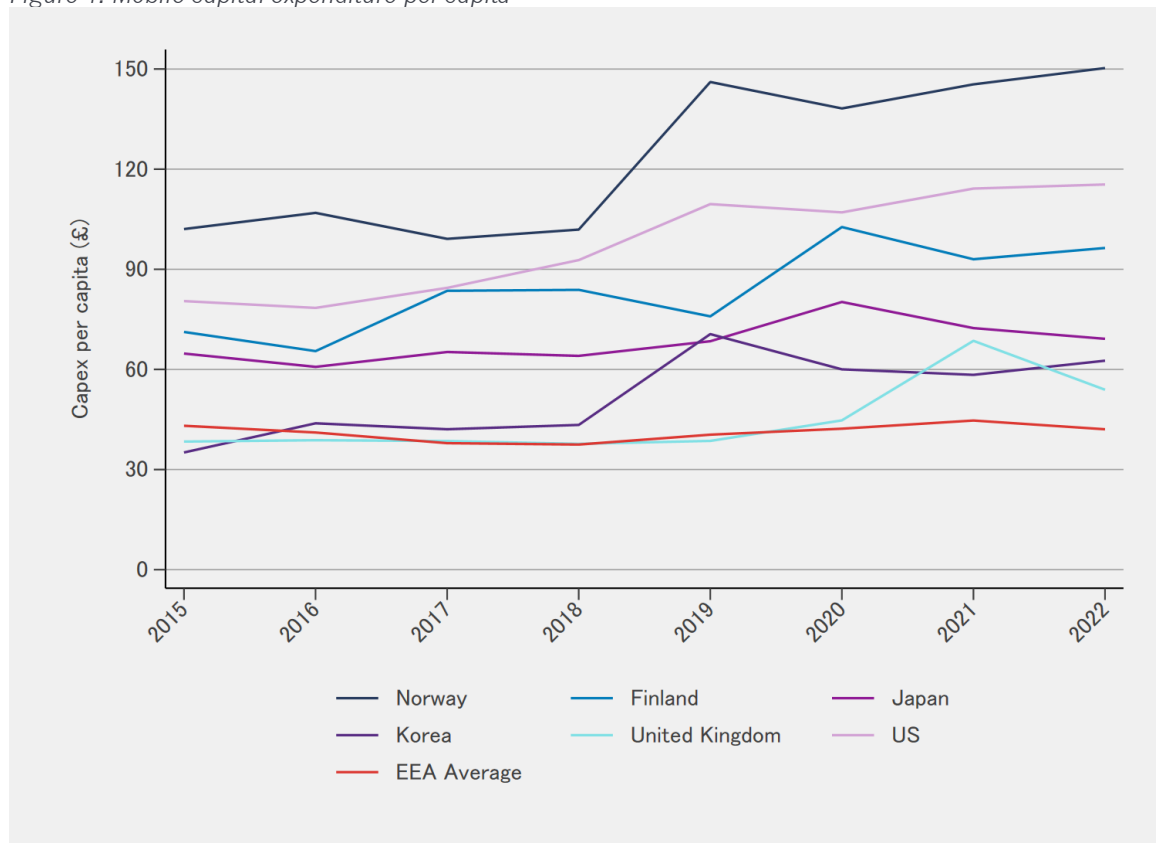
3.2 Relative to international comparators, the UK is falling behind on 5G, as evidenced by the various metrics summarised below:

- **Mobile capital expenditure per capita:** The countries leading in 5G (such as the US, Finland, Japan and Korea) support significantly higher mobile capital expenditure per capita than the UK (see Figure 4).

³⁵ Frontier Economics, 2022, "[The Investment Gap to Full 5G Rollout](#)". Last accessed on 21 September 2022.

³⁶ Enhanced 5G services is defined as providing similar quality in rural areas as in urban areas but excluding Advanced 5G capabilities such as low latency connectivity.

Figure 4: Mobile capital expenditure per capita



Source: Compass Lexecon analysis based on data from GSMA Intelligence.

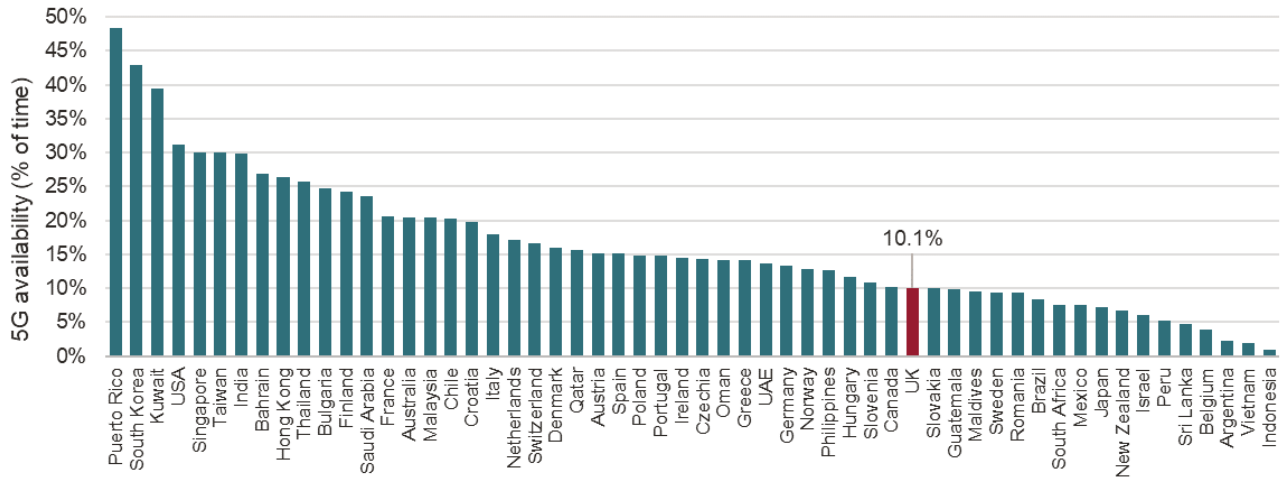
- 5G availability and coverage:**³⁷ According to Ofcom, outdoor 5G coverage by all MNOs is low, at 16-25% of premises as of September 2023.³⁸ As shown in Figure 5 below, as of June 2023 the UK ranked 39th out of 56 countries in terms of 5G availability, according to an OpenSignal study. The study concluded that users with 5G-enabled devices in the UK spent only around 10% of their time with a 5G connection on average, compared to a figure of 50% for markets such as Puerto Rico or South Korea.³⁹ 5G population coverage in the UK, at less than 80%, is behind many other European countries and also lags 5G global leaders such as Japan, South Korea, and the US (Figure 6).

³⁷ 5G availability refers to the percentage of time 5G users in these markets spent with an active 5G connection.

³⁸ Ofcom (2023), Connected Nations UK Report 2023, page 36. The range reflects different measurement thresholds – the 16% figure reflects “very high” confidence that a given premise has coverage, while the 25% figure reflects merely “high” confidence.

³⁹ OpenSignal, June 2023, “Benchmarking the Global 5G Experience”.

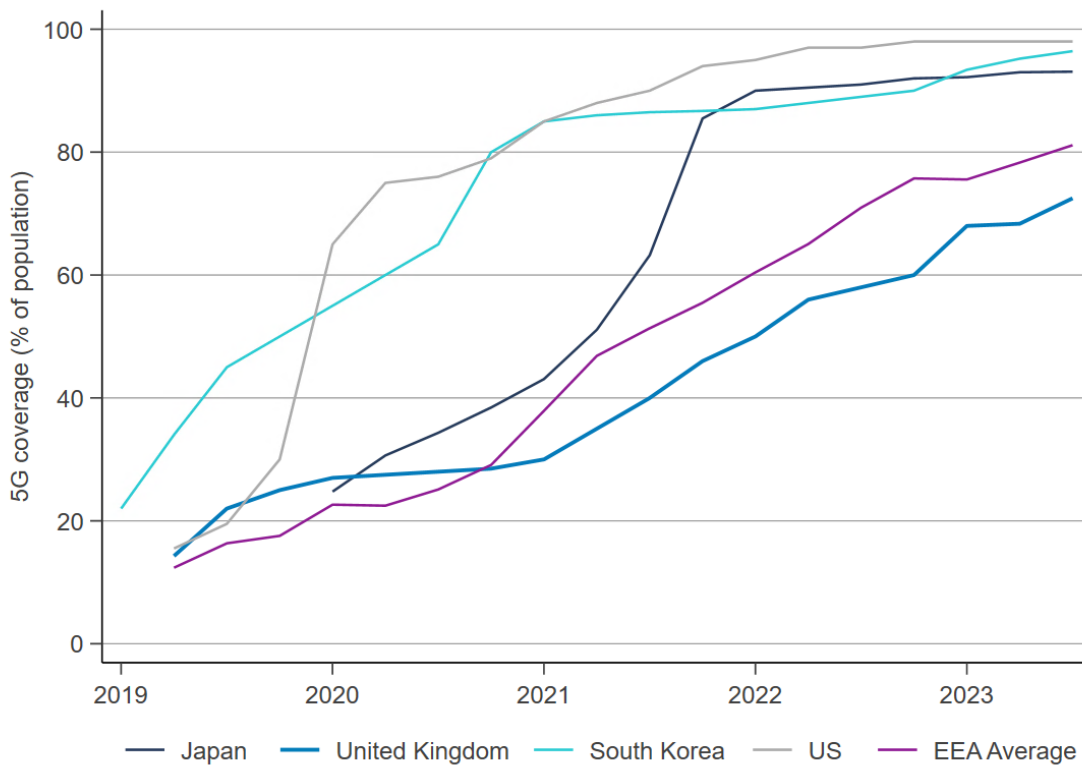
Figure 5: Global 5G availability (% of time)



Source: OpenSignal, June 2023, "Benchmarking the Global 5G Experience – June 2023".

Note: 5G availability refers to the percentage of time users with 5G-enabled devices in these markets spent with an active 5G connection.

Figure 6: Per cent of population covered by at least one 5G network



Source: Compass Lexecon analysis based on data from GSMA intelligence

- 5G download speed:** According to OpenSignal, the UK's average 5G download speed of 124.4 Mbps was considerably below the average 5G download speed in other markets, such as South Korea (432.5 Mbps), Singapore (376.8 Mbps) and Brazil (346.4 Mbps).

Leading countries in Europe included Bulgaria (300.5 Mbps), Sweden (274.6 Mbps) and Denmark (273.4 Mbps).⁴⁰

- **Latency:** According to Ookla Speedtest, median latency on UK mobile networks was 34 ms as of October 2023, which was significantly slower than the global median of 27 ms, European countries such as Finland (21 ms) and the Netherlands (22 ms) and the global leaders Macau (13 ms), Brunei (16 ms) and Singapore (17 ms).⁴¹
- **User experience:** In the OpenSignal 2023 Global Mobile Network Experience Awards, none of the four UK MNOs managed to rank in the top 15 across any of the tested categories related to 5G experience.⁴²

3.3 The UK is also well behind leading countries which have already deployed 5G Standalone networks, which are a stepping stone to achieving Advanced 5G. There have been no deployments of public 5G Standalone networks in the UK at all beyond Vodafone’s limited network in London, Manchester, Glasgow and Cardiff (and as discussed above, Vodafone’s ability and incentive to deploy 5G Standalone further is limited).⁴³ In contrast, leading countries are making the investments required for Advanced 5G: 43 MNOs internationally have already launched or deployed 5G Standalone in public networks and 121 MNOs are investing in 5G Standalone.⁴⁴ For example:

- In the US, T-Mobile launched 5G Standalone as early as 2020.⁴⁵
- In Korea, SK Telecom and KT have both launched 5G Standalone.⁴⁶ In Japan, both NTT DoComomo and Softbank have launched 5G Standalone while KDDI is trialling 5G Standalone on Open RAN.⁴⁷
- Canada launched its first 5G Standalone network in 2021.⁴⁸
- In Europe, MNOs have launched 5G Standalone in Austria, Finland, and Germany.

3.4 As 5G Standalone is an intermediate step to delivering Advanced 5G, this leaves the UK in a poor position to deploy Advanced 5G, which requires a step-change in investment compared to previous technologies.

⁴⁰ Opensignal, June 2023, “Benchmarking the Global 5G Experience”.

⁴¹ Ookla, 2023, “Speedtest Global Index” <https://www.speedtest.net/global-index#mobile> (accessed 20.11.2023).

⁴² Using crowd-sourced data from the first half of 2023, OpenSignal examined various categories of network quality, including 5G availability, 5G download speed, 5G gaming experience, and video streaming quality using 5G. The test treated countries with over 200,000km² land area (“Group I”) as distinct from those of smaller geographies. Group I, containing the UK and those countries with over 200,000km², consists of 90 mobile MNOs across 29 different countries.

⁴³ [Vodafone launches 5G Ultra, the UK’s first 5G Standalone mobile network for consumers](#)

⁴⁴ GSA, [5G-Market Snapshot November 2023](#).

⁴⁵ [T-Mobile launches nationwide 5G standalone network](#). Last accessed on 21 September 2022.

⁴⁶ [SK Telecom and Samsung Complete Industry’s First 5G-4G SA Option 4 \(NE-DC\) Trial in 5G Commercial Network](#) and [Samsung, KT launch 5G SA in South Korea](#). Last accessed 26 October 2022.

