Non-confidential

Ofcom's future approach to mobile markets

BT response to Ofcom's discussion paper

26 April 2022

Executive summary

Ofcom's review is timely: material changes in technology, the mobile value chain and market structures are under way. BT agrees with Government that future national mobile networks will be key in "*unlocking new opportunities for growth and prosperity, and delivering the government's key objectives including levelling up, building back better, net zero and Global Britain*".[1]

We share Government's vision, but believe a step-change in investment requires a step change in policy. Simply continuing with the current model because it has worked so far is not credible. Ofcom's discussion document falls short in this regard: it is an unrealistic appraisal of today's market situation, thus stopping short of new ideas on how policy and regulation could change.

The current policy environment is unlikely to support the step-change in industry investment needed

Ofcom recently set out a wide range of possible mobile traffic growth scenarios over the next decade and beyond. There is a high likelihood that the step change in the 5G infrastructure investment required to meet even Ofcom's medium traffic growth scenario will overly stretch industry's resources.

Ofcom's view is that "*at an industry level, financial performance appears to support investment*", but its own analysis does not support this statement: it shows two of four MNOs have not covered their cost of capital on a continuous basis. It also shows industry profitability on a declining trend. This is the situation under Ofcom's preferred view of economic returns: the position is even more pronounced under accounting terms. Ofcom's overall analysis over-states industry profitability, based on adjustments to EE's (and other MNOs') balance sheets.

Ofcom must recognise how investment decisions are really taken. Past, current and future profitability matter as investors take past performance as an indicator for future performance unless the current market dynamics and regulatory approach change. In addition, profits are a key source of funds for investment in the industry: for example, BT interrupted its dividend payment for two years from 2019-2021 to create capacity for our investments.[2]

Ofcom's historic approach to regulation needs to change more fundamentally than proposed

Mobile competition has driven operator investment to avoid losing scale. This model may have delivered good consumer outcomes in the past, but the sector is undergoing fundamental changes. [✂] Changing customer and product mixes suggest declining average per user revenue. Yet, the investment required for the UK to benefit from a world-class 5G eco-system is significant. This market context needs more fundamental changes in policy and regulation than suggested by Ofcom.

Simplistically concluding competition will drive investment, almost regardless of financial performance, underplays risks to investment. This risk is real for consumers: constrained investment means new use cases could be delayed, and consumers and businesses could see network performance suffer as demand exceeds supply. Future market changes require more fundamental changes in policy and regulation than suggested by Ofcom.

[1] DCMS (2021), Wireless Infrastructure Strategy: a vision for 2030.
[2] BT (2022), Dividends.

We welcome Ofcom's openness to considering mobile mergers on their merits, rather than pre-supposing outcomes on the number of players. But we think the UK needs fresh policy ideas: many of Ofcom's positions build on policies that are at times more than a decade old, including: a strategy for balancing TV versus mobile spectrum set in 2014, spectrum pricing frameworks put in place in 2010, net neutrality rules stemming from a policy debate that pre-dated even superfast broadband and 4G. The world has, and will continue to, move on at pace. Policy needs to do the same.

We have five recommendations that could kick-start a change in mobile markets for the benefit of all UK consumers and businesses, across competition policy, spectrum policy, connectivity business models (net neutrality), digital competition, and measuring outcomes. This is in addition to actions for Government set separately out in our response to Government's review of wireless infrastructure (see Appendix H).

Our recommendations

1. An investment step change needs an equivalent change in how policy-makers consider market structures

Given market returns, consolidation is likely a necessary (but not sufficient) condition for a step-up in efficient 5G investment. Consumer benefits will continue to be driven by technology innovation and investment. In the past, this has driven dramatic data price reductions, but these trends are unsustainable if investment is to be sustained or stepped up. Past merger policy has predominantly focused on short-run price effects. Competition and merger assessments must place greater focus on long term consumer benefits driven by investment than they have in the past.

2. Spectrum policy and release need to recognise short term measures to increase capacity and look further out too

Current spectrum release plans help but are insufficient to allow industry to deliver even Ofcom's medium traffic demand scenario.

Ofcom should pursue 600 MHz designation for mobile at the 2023 International Telecommunications Union World Radio Conference. Policy-makers must revisit past TV distribution policy now: the lead time for changes in this area is long. Additional 6 GHz mid-band spectrum is also needed. Further licence-exemption and localised licensing are likely to exacerbate this spectrum shortfall.

Annual Licence Fee ('ALF') policy originates from 2010 (2013 for broadcast spectrum): this needs to be reviewed holistically. We think ALFs hinder efficient spectrum trading and are a c.£350m pa direct cost that could otherwise be re-invested.

3. A step change in investment can only be funded by more sophisticated business models - Net Neutrality rules need to break with a past debate first initiated in 2003

Internet traffic rules must support efficient network investment and traffic delivery in the most efficient way. The current net neutrality rules were written when linear TV was more important than streaming and before 5G and the metaverse were even in prospect. They constrain network and

business model innovation. They limit incentives for efficient traffic delivery and create a charging structure that does not link payments to cost drivers.

Net neutrality policy must take a forward-looking view – it should create options to allow traffic management and charges for inefficient use, enable more commercial relationships with the largest content providers and provide more clarity on rules for services for large business users ('specialised services').

4. Regulation must credibly address the risks to consumers from wider, digital markets

Ofcom's consumer regulation must evolve so positive consumer outcomes in wider digital markets remain unaffected. Large digital firms' activities are increasingly overlapping with communications markets, with implications for consumer experience and investment. Risks include leveraging market power into adjacent communications markets (by becoming gatekeepers to consumers, restricting customer choice and imposing unfair partnership terms on network providers).

Ofcom should proactively pursue (and be given) a formal role under the Government's planned pro-competition regime for digital markets. This could include on-going market monitoring, recommending digital market studies where bottlenecks emerge, and assisting the CMA with its analysis and remedy design.

5. Ofcom needs a more holistic approach to measuring outcomes, including consumer value and the cumulative burden of regulation

Today, Ofcom's reporting on customer value is still dominated by pure price measures. Monitoring monthly expenditure is important, especially for lower income customers. But Ofcom should also consider value holistically, including quality, to really judge how good consumer outcomes are.

We welcome that Ofcom believes no new mobile consumer protections measures are required and are committing to consider new rules' investment effects. Ofcom must also periodically review the cumulative burden of regulation and its effect on investment. Current policy is expected to result in annual costs to BT alone of c. £200-300m, around a third to a half of our mobile capex.

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1 A step change in investment is needed

Fairness and consumer protection are important aspects of consumer outcomes and we agree with Ofcom that there is no case for further intervention given the range of choice available, high levels of customer satisfaction and increasing engagement. Our focus therefore is on what we see as the biggest risk area: investment levels to deliver the future mobile networks the UK needs.

This section sets out why 5G networks are a key pillar to future UK productivity. While stable investment has to date delivered great benefits to UK consumers and the economy, a step up in investment is likely to be needed going forward so 5G can live up to its potential.

1.1 5G is a key pillar of future UK productivity

As set out in our response to the Government's call for evidence on its wireless infrastructure strategy ('WIR'),[3] 5G will enable productivity improvements across a much wider range of sectors and activities than previous generations of mobile technology upgrades. Accelerating digitalisation across all sectors, which has been fuelled by the COVID-19 pandemic, is likely to further increase the share of productivity improvements attributable to telecoms services. Indeed, PwC have recently estimated that productivity and efficiency gains enabled by the roll-out of 5G technology in five key sectors will drive business, skills and service change worth £43bn to UK GDP by 2030, while uplifting global GDP by about 1% every year 2030.[4]

We agree with Digital Catapult's assessment that "*[g]etting the infrastructure right is crucial to a country's ability to roll out, adopt and innovate successfully*": existing and next generation mobile connectivity is a key part of that.[5] The rollout of 5G (combined with full fibre), particularly the deployment of 5G Stand Alone (that is not reliant on support from existing 4G infrastructure), can transform the impact connectivity has on other sectors of the economy. The value of 5G lies in combining a first-class network with the value and competitive differentiation offered by the services delivered over them. 4G was principally about driving a step change in the number of applications delivered into consumer markets. 5G will deliver new applications and use cases for consumers (e.g. video gaming) but is likely to be more transformative in B2B markets than previous generations of mobile technology upgrades.[6]

Unlike in previous technology roll outs, new use cases are developing for specific industry verticals. Ofcom is right to call out 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 (often referred to as the Industrial Internet of Things, 'IoT') and which are likely to require features such as high reliability, security, bespoke capabilities and speeds.[7] We can see 5G come to life through:

- Healthcare – medical device tracking, emergency communications, remote healthcare for diagnosis and treatment, and remote surgery.
- Manufacturing – augmented reality to monitor processes and production flow, connected robots to assist with transport of goods and materials.

[3] Our response to the Government's call for evidence: see Appendix H.

[4] PwC (2021), Adoption of 5G technology to add £43bn to UK GDP by 2030.

[5] Digital Catapult (2021), Digital Future Index 2021-22, page 53.