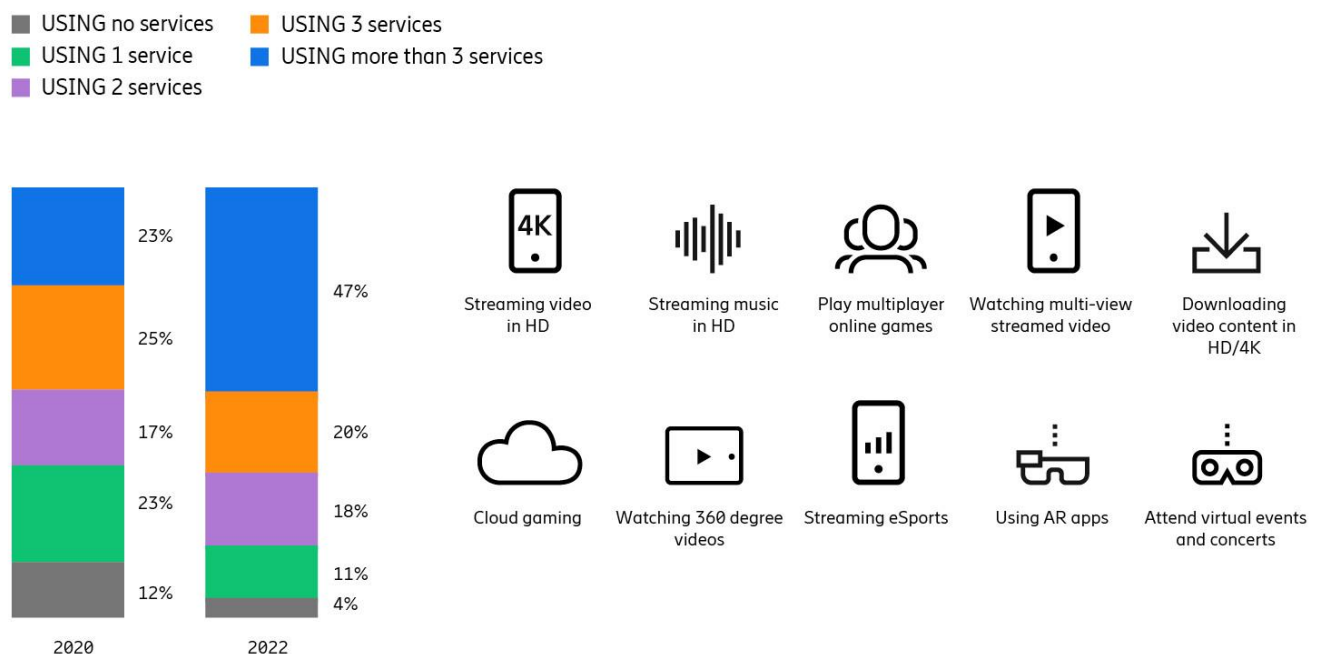
⁴⁷ [SoftBank Corp. First Carrier in Japan to Provide 5G Standalone Commercial Services, NEC contributes to NTT DOCOMO’s 5G standalone \(SA\) services launch with packet core](#) and [KDDI Successfully Turns on the World’s First 5G Standalone Open RAN Site Powered by vRAN in Japan](#). Last accessed 26 October 2022.

⁴⁸ [Rodgers claims Canada’s first 5G standalone network](#). Last accessed on 25 October 2022.

The slow roll-out of 5G is already adversely impacting customer experience today

3.5 The habits of UK mobile customers are changing. Whereas customers once used their mobile phones primarily for voice calls and text messaging, today they increasingly use phones to connect to the internet. Indeed, as of 2022, UK adults spent an average of 2 hours and 47 minutes per day using a mobile phone to access the internet, with phones making up 76% of the total time spent on-line.⁴⁹ What is more, consumers demand more and more data-intensive digital services. A survey conducted by Ericsson found that the number of 5G users is steadily growing, and that the percentage of 5G customers using more than three “immersive digital services” more than doubled from 2020 to 2022, going from 23% to 47%; almost all 5G users (96%) already used at least one of these services in 2022. Going forward, Ofcom expects people’s use of data to continue to grow.⁵⁰

Figure 7: Service usage of 5G users, 2020 and 2022



Source: Ericsson, [What do next wave 5G customers want?](#)

3.6 UK mobile MNOs have not been able to keep up with the growing expectations of their customers. Ofcom indicated that the most common reasons for complaint among mobile customers in 2022 were network quality issues (including poor connection quality and loss of service), making up 47% of all complaints to mobile MNOs.⁵¹ According to a survey conducted by Which?, 20% of mobile users complained about problems with signal and network issues.⁵² Going forward, mobile MNOs will need to invest heavily into their

⁴⁹ Ofcom, Online Nation 2023 report, 28 November 2023, figure 4.

⁵⁰ Ofcom, Ofcom’s future approach to mobile markets and spectrum, Discussion paper, 9 February 2022, para. 5.5.

⁵¹ Ofcom, Comparing customer service: mobile, landline and home broadband, 18 May 2023.

⁵² Which? [The most common mobile network complaints \(and what to do about them\)](#).

networks, including in 5G Standalone and Advanced 5G technology, to satisfy the rapidly increasing needs of their customer base.

4 Advanced 5G requires a step-change in investment compared to previous technologies

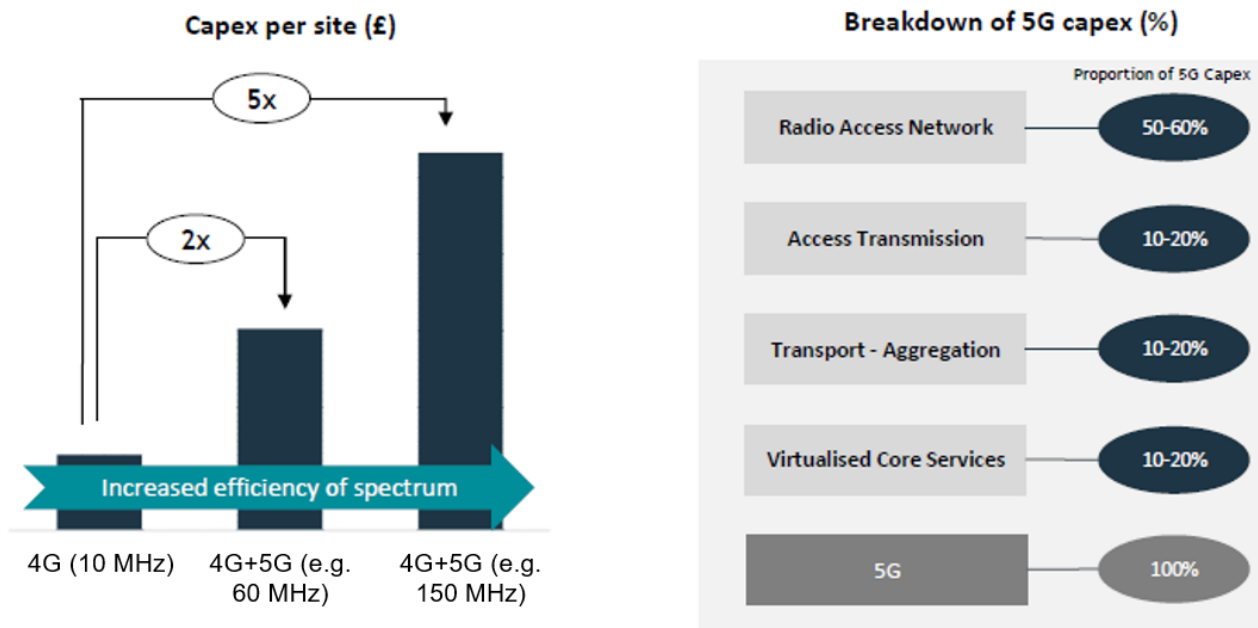
- 4.1 Advanced 5G offers great potential, but it is expensive. Annual capital expenditure levels for Advanced 5G will be significantly higher than the levels observed over the past decade. Many of the costs are fixed or semi-fixed rather than variable which means the minimum scale for an MNO to be viable is greater than for previous generations of mobile technology.

Advanced 5G will require a significantly larger investment compared to earlier technologies

- 4.2 Advanced 5G requires major investments across all parts of the network (Figure 8, right side). These investments include the following.
- **Improved Radio Access Network (RAN) coverage and performance.** The RAN is the national network of sites and spectrum that connect a mobile network to end-user devices. The functionality of Advanced 5G requires a large-scale rollout of new radio equipment and antenna elements⁵³, site densification and deployment of further spectrum to support data demand and deliver fast speeds.
 - **Enhanced mobile backhaul capacity.** To provide the necessary bandwidth, latency and resilience, MNOs need to expand mobile backhaul capacity, in particular by installing higher capacity fibre to connect sites both to each other and to the core network. Neglecting the quality and capacity of the backhaul link can limit the quality experienced by consumers connected to any given site, regardless of the investment in the site's radio equipment.
 - **Strengthened distributed cloud-based core capability.** Advanced 5G requires significant additional investments in distributed core networks including a new, dedicated 5G Standalone core network and an expanding network of data centres closer to users.

⁵³ Massive Multiple in Multiple Out (“mMIMO” or “Massive MIMO”) radiating C-band spectrum.

Figure 8: Delivering Advanced 5G networks require transformational investment



Source: Vodafone UK

- 4.3 The costs to roll out Advanced 5G are significantly greater than previous technologies. For example, as Figure 8 (left side) shows, deploying a high-capacity 5G site multiple times costlier than deploying 4G only.
- 4.4 In addition, the investment costs of deploying an Advanced 5G network involve significant fixed and semi-fixed costs. Fixed costs are costs which are incurred regardless of the number of subscribers using the network, and therefore do not vary with the number of customers. Semi-fixed costs are costs that are fixed as long as output remains below a threshold level (determined by the capacity provided by the network equipment currently installed), but additional costs are incurred once this level is exceeded.
- Fixed costs. MNOs must deploy 5G equipment at thousands of sites across the country (“**coverage layer**”) to deliver nationwide 5G population and geographic coverage (both indoor and outdoor). The cost of an engineer team visit to install 5G on a given site is a fixed cost that does not depend on the number of users served from that site. MNOs must have sufficiently large subscriber bases to be able to earn sufficient revenue to cover these costs.
 - Semi-fixed costs. Some required network components are standardised and typically only available in large ‘lumpy’ units of capacity.⁵⁴ For each component size, there are scale economies arising from spreading fixed equipment costs up to the capacity of the unit, with larger MNOs incurring lower unit costs up to that point.
 - Some other costs do not increase proportionately with the capacity provided (e.g., the core network and data centres) and are such that, while larger MNOs incur

⁵⁴ E.g., a 64T64R mMIMO unit (a very large antenna with 64 transmit and 64 receive antenna elements) or a high-capacity 10Gbps fibre backhaul line.

higher equipment costs overall, their per unit costs of supplying 5G are lower. This means that larger MNOs are able to invest in larger 5G networks and will have lower incremental costs in providing additional capacity.

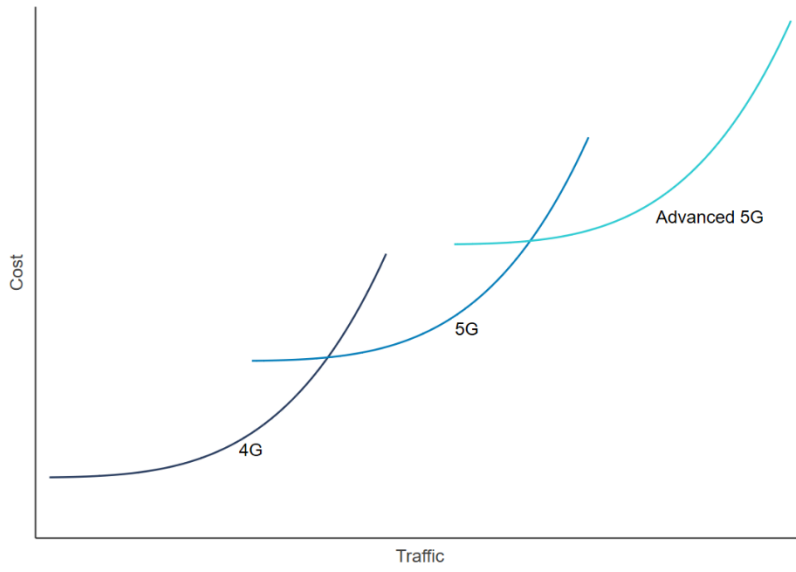
The high fixed and semi-fixed costs of deploying Advanced 5G means that the minimum scale for an MNO to be viable is greater

- 4.5 Given the significantly higher fixed costs of Advanced 5G, the business case for investing depends on an MNO's ability to spread these costs over as many 5G users and connections as possible (including consumer mobile, fixed wireless access ("FWA")⁵⁵, industry verticals, public users, business and enterprise, private networks, etc.). Therefore, MNOs need to attract more subscribers (i.e. require a greater minimum scale) to generate enough revenue to cover these costs, and these scale economies favour deployment of Advanced 5G by larger MNOs; MNOs with smaller customer bases will not have the scale to economically deploy Advanced 5G as widely as larger MNOs.⁵⁶
- 4.6 Figure 9 illustrates this point. 4G can be deployed to serve a relatively low amount of traffic at the lowest cost. However, as the amount of traffic increases, the incremental costs of carrying more traffic increase with the need to resort to increasingly costly solutions to create capacity, such as erecting additional sites. From a certain level of traffic, it becomes more economic to carry this traffic using 5G rather than 4G technology. The deployment of Advanced 5G is more costly still; but Advanced 5G also handles large amounts of traffic more cost-effectively than previous generations of mobile technology. As a consequence, the minimum efficient scale for an MNO to be viable and competitive will be greater going forward than in the past.

⁵⁵ FWA is a broadband product that uses mobile networks to provide broadband in a fixed location.