[6] The ONS' latest communications sector GVA multiplier (1.342) provides a base case for 5G spill-over effects, which is likely to be exceeded by 5G given that the technology will enable so many fundamental changes in particular in business to business ('B2B') applications. Office for National Statistics (2018), UK input-output analytical tables (2018 edition). This multiplier means that for every £1 of direct economic output (GVA) generated by the UK telecoms sector, a further £0.34 of economic output is generated in the rest of the UK economy, making its total economic contribution £1.34.

[7] Ofcom (2022), Ofcom's future approach to mobile markets: a discussion paper, paragraph 5.12 ('Ofcom discussion paper').

- Public sector – asset tracking, waste management (e.g., sensing when bins require collection), smart parking (reducing congestion and improving usage of parking spaces).
- Road safety and efficiency – services providing information to drivers about imminent dangers such as red-light violations, hazard, collision, and traffic jam warnings.

Public 5G mobile networks will have material external benefits to the economy and wider society. These are likely to be realised through both as spill-over effects from commercial investment (as summarised above) as well as publicly funded activities targeting specific externality benefits.[8] These might include environmental benefits[9] or economic productivity improvements resulting from stimulating demand (such as 5G test beds and trials), or social inclusion (e.g., via coverage obligations).

The spill-over effects from commercial investment in 5G include the wide coverage and availability of 5G networks. For example, we expect EE's 5G network to cover more than half the UK population very soon (and well ahead of the Government's 2027 ambition). We aim to deliver 5G connectivity solutions anywhere in the UK by 2028 and complete the country's only fully converged network by the mid-2020s.

1.2 A step-up in investment is needed for the UK to lead in 5G

Capex envelopes have been relatively constant over the past five years with capex-to-sales ratios of around 17% in Europe since 2016, and capital non-network capital expenditure (excluding spectrum) broadly stable in nominal terms in the UK.[10] So far in the UK, the main rationale for the current phase of 5G investment is support of enhanced mobile broadband (eMBB). The nature of 5G competition in the mobile sector today means that the services supporting unlimited data offers (made popular under 4G) therefore largely maintain existing revenues.

For 5G to enable the most demanding use cases delivering mobile networks fit for the next decade and beyond, extensive changes will be needed across the entire mobile network. These will include investments so networks can support ultra-low latency applications (allowing a very high volume of data packets with an extraordinarily low tolerance for delay to be processed) and mMTC (Massive Machine-Type Communications) (a category of 5G that can support extremely high connection density of online devices). In turn, this is likely to require upgrades including but not limited to small cells, as well as in the radio access network, core and backhaul network (i.e., the fibre links serving new cell sites or delivering increased fibre capacity to them) not in operator plans today.[11]

Comparing the number of small cells Ofcom considers will be necessary to cater to even its medium growth scenario (30,000-50,000 everywhere except the less busy rural areas by 2035) to those in BT's most recent medium-term plan (for the next 5 years) [✂] illustrates this point.

Figure 1 shows there already is a gap between mobile download speeds and data consumption in the UK vs market leaders in other countries. For UK mobile networks to lead globally, a step up in investment will be needed.

[8] Positive externalities are benefits of a private transaction impacting third parties not part of the transaction.

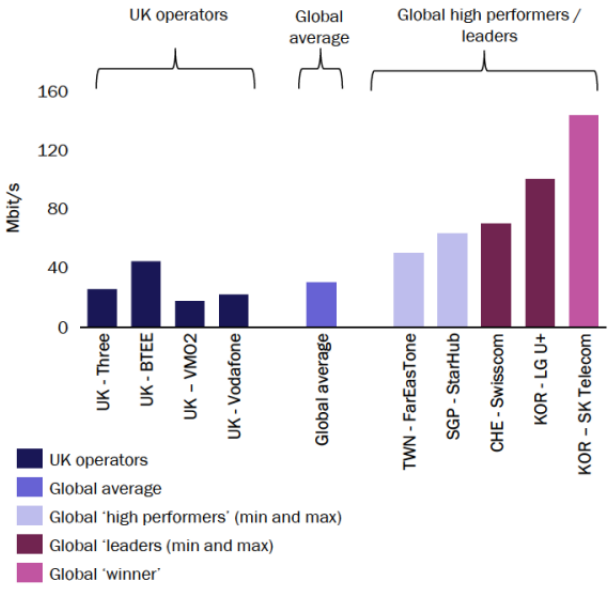
[9] For example, 5G networks are up to 90 per cent more energy efficient per unit of traffic than legacy 4G networks, according to both Ericsson and Nokia. See: Ericsson (2021), Sustainability and Corporate Responsibility report 2021, page 3; and Nokia (2020), Nokia confirms 5G as 90 percent more energy efficient.

[10] Credit Suisse (2021), Q2 21 Euro Mobile Review: Mobile revenues return to growth, Figure 50, page 24. Ofcom discussion paper, Figure 4.2.

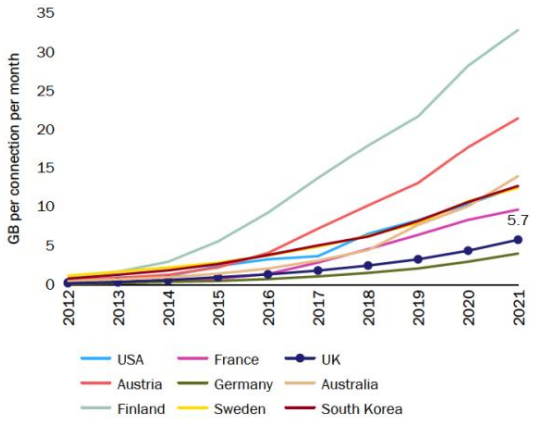
[11] Ofcom should also consider that mobile network operators need bespoke products to serve their connectivity needs to and from mobile cell sites, and that this is likely to increase as 5G deployment progresses. Therefore, as part of the next WFTMR Openreach should be given greater flexibility to tailor its offerings to MNOs specifically so it can do more to facilitate the deployment of 5G.

Figure 1: How does the UK compare internationally? [12,13]

International download speeds



International mobile data usage over time



On the current trajectory, the UK risks constrained capacity and less innovation enabled by public 5G mobile networks than market leaders enable elsewhere.

The Broadband Stakeholder Group have commissioned a study from Frontier Economics which will estimate the forward-looking investment gap for full 5G rollout. We encourage Ofcom to carefully take its findings into account in its assessment as we consider that on the current trajectory industry is unlikely to be able to meet Ofcom's anticipated traffic demand (as noted above), nor the likely wider investment requirements of the 5G ecosystem.

Making more spectrum available for public mobile networks will go some way in helping deliver better mobile infrastructure for the UK (see section 4.2 below). However, in addition to making the spectrum available that would enable efficient investment in mobile infrastructure for 5G, a more general pivot to an investment friendly regulatory framework is needed.

[12] Analysys Mason (2022), based on Opensignal (2022), United Kingdom Mobile Network Experience Report September 2021 and Opensignal (2022), Global Mobile Network Experience Awards 2022 report.
[13] Analysys Mason (2022).

2 Returns on investment are already low for this industry

We have concerns Ofcom's review underpays the importance of and current trends in industry returns. It is too sanguine about the implications for future investment given:

- comparative profitability in the UK is low both in absolute terms and by international comparison,
- Ofcom overstates BT's mobile profitability with simplistic adjustments to EE's (and other MNOs') balance sheets,
- past, current and future profitability matter greatly for current and future incentives to invest,
- forward looking trends suggest returns will continue to face pressure, and
- pressure on returns influences investment.

2.1 Comparative profitability in the UK is low both in absolute terms and by international comparison

It is not sufficient for Ofcom's discussion paper to simply say "*Based on recent reports from a number of different equity analysts, falling returns are a common trend across Europe, suggesting that declining returns in the mobile market is not a UK specific issue*".[14] Ofcom needs to consider what it **can** do to address deteriorating returns in the UK if it wishes to see significant continued investment in UK public mobile networks.

The investment environment for telecommunications in Europe, including in the UK, has been poor in comparison with other advanced countries. [15] Investment by operators in the European telecoms sector is significantly lower than in the USA, Japan and South Korea, even after allowing for differences in GDP: for example, Japan's investment per capita is about two and a half times higher than in Europe. [16] This pattern is also matched by differences in network operator profitability between Europe and elsewhere.