⁵⁶ For example, Ofcom notes: "The high fixed costs give rise to economies of scale, whereby the average unit costs of an MNO decline as output/scale increases. As a result, an MNO needs to serve a sufficiently large share of the market to be economically viable. While the precise minimum viable scale (MVS) will vary by MNO depending on its overall cost efficiency and revenue per customer, where there are economies of scale, an MNO with a larger subscriber base is likely to face lower per unit costs than a much smaller MNO". (Ofcom's future approach to mobile markets – Discussion paper, para 4.50)

Figure 9: Illustration of the costs of deploying mobile technologies



5 The current UK market structure, with two smaller MNOs, is unable to deliver this investment

- 5.1 To invest in its network, a mobile network MNO needs to have both the ability and incentive to invest. Mobile network MNOs regularly assess their investment plans, and respond to changes in their ability and/or incentives, which will in turn affect where they will invest and how quickly. This can be affected by a range of factors, including their own expectations around profitability of those investments (reflecting changes in forecasted revenues or investment costs) as well as competitive responses from rivals.
- 5.2 For example, Ofcom recognises that *“A weakened MNO may also be less able, or have less incentive, to invest as fully in its network than a larger, stronger player. If so, it may opt to scale back investment to reduce its costs, which could affect its future quality of service and potentially its ability to retain or gain market share. In turn, this may weaken the incentives of rival operators to invest in improving their networks, leading to weaker competition and poorer outcomes for customers.”*⁵⁷
- 5.3 To date, we have seen some rollout of Basic 5G services by all UK MNOs, and some very limited rollout of Standalone 5G by Vodafone in four UK cities.⁵⁸ As well as already lagging behind international comparators, the structure of the UK market means investment in 5G Standalone and Advanced 5G is likely to be slow and geographically limited.

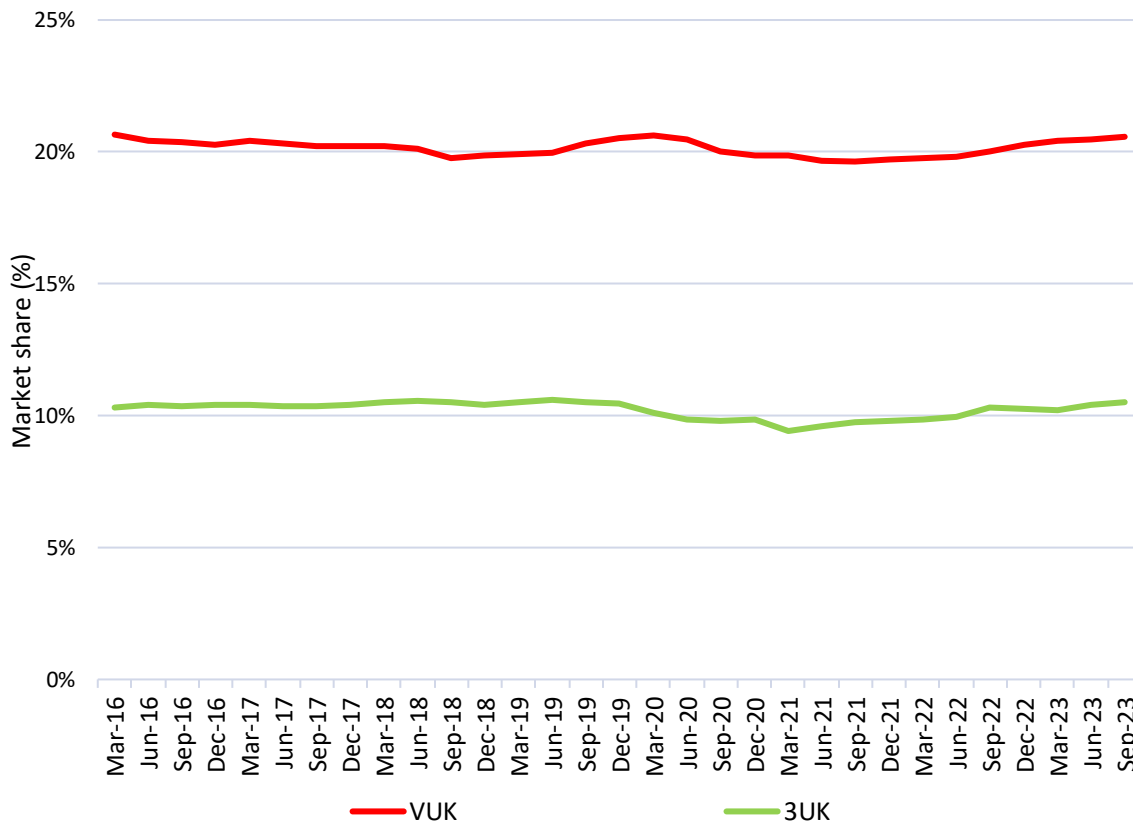
Vodafone and Three are sub-scale, which limits their ability to invest.

- 5.4 Three and Vodafone are the smallest of the UK MNOs, lagging behind market leaders VM02 and BT/EE. Figure 10 shows that Three only had a 10% share of subscribers as of Q1-Q3 2023, while Vodafone holds a 21% share. Both Three’s and Vodafone’s market shares have remained persistently flat since at least 2016 at around 10% and 20%, respectively.

⁵⁷ Ofcom, Ofcom’s future approach to mobile markets and spectrum – conclusions paper

⁵⁸ [Vodafone launches 5G Ultra, the UK’s first 5G Standalone mobile network for consumers](#)

Figure 10: VUK and 3UK overall retail market shares by subscribers, 2016- Q3 2023



Notes:

1. Subscribers reflect total mobile connections, defined as total unique SIM cards (or phone numbers, where SIM cards are not used), excluding cellular IoT, that have been registered on the mobile network at the end of the period.
2. Revenues reflect recurring cellular revenues, defined as recurring service revenue generated in the period, including revenue generated from the use of network (voice, messaging, data, VAS) but excluding non-recurring revenue such as handset or equipment sales.

Source: Compass Lexecon analysis based on data from GSMA Intelligence.

5.5 This is significantly lower than VMO2 and BT/EE, who held 27% and 25% of subscribers respectively as of Q1-Q3 2023.⁵⁹ These figures include retail subscribers only; but VMO2 additionally has the largest wholesale customer base, which further adds to its scale advantage over Three and Vodafone. Three’s and Vodafone’s smaller scale has had a direct impact on both companies’ gross margins, and therefore on their ability to invest.

BT/EE and VMO2 generate almost all of the mobile industry’s cashflows

5.6 Vodafone and Three are much smaller than BT/EE and VMO2 when it comes to their ability of their business to generate the money to pay for that investment. Enders Analysis estimates that BT/EE and VMO2 record EBITDA margins that are nearly twice as high as those of Vodafone and Three.⁶⁰ In comparison, mobile capex does not proportionally scale back in line with EBITDA, because a significant element of the investments MNOs need to make are fixed or semi-fixed. As a result, after accounting for network investment, Three

⁵⁹ GSMA Intelligence.

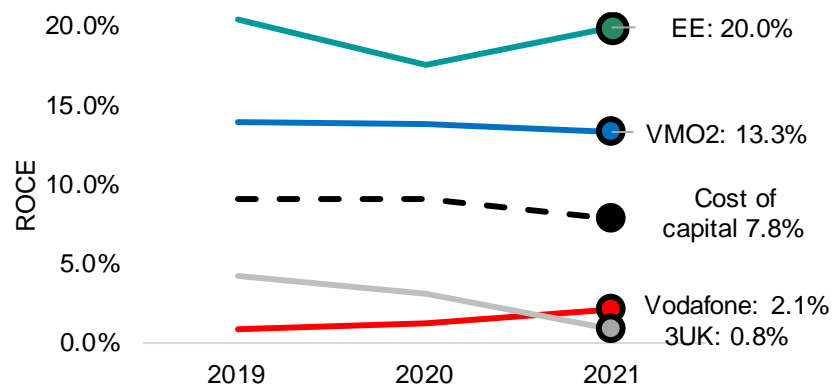
⁶⁰ Enders Analysis, Pressures mounting: UK mobile market in Q3 2023.

suffered from negative cash flows in the last three years, while Vodafone was only barely cash positive.

Vodafone and Three are not seeing returns on their investments

5.7 Already behind BT/EE and VMO2 in terms of performance, significant investments by Vodafone and Three have failed to deliver gains and narrow the gap with their rivals. Ofcom has found that Vodafone and Three have earned returns well below the cost of capital since at least 2019 (2.1% and 0.8% respectively in 2021, with Ofcom’s estimate of the cost of capital at 7.8%). The cost of capital is the minimum return that investors expect for providing capital to the MNO given the risks associated with that investment. When returns fall below the cost of capital, investors (including parent companies of the MNOs) have no incentive to provide additional funds to the MNOs as they can make a higher return from investing that capital elsewhere. As Ofcom also recognises, “If an MNO’s financial returns were below the cost of capital for a sustained period of time, this could reduce its incentives to invest.”⁶¹

Figure 11: Ofcom analysis of MNOs’ economic ROCEs



Source: Ofcom

5.8 Vodafone’s persistently low returns (below its cost of capital) and a record of failing to meet its own financial forecasts reduce investors’ confidence. This limits Vodafone’s ability to invest, as shareholders will consider Vodafone’s recent track record when assessing whether to allocate additional funds to network investments and network innovation. Furthermore, Vodafone UK is just one of several Vodafone Group subsidiaries, with whom it must compete for a share of the group’s finite capital expenditure budget. Its poor returns and financial performance mean that the UK is not an attractive market for increasing capital expenditure above the minimum run rate required to sustain the business. Against this backdrop, it would not be rational for shareholders to commit the funds necessary to accelerate technology and capacity rollout or improve network performance.

5.9 From 2020, Three significantly increased its investment in 5G (in part funded by the proceeds of the sale of its mobile towers to telecoms infrastructure provider Cellnex) in response to traffic growth and growing congestion on its 4G network. Over three years it spent £2.3bn and incurred significant cash losses. However, despite this investment, Three’s network quality reputation remains poor, and crucially, network performance has not been consistent enough across the UK to lead to any increase in its overall share of

⁶¹ Ofcom’s future approach to mobile markets and spectrum, [Conclusions paper](#)

supply. Three's inability to offer a consistent service across the UK is reflected in its particularly poor performance in Scotland (less than 60% 4G geographic coverage), which has large swaths of rural areas.⁶² Enders Analysis have found that Three experiences significantly higher churn than the other MNOs.⁶³ Customers are also significantly more likely to leave Three for network quality related reasons compared to others.⁶⁴ Therefore rather than begin to close the gap with its rivals, this significant increase in its investment has only enabled it to maintain its share of supply.

5.10 As standalone MNOs, Vodafone and Three are not positioned to deploy nationwide Advanced 5G. Absent the merger, both Vodafone and Three's market position – and hence financial performance – can be expected to weaken further, as a result of their limited ability to invest in 5G Standalone/Advanced 5G. As Figure 10 shows, Vodafone and Three's market shares have stagnated, and going forward, the Parties expect their combined consumer mobile subscriber share to fall as their inability to sustainably fund their networks will increasingly put them at a competitive disadvantage.

5.11 For both parties, these challenges are further exacerbated by other market developments, including:

- rapid growth in demand for data, which will limit their ability and incentive to compete aggressively on data allowances and bring new customers onto their networks given their capacity constraints – and high costs of expanding capacity – absent the merger;
- the increasing competitive pressure from fully converged players (VMO2 and BT/EE), both of whom are able to offer fixed / mobile bundled products with material discounts and have a significant advantage with respect to investment in network quality (both mobile and fixed); and
- other initiatives which also require significant investments by mobile network MNOs, including the Shared Rural Network (which is committing to expanding coverage of 4G services) and the costs of replacing installed network equipment to comply with the Telecoms Security Act.

5.12 Therefore, Three and Vodafone's future network investments will also fail to deliver sufficient returns. Both MNOs will lack the ability and incentive to invest in rolling out nationwide Advanced 5G networks.

BT/EE and VMO2 will invest more slowly if they face less competitive pressure.

5.13 Mobile MNOs must decide not only whether to invest in 5G Advanced, but also when. Those with strong market positions may not immediately invest if they have an option to delay (e.g. because the economics might be better/more certain in the future), particularly if they do not feel sufficient competitive pressure to do so.

5.14 Without an effective investment threat from Vodafone and Three, BT/EE and VMO2 would have little to gain from accelerating their investments, even though they have the ability to do so. This is because they would have to incur significant investment costs, but with little

⁶² Ofcom, Connected Nations 2023, pages 42-43.

⁶³ Enders Analysis, "UK Mobile Market in Q3 2023", page 9.

⁶⁴ Frontier Economics analysis of GfK Tech 360 survey (January 2022 – December 2022).

revenue upside given they already maintain clear market share leadership and BT/EE has maintained a leading position on network quality. As such, it is likely to be more profitable for them to sweat their current assets and invest just enough to maintain their existing advantages over time, than to accelerate their 5G investments.

- 5.15 This is demonstrated in their existing investments. For example, BT/EE's and VMO2's 5G deployments are not progressing at pace and are significantly behind those of market leaders in other European countries. While BT/EE announced it had reached 68% 5G population coverage in the UK (as at May 2023),⁶⁵ this is far lower than the 5G population coverage achieved elsewhere, for example in Germany (Deutsche Telekom, 95%),⁶⁶ the US (T-Mobile, 98%),⁶⁷ and Sweden (Telia, 84%).⁶⁸
- 5.16 BT/EE and VMO2 will continue to invest (slowly) in their networks in response to reaching capacity constraints in serving their large customer bases. Because their larger customer bases mean that it will be economic for them to deploy Advanced 5G spectrum to address demand growth sooner than it would be for Vodafone and Three, this investment will deliver enhanced network performance in addition to higher capacity. As Vodafone and Three lack the scale needed to invest on a standalone basis and face capacity constraints, they are not and would not be able to compete in the ramp-up period of 5G take-up, meaning the gap between them and BT/EE and VMO2 will widen as the latter would capture new demand driven by 5G use cases. Over time, BT/EE and VMO2 will build an increasing network advantage over Vodafone and Three.
- 5.17 BT/EE and VMO2's incentive will be to invest just enough to stay ahead and maintain their advantage over sub-scale players, particularly given the substantial costs of rolling out Advanced 5G and the uncertain returns of new 5G use cases. Uncertainty over the expected returns on investment means there is an option value for market leaders – such as BT/EE and VMO2 – to delay investing until more information becomes available.⁶⁹ Absent the merger, BT/EE and VMO2 do not have to worry about Vodafone and Three gaining market position, and can therefore afford to wait and see how 5G develops in other countries.
- 5.18 In summary, because Vodafone and Three do not have the ability to invest more, BT/EE and VMO2 lack the incentive to accelerate their own investments. This means that the UK mobile market is currently in a low-investment equilibrium. This is consistent with the view of Ofcom, which has noted that MNOs in the UK have opted for an incremental 5G roll-out strategy based on non-standalone networks, which places constraints on some of the full

⁶⁵ BT Group plc, Results for the full year to 31 March 2023, 18 May 2023, <https://www.bt.com/bt-plc/assets/documents/investors/financial-reporting-and-news/quarterly-results/fy23/q4/q4-fy23-release.pdf> (accessed 20 August 2023), page 1. RCR Wireless News, EE expands 5G footprint in rural areas across the UK, 9 February 2023, <https://www.rcrwireless.com/20230209/5g/ee-expands-5g-footprint-rural-areas-across-uk> (accessed 19 August 2023). The 60% population coverage announced by BT/EE is based on mMIMO C-band investments.

⁶⁶ 5G Observatory: <https://5gobservatory.eu/deutsche-telekom-says-its-5g-network-reaches-95-of-the-population/>

⁶⁷ Fierce Wireless: <https://www.fiercewireless.com/5g/t-mobile-5g-covers-98-us-population-other-countries-lag-moore#:~:text=Carriers%20update%20their%205G%20coverage,reference%20to%20mid%20band%20spectrum.>

⁶⁸ Telia: <https://www.teliacompany.com/en/news-articles/telia-company-increases-5g-population-coverage-to-84>

⁶⁹ Huisman (2001) has developed a model where firms are considering an investment but returns are uncertain; the presence of rivals who themselves might invest increases incentives to invest in order to avoid being pre-empted. See Huisman, K. (2001). *Technology Investment: A Game Theoretic Real Options Approach*, New York: Springer Science+Business Media, chapter 8.

capabilities of 5G.⁷⁰ As a result, the UK will lose out on the substantial economic benefits of Advanced 5G.

⁷⁰ Ofcom Connected Nations 2023, page 37.

6 The proposed Vodafone/Three merger will create an MNO with the ability and incentive to invest to be a viable and competitive third network

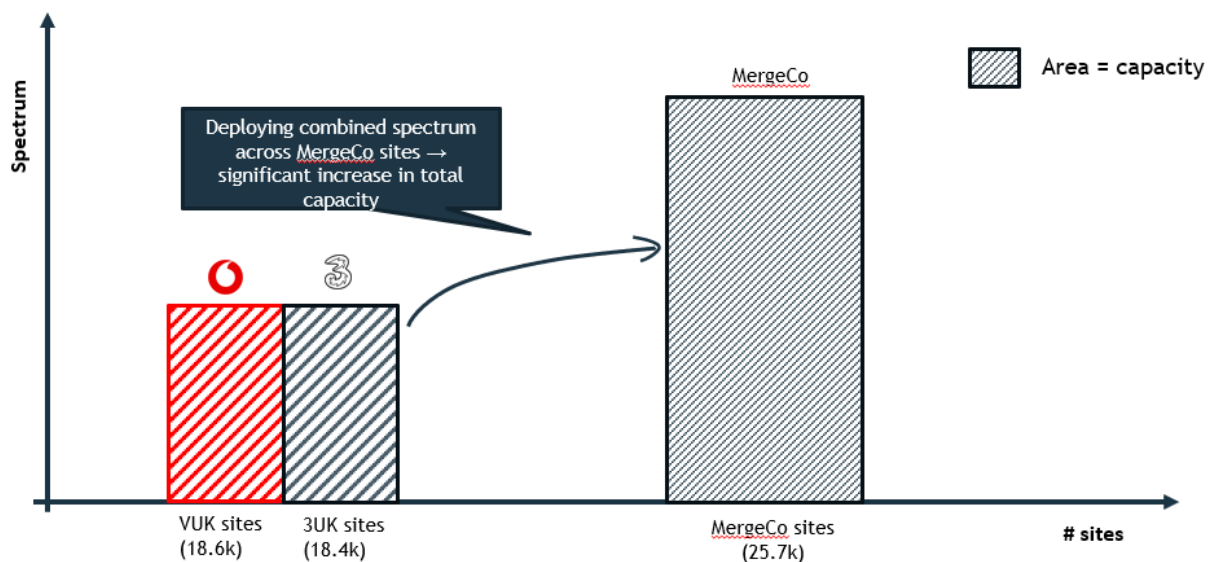
- 6.1 Post-merger, Three and Vodafone intend to invest over £11bn in the UK over 10 years to create one of Europe's most advanced 5G networks.
- 6.2 The merged entity will have both the ability and incentive to invest rapidly in 5G Standalone and Advanced 5G because:
 - a. Unlike the standalone companies, the merged entity will be able to combine spectrum and assets in a single network, providing the necessary scale and synergies for cost recovery; and
 - b. Investment in a superior network is expected to deliver significant revenue benefits for the merged entity relative to the counterfactual, by enabling it to capture market share and unlock greater new revenue opportunities underpinned by Advanced 5G. Taken together, these revenue synergies provide the merged entity with a greater incentive to invest than either Vodafone or Three would face on a standalone basis.

The merger provides the scale and synergies which are necessary for a third network to have the ability to invest in Advanced 5G in the UK

- 6.3 Combining Vodafone's and Three's spectrum and assets will unlock significant network investment and better quality for four reasons.
- 6.4 First, compared to the standalone companies, the merged entity will have a larger customer base. This means that the merged entity will have greater revenues than either standalone company. A larger customer base also means that the merged entity can recover the costs of upgrading its (single) network over more customers, resulting in a lower cost of investment per customer compared to if both parties upgraded their networks on a standalone basis. Both effects are important for increasing the merged entity's ability to invest given the fixed/semi-fixed nature of 5G Standalone and Advanced 5G costs.
- 6.5 Second, combining Vodafone's and Three's network assets will deliver a much more reliable network with far better quality coverage than Vodafone and Three could achieve on a standalone basis. The merged entity can remove duplicate costs, in particular by relying on a single set of core, backhaul, and edge facilities. The merged entity will also start with the parties' combined network assets meaning that the incremental costs for Merged entity to build the best-in-class network are much smaller than the costs that either party would face if they were to build such a network individually. Further, the merged entity will have a combined grid of around 26,000 radio sites, far denser than Three's and Vodafone's current separate grids with c. 18,500 sites each. Finally, the merged entity will be able to draw on the combined spectrum of both Vodafone and Three. Importantly, this combination of the Parties' networks, together with the rapid deployment of the Parties' combined spectrum holdings and Advanced 5G spectrally-efficient MIMO radio equipment across the densified combined grid, means that the merged entity's future network capacity will significantly exceed that of either Vodafone's or Three's standalone networks.

- a. An MNO's network capacity depends on the product of the amount of spectrum deployed, the number of cell sites in the area on which that spectrum is deployed, and the efficiency of the technology used.⁷¹ This means that if both spectrum and the number of cells doubles, an MNO can deliver a four-fold improvement in capacity (other things being equal). This multiplicative relationship between spectrum and sites means that by bringing together the Parties' spectrum holdings on a single, densified grid, the merger can cost-effectively deliver a network with far more capacity than the standalone networks combined, as implementation of spectrum and site sharing will allow Vodafone spectrum to be deployed on Three sites and used by Three customers, and vice versa.
- b. Through network integration, the capacity of the merged entity's network will be substantially greater than the sum of the projected capacity of Vodafone's and Three's networks. This uplift is the result of the merged entity's significantly denser site grid and the fact that the merged entity will be able to draw upon the combined spectrum holdings of Three and Vodafone.
- c. By contrast, there is no realistic prospect that either MNO could come close to matching the capacity of the merged entity's network on a standalone basis. Each MNO would need to separately build more than 7,000 additional sites, which would come with significant costs and pose severe operational challenges, such as getting access to land for site builds. Even then, neither MNO could deliver the capacity benefits associated with combining Vodafone's and Three's spectrum holdings, as MNOs will not be able to acquire additional spectrum.⁷²

Figure 12: Multiplicative effect of sites and spectrum on capacity



6.6 Third, the merger will generate significant cost synergies that are not network-related, including through eliminating duplicated costs across the two businesses, that the merged

⁷¹ Real Wireless on behalf of Ofcom, Techniques for increasing capacity of wireless broadband networks: UK 2012-2030, 2012, p. 22.

⁷² Ofcom is not planning any relevant spectrum auctions, and there is no realistic prospect of acquiring a significant amount of spectrum from other MNOs.

entity can use to accelerate 5G Standalone and Advanced 5G rollout and deliver a best-in-class network. Overlapping infrastructure and operations create significant opportunities to eliminate duplicated costs across the value chain. For example, the merger is expected to generate over £970 million in net cost savings across commercial, organisation and IT (i.e., after integration costs) in the first five years. These cost savings provide the merged entity with the necessary funds for the capital expenditure required to integrate their networks as quickly as possible.

- 6.7 The merged entity will have substantial capacity above that needed to meet its current customers' requirements years into the future because it is economic for the merged entity to fully deploy the combined spectrum holdings as part of the network integration's "refresh" of equipment at every site, rather than via multiple visits to each site. This spare capacity will incentivise the merged entity to compete aggressively to attract new customers to fill the available capacity.
- 6.8 Finally, the merged entity will have lower incremental costs of increasing capacity in the future (once the initial capacity uplift is fully utilised) than the standalone businesses, which means it can meet growing demand for its Advanced 5G service by upgrading its network more cost effectively.
- a. This follows from capacity being the product of the number of sites and amount of spectrum – having more spectrum and sites means that for a given amount of expenditure, the network is able to realise a greater capacity gain.
 - b. The merged entity's incremental costs to serve additional customers will also reduce because The merged entity will use capacity more efficiently than Three and Vodafone operating independently. For example, in areas that are congested for Three but where Vodafone has spare capacity (and vice versa), under the merged entity, Vodafone's capacity can be used for Three's customers, reducing the need for additional investments to be able to address traffic growth.
 - c. Having a greater 'base' capacity also means that the need to deploy more costly congestion solutions (e.g. small cells) will be reduced. As noted by Ofcom, the cost of sites may increase as more sites are added, given an MNO may have to rely on increasingly less cost effective sites. The most cost-effective sites are likely to be the first ones used, such as sites which are optimally located to provide the needed additional volumes and sites which are lower cost to deploy.⁷³ By gaining additional capacity through deploying Vodafone and Three's combined spectrum, the merged entity will be able to reduce and delay the need to use less cost effective sites compared with the individual site networks that Vodafone and Three would need to deploy as standalone MNOs.
- 6.9 Together, these factors mean the merged entity is able to deliver much higher Advanced 5G capacity, in a more cost-effective manner, for a given level of investment than the standalone companies. As a result, the merger transforms Vodafone and Three from two sub-scale players facing unattractive returns on their investments into a third player with scale for whom investment is now financially rational, giving it the ability to deploy 5G Standalone and Advanced 5G further and faster than Vodafone or Three on a standalone basis.

⁷³ Ofcom, Award of the 2.3 and 3.4 GHz spectrum bands, Annexes to the statement, November 2016, paragraph A11.48.

6.10 The merged entity's network will enable it to offer a step-change in customer experience, creating a leading 5G network.

- a. Overall, more than 86% of the population – i.e., those concentrated in high-traffic areas (e.g., London, Manchester, Liverpool, etc.) – will benefit from average speeds of around 800Mbps, which is around double what a sub-scale player could deliver. The remaining 14% of the population – in mid- and low-traffic areas of the country – will benefit from average speeds of around 200Mbps – which is a 6-fold increase compared to what a sub-scale player could deliver and fully supports the Government's Wireless Infrastructure Strategy ambitions.⁷⁴ Everyday consumer activities, such as participating in HD video calls, streaming HD live video or loading an image-rich webpage (such as amazon.com), will be significantly improved, even in the most remote areas covered by the merged entity's network. This will greatly help address the UK's urban/rural connectivity divide, by delivering high-quality coverage to even the most remote parts of the country.
- b. The high speeds on the merged entity's network will be driven, to a large extent, by a significant expansion of C-band spectrum coverage, which will be extended to c. 10 million people in areas that would not receive C-band spectrum coverage by either Three or Vodafone.
- c. Densification of the merged entity's mobile network will provide a much more consistent and reliable service to all of the merged entity's customers. The merged entity will achieve on average a 55% higher densification of sites compared to Vodafone and Three in the UK's six largest cities (London, Liverpool, Birmingham, Glasgow, Manchester and Bristol). In rural areas, the merged entity will achieve a 46% higher densification of sites compared to Vodafone and Three. The site densification in rural areas will further help to reduce the urban/rural connectivity divide and enable customers in these areas to be provided with a much more consistent experience and therefore higher network quality.
- d. 96% of the merged entity's customers will benefit from latencies that are expected to be approximately five times as low as the current latencies for the standalone networks.⁷⁵
- e. Both Three and Vodafone expect congestion to be a persistent problem going forward – with 20-30% of sites of their mobile networks to provide average speeds of less than 5Mbps – in light of the rapidly growing demand for data. By contrast, thanks to its significantly larger capacity, the merged entity network is forecast to have negligible congestion into the 2030s.