Moreover, Deloitte indicates returns in the UK are even below those in Europe, which, coupled with uncertainty around future returns from 5G investment, may already be contributing to lower capital investment in the UK.[17] UK MNOs' EBITDA margins have generally been below European mobile operators (with some operations in other large European markets earning double) and, over the same period, levels of UK investment (i.e. capex/revenue ratios) have remained below those of MNO operations in other European markets.[18]

Expectations of continuing low rates of return in the UK are likely to lead to investment being focused on other markets with higher (risk-weighted) returns. European telcos are experiencing an all-time low performance relative to broader equities and the sector is not growing despite investment.[19]

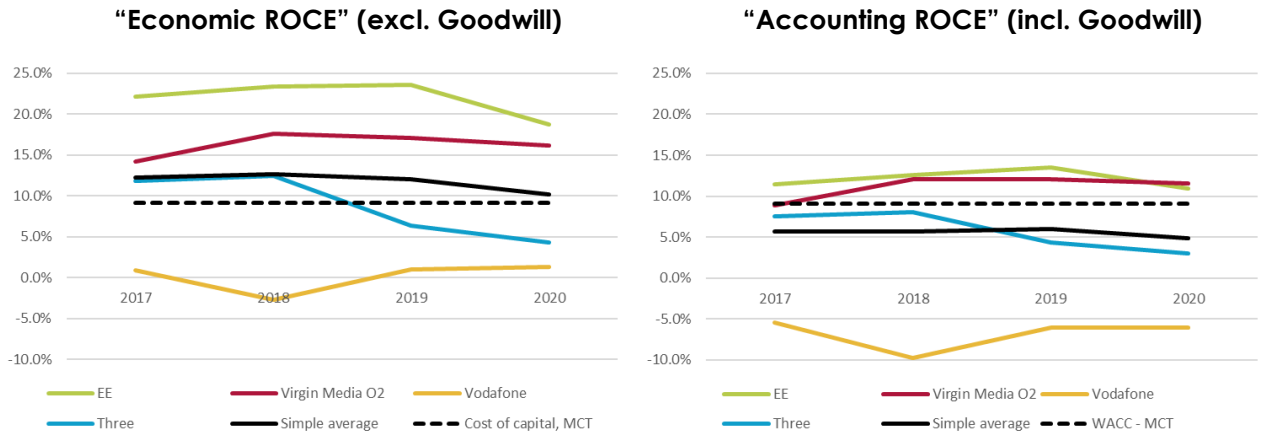
[14] Ofcom discussion paper, page 59.
[15] AllianceBernstein (2020), Time to Hang Up on European Telecom Stocks?.
[16] ETNO (2021), The state of digital communications, Figure 1-20.
[17] Deloitte (2022), Future of the UK Mobile and Wider Communications Value Chain, page 5.
[18] Ibid, pages 4-5.
[19] Credit Suisse (2022), European Telecoms: Getting out of the rut II, Figures 3, 8 and 9.

2.2 Ofcom's analysis over-states today's industry profitability

Despite setting out the variation in industry profitability – with Vodafone and Three reported to have made below WACC returns since 2017 and 2019 respectively – Ofcom concludes average industry profitability is healthy.

Ofcom puts this down to its measure of average economic return on capital employed ('economic ROCE') of around 11% (compared with its forward-looking estimate pre-tax nominal mobile WACC of 7.8%). Ofcom finds BT/EE's economic ROCE to be very high at 18-22% – up to nearly three times the mobile WACC.[20] Ofcom's findings of economic ROCE contrast significantly with its view of accounting ROCE, as Figure 2 below shows.

Figure 2: MNOs' ROCE using Ofcom's "economic ROCE" and "accounting ROCE" approaches[21]



The main difference between Ofcom's accounting and economic ROCE is the exclusion of goodwill.[22] Including goodwill (identified by Ofcom from operators' published accounts) in economic ROCE would result in average industry profitability in 2020 of around 7%, compared to the 10% Ofcom finds and below its forward looking WACC estimate. This would make BT/EE's economic ROCE around [✂].

Ofcom recognises that investors "*may consider*" goodwill when "*evaluating how successful management has been at investing historically and inferring the likely future direction of returns and thus rely on something closer to accounting ROCE*".

Yet, Ofcom concludes that for its own assessment of investment prospects, economic ROCE is more relevant. Ofcom's explanation for excluding goodwill is that this is "*appropriate if the purpose of the profitability analysis is to understand whether the market dynamics allow operators to earn sufficient returns to continue investing (i.e., above the cost of capital).*"[23] But most investors do not use Ofcom's measure of returns to assess historic performance, using accounting measures instead; and they tend to also use accounting ROCE to construct their forecasts.[24]

We don't consider it wrong in principle to adjust accounting returns so they better reflect the underlying economic returns of a business and don't disagree that such a measure should reflect replacement cost valued at current cost. But we do not agree this means all goodwill should,

[20] Ibid, over the period 2017-2020.

[21] BT analysis of data in Ofcom (2022), MNOs' ROCE calculations.

[22] Ofcom excludes MNO goodwill from economic ROCE in 2020: EE (£6.4bn); O2 (£2.4n); Vodafone (£310m).

[23] Ofcom discussion paper, paragraph 6.15.

[24] See, for example: (i) Barclays (2022), European telecom services: who is creating and who will create value?, page 3, (ii) Berenberg (2022), Some green shoots, eyes on the 2023 silver bullet, notes on page 3, (iii) Bank of America (2021), BT: Visibility supports re-rating – upgrade to Buy, page 14 and (iv) Goldman Sachs (2022), BT Group: Growing confidence in BT's 'Digital Infrastructure' monetisation, page 7.

practically by definition, be excluded from a measure of economic ROCE as Ofcom seems to suggest.

Goodwill is a revenue generating asset with investment costs set against it. It reflects genuine investments any company would have had to make in building up a valuable business such as EE at the time of its acquisition by BT. At the time of the merger with EE, BT noted that the goodwill of £6.4bn arising from the acquisition was attributable to "*the revenue synergies expected to be generated from new cross-selling and bundling opportunities across the enlarged customer base as well as EE's ability to generate a new subscriber base in the future to replace subscribers churn.*"[25]

Ofcom claims that it is "*generally appropriate to exclude*" goodwill from the calculation of capital employed by reference to the CMA's energy market investigation,[26] noting that "*this approach avoids the risk of capitalising the value of any excess profits that the business is able to generate, which may be reflected in the purchase price and hence the purchased goodwill*". [27] However, there is no general rule as to whether specific asset classes should be included in economic ROCE in general. Instead, whether assets should be included, or their valuation adjusted in an economic assessment of replacement cost (assessed at current cost) must be considered by reference to specific evidence.[28] Ofcom has not conducted any such analysis or presented any compelling evidence.

To the contrary, Ofcom has over the years re-iterated its view (which we agree with) that mobile markets are competitive since well prior to the BT/EE merger. At the time of the merger, the CMA did not identify any competition issues. Ofcom has provided no valid justification for excluding goodwill from (or even reducing its value as part of) the denominator in its ROCE calculation.[29] It also presents no other evidence to suggest that the underlying value of goodwill arising from BT's acquisition of EE might not be consistent with the true economic value of the assets at the time of the acquisition. In fact, at the time of the acquisition the CMA noted "*[w]e consider that the agreed acquisition price largely reflects the underlying value of the standalone EE business.*" [30]

We consider that the price paid by BT for EE reflected the long run value we and our shareholders considered that EE would bring to the business within a highly competitive mobile market. BT's annual impairment review would reflect any reduction in the value of goodwill (or any other revenue generating assets) over time.

2.3 Past, current and future profitability matter for investment incentives

It is not clear to us how Ofcom can conclude that financial performance appears to be supportive of investment when average returns are declining, and two out of four MNOs have not made back their cost of capital on a continuous basis. Investment is not a single decision, but rather a series of decisions made over decades, the historic approach to regulation, market dynamics and returns

[25] BT (2016), Annual Report 2016, page 196.

[26] Ofcom discussion paper, Annex 6, footnote 64.

[27] Ofcom discussion paper, paragraph A6.10.

[28] The CMA Guidelines set out that, "*in industries with a relatively low level of tangible assets, such as service and knowledge-based industries, the book value of capital employed may bear little relationship to the economic value because of the presence of significant intangible assets. In digital markets, this is particularly the case where there is internal investment in intangible assets such as intellectual property (IP), R&D and patents, rather than acquisition of technology from third parties*". See for example: CMA (2021), Mobile ecosystems market study interim report, Appendix D, paragraph 32. We recognise that intangible assets are not necessarily the same as goodwill (although goodwill can represent an intangible asset created by virtue of M&A activity). Goodwill can relate to intangible assets that have not been identified or fully valued elsewhere on the balance sheet.

[29] In the Annex to its discussion paper, Ofcom justifies the exclusion of Goodwill by reference to the CMA's investigation into energy markets (here) which, at the time, concluded that markets and competition were not working well for consumers (CMA (2016), Energy market investigation, summary report).

[30] Competition and Markets Authority (2015), A report on the anticipated acquisition by BT Group plc of EE Limited, Appendices and glossary, Appendix E, paragraph 11.

(made on previous investments in technology) inform future expectations. Unless market dynamics or regulation change, investors are unlikely to see a change in the trend in returns.

For example, Credit Suisse notes "*sector returns [have been] below cost of capital for over a decade*" and questions whether the sector is "*broken*".[31] Similarly, Bernstein writes "*With poor market structures continuing to be the norm in 2022, traditional telcos will remain a story of weak fundamentals with limited topline growth, a lot of capex and high leverage*".[32]

Furthermore, current profits (i.e., retained earnings) are a key source of funds for investment for MNOs, given they work within constrained capex envelopes. A material expansion of the balance sheet either through new debt or equity issuance ultimately risks increasing an operator's cost of capital, impacts their credit rating or both, thus increasing the cost of finance. This in turn tends to set the bar for investment higher, ultimately also impacting consumers. BT suspended its dividend for two years in a row to create capacity for its fibre investment, and the CMA reported that Hutchison's incentive for selling its towers was to generate cash for its investments in 5G: past and current returns matter greatly for industry's capacity to invest. [33]

2.4 Forward looking trends suggest returns will continue to face pressure

Given levels of profitability today, the trajectory of future revenues and average revenue per user (ARPU) matter as do the changes in the value chain (see section 3). While Ofcom calls out some of these trends, it does not draw out the implications for industry's capacity to invest on a forward-looking basis.

Examples of challenging future trends

Industry margins per Gigabit of traffic are likely to continue to be challenged	Looking to the future, [✂], while traffic demand continues to grow and aggregate service and B2B revenue in the UK have been declining year on year.[34] This is driven by lower service ARPU customer segments increasing, with higher ARPU segments decreasing.

[31] Credit Suisse (2022), European Telecoms: Getting out of the rut II, pages 2 and 3.

[32] Bernstein (2022), European Telecommunications: 2022 Outlook, page 1.

[33] For example, the CMA recognised that Hutchison wanted to use cash proceeds from its Cellnex transaction to enable it to increase funding of its mobile network in the UK. CMA (2022), Anticipated acquisition by Cellnex UK Limited of the passive infrastructure assets of CK Hutchison Networks Europe Investments S.À R.L. Final report, paragraphs 5.97 and 5.91.

[34] Morgan Stanley (2022), Telco in ten charts, Exhibits 7 and 8.

Customer mix and associated revenues are changing	Business to consumer (B2C) SIM only accounts and business to business (B2B) accounts are growing at the expense of the highest ARPU segments (B2C handset), and intense competition for the custom of MVNOs is set to continue if not intensify in particular if hyperscalers[35] enter the market (see section 3).[36, 37] Split and SIM only contracts now dominate the market (CCS Insights put this at 44% and 17% of the market in 2020) with SIM only forecast to continue to grow (to 60% of the market by 2026).[38] Overall consumer ARPU is forecast to decline: CCS Insight forecast a decline in contract ARPU of 5% in 2021 to £18.12, and reaching £15.55 in 2026 (not materially offset by a slight rise in pre-paid ARPU).[39] Credit Suisse notes UK ARPUs 'look particularly vulnerable' vis-à-vis even European comparators.[40] As Ofcom recognises, today's wholesale market is very competitive, with MVNOs having significant power in negotiations. We also observe [✂].[41]
New digital entrants risk further reducing connectivity providers' sources of revenues and value	We welcome competition and consider it is good for consumers and investment. But there are risks of new competitive bottlenecks emerging, which could exacerbate the focus on price rather than quality and network investment, and limit customer choice. It would also weaken telecoms providers' negotiating power with hyperscalers who are often suppliers of inputs to the industry, partners (in providing services to end users) as well as competitors (see section 3). In turn, this could put further pressure on the ability to monetise network investments and make fair returns.

2.5 Pressure on returns influences investment

The above trends taken together have led to analyst and investor calls for sector consolidation.[42,43] For example, J.P. Morgan states "*one could legitimately question the long term sustainability of [3UK] currently "losing" £0.2bn pa in EBITDA minus capex, and where there is very little prospect of ever generating a healthy return on capital*".[44] It then goes on to say "*we suspect the UK market post [a Vodafone-3UK] deal would still remain competitive given the highly fragmented convergent Telco market, and the presence of numerous successful MVNOs*".[45]

[35] Hyperscalers provide cloud, networking, and digital services on a very large scale.
[36] CCS Insight (2021), Market Landscape and Forecast: Telecom Operators, UK, 2021-2026, December 2021 update, page 23.
[37] GlobalData (2022), UK Mobile Broadband Forecast, March 2022, rows 98 and 99.
[38] CCS insights (2021), Market landscape and forecast telecom operators UK, December 2021 Update, page 23.
[39] Ibid, page 25.
[40] Credit Suisse (2022), European Telecoms: Getting out of the rut II, page 10.
[41] [✂]
[42] Enders states "*we see a strong case for consolidation*" in Enders (2022), Modest gains in growth and regulation: UK mobile market in Q4 2021, page 12.
[43] Credit Suisse states "*consolidation is positive and any improvement would be welcome*" in Credit Suisse (2022), European Telecoms: Getting out of the rut II, page 30.
[44] J.P. Morgan (2022), European Telcos: Deal or no-deal? Assessing the prospects for future in-market European consolidation, page 68.
[45] Ibid, page 69.

Network investors will only invest beyond what's required to maintain the value of existing assets if the additional investment comes with commensurate expected returns in the context of a risk assessment. MNOs may forego marginally NPV positive projects if the expected NPV of the project is subject to material uncertainty about future policy and regulatory interventions. Similarly, if the expectation is that the regulatory environment remains unfavourable, NPV positive projects will not be realised.

3 Wider value chain changes may create new challenges

Exacerbating the above trends are future risks resulting from the changes in the value chain we are observing. Large tech firms could become gatekeepers to consumers (disintermediating telecoms providers to the detriment of consumers) or develop entrenched market positions that could limit mobile operators' choice when contracting with large tech partners, subject them to unfair terms, in turn impacting their ability to compete against them on a level playing field.[46]

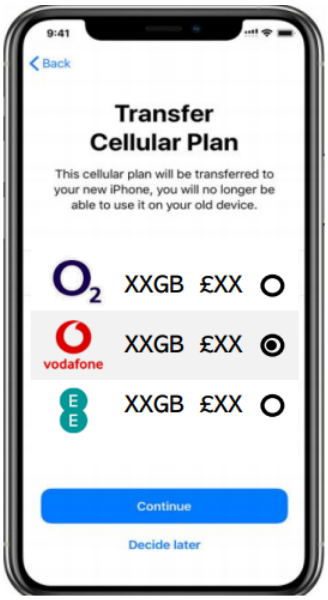
These risks, should they materialise, would negatively impact consumer choice, and mobile network operators' ability to invest. Investors take these risks into account when assessing network investments' future earnings potential.

3.1 eSIM could enable a mobile operating system to become a gatekeeper to the consumer

eSIM integrates the SIM card[47] as a module built into a mobile device. The SIM is embedded in the device and can be configured to connect to different mobile networks without the need to remove and replace any physical SIM card used with the device. This means the SIM becomes reprogrammable and agnostic to the MNO or MVNO and can be updated to connect to different networks as and when needed.

As illustrated in the figure below, eSIM could allow a handset provider or mobile operating system to provide customers with a choice of mobile connectivity provider on the device.

Figure 3: Choice screen on a mobile handset enabled by eSIMs



The customer could select the provider and is then taken to that provider's landing page to complete sign up. The mobile operating system can determine which connectivity providers appear on the choice screen and in what order. Moreover, the handset provider has other means of steering customers to a particular provider, for instance through advisor recommendations in store or in its marketing literature.

[46] Enders (2022), The wolves start to circle: Mobile eSIMs in prospect, page 12.

[47] A smart card inside a mobile phone carrying the owner's unique identification number and personal data and preventing operation if removed.

The provision of mobile connectivity through a choice screen enabled by eSIMs would change the user experience. It could increase ease of switching (which would be positive); however, it may also enable the handset provider or mobile operating system (e.g., via its app store) to act as the gatekeeper to the customer for connectivity and other services telecoms providers supply to their customers today.

If a digital firm with market power in its primary market (e.g., mobile handsets and other services or content) provides mobile services using eSIMs, it may be able to leverage market power into the adjacent mobile network services market (including connectivity, handset financing, service or content, etc.). It could do this by bundling services in its primary market (e.g., handsets) with mobile services (delivered through eSIMs).

Such bundling may provide the digital firm with incentives that do not ultimately benefit customers. For example, the digital firm could structure its bundle in a manner that promotes the services in its primary market, with less focus on mobile services. It may also exclude mobile network operators from offering certain ancillary services or content, self-preferencing its own services instead. Such a bundle may promote a mobile handset and accessories, with connectivity included as a supplementary benefit within the headline price.

Consumers purchasing such a bundle may then be able to exercise less choice on mobile services, network coverage or customer service. In this instance, the consumer's preferences for connectivity may not align with the digital firm, who might be keen to promote aspects of connectivity that complement its own core digital products (and minimise competition), rather than ensuring the consumer can choose the best network for their needs.

The digital firm could also present itself as a price-comparison agent, asking its customers to select their preferred mobile network based on its own commercial considerations (such as whether it has received payments for preference). Whilst this could help the tech firm receive higher payments for preference, the customer would not be able to exert their preferences over the quality of the network. In this regard, the tech firm's incentives may be inconsistent with consumers' long-term interests in improving quality of service, as tech firms would effectively become "mediators" of end user demand.

This misalignment in incentives may lead to consumer harm over time, as MNOs' ability to compete on network and service quality could be compromised, rendering investment in the network less profitable, and less material.