6.11 The benefits from the joint network will begin to materialize shortly after completion of the transaction. The merged entity will be able to share Vodafone's and Three's spectrum on all sites, allowing specific Vodafone spectrum to be deployed on Three's sites, which will lead to a significant reduction in congestion and improved performance for at least 7 million customers on Three's network. The merged entity will then begin implementing a multi-MNO core network ("**MOCN**") in the near term, which will provide Three customers

⁷⁴ UK Wireless Infrastructure Strategy Report.

⁷⁵ Based on game latency as per Ookla Intelligence Platform (June 2023) utilised for VUK and 3UK standalone (range considers "Best 10%" and "Worst 10%") – at around 35 – 85ms and 30 – 93ms respectively.

with access to Vodafone’s sites and vice versa, thereby eliminating 25% of “Not spots” (uncovered areas) and allowing for a more efficient use of spectrum, which saves energy.

Significant revenue synergies provide the merged entity with a strong incentive to invest in Advanced 5G

- 6.12 Unlike the standalone parties, the merged entity will have the scale and synergies needed to sustainably invest in Advanced 5G. The scope for significant revenue synergies provides the merged entity with a strong financial incentive to deliver these investments.
- 6.13 Having a market leading – superior quality, high capacity – network will materially improve the combined market position of the merged entity relative to the standalone parties in the counterfactual. This provides the opportunity for **three incremental revenue benefits** that flow from accelerated Advanced 5G deployment, which are magnified by the much larger customer base of the combined business:
- The merged entity’s superior network will sharply improve its ability to attract and retain customers, both wholesale and retail;
 - New Advanced 5G use cases supported by the merged entity’s superior network will provide a new revenue source; and
 - The merged entity will be able to use the much greater capacity compared to either standalone party to support the expansion of FWA services to a much greater number of customers, offering those customers a viable alternative to broadband products offered over a wired connection.
- 6.14 These revenue benefits are underpinned by the significant uplift in capacity unlocked by the merger, which will allow the merged entity to accommodate higher usage of its network at a lower cost (and lower incremental costs of further expansion) compared to the counterfactual. This means it is economic for the merged entity to deliver this network whereas it would not be for either party on a standalone basis. The largely fixed nature of the investment costs also means the merged entity is incentivised to compete for these incremental revenue streams to fill its capacity, as attracting more subscribers increases revenues without increasing costs to the same extent, thus increasing profits. This results in a positive cycle, where as a result of the merger’s positive impact on its ability to invest, the merged entity invests more in its network which attracts customers and boosts revenues, which in turn enables further investments to be made, thus further increasing the attractiveness of the network to customers.

The merged entity’s superior network will sharply improve its ability to attract and retain customers, both retail and wholesale.

- 6.15 Network quality is important for UK consumers and businesses and as a result is a key parameter of competition. This has been noted by Ofcom, who stated that “*while coverage is a prerequisite for connectivity, the quality of mobile connectivity is becoming increasingly important as services used by consumers become more demanding*”.⁷⁶ As such, Ofcom stated “*network quality [is set] to become more important as dependence on mobile internet access*

⁷⁶ UK Connected Nations Report 2022, page 39.

grows, and people expect faster, more reliable connections on the move.”⁷⁷ Ofcom referred to growing data usage and new and existing use cases as reasons for why network quality will continue to be important to customers, citing “existing applications that require higher bandwidth, such as video streaming, video calling and cloud gaming on the go, as well as higher quality services that entail higher data consumption (e.g. UHD video streaming)”.⁷⁸

- 6.16 As well as for individual consumers, network quality is also highly important for businesses. For example, Ofcom has collected qualitative evidence which indicates that “some small businesses consider reliability and service to be more important than cost when deciding whether to stay or switch provider”.⁷⁹
- 6.17 As a result, network quality plays a significant role in customer switching decisions, affecting a customer’s decision to stay with its existing provider, motivating a customer to switch providers and driving a customer’s choice of a new provider. For example:
- Surveys undertaken by Ofcom highlight the importance of perceived network quality to customers. In its May 2023 report, Ofcom indicated that the most common reasons for complaint among mobile customers in 2022 were network quality issues (including poor connection quality and loss of service), making up 47% of all complaints to mobile MNOs. This was followed by billing, pricing and payment issues (36%) and dissatisfaction with customer service (22%).⁸⁰
 - A 2019 customer survey conducted by ATKearney on behalf of Liberty Global indicates that perceived network quality is important in consumers’ choices of mobile provider. It found that in the UK, customers consider network quality to be the most important benefit MNOs can offer (27%), followed by personal benefits (e.g., the speed of service, bundle size and availability) (23%) and price (16%).⁸¹
- 6.18 Similarly, network quality is also important at the wholesale level. In seeking MNO hosts, MVNOs consider key parameters such as costs, network quality, and access to future technology.⁸² These parameters allow MVNOs to compete effectively against MNOs at the retail level and offer attractive deals to their customers, as MVNOs can offer competitive prices and network quality which matches that of their competitors. In order to attract MVNOs onto their networks, MNOs must therefore be able to offer attractive wholesale prices and high-quality networks. The CMA has noted that MVNOs may not consider MNOs as viable hosts if they do not have sufficient spare network capacity or quality, and are unable to add additional capacity in a timely manner.⁸³
- 6.19 Ultimately, network quality is driven by the investments made by the MNOs, which means that network quality today reflects historical investment cycles over many years. Similarly,

⁷⁷ Ofcom (2022). Ofcom’s future approach to mobile markets and spectrum, paragraph 1.7.

⁷⁸ Ofcom (2022). Ofcom’s future approach to mobile markets and spectrum, paragraph 5.5.

⁷⁹ Ofcom (2022). Ofcom’s future approach to mobile markets and spectrum, paragraph 4.40.

⁸⁰ Ofcom, Comparing customer service: mobile, landline and home broadband, 18 May 2023,

https://www.ofcom.org.uk/_data/assets/pdf_file/0014/261500/comparing-customer-service-report-2023.pdf

(accessed 20 August 2023), page 9.

⁸¹ ATKearney for Liberty Global, Viewed through the Lens of the Consumer – Value Creation in the Telecommunications Sector, February 2019, <https://www.libertyglobal.com/wp-content/uploads/2019/02/Viewed-Through-the-Lens-of-the-Consumer.pdf> (accessed 20 August 2023), page 12.

⁸² CMA Final Findings Report *Liberty Global plc / Telefonica S.A.*, paragraph 10.29.

⁸³ CMA Final Findings Report *Liberty Global plc / Telefonica S.A.*, paragraph 10.65.

future investments are crucial for meeting consumer expectations across different dimensions of quality in the future. For example, investments are required for the following.

- To provide sufficient data capacity, to keep up with the explosive growth in demand for data usage and avoid quality degradation from congestion. Growth in data demand is expected to continue, and although there is considerable uncertainty around future growth levels, Ofcom’s medium-growth scenario based on a continuation of the recent 40% yoy rate suggests that total monthly data used on mobile networks could increase by a multiple of 20 by 2030.⁸⁴
- To provide coverage of services where their customers want to use them, both indoors and outdoors.
- To roll out new technology upgrades which deliver faster and more reliable connections as well as new services, with Advanced 5G the next iteration.

6.20 By investing in its network, the merged entity will deliver a network with far greater capacity, quality and coverage than the Parties could achieve on a standalone basis. This means the merged entity will be better able to attract and retain mobile customers than Vodafone or Three individually. The additional revenues generated by the larger customer base will allow the merged entity to cover the largely fixed/semi-fixed costs of investment without any change in pricing strategy.

New Advanced 5G use cases are expected to provide additional revenue uplift

6.21 The merged entity’s superior network will be able to support new use cases that leverage the benefits of Advanced 5G on a nationwide basis. This includes opportunities across healthcare, the public sector, transport and energy. For example, Ofcom noted that growing 5G use cases for businesses will require strong network quality, stating that: *“in the nearer term, the most transformative effects of 5G for businesses may relate to the development of very large-scale machine-to-machine applications (M2M), as part of the digitisation of manufacturing and service provision. Collectively, these are often referred to as the Industrial Internet of Things and are likely to require features such as high reliability, security, bespoke capabilities and speeds.”*⁸⁵

6.22 Although such use cases are more speculative at this stage, they would still be expected to provide revenue upsides from Advanced 5G investments. The use cases are expected to be supported by widespread Advanced 5G coverage and network slicing and including applications across healthcare, the public sector, broadcasting and streaming, automotive, energy and the railway sector.

The merged entity will be better placed to expand into fixed broadband services than either standalone party

6.23 There are a range of broadband products which fundamentally provide the same service to customers, i.e. internet connectivity at a fixed location (e.g. as a residential address). Fixed Wireless Access (FWA) uses mobile networks to provide broadband in a fixed location, and

⁸⁴ Ofcom (2022). Ofcom’s future approach to mobile markets and spectrum, paragraph 1.16.

⁸⁵ Ofcom (2022). Ofcom’s future approach to mobile markets and spectrum, paragraph 5.12.

is an alternative to other broadband products delivered over a wired connection such as fibre-to-the-cabinet (FTTC) and fibre-to-the-premises (FTTP).

- 6.24 Although dependent on available spectrum and the quality and coverage of the underlying 5G network, 5G FWA can surpass the speeds of some traditional wired connections and match the speeds of FTTP where the mobile network has sufficient capacity. It can also be easier and faster to install than wired connections, as it does not require extensive digging and laying of physical cables. Providers of FWA are therefore an emerging constraint on traditional broadband providers, and so this can provide an additional revenue source for the merged entity.
- 6.25 This has been seen in the US market, for example, following the merger of T-Mobile and Sprint in 2020. T-Mobile's 5G network build has allowed the company to aggressively push into FWA, which is "*challenging some of the traditional pricing models for established wired broadband providers and creating ancillary pricing benefits for consumers*".⁸⁶ The ITIF noted that T-Mobile's FWA service is the fastest-growing home broadband service in the country, gaining one million home Internet customers within a year of its inception.⁸⁷ This is driving a fundamental shift in the market as, for the first time ever, mobile MNOs are taking share from traditional cable and fiber broadband companies. For example, FWA accounted for 90% of all net broadband customer additions in the US during 2022.⁸⁸ T-Mobile also said that the bulk of their new FWA customers are coming from cable providers.⁸⁹
- 6.26 However, for FWA to be a viable substitute for traditional fixed broadband services, it needs to be able to provide sufficient capacity to serve the significant data demands of fixed broadband customers.⁹⁰ As such, FWA is only viable where providers have sufficient spare capacity on their network, meaning it is currently only available in areas of relatively low population density where the mobile network can support its requirements and its growth is managed accordingly.
- 6.27 Three currently markets an FWA product, but it is only available in parts of the country where it expects to have sufficient capacity available. FWA customers benefit from extra flexibility and include (i) existing fixed broadband customers, (ii) customers with data-only mobile devices, and (iii) households without access to fixed broadband or where planned roll-out is in the distant future.
- 6.28 The merged entity is expected to deliver faster speeds and greater capacity than the Parties on a standalone basis. This can be expected to support the merged entity's 5G FWA being a better alternative to customers for their home broadband needs. The merged entity's greater capacity will be critical to enable 5G FWA to be offered in more areas and support more customers than Three would offer on a standalone basis, as the latter will face increasing congestion of its (smaller) capacity and so will likely need to prioritise core mobile services. Therefore the merged entity's best-in-class network will provide it with the ability and incentive to offer innovative FWA in more locations and to accommodate more customers / traffic on the network, generating further revenue synergies.

⁸⁶ [IDC](#)

⁸⁷ [ITIF](#)

⁸⁸ [Light Reading](#)

⁸⁹ [Light Reading](#)

⁹⁰ Ofcom's 2023 Communications Market Report found that average data use per user on fixed broadband connections was 482GB per month in 2023, compared with 8GB for mobile users.

- 6.29 In addition to FWA, the merged entity also provides additional revenue opportunities from wired fixed broadband services. Vodafone currently offers a fixed broadband service to residential and business consumers (using other MNO's fixed networks). The merged entity's larger mobile base will allow it to cross-sell these fixed broadband products to more customers, providing opportunities for additional incremental revenues alongside FWA.
- 6.30 Together, these revenue synergies mean investment in a superior network is expected to have benefits for the merged entity by allowing it to capture market share as well as unlock revenue from new 5G SA/Advanced use cases and expansion in fixed broadband.
- 6.31 Furthermore, unlike BT/EE and VMO2, which are converged players with strong fixed / content offerings, the merger will make the merged entity the only mobile-focused converged MNO. The merged entity will therefore have a strong incentive to invest in a superior network to obtain a competitive advantage and differentiate itself from its competitors. This incentive, when combined with the merged entity's increased scale and merger synergies, will lead it to deploy 5G Standalone and Advanced 5G further and faster than either Vodafone or Three on a standalone basis.

The proposed Vodafone/Three merger will deliver a step change in investment

- 6.32 Both Vodafone and Three are hampered by their lack of scale and poor cash flow positions, limiting their ability to invest. Between 2017 and 2022, Vodafone's and Three's average capital expenditure was £760m per year. This level of investment may not be sustainable going forward. Ofcom, while noting that the industry is planning to undertake further significant investment, cautioned that the economic climate has become more uncertain, which could impact the business case for future investments and result in a slowing down of network improvements.⁹¹
- 6.33 By contrast, the proposed merger will deliver a significant uplift in capital expenditure: Over the first five years of network integration (i.e., 2025-2029), the merged entity is expected to invest on average £1.25bn per year as it builds the UK's leading mobile network – more than the sum of the planned investments Vodafone and Three forecast to make over the same period. Moreover, the merged entity will deliver greater quality improvements to customers per pound invested.
- a. Rather than two networks duplicating the fixed costs, the merged entity will be able to spend a greater proportion of its capex on delivering better quality so as to compete more effectively. The Transaction is also expected to generate significant cost savings across commercial, organisational and IT costs, freeing up further funds to be re-allocated to the deployment of its Advanced 5G network.
 - b. In addition, each time the merged entity builds a new site or upgrades an existing site, the merged entity will be able to deploy the parties' combined spectrum, delivering much more capacity compared with the standalone MNOs. Similarly, investment in new spectrum by the merged entity will deliver more capacity because of the ability to deploy that spectrum over the merged entity's larger site network.