3.2 Potential for new MVNO entry by large digital firms

Large digital firms could also enter the retail market for mobile connectivity, by becoming an MVNO. Whilst such entry could take place in various forms, we highlight two scenarios below:

- **Mobile connectivity provided using eSIMs**: As described above, eSIMs could allow a large digital firm to provide a choice screen within the mobile handset for end users to select their mobile connectivity. That digital firm could take a step further into the mobile value chain by also providing its own connectivity service as an MVNO, which would be simultaneously displayed on the choice screen. The firm could design the choice screen to self-preference its own connectivity service over rivals, thereby harming competitors.
- **Mobile connectivity bundled with other services**: A large digital firm could also provide mobile connectivity as an MVNO and bundle it with other digital products in which it has market power. For example, mobile connectivity could be bundled with online retail store memberships, which could allow the digital firm to structure the bundle in a way that rivals (who do not operate an online retail store) cannot match.

The scenarios above are examples of how the end user experience of choosing and buying mobile connectivity may change as a result of entry by large tech firms. Some such entry has already

happened with Google Fi, in the US, where Google provides a mobile connectivity service based on eSIM technology.[48]

In such instances, the digital firm may have the ability to foreclose to foreclose rival MNOs and MVNOs, for example, if it has market power in the supply of mobile handsets or mobile operating systems. If the digital firm moves to a direct distribution model (rather than supplying through connectivity partners), then end users may not be able to buy their preferred mobile handset through a different channel. The CMA has found that there are real and perceived barriers for end users to switch to an alternative handset provider.[49] As a result, if the digital firm only allows end users to make their connectivity choice through the handset, end users may have no choice but to choose connectivity through this channel.

The digital firm might also have the incentive to foreclose, for example to maximise its own market share in the retail mobile connectivity market. I It could do this either by only offering its own service on the choice screen, or by designing the choice architecture on the mobile screen to steer a customer to its own service.

As an MVNO, the digital firm may also lack incentives to provide the best network. Their business models involve competing on other product and service dimensions. Becoming an MVNO may simply be a means to increase profits in its core business, for example by (i) harvesting customer data to monetise through advertising, or (ii) increasing loyalty in their wider ecosystem and raise switching costs for end users. These incentives might undermine network investment at the expense of large digital firms entrenching their position within their ecosystem.

3.3 Cloud and network edge will enable new use cases but there are also risks to competition

Cloud services are infrastructure, platforms or software that are hosted by third-party providers and made available to users through the internet. They facilitate the flow of user data from end users' devices through the internet to the provider's systems and back to the end user. As a result, end users do not need to store data and applications locally on their devices. This means software applications (business and consumer) can be delivered more effectively.

Cloud services are adopted by users across the economy because they enable significant efficiency improvements. They allow firms to trade capital expense against variable cost, allow the cost of storage to be shared across a large number of users (scale economies) and allow capacity to be dialled up and down on demand. They can also enable more economic disaster recovery in emergencies.

Cloud services traditionally work using central services. With the rising demand for faster compute and processing power, the cloud services provided at the network edge will be key to delivering the benefits 5G can offer. This is because it is at the network edge where data will need to be stored and processed for applications that require low latency, higher bandwidth and security.[50]

For example, an autonomous car or a precision robot at a plant, or a surgeon operating on a patient remotely cannot wait for a few milliseconds to correct course. The further data needs to travel (even with 5G), the longer it will take to arrive, be processed and sent back so the instructions created by software (including Artificial Intelligence) can be executed locally in real time. Ensuring

[48] Android Police (2022), Google Fi: What is it and should you subscribe?.

[49] CMA (2021), Mobile Ecosystems - market study interim report.

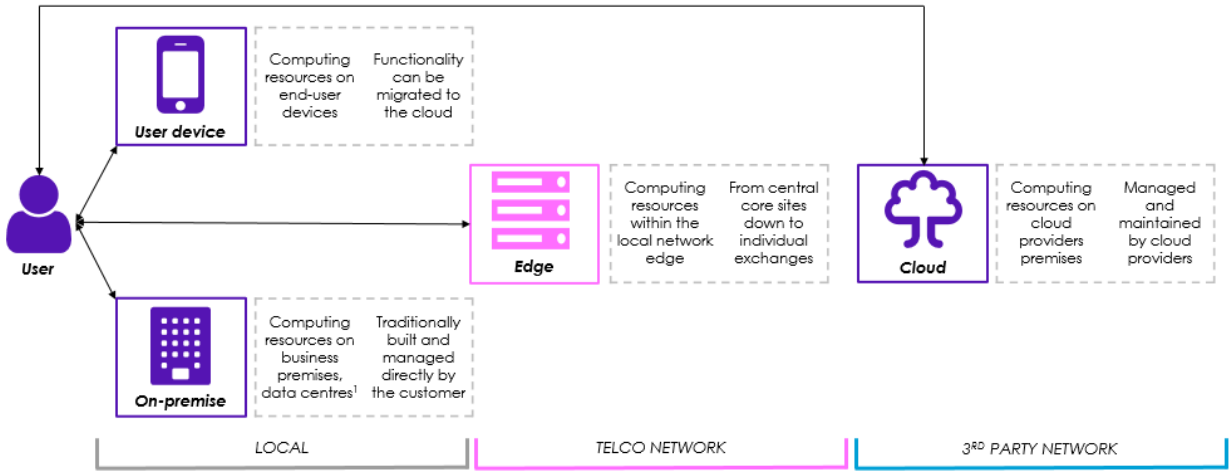
[50] A second driver for edge processing is volume. If the volume of data to be processed is particularly large (e.g. a continuous video stream to be processed by video analytics software), it may be more effective to process it at the edge. than the cost of transport to a centralised location. The caveat here is that the transport costs would typically be borne by the operator, not the end customer, depending on the business model. A third driver for edge processing is security, privacy or data regulation e.g. having to store and/or process data in a particular country, region or location.

that some data is kept and processed locally will therefore make or break such innovative applications.

We are continuing to evolve our core network towards a common cloud-based solution that can manage 4G and 5G and are running pilot 'use cases' to explore edge-enabled services.[51] Regarding specific consumer applications using cloud deployed at the network edge, we are testing solutions to enable low latency, real-time uses such as augmented reality experiences as part of the 'Green Planet 5G AR' consortium. The lower latency of these new network capabilities means virtually no waiting. For example, we created the 5G Edge-XR, a real-time service which combines cloud computing and 5G networks for sports fans to watch immersive events from any device.[52]

As illustrated in Figure 4 below, our network edge (in pink) allows computing capabilities to be hosted closer to the end user with improvements in latency, speed and security.

Figure 4: The network edge allows computing capabilities to be hosted closer to the end user with improvements in latency, speed and security



In terms of overall market structure, the supply of cloud services is very concentrated. In the enterprise segment, the largest three specialist providers (led by Microsoft) collectively have 61% share of supply in global cloud services and often have direct relationships with business customers that MNOs may have owned exclusively in the past.[53]

Differentiation and specialisation in cloud services is high, which means that in reality market concentration could be much higher and customer choice more restricted than indicated by more generic shares of supply. Even the largest cloud services providers specialise in particular services and tailor their business model accordingly. For example, on the one hand, Google specialises in data and AI using its open-source Kubernetes engine and a hybrid public/private platform (Anthos).[54] On the other hand, Amazon is specialising in the services delivered over the cloud and is reported to have the largest set of its own cloud products and services of all private cloud services providers; it also operates a more closed eco-system.[55]

[51] For example, we have worked with Worcester Bosch to enable smart manufacturing via a private 5G network and a BT-managed edge computing infrastructure. The Worcestershire 5G Testbed (W5G) will accelerate a shared vision of smart manufacturing, with BT providing expertise in 5G Private Networks, wearable devices, Internet of Things (IoT) solutions, data analytics.

[52] BT Group plc (2021), Annual Report 2021, page 21.

[53] Deloitte (2022), Future of the UK Mobile and Wider Communications Value Chain, page 11.

[54] Analysys Mason (2022), Google cloud in the telecoms industry.

[55] Analysys Mason (2022), AWS in the telecoms industry.

There are strong network effects in the provision of such a platform that could make it prone to 'tipping' in favour of one or few large digital firms.[56] In the specific case of the network edge, users of network edge services might value being on a single platform, and benefit from others using the same platform, too. This helps resolve coordination problems (given fewer technical standards and improved interoperability). Applications are likely to seek access to a large (potentially global) market, and benefit from using a single platform to provide network edge services. Using a single platform means the application may benefit from lower costs, less complexity of using multiple interfaces/APIs and unified security across its software. It also means the platform attracts more applications, in turn attracting more end users as it grows.

Digital cloud platform providers have already partnered with a number of telecoms operators to provide network edge services. Recent examples include partnerships AWS have agreed with Verizon and Vodafone.[57] In these partnerships, the telecoms provider typically provides infrastructure and access to the network edge, including connectivity and space in local exchanges and sites.