⁹¹ Ofcom's future approach to mobile markets and spectrum, [Conclusions paper, paragraph 4.35-4.37](#).

7 The merged entity will drive price competition in retail and wholesale markets

The merged entity will have a strong incentive to price competitively to attract and retain retail customers.

- 7.1 In dynamic markets, where prices and products themselves change over time, nominal prices are not a meaningful metric to look at. Customers often benefit from quality improvements resulting from changes to mobile networks (e.g. improved coverage and speeds) and new services. This is why officials from the UK Office for National Statistics (ONS) and academics have proposed using revenue per unit of data as an appropriate indicator of changes in **quality-adjusted prices** on the basis that improvements in coverage, increasing speeds and new services can be expected to be reflected in increased data usage at any given price level.⁹²
- 7.2 In the UK, average revenue per GB of data consumed (as a measure of quality-adjusted prices) has been declining over time, reflecting this effect. Even with a merger, there are strong reasons why such prices are likely to continue to decline, and the rate of decline may even accelerate.
- 7.3 Firstly, the merged entity's customers will benefit from greater network coverage, faster and more reliable speeds, and lower latency 5G services than would be possible for customers of either Vodafone or Three on a standalone basis. With speeds that are at least double of what a sub-scale player could deliver, C-band coverage for an additional 10 million customers, five times lower latencies than what Three and Vodafone offer today, and a smooth and consistent experience thanks to negligible congestion, the merged entity's network will offer a greatly improved customer experience. The large quality gains can be expected to result in lower prices when adjusted for quality for the merged entity's customers (even greater reductions than implied by average revenue per GB).
- 7.4 Secondly, this merger will result in an increase in supply compared to the counterfactual, due to the significant increase in capacity facilitated by combining Vodafone and Three's sites and spectrum, which is forecast to virtually eliminate congestion on the merged entity's network. This increase in capacity combined with the largely fixed nature of costs means the merged entity will face a strong incentive to fill its network – because attracting more subscribers increases revenues without increasing costs to the same extent. Furthermore, the merged entity will continue to face strong retail competition from a large number of players including MVNOs such as Sky Mobile, Tesco Mobile, Lebara and Lycamobile (who together account for c. 17% of subscribers) as well as EE/BT and VMO2. As a result, the merged entity will need to compete aggressively through offering better value (e.g. more data for the same price, or the same amount of data at lower prices) to attract customers from these rivals. This, combined with the need to maximise the use of the (higher) network capacity and the cost synergies from the merger will put downward pressure on pricing.
- 7.5 Even once the additional capacity from combining the parties' assets is taken up by customers, the merged entity will be able to expand capacity at a lower incremental cost as

⁹² Abdirahman, M., Coyle, D., Heys, R. & Stewart, W., A Comparison of Deflators for Telecommunications Services Output, *Economie et Statistique*, 517-518-519, 2020.

explained in paragraph 6.8. Thus, the merged entity will have an incentive to continue pricing competitively to attract new customers on an ongoing basis in order to use the available capacity and increase revenue.

- 7.6 This is reflected in the Parties' proposed business plan for the merger, which does not rely on price increases for delivery, but instead relies on attracting and retaining customers by offering a superior network.
- 7.7 Unlike the merged entity, Vodafone and Three as standalone companies will have lower incentive to price to attract customers to their networks, given increasing congestion of their networks and the higher incremental cost of expanding capacity. Rather, they would have an incentive to price to ration their limited capacity. That being said, given that Three will face greater congestion of its network which would result in deteriorating quality, it may need to reduce its nominal prices to maintain even its existing customers (although this would still mean its quality-adjusted prices would be higher).
- 7.8 This view that quality-adjusted prices can continue to fall even after a merger is consistent with the findings of a robust meta-study of recent four-to-three mobile mergers in Europe and the US (see Table 3). In two of the mergers – Austria and Ireland – average revenue per GB of data consumed declined faster after the merger than before it. In the US, Italy and Germany, quality-adjusted prices still continued to fall at the same rate. In the Netherlands, revenue per GB did not decline as fast post-merger, although this is most likely because of slower growth in data volumes from 2019 onwards as mobile prices in the Netherlands continued to fall to below the EU average.⁹³

⁹³ Further, the EC's T-Mobile/Tele2 merger decision suggests that the pre-merger rate of decline in average revenue per GB might not have been sustained in the Netherlands absent the merger, i.e. it notes that Tele2's competitiveness and quality was declining and that some of the pre-merger decline in prices was the result of significant additional capacity from the deployment of new spectrum.

Table 3: Effects of four-to-three mergers on rate of decline in average revenue per GB consumed

Merger	Was there a statistically significant post-merger deviation from the pre-merger rate of decline?
Austrian Hutchison/Orange 2013 merger	Faster decline in average revenue per GB post-merger (**)
Irish Hutchison/Telefonica 2014 merger	Faster decline in average revenue per GB post-merger (**)
German Telefonica/KPN 2014 merger	No statistically significant difference in rate of decline
Italian Wind/Tre 2016 merger ⁹⁴	No statistically significant difference in rate of decline in post-merger period prior to Iliad's entry before faster decline
Dutch T-Mobile/Tele2 2018 merger	Slower decline in average revenue per GB post-merger (***)
US Sprint/T-Mobile 2020 merger	No statistically significant difference in rate of decline

Notes: Based on measures of mobile service revenues by market divided by market mobile data traffic, and voice and SMS traffic converted to GB equivalent following Abdirahman et al. (2020). Test undertaken with respect to a logarithmic trend, considering four years before and after the merger. For Italy, the period considered ends in Q2 2018 (the quarter of Iliad's entry). $p < .01$ ***, $p < .05$ **, $p < .1$ *

Source: Padilla et al (2023), [Do four-to-three mobile mergers harm consumers?](#)

The merged entity will provide stronger competitive pressure at wholesale level

- 7.9 Given the importance of quality and capacity for MVNOs in seeking MNO hosts, Three is already unable to compete in the wholesale market today, due to the substantial perceived quality disadvantage of its network compared to the other MNOs. VMO2 is the market-leading provider of wholesale services and hosts the two largest MVNOs, Tesco Mobile and Sky Mobile, together serving c. 8.7 million subscribers. BT/EE hosts more than 50 MVNOs on its network and competes aggressively to add further MVNOs, recently winning one of the UK's largest MVNOs, Lyca Mobile.
- 7.10 The merger will allow the merged entity to be a more effective third player than Vodafone would be in the counterfactual, capable of competing against BT/EE and VMO2 in the wholesale market by offering a best-in-class network with sufficient spare capacity to host MVNOs. Given the fixed nature of its investment costs, the merged entity will also have a strong incentive to compete for these MVNO customers to increase utilisation of its (increased) capacity. As a result, MVNOs will benefit from competitive wholesale deals, which would also allow them to compete more effectively against MNOs at the retail level,

⁹⁴ As a result of the Wind/Tre merger in 2016, the market reduced from a four-MNO market to a three-MNO market, but that the remedy of packages agreed with the European Commission allowed the entry of Iliad in May 2018 as a new mobile network MNO and therefore the market subsequently became a four-MNO market. The result for Italy in Table 3 considers the post-merger period to end in Q2 2018, the quarter of Iliad's entry.

by offering attractive prices, high quality-of-service, and the latest available technologies to their customers.

8 The Vodafone/Three merger will increase competitive pressure on BT/EE and VMO2 to invest in their networks and price competitively

- 8.1 Today's poor 5G outcomes in the UK reflect not only the inability of Three and Vodafone to invest and compete; they also reflect the weak incentive of BT/EE and VMO2 to invest in their own offerings. The merger will address both of these problems. As explained above, the merger will create a viable and competitive third network with the ability and incentive to invest in a best-in-class network and price competitively to attract and retain customers. In addition, it will fundamentally change the incentive for BT/EE and VMO2 to invest in their own networks, as they will need to expand capacity and improve quality in order to keep up. As a result, the merger will have a positive impact on dynamic competition, with three networks trying to win customers by rolling out the best possible 5G technology as quickly as possible and as widely as possible.

The merged entity's new network fundamentally changes the incentive for BT/EE and VMO2 to invest in their own networks

- 8.2 At the moment, both BT/EE and VMO2 have the ability to invest, but they lack sufficient competitive incentive, as explained in paragraphs 5.13-5.18. However, the merged entity will be able to move ahead of BT/EE into the position of the UK's best network, because it will combine the networks of Vodafone and Three (improving quality almost from day one), and because it will have much greater ability and incentive to invest in 5G Standalone and Advanced 5G. This will fundamentally change BT/EE's and VMO2's incentives. Suddenly, they risk losing substantial numbers of customers to the merged entity unless they invest in 5G roll-out as quickly as they can.
- 8.3 This incentive is likely to be especially strong in the case of BT/EE, given the importance of network quality to its brand and market position over the past decade. Because of this, it is likely that BT/EE has attracted a lot of customers who care a lot about network quality. On that basis, the potential customer loss from BT/EE from not responding to the merged entity's investments is likely to be especially large, leading to a negative impact on BT/EE's revenues and profits. It is not possible to quantify with any confidence the likely extent of switching from BT/EE to the merged entity in the event that BT/EE does not respond, but the risk is reflected in the fact that a large number of BT/EE's customers say they have chosen BT/EE due to its relatively better network quality.⁹⁵ If BT/EE responds by accelerating its own investments, VMO2's incentive will further increase as otherwise it would fall well behind both BT/EE and the merged entity in terms of network quality, and risk losing even more customers.

This increased incentive to invest is supported by relevant case studies

- 8.4 Evidence from past case studies which have parallels to the merger are informative of the expected dynamic response from BT/EE and VMO2 following the merger. These include:

⁹⁵ Based on a survey for Vodafone on reasons to join in Q3 2023.

The *T-Mobile/Sprint* merger in the US, and in particular the positive investment response of rival MNOs following the merger; and

BT's FTTP (Fibre to the premises) deployment in the UK, which was a response to rivals investing in FTTP networks.

Rivals invested a lot more following the T-Mobile/Sprint merger in the US

8.5 In April 2020, T-Mobile and Sprint, respectively the third and fourth largest MNOs by subscribers and annual network capital expenditure in the US, merged.

8.6 Prior to the merger:

- AT&T and Verizon, the first and second largest MNOs in the US, were investing in 5G roll-out at a slow pace, mainly attempting to deploy Basic 5G on either performance-limited low-band spectrum or on coverage-limited mmWave;
- T-Mobile and Sprint lagged behind AT&T and Verizon in terms of investments. From 2015 to 2019, Verizon and AT&T averaged \$10.5 billion and \$10.2 billion per year in wireless capital expenditures, respectively, whereas T-Mobile averaged \$5.1 billion, and Sprint averaged \$3.3 billion.⁹⁶ Furthermore, Sprint had a track record of poor financial returns and made losses in the years 2015-2017 and 2019.⁹⁷

8.7 As a result of the merger, the new T-Mobile was able to invest in rolling out 5G across the country, becoming the first MNO to launch 5G standalone in 2020.⁹⁸ This led AT&T and Verizon to accelerate their 5G roll-out to catch up with T-Mobile:

- Following the merger, AT&T announced plans to cover 70-75 million people with its C-Band roll-out by the end of 2022, but later announced its coverage had actually reached 150 million people.⁹⁹ Similarly, Verizon's original plan was to reach 175 million points of presence (POPs) by the end of 2023¹⁰⁰ but recent data instead show that it passed 200 million POPs covered.¹⁰¹
- AT&T and Verizon launched 5G standalone in 2022¹⁰² following the merger in 2020.
- In February 2023, rating agency Fitch noted that that the US wireless market “*continues to be very competitive*”, with AT&T, Verizon and T-Mobile going head-to-head. According to Fitch, “*spending in the past two 3 gigahertz (GHz) auctions was aggressive, led by Verizon and AT&T which used the majority of their spending to increase spectrum positions and*

⁹⁶ Asker, J., & Katz, M. L. (2022). The Sprint/T-Mobile Merger. *Antitrust Economics at a Time of Upheaval*, p. 5. <http://www.johnasker.com/STMO.pdf>.

⁹⁷ See Sprint's SEC filings for the years 2017 and 2019, available at <https://d18rn0p25nwr6d.cloudfront.net/CIK-0000101830/542b3ac9-244f-4b19-ba7c-8d6541c5de41.pdf> and <https://d18rn0p25nwr6d.cloudfront.net/CIK-0000101830/b3706741-5644-4c1d-8e1e-80d91085fe07.pdf>.

⁹⁸ <https://www.lightreading.com/mobile-core/standalone-5g-progress-remains-a-disappointment->

⁹⁹ IDC (2023), *Gauging the Success of the T-Mobile-Sprint Merger Three Years In*, p. 4.

¹⁰⁰ IDC (2023), *Gauging the Success of the T-Mobile-Sprint Merger Three Years In*, p. 4.

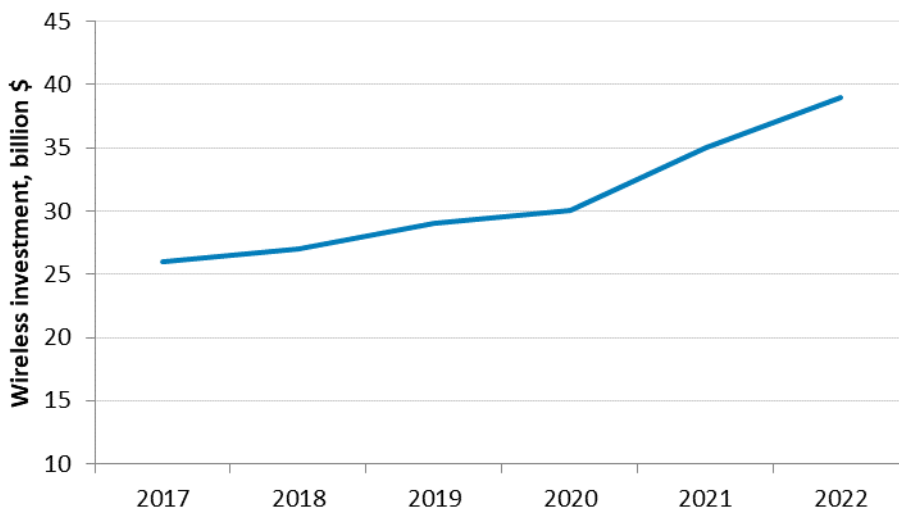
¹⁰¹ <https://www.verizon.com/about/news/verizons-5g-ultra-wideband-now-reaches-200-million-people>.

¹⁰² <https://www.lightreading.com/mobile-core/standalone-5g-progress-remains-a-disappointment->

upgrade capabilities for 5G deployments that align with a network investment-oriented philosophy for a strong wireless foundation to support their competitive positions.”¹⁰³

8.8 The higher investment activity post-merger is also apparent in aggregate investment figures across all MNOs. According to CTIA (2022), investment in the US wireless industry grew slowly from \$26 billion in 2017, to \$27 billion in 2018, to \$29 billion in 2019, to \$30 billion in 2020 but jumped to \$35 billion in 2021 (i.e., a year after the merger),¹⁰⁴ with AT&T and Verizon increasing their investment levels above pre-merger levels.¹⁰⁵ Figure 13 shows that the US MNOs have invested post the Sprint-T-Mobile merger at historically high levels.

Figure 13: Mobile capital expenditure in the US (\$ billion, 2017 – 2022)



Source: Compass Lexecon analysis based on data from CTIA, available at <https://www.ctia.org/news/2023-annual-survey-highlights>.

8.9 Consistent with the higher investment activity, the US is now one of the worldwide leaders in terms of 5G availability – as shown in Figure 14. This example illustrates how a merger can spark an investment race between companies, which can lead to quality improvements that benefit consumers. Increased investments did not coincide with higher prices: consumer prices and average revenue per user continued to decrease in real terms post-merger¹⁰⁶, with quality-adjusted prices falling at the same rate post-merger, as shown in Table 3.

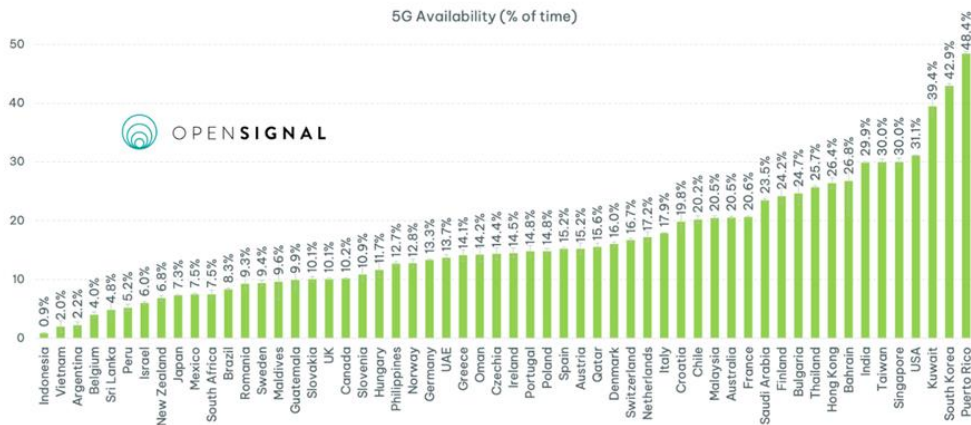
¹⁰³<https://www.fitchratings.com/research/corporate-finance/fitch-rates-t-mobile-senior-unsecured-notes-bbb-06-02-2023>.

¹⁰⁴ CTIA (2022), *2022 Annual Survey Highlights*, 13 September 2022, <https://www.ctia.org/news/2022-annual-survey-highlights> (accessed 20 August 2023).

¹⁰⁵ Compass Lexecon based on GSMA Intelligence data.

¹⁰⁶ Asker, J., & Katz, M. L. (2022). The Sprint/T-Mobile Merger. *Antitrust Economics at a Time of Upheaval*, p. 40. <http://www.johnasker.com/STMO.pdf>

Figure 14: 5G availability, 1 March to 29 May 2023



Source: Opensignal, June 2023 (available at: <https://www.opensignal.com/2023/06/30/benchmarking-the-global-5g-experience-june-2023>).

Fibre roll-out by rivals in the UK led BT to invest more in fibre

- 8.10 At the end of 2017, the UK ranked last in terms of households served by “full-fibre” or “Fibre to the premises” (“FTTP”)¹⁰⁷, when compared to Spain, France, Italy and Germany.¹⁰⁸ At the time, those countries all served more than twice the amount of households than the UK.¹⁰⁹
- 8.11 The UK lagging behind other countries in full-fibre connections was largely due to BT’s strategy to focus on “fibre to the cabinet” (“FTTC”)¹¹⁰ connections and upgrades to FTTC.¹¹¹ For example, despite a 2009 pledge to deploy FTTP services to 2.5 million premises, only about 100,000 premises had FTTP by the end of 2012.¹¹²
- 8.12 At around the time when BT scaled back its FTTP roll-out aspirations, many other (smaller) companies (so-called “Altnets”) started building their own full-fibre connections, with the aim to “capitalise on BT’s hesitation”.¹¹³ In fact, a 2016 survey across INCA members showed that Altnets served more than twice as many premises with FTTP as BT.¹¹⁴ In particular:

¹⁰⁷“FTTP refers to fixed broadband connections where fibre cables extend all the way from the network MNO’s exchange point to end-users’ premises.

¹⁰⁸<https://www.ofcom.org.uk/research-and-data/telecoms-research/broadband-research/eu-broadband-scorecard/2018-interactive-data>.

¹⁰⁹<https://www.ofcom.org.uk/research-and-data/telecoms-research/broadband-research/eu-broadband-scorecard/international-broadband-scorecard-2020-interactive-data>.

¹¹⁰Unlike full-fibre, FTTC only uses fibre cables from the network MNOs’ exchange point to a roadside cabinet. Standard copper telephone cables are then used to deliver broadband from the cabinet to various properties in the area. While FTTC is less costly to deploy, it has significantly lower and less reliable speeds compared to FTTP.

¹¹¹<https://www.inca.coop/sites/default/files/BuildingGigabitBritain.pdf>.

¹¹²<https://www.ispreview.co.uk/index.php/2018/04/building-uk-summary-ftp-broadband-rollouts-investment.html>.

¹¹³<https://www.ispreview.co.uk/index.php/2018/04/building-uk-summary-ftp-broadband-rollouts-investment.html>.

¹¹⁴INCA member survey conducted in June and July 2016. BT reported in June 2016 that “More than 300,000 homes and businesses already have access to FTTP today via Openreach’s network” and INCA’s Member Survey 2016, also from June 2016, showed that Altnets pass 663,670 of UK premises with FTTP.

- In 2017, CityFibre announced plans to bring FTTP to up to 5m premises, working together with Vodafone.¹¹⁵ Industry commentary around that time suggests that “[a]t the very least today’s announcement may further encourage Openreach to do much more FTTP/H than currently planned”.¹¹⁶
- In February 2018, TalkTalk announced it was investing in a joint venture with Infracapital to deploy FTTP to over 3m premises.¹¹⁷
- Similar announcements have been made by a growing number of other Altnets, such as Hyperoptic¹¹⁸ and Virgin Media.

8.13 BT then changed course and announced a “fibre-first” strategy in February 2018¹¹⁹ with industry commentary at the time saying “...pressure from competitors, Ofcom and the Government’s move to prioritise “full fibre” networks has combined to encourage a greater focus toward much more desirable Fibre-to-the-Premises (FTTP) lines.”¹²⁰

8.14 The example of full-fibre roll-out in the UK shows how BT’s initial hesitation to invest in the most advanced technology was reversed in part because of competitors’ increased investment.

The expected response of BT/EE and VMO2 is also supported by the economic literature

8.15 The economic literature offers some insights into the nature of investments and are therefore informative for the expected response from BT/EE and VMO2. In particular, the literature identifies the following mechanisms showing how (potential) investments from one firm may spur a reaction from its rivals:

- **Escape competition effect:** one important motivation to invest in greater quality is the desire to “escape” competition and create a profitable market-leading position. Where a merger results in firms having similar quality and thus more neck and neck competition, each firm can have a greater incentive to invest so as to differentiate its services from rivals.¹²¹
- **Fear of pre-emption:** firms that do not face effective competition may choose to delay investments particularly where there is uncertainty over the returns. However, the

¹¹⁵<https://www.bt.com/content/dam/bt-plc/assets/documents/investors/financial-reporting-and-news/annual-reports/2018/bt-annual-report-form-20-f-2018.pdf>.

¹¹⁶<https://www.ispreview.co.uk/index.php/2017/07/cityfibre-raise-185m-prep-ftth-broadband-homes-5-10-uk-cities.html>.

¹¹⁷<https://www.bt.com/content/dam/bt-plc/assets/documents/investors/financial-reporting-and-news/annual-reports/2018/bt-annual-report-form-20-f-2018.pdf>.

¹¹⁸<https://www.ispreview.co.uk/index.php/2018/11/hyperoptic-get-500m-to-bring-forward-1gbps-uk-broadband-rollout.html>.

¹¹⁹<https://www.reuters.com/article/bt-openreach-broadband-idUSL8N1PR1HJ>.

¹²⁰<https://www.ispreview.co.uk/index.php/2019/09/openreach-put-the-brakes-on-future-uk-g-fast-broadband-plans.html>.

¹²¹ This effect has been studied in the economic literature. E.g., Aghion et al. (2005) show empirically that ‘neck-and-neck’ markets, where all firms operate with the same technology, exhibit higher rates of innovation compared to markets characterized by the presence of some laggards. See Aghion, P. et al (2005), “Competition and innovation: an inverted U Relationship”, *The Quarterly Journal of Economics*, Vol. 120, No.2, p. 719.

greater the risk of a rival pre-empting them to become the market leader, the greater the incentive to bring forward investments rather than delaying them.¹²²

- 8.16 Both of these effects are applicable to the proposed merger, which would create a credible and sustainable third network MNO with the ability and incentive to invest in its network. This indicates that BT/EE and VMO2 will be strongly incentivised to invest in network improvements in response to the merged entity's investments.

¹²² Huisman (2001) has developed a model where firms are considering an investment but returns are uncertain; the presence of rivals who themselves might invest increases incentives to invest in order to avoid being pre-empted. See Huisman, K. (2001). *Technology Investment: A Game Theoretic Real Options Approach*, New York: Springer Science+Business Media, chapter 8. Similar dynamics have been studied by Weeds (2002), see Weeds, H., Strategic Delay in a Real Options Model of R&D Competition, *The Review of Economic Studies*, 69(3), 729–747, 2002.

9 Critics claim that the merger will lead to higher prices without increasing investment, but this is not supported by the empirical evidence

- 9.1 Critics of the proposed merger argue that it will increase prices without increasing investment. However, these claims are based on a limited and selective assessment of the literature, and do not stand up to scrutiny. There is no consensus in the economic literature that mobile mergers in general and four-to-three mobile mergers in particular tend to lead to price increases, a stagnation of investment, or poorer quality and customer service.
- 9.2 Instead, a robust meta-study of the academic literature shows that there is no sound basis for a presumption that four-to-three mobile mergers are likely to harm consumers.¹²³ Market-specific and merger-specific factors are key in assessing the likely effects of any merger and assessing whether consumers are likely to be better or worse off. The UK Government reached the same conclusion in its Wireless Infrastructure Strategy (2023) where it found that “*there is no ‘magic number’ of mobile network MNOs in the market*” and that “*the impact of consolidation on the market will be highly contextual and specific and must be assessed on a case-by-case basis*”.¹²⁴

The empirical evidence shows that there is no basis for a presumption that four-to-three mobile mergers will result in higher prices or lower quality

- 9.3 Some critics of the proposed merger claim that the empirical evidence shows that telecoms prices in three-player countries are higher than in four-player countries, and previous four-to-three mergers have led to price increases, to the detriment of consumers.¹²⁵
- 9.4 These critics often take a partial analysis of the effects of mobile mergers and fail to engage with the important effects of mergers on network capacity and quality which rise over time, including the multiplicative effect on capacity that results as the MNOs’ sites and spectrum are integrated.
- 9.5 Even when considering pricing alone, claims that mobile mergers necessarily lead to higher prices misrepresent the results of previous studies and flawed assumptions that do not reflect the reality of the UK’s mobile market. A report by the Balanced Economy Project¹²⁶ claiming that the merger would raise prices relies on a small selection of empirical evidence, which is biased and not representative of the economic literature on the topic, and fails to acknowledge the limitations of the papers it references.
- a. The report relies heavily on a study by Genakos et al. (2015), which assumes a pre-merger market structure with four equal-sized MNOs to estimate a merger effect. In

¹²³ Padilla et al (2023), [Do four-to-three mobile mergers harm consumers?](#)

¹²⁴ UK Wireless Infrastructure Strategy, 11 April 2023 at <https://www.gov.uk/government/publications/uk-wireless-infrastructure-strategy/uk-wireless-infrastructure-strategy> (accessed 10 November 2023); Future Telecoms Infrastructure Review, 23 July 2018, available <https://www.gov.uk/government/publications/future-telecoms-infrastructure-review> (accessed 10 November 2023).