Where network effects and barriers to switching are strong this could reduce choice of potential partners for telecoms providers, in turn enabling hyperscale providers to dictate commercial and technical terms and conditions. This could be exacerbated where the same hyperscalers also provide other, related services to telecoms providers which they may depend on, and the risk of being left behind as other telecoms operators rush to accept unfair terms (given the lack of choice). Ultimately this lack of choice, if it translates into unfair terms, could harm innovation as well as telecoms operators' profitability and capacity to investment in public mobile networks.

If this were the case, customers would have less resilient services and/or less choice. Connectivity partners might also get poorer partnership terms than would otherwise be the case. This could limit their ability to compete in cloud and network edge services markets, by impacting the partnership terms for inputs they require to remain competitive.

[56] Professor Frédéric Jenny for CISPE (2021), Cloud Infrastructure Services: An analysis of potentially anti-competitive practices; ARCEP has recently announced an investigation into cloud services, while EU Commissioner Vestager recently announced the Commission currently had no antitrust concerns yet about cloud computing, Reuters (2022), EU's Vestager says no antitrust concerns yet about cloud computing.

[57] Businesswire (2019), AWS and Verizon team up to deliver 5G edge cloud computing. Vodafone (2019), Vodafone Business and Amazon Web Services to bring edge computing closer to customers.

4 Simply rolling over existing policies won't deliver a step change in investment: more innovative policy thinking is required

The downward trend in average industry profitability Ofcom has observed, and fundamental technology and market changes the sector is undergoing, require a re-evaluation of the policy and regulatory framework. Past presumptions that policy has relied on will cease to be valid in future. We believe:

- Regulatory assessments of consolidation should place greater emphasis on long term efficiencies and investment incentives.
- Ofcom's spectrum roadmap needs to provide a long-term path to sustainable increases in mobile network capacity.
- The design of internet traffic rules must be brought up to date.
- Ofcom should monitor and be ready to address emerging risks from large digital firms so competition and consumers remain protected.
- A more holistic focus on consumer outcome is needed with greater regulatory focus on value including quality rather than headline price and regular reviews of the aggregate impact of sectoral regulation on investment.

4.1 Regulatory assessments of sector consolidation must place greater weight on investment incentives

Ofcom must review the premises underpinning its historic position on mobile market structure

We welcome that Ofcom has no fixed position in relation to future mobile consolidation and that it will consider future mergers on a case-by-case basis. Ofcom's assessment of the competitive dynamics in mobile, as the sectoral regulator, matters even if any proposals for consolidation will be for the CMA to decide on.

In the WFTMR Ofcom sets out that markets are likely to be deregulated when there are three or more parallel networks.[58] This is in stark contrast to Ofcom's view in previous spectrum auctions (dating back to 2013) where Ofcom reiterated, without fundamental analysis of market dynamics, that four viable players are needed for effective competition in mobile markets to be maintained).[59,60] It is therefore vital that Ofcom considers how changes in market dynamics

[58] Ofcom states: "*We also considered defining an 'Area 1' market, where there are at least two established rival networks to BT. Although we identified a small number of areas that had seen investment by two rivals to BT, we considered that competition was not yet well established in those areas and did not therefore propose to define an Area 1 market*." Ofcom (2021), Statement: Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, Volume 2, paragraph 7.29.

[59] "*…operators may seek further consolidation (whether by merger or co-operative joint venture) in the future, and any such proposed consolidation would be considered by the relevant competition authorities at the time. Our intention here is to avoid the effects of consolidation (i.e. a reduction in the current number of competitors) as a result of the Auction outcome.*" Ofcom (2012), Statement: Assessment of future mobile competition and award of 800 MHz and 2.6 GHz, paragraph 4.24; this position is more or less re-iterated in Ofcom's spectrum award consultations and statements ever since using similar or the same wording "*We remain of the view that it is in consumers' interests for there to be at least four credible MNOs. We consider that the existence of four credible MNOs supports retail competition directly because MNOs are major competitors in supplying retail mobile services to consumers. It also supports retail competition indirectly because the MNOs compete to provide wholesale access to MVNOs.*" Ofcom (2017), Statement: Award of the 2.3 and 3.4 GHz spectrum bands, paragraph 6.104.

[60] "*Barriers to entry are high in mobile services and if the number of MNOs were to decrease from four to three, any resulting weakening of competition could be long lasting and difficult to reverse, as new entrants might face high barriers to entry even if competition were not working as well for consumers, such as through higher prices or less innovation*". Ofcom (2020), Consultation: Award of the 700 MHz and 3.6-3.8 GHz spectrum bands, paragraph 4.305.

observed today might impact its assessment of the number of vertically integrated players required for competition to remain a catalyst for investment. Indeed, there should be no reason why competition should not deliver good consumer outcomes in the long term with two players (as the courts have recently found in the Netherlands), depending on evidence on concrete market dynamics.[61]

Any future assessment of consolidation should focus on long term efficiencies, investment and market dynamics

Long term consumer benefits are driven by investment in capacity and technology upgrades. However, merger policy in Europe and the UK has predominantly focussed on short run price effects. Ofcom should consider merger cases such as in the US and Australia (between Vodafone and TPG) which have been cleared based on the premise that consolidation was necessary to support investment in 5G. The text box below summarises the US case.

Mobile mergers in the US have been cleared based on 5G investment arguments

5G investment arguments have been crucial factors in the decision to clear mobile mergers in the US "*where 5G deployment was a key issue. In relation to the Sprint/T-Mobile USA merger, the courts focused on the assessment of dynamic competition and accepted that the mergers would allow for a combination of assets which would make for a more effective competitor than the parties remaining independent. The merging parties would continue to face two strong competitors.*" [62]

The US Federal Communications Commission stated at the time that it "*agree[d] with the Applicants that the proposed transaction will significantly increase new T-Mobile's coverage, speed, and capacity, which should increase competition in quality. Moreover, the network benefits are likely to engender competitive responses from AT&T and Verizon Wireless that are not fully accounted for in a static merger simulation*".[63]

While the proposed merger between Three and O2 in the UK was prohibited on the grounds that it would lead to a significant lessening of competition, the European Commission's decision was annulled by the General Court amongst other things on the basis that the Commission's reliance on a simple Upward Pricing Pressure (UPP) analysis lacked probative value (indeed, any four-to-three merger would result in positive price increases based on an UPP analysis). The court also noted that the Commission's quantitative analysis failed to consider long-term efficiencies potentially offsetting short-term price increases.[64]

The competitive counter-factual matters greatly to investment. Should the counter-factual place too great a focus on short-run static competition, it will lead to remedies that focus on the same. The outcome could be the same or worse market conditions for investment (as illustrated by the Italian example in the text box below).

A focus on short-run, static competition could lead regulators to miss the long-term effects of weak competitors on industry levels of investment. Ofcom itself notes the risk that one of the MNOs may

[61] The Dutch Administrative High Court for Trade and Industry (CBb) annulled the Dutch Authority for Consumers and Markets (ACM's) joint dominance decision concluding that the ACM had not sufficiently proven that absent regulation, KPN and VodafoneZiggo would enjoy joint dominance in the retail market for broadband internet or bundles including internet services. CBb Appeal Court Decision. For an economic analysis for the CBb decision see Oxera (2020), CBb reverses ACM's finding of joint dominance by KPN and VodafoneZiggo.

[62] Jorge Padilla, Paul Reynolds, Joe Perkins (2021), Mobile market structure: Policy and investment, a report commissioned by Vodafone, page 6, footnote 8.

[63] FCC (2019), T-Mobile US/Sprint: Memorandum opinion and order, declaratory ruling and order of proposed modification, paragraph 164. the transaction was subject to remedies including the divestment to Dish of Sprint's relatively small pre-paid subsidiary and of T-Mobile's 14 MHz of 800 MHz spectrum as well as an obligation to reach an MVNO agreement with Dish.

[64] International Institute of Communications (2020), Comment: the EU General Court's decision on Three-O2 deal.

become a weaker competitor, for example because scale becomes more important.[65] Ofcom conjectures this could weaken its ability to invest and in turn the incentives of rival MNOs to do so, too.

We think Ofcom is right, however this is no longer just a risk. Profitability in mobile markets is already too low to lead to a sustainable step up in investment. Effectively, what we observe is the consequence of high barriers to exit in the wireless industry: once operators have sunk material cost into their networks, investors are effectively captive as there is no outside use for the physical assets they invested in. Any new investor will face the same challenges around profitability and investment unless a fundamental change in market dynamics (or regulation) occurs.

As Ofcom notes: UK mobile operators currently invest to maintain market share and thus existing revenue to protect existing assets. In other words, they are not investing to deliver a significant step up in value. More generally, investors will show little support for risky investments ahead of demand (unless the risk can be mitigated in some way).

Ofcom also notes that sub-scale players may emerge as a result of changes in market dynamics. It explains that if such an MNO started to pare back its investment and others might follow suit, this might be "*perhaps because of a lack of incentive to 'invest to get ahead of the market' or to maintain parity with rivals*".[66] We agree this is a risk, and a relevant consideration when authorities consider merger remedies (see text box below).

Mobile market structure in Italy has led to unsustainable market dynamics

The EC required remedies for the approval of the Hutchison/VimpelCom JV in 2016 (Wind Tre). These consisted of the divestment of spectrum and the transfer/colocation of base station sites to a new entrant as well as access to national roaming services to the new entrant. The Italian regulator provided further concessions in auctioning spectrum for 5G services in 2018 by reserving spectrum for Iliad (the remedy taker), providing regulated access to MNO networks with 700 MHz and wholesale access to service providers[67,68]

While these measures enabled Iliad to price aggressively in the short-term, such pricing may not be compatible with incentivising significant new network investment by either the entrant or incumbent operators. Enders reports that after four years Iliad is only just EBITDA positive, with positive cash flows still "*around four years away*". Vodafone Italy, reported to have been struggling for years, reported service revenue growth averaging -9% annually in the first two years after Iliad's entry. This may explain Iliad's recent offer to buy Vodafone Italy.[69,70]

While Ofcom considers a generally weaker player may reduce the need for other MNOs to 'invest to get ahead', we consider smaller, weaker competitors, when faced with high barriers of exit may in fact reduce **other** competing MNOs' capacity to invest. As the Italian example suggests, a weak competitor has been observed in some mobile markets to lead to an excessive and unsustainable short-term focus on price, thus not just weakening investment incentives but their capacity to do so.

[65] Ofcom discussion paper, paragraph 6.29ff

[66] Ofcom discussion paper, paragraph 6.31.

[67] Jorge Padilla, Paul Reynolds, Joe Perkins (2021), Mobile market structure: Policy and investment, a report commissioned by Vodafone, page 25.

[68] De Luca, S. (2019), The Italian approach to the licensing of the spectrum in 5G pioneer bands.

[69] Enders Analysis (2022), Taking a punt on approval: Iliad reportedly bids for Vodafone Italy, 8 February.

[70] Enders note "*Iliad's bid for Vodafone's Italian business has been rejected but that may not be the end of consolidation talks between the two players given the ongoing troubled state of the market*" in Enders Analysis (2022), Consolidation dominates as the sector flatlines, European mobile in Q4 2021, page 27.

Competition from MVNOs is strong and could increase further

As we set out in section 2.4 above, and as recognised by Ofcom, today's wholesale market is very competitive, with a number of MVNOs having significant power in negotiations with four national operators (and where two large MVNOs have changed wholesale supplier in the last twelve months).[71] [✂]

Changes in the value chain (including but not limited to those set out in section 3 above), could encourage entry by new MVNOs including facilitating entry by virtual networks. While traditional physical mobile networks (i.e., transport, hardware and middleware) will continue to remain key to network quality and differentiation, virtual networks (i.e., enabled by platforms and the software running over them) will play an increasingly important role. Accordingly, future assessments of the level of mobile infrastructure and wholesale competition will likely understate the intensity of competition if they rely solely on the number of providers and operators in the market.

4.2 Spectrum policy and release require short term measures to increase capacity and look further out too

As set out in our response to Ofcom's spectrum demand consultation, BT agrees that future projection of mobile data demand is difficult, especially over the medium to long-term.[72] Ofcom's assumption of 40% CAGR for the period to 2035 (as per its medium forecast) risks underestimating traffic growth. But even assuming the traffic estimate is reasonable, it is not practical to deliver the number of small cells that Ofcom estimates will be required in this case if only new mmWave spectrum and a small increment of 1400 MHz downlink spectrum is made available. Additional low-band and mid-band spectrum is needed in the medium to long-term to help industry deliver increased capacity in urban and suburban areas without requiring an impracticable number of small cells. Additional low- and mid-band spectrum will also improve the quality of indoor coverage and in rural areas.

Ofcom should therefore support identifying the Upper 6 GHz band for International Mobile Telecommunications (IMT) use at the 2023 World Radio Conference and lead the charge for 600 MHz designation for mobile well ahead of the end of the decade. This will require policy makers to revisit past views on TV distribution policy given customers are accessing public service broadcast content over the 600 MHz spectrum today. As set out in our response to Ofcom's spectrum demand discussion paper, lack of a credible spectrum roadmap risks industry's ability to respond to increased demand efficiently.

Further spectrum sharing and localised licensing are likely to exacerbate this spectrum shortfall. 5G SA (and later on potentially network slicing) are likely to enable MNOs to provide private networks more efficiently than they can today. Private wireless networks don't necessarily provide access to public mobile networks, but public networks will cater for both. Telecoms providers like BT have delivered private networks to business customers (on industrial campuses or connecting multiple business sites) for decades and 5G stand-alone will fundamentally change the services that can be delivered over them. Our strategy is to invest in a public 5G mobile network that can cater for all the different use cases 5G promises, and which can adapt to changes in demand over time and by location. For example, we have worked with Belfast Harbour to build the UK and Ireland's first private network for ports,[73] and with Worcester Bosch to enable smart manufacturing via a private 5G network and a BT-managed edge computing infrastructure.

As 5G SA will enable the efficient sharing of network capacity and infrastructure between public and private 5G networks, MNOs will be able to utilise these economies to offer connectivity at

[71] Both Virgin Media and ASDA have moved from EE to Vodafone for wholesale mobile supply services as per ISPreview (2020), ASDA Mobile UK Swaps MVNO Supplier from EE to Vodafone.

[72] Please for further detail see: BT (2022), Response to Ofcom's discussion document on demand for mobile data.

[73] BT Group plc (2020), Belfast Harbour and BT to build the UK and Ireland's first 5G Private Network for ports.

efficient cost to the most demanding use cases locally. Ofcom should include these considerations when considering how to facilitate spectrum sharing and local licensing, especially where there are trade-offs between supporting sub-scale entry in an already competitive market on the one hand, and ensuring MNOs can invest in public mobile networks at scale on the other. Spectrum trading (and existing sharing arrangements) should already facilitate the efficient allocation of spectrum without the need for additional measures. As explained in section 4.3 below, to facilitate the provision of private networks by public mobile networks provided by MNOs, Ofcom must also review net neutrality rules. This would enable MNOs to differentiate service quality more effectively for different customers and use cases.

Annual License Fees for spectrum are an additional impediment not just to its efficient use but remove funds from industry that could be re-invested instead. Government and Ofcom should consider whether there may be a way to – if not remove ALFs – at least ensure the that the funds thus raised are made available to be re-invested in the sector. More fundamentally however, where mobile spectrum licences are tradeable, ALFs[74] have not promoted efficiency. Instead, they are likely to disincentivise investment, thereby ultimately harming consumers. We have [✂]; while Enders report that "*Annual Licence Fees (ALFs) attached to H3G's spectrum are the crucial stumbling block in spectrum trading negotiations, creating a level of uncertainty which is not conducive to striking a sensible deal*".[75]

4.3 The design of internet traffic rules needs to be brought up to date

As Ofcom continues its review of net neutrality rules, we stress the need for change also in the mobile sector context. BT continues to support the core principles of net neutrality: customers should be free to access the content they want, the open internet should remain a viable channel for businesses to launch new services, and telecoms providers should be transparent with customers about how they manage traffic over their networks.

5G opens new opportunities for mobile use cases including the metaverse and immersive gaming as well as demanding business to business applications, but these will require very high bandwidth and low latency.

Previous business models underpinning mobile network investment will not be suitable for the future. Policies to enable investment need to recognise the key cost drivers: (i) the rate of future traffic growth (estimated by Ofcom at 40% year-on-year in its medium scenario)[76]; (ii) unlike fixed, peak mobile traffic demand impacts not just core network costs but also costs considered as part of the access network in mobile (e.g. costs relating to connectivity to and from cell sites, active RAN equipment and spectrum usage / costs); (iii) higher unit cost economics for mobile networks relative to fixed; (iv) the demands particular use cases place on the network given their need for greater (or lesser) speed, resilience and latency (and the resulting need to dimension the network to deliver good quality of service at peak times and in locations of peak usage).

Current net neutrality rules should be amended in three key areas, consistent with Ofcom's principles of cost recovery.[77]

Incentivising efficient delivery by content and service providers

It is important that content providers are incentivised to distribute content in the most efficient way, thereby minimising costs of the overall network. For example, content providers should be

[74] ALFs are currently set by Ofcom to reflect full market value as required by the 2010 Direction.
[75] Enders (2022), Spectrum trading thwarted: 5G stumbling blocks endure.
[76] Ofcom (2022), Mobile networks and spectrum: meeting future demand for mobile data, paragraph 4.22.
[77] Cost causality, cost minimisation, regard to externalities. See Ofcom (2017), Wholesale Local Access Market Review Recovering the costs of investment in network expansion, Consultation, paragraph 6.11

incentivised to cache their traffic to avoid imposing unnecessary costs on the network. A practical way of doing this would be to enable network providers to traffic manage and charge for inefficient content distribution.

Even where content providers use technically efficient means to distribute traffic within the network, they don't have incentives to distribute traffic at an efficient time of day e.g., timing of gaming downloads such as Fortnite, Call of Duty might occur during network peaks. This leads to unnecessarily large peak time traffic loads, requiring more investment to deliver a given amount of traffic. Traffic managing non-time-sensitive content (to reduce peaks) or charging for large peak downloads of content would help address this, so networks can be dimensioned more efficiently thereby reducing inefficient investment cost.