¹²⁵ Tommaso Valletti (writing for the [Balanced Economy Project](#)) claims that the merger would increase market power and thus be expected to cost each mobile user in the UK an extra £4-£15 a month, or £50-£180 a year, while [Unite the Union](#) relies heavily on a case study of a previous merger in Australia to make these points.

¹²⁶ [Balanced Economy Project](#)

reality, the UK market is characterised by two larger MNOs (BT/EE and VMO2), two smaller MNOs (Vodafone and Three), and a number of MVNOs. The study also uses outdated data that does not take into account the recent evolution of the mobile market (in particular, the significantly greater investment required to roll out 5G compared to previous generations of mobile technology).

- b. The Balanced Economy Project report estimates that there would be a price rise by sourcing figures from Aguzzoni et al. (2017). However, the Aguzzoni et al. (2017) results are taken out of context and used to make a point that is not consistent with the authors' own conclusions. Aguzzoni et al. (2017) study two mergers (Austria, 2006; the Netherlands, 2007) and find that prices for data appear to fall post-merger in Austria (by up to 20%) whereas they increase in the Netherlands (by up to 15%). They conclude that price effects of mobile mergers will be transaction-specific. In no way does this study support a general presumption that mobile mergers increase prices.
- c. The report further relies on two empirical studies published by Rewheel in 2022 and 2020, which have serious shortcomings and cannot be relied upon.
 - i. The 2022 study is a simple analysis which plots smartphone plan prices against an adjusted Herfindahl-Hirschman Index ("HHI"), a measure of market concentration. The study claims to show a positive correlation between concentration and prices. However, it fails to control for omitted factors that might influence both price and the level of concentration in a country. By way of example, deploying a mobile network in a large, sparsely populated country will be more costly compared to a small, densely populated country that requires a smaller coverage layer; hence, the former country can be expected to support fewer mobile MNOs, who will need to charge higher prices to cover their fixed costs. In this example, it would be wrong to conclude that concentration drives higher prices, when in fact geography determines both prices and concentration. Rewheel's simplistic analysis fails to consider such factors.
 - ii. The 2020 study simply groups 41 countries into three-MNO markets, four-MNO markets, and "transitioning" markets, and compares the median price across these, finding lower prices in four-MNO markets. As in the case of the 2022 study, this study fails to account for other factors that might affect both the level of prices and the number of firms. What is more, the analysis ignores any price differences between the countries *within* these groups, and presents only the median price within each group, which can mask significant variation in prices. These median prices may bear little to no relationship with the actual purchasing decisions of consumers and, therefore, with the outcome of competition between MNOs.

9.6 Similarly, some commentators have referred to the 2020 *Vodafone Hutchison Australia/TPG* merger in Australia as an example of where prices have increased following a 4-to-3 merger.¹²⁷ Notwithstanding the fact that this was not a 4-to-3 MNO merger at all (but a merger between an MNO and an MVNO/fixed MNO), the evidence from the Australian

¹²⁷ Oral evidence: Three-Vodafone merger: implications for competition, HC 1869, Business and Trade Committee, House of Commons, 17 October 2023.

Competition and Consumer Commission (ACCC) shows that in the two years following the 2020 merger, prices fell in real terms and feature-adjusted prices decreased by 20.2%.¹²⁸

- 9.7 Instead, a robust meta-study of the empirical evidence on recent four-to-three mergers shows that there is no basis for a presumption that four-to-three mobile mergers will result in higher prices or lower quality.¹²⁹ The study finds that the mergers had little impact on prices, typically having no effect at all, or increasing prices for some customers for a short period only. As shown in Table 3 above, the meta-study also shows that quality-adjusted prices (measured by average revenue per gigabyte of data) fell at the same rate or at a faster rate in several countries following the four-to-three mergers.

The empirical evidence shows that the impact of four-to-three mergers on industry investment and quality has typically been positive

- 9.8 Critics claim that the merger will not lead to increased investment.¹³⁰ They argue that the evidence shows that following four-to-three mobile mergers, while the average investment per MNO may sometimes increase, market-wide investment (aggregated across all MNOs) is generally reduced.
- 9.9 However, the empirical evidence from past four-to-three mergers does not support these claims. The aforementioned meta-study of the empirical evidence on recent four-to-three mergers shows that the impact of four-to-three mergers on industry investment and quality has typically been positive, for instance by extending network coverage and/or increasing download speeds.¹³¹ As Figure 15 shows, European markets in which four-to-three mergers took place have increased their ranking in terms of mobile network performance. This makes sense. If total industry investment stays the same following a merger, even though the merging companies have eliminated some duplicate investment, that must mean that more money is spent on non-duplicative investment in improving network quality.

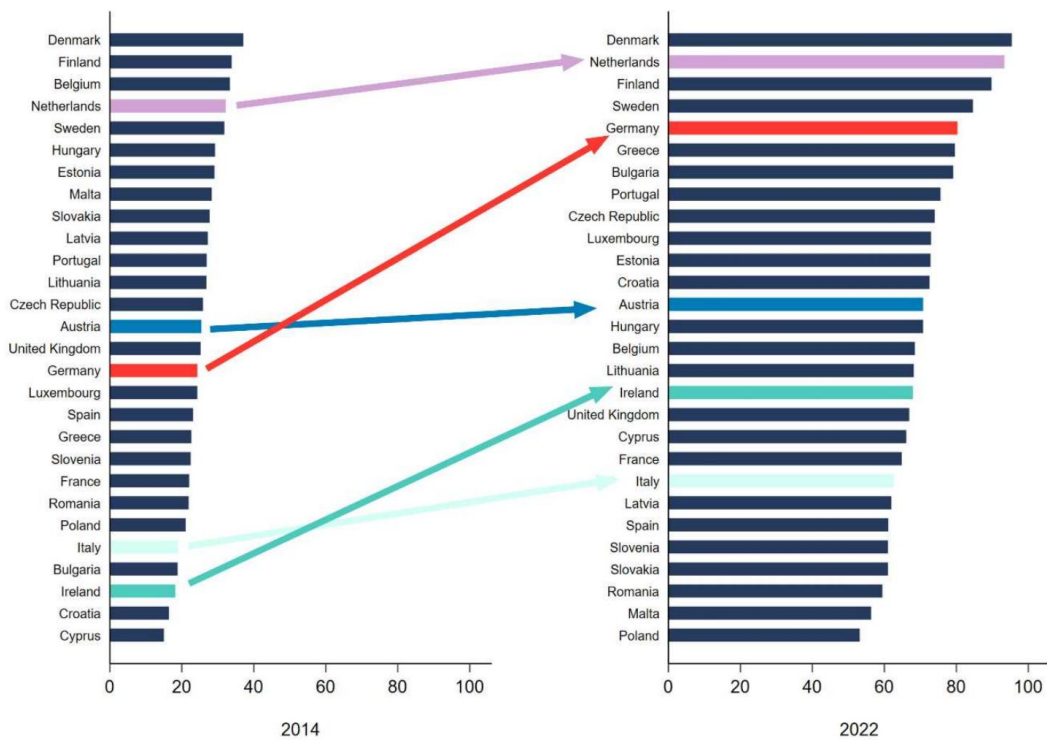
¹²⁸ ACCC (2022), Communications Market Report 2021-2022, Table 5.4, p. 35.

¹²⁹ Padilla et al (2023), [Do four-to-three mobile mergers harm consumers?](#)

¹³⁰ See, for example, a [report](#) for the Balanced Economy Project by Tommaso Valletti.

¹³¹ Padilla et al (2023), [Do four-to-three mobile mergers harm consumers?](#)

Figure 15: GSMA network performance index



Notes: Index is composed of performances in mobile download speeds, mobile upload speeds, and latencies collected by Ookla Speedtest Intelligence. Scaled between 0 and 100 with equal weight on each of the three performance indicators.
Source: GSMA Mobile Connectivity Index.

- 9.10 As explained in Section 8, a range of evidence shows that following the T-Mobile/Sprint (2020) merger in the US, investment and quality have grown at a faster rate. While there are important differences between the US and UK markets, this cautions against a simplistic view that four-to-three mergers necessarily reduce investment and quality, as some critics claim.
- 9.11 Similarly, following the 2020 Vodafone Hutchison Australia/TPG merger, the ACCC noted that all three of Australia’s MNOs continued to make large investments in 5G rollout in 2021-22.¹³² Australia ranks among the leading countries in the world for 5G availability and fast download speeds.¹³³ The merger also appears to have allowed Vodafone/TPG to accelerate its 5G rollout: while Telstra and Optus had a head-start in rolling out 5G, Vodafone/TPG has closed the gap post-merger.¹³⁴ This year, Vodafone/TPG was awarded the 5G Availability award and also made impressive gains in 5G Reach, according to OpenSignal.¹³⁵

¹³² ACCC. (2022). *Communications Market Report 2021-2022*, p. ix.
¹³³ OpenSignal. (2023). *Benchmarking the Global 5G Experience – June 2023*.
<https://www.opensignal.com/2023/06/30/benchmarking-the-global-5g-experience-june-2023>
¹³⁴ <https://whatphone.com.au/coverage/tpg-is-taking-the-5g-race-to-telstra/>
¹³⁵ OpenSignal: <https://www.opensignal.com/reports/2023/04/australia/mobile-network-experience#:~:text=Telstra%20has%20the%20best%20consistent%20quality&text=Telstra%20comes%20top%20for%20Excellent,percentage%20points%20over%20Vodafone's%2090.2%25.>

The Vodafone/Three merger must be evaluated on the basis of evidence specific to the circumstances of the merging parties and the UK's mobile market

- 9.12 Market-specific and merger-specific factors are key in assessing the likely effects of any merger and assessing whether consumers are likely to be better or worse off. Instead of relying on selective pieces of evidence from past four-to-three mergers – which are often outdated and irrelevant to the UK – to predict the potential effects of the Vodafone/Three merger, it is important to assess the merger on its own merits. That is what CMA will do in its merger review process. This will involve taking into account prevailing and future market conditions, the market positions and financial performance of the merging parties, the significantly higher investment required to roll out 5G Standalone and Advanced 5G, and the competitive impact of the merger on existing rivals.
- 9.13 Given the significantly higher investment requirements to roll out Advanced 5G, with much of this investment of a fixed cost nature, the minimum scale for an MNO to be viable is higher with Advanced 5G. The current UK market structure, with two sub-scale MNOs, is unable to deliver this investment. The merger will create a viable and competitive third scale network with the ability and incentive to invest, increasing competitive pressure on the two scale players to invest in their networks.
- 9.14 As explained in Section 7, the significant increase in capacity combined with the largely fixed nature of costs means that the merged entity will be incentivised to fill its network by offering better value (e.g. more data for the same price) and lower prices when adjusted for quality to attract customers from rivals. The merged entity also will have a lower incremental cost of expanding capacity to serve new customers. These factors will exert a downward pressure on prices in both retail and wholesale markets.

10 Conclusion

- 10.1 **The UK is falling behind leading countries in the rollout of Basic 5G and 5G Standalone, which are stepping stones to achieving Advanced 5G.** Advanced 5G – the fully mature version of 5G technology – can deliver the full potential of 5G, including large gains in network capacity, high data transfer speeds, high reliability, low latency, and much higher user density, which are required to support new use cases. A successful and timely rollout of Advanced 5G will lead to significant benefits for consumers, industry, and the UK economy.
- 10.2 **The current UK market structure, with two smaller mobile MNOs that lack the ability and incentive to invest, will not deliver this investment.** Vodafone and Three are currently sub-scale and making returns below cost of capital. Their poor financial performance means that they are unable to fund the levels of investment required to roll out nationwide Advanced 5G networks. Without competitive pressure from Vodafone and Three, BT/EE and VMO2 will be incentivised to slow walk their own Advanced 5G network deployments, to the detriment of UK consumers and the wider economy.
- 10.3 **However, the proposed Vodafone/Three merger changes that.** The merged entity will become a viable and competitive third network that has both the ability and incentive to invest in deploying one of Europe’s most comprehensive and 5G SA/Advanced networks, powering the UK’s digital economy and creating the jobs of the future. The parties plan to invest over £6 billion during the first five years post-merger, and more than £11 billion across the first ten. This level of infrastructure investment would be expected to support a large number of new jobs, both directly related to the network roll-out and across the wider economy as the Advanced 5G technology transforms business practices and drives economic growth.¹³⁶ The presence of a third player with scale will also increase competitive pressure on BT/EE and VMO2 to invest in their networks and price competitively, benefitting competition in both retail and wholesale markets.
- 10.4 **The merger will deliver on the Government’s key objectives.**
- By putting in place a better, more extensive best-in-class network more quickly, the merger will deliver up to £5 billion per year in economic benefits to the UK by 2030. This includes supporting digital transformation and delivering Advanced 5G/5G Standalone to all schools and hospitals across the nation by 2030.
 - The merger will also be pivotal in tackling the urban vs rural digital divide – the merged entity’s network will deliver 95% 4G geographic coverage by 2027 and 5G Standalone to 99% of the UK’s population by 2034.
 - By driving forward the rollout of Advanced 5G, the merger will accelerate the development of new sectors and new use cases, establishing the UK as a 5G world leader and a leader in innovation.

¹³⁶ For example, Boston Consulting Group has predicted massive job and GDP growth, with between 800,000 and 1 million new jobs created, resulting from 5G roll-out in the US. See Boston Consulting Group, [5G Promises Massive Job and GDP Growth in the US](#).

- Advanced 5G will help to reduce greenhouse gas emissions and ensure efficient public service delivery, delivering significant cost savings for the UK public sector.