Ensure network innovation is enabled by up-to-date definitions of 'specialised services'

Enabling investment for innovative services requiring high bandwidth and low latency requires greater clarity on which services will qualify as a 'specialised service' and additional flexibility than current rules. Ofcom should offer greater flexibility in the following areas:

- Currently, we can only offer specialised services where this is 'objectively necessary' from a technical perspective. Ofcom should clarify that this rule can also include justification based on user needs. This change would enable a particular service category such as video conferencing (e.g., Skype, Teams, Zoom etc.) to be prioritised over other traffic where the service delivered value for customers (i.e., they value the higher quality of service).
- Currently we can offer specialised services only if network capacity is 'sufficient' such that internet access services are not degraded. Ofcom should clarify that materiality is an important consideration when determining whether a specialised service could lead to degradation of network capacity. Whilst the general internet must remain viable, network capacity is shared and therefore there will always be a network impact during peak times. Provided it doesn't have a material impact on sufficiency of network capacity for internet access, providers should be able to innovate and create specialised services.
- Currently it is unclear whether we can restrict SIMs to particular types of devices / use cases. We believe we should be able to do this to ensure that industry can support a vast range of new commercial propositions enabled by 5G that require differentiation based on a particular use case. For example, a device with a SIM for remote communication of data with a healthcare provider could provide connectivity at a low price to meet the low data needs of the customer. However current rules on tethering are unclear and could allow for that SIM to be inserted into a router, which would significantly increase data usage and potentially drive unpredictable peaks in mobile traffic. This risk reduces the incentive to develop tailored propositions for customers as business cases must account for the broader usage of the SIM.

Policy must enable, not prevent, business models seen in many other efficient two-sided markets

Under current net neutrality rules, network providers are also restricted from directly charging large content providers the investment for costs they cause on the network. There is significant concentration in the drivers of internet traffic: today 80% of internet traffic can at times be created by just four companies, and we expect this trend to worsen as new bandwidth hungry services reliant on 5G networks emerge. The impact of this trend is that the largest content providers are likely to cause a level of peak traffic demand that results in network deterioration for other users at those times.

Enabling network operators to fairly charge the largest content providers who cause significant network investment costs will help protect the quality of the network for all users and can contribute to funding the step change in mobile network investment needed in the UK. This would bring

business models in the telecommunications industry up to date consistent with models elsewhere in the economy where charging multiple sides of a market has become key to enabling innovation and investment (examples online marketplaces such as eBay, open banking apps such as Plum or Chime, and traditional broadcasters and publishers – funded by both advertisers and users – and many more throughout the economy).

4.4 Regulation must credibly address the risks to consumers from wider, digital markets

The UK Government has stated its intent to legislate for a new digital regulatory framework to ensure large digital firms with market power cannot abuse their position to the detriment of consumers.[78] The new pro-competitive regime for digital markets proposed by Government is important so all forms of persistent market power **can** be addressed effectively by regulation to protect competition and consumers.

In the event that legislation is delayed we consider even more important that Ofcom takes a proactive approach to monitoring and mitigating – insofar as the current regime allows - emerging risks through existing means.

As described in section 3, the activities of these large digital firms are increasingly overlapping with communications markets. Where this is the case, Ofcom should proactively pursue (and be given) a formal role under the Government's planned pro-competition regime for digital markets. This could be, for example, via formal roles in on-going market monitoring, recommending market studies where it sees bottlenecks emerge, and assisting the CMA with its market analysis and the design of potential remedies.

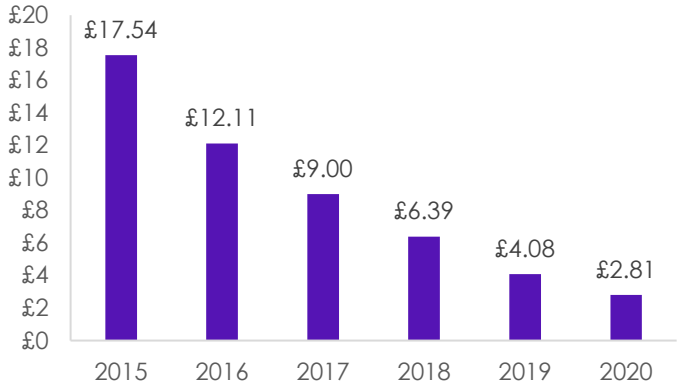
4.5 Ofcom's measurement of consumer outcomes must better reflect consumer value and the cumulative effect of regulation

Ofcom should focus more on holistic value to consumers including quality, less on headline price

Average prices have continued to decline in recent years[79] whilst data usage has increased significantly in addition to increases in speeds and consistency/reliability.[80] By way of example, in 2020 price per GB was one-sixth of prices in 2015 as shown by the chart below.

[78] DCMS and BEIS (2021). A new pro-competition regime for digital markets.
[79] Ofcom (2021), Pricing trends for communications services in the UK
[80] Umlaut (2021), The 2021 Mobile Network Test in the United Kingdom, Rootmetrics (2021), The state of 5G in the UK - 2H 2021 and Opensignal (2022), Mobile Network Experience Report April 2022.

Figure 5: Average price per GB (excluding handset cost) across the UK mobile market[81]



Currently Ofcom regularly publishes pricing information mainly in its "Pricing trends for communications services" reports, its Communication Market Reports and its Telecoms Market Data Updates. However, we think Ofcom's value for money metrics should extend beyond aggregate spend to include the change in the quality of the connectivity bought over time. For example:

- Ofcom's Telecoms Market Data tables report provides "*Average monthly retail revenue per subscriber*" but does not report on changing data allowances or data usage over time.
- Ofcom's "Pricing trends for communications services" 2021 report states "*the average cost of a SIM Only mobile service based on average use fell by 10% in 2020 despite increasing voice and data use*" but makes no reference to increasing data speeds or improved consistency/reliability during this period (which are currently captured only by reports by Umlaut, Rootmetrics, Opensignal and others).[82]
- Ofcom's Communications Market Report 2021 states "*The average UK household spent £79.08 per month on telecoms services in 2020, a 0.3% decrease since 2019 and equivalent to 3.1% of average total monthly household spend*", but makes no reference to rising data usage, increased data speeds or improved consistency/reliability which would have accompanied the migration of customers to 5G and FTTP.

While using price baskets for telecoms services in aggregate is helpful in understanding aggregate consumer spend on communication services over time, it is not a helpful way to assess the evolution of value for money over time.[83] Ofcom should develop metrics which also reflect the changing nature and quality of the service consumers get in return as a result of improvements in quality over time versus reporting on pricing in a way that implicitly assumes a stagnating level of service. Telecoms is different to utilities, where innovation and investment does not drive rapid improvements in value over time.

In July 2020 the Office of National Statistics (ONS) announced that it had revised its telecommunication services deflator so the price index for telecommunications now reflects a price decline of around 95% over the period from 1997 to 2016, to better account for the technological and associated quality that occurred in telecommunications services over the past two decades.[84] We have not seen Ofcom reflect on what this should mean for how it reports on trends in value for money for consumers.

[81] BT analysis of Ofcom (2021), Pricing trends for communications services in the UK, Figure 33. Average price per GB was calculated by dividing "*weighted average monthly prices*" by "*Data (GB)*" in Figure 33. Whilst we recognise that average minutes and texts also changed during this period, by far the most significant change was in data usage.

[82] Umlaut (2021), The 2021 Mobile Network Test in the United Kingdom, Rootmetrics (2021), The state of 5G in the UK - 2H 2021 and Opensignal (2022), Mobile Network Experience Report April 2022.

[83] Ofcom discussion paper, paragraph 4.23.

[84] ONS (2020), Improvements to the measurement of UK GDP: an update on progress, section 5 titled "*Quality improvements to deflators*".

Ofcom should regularly review the aggregate impact of sector regulation on investment

Whilst we welcome Ofcom's proposal to set out more explicitly how it has considered investment when making policy decisions, we believe this is not sufficient. Recent and forthcoming regulations and Government policy decisions are expected to result in annual costs to BT alone of c. £200-300m, around a third to a half of our mobile capex, as explained in Appendix E.

In an increasingly challenging investment environment, care must be taken when considering interventions and how they drive operator costs. We consider that Ofcom should commit to reviewing the cumulative burden of regulation regularly and consider the impact this has on the industry's investment capacity in aggregate, rather than the incremental benefit and cost of each regulatory proposal on its own.

4.6 Next steps

We look forward to the opportunity of discussing our suggestions with Ofcom both as part of this review (including its work on spectrum demand) as well as part of the following other areas of its work, including its:

- Spectrum roadmap: delivering Ofcom's spectrum management strategy consultation[85]
- 26 GHz spectrum award consultation[86]
- Net neutrality review[87]
- Mobile coverage and quality reporting work[88]
- Ongoing work on cloud[89]
- Drones consultation[90]

[85] Ofcom (2022), Spectrum Roadmap: Delivering Ofcom's Spectrum Management Strategy.
[86] See "Award spectrum bands as they are cleared and released" on page 44 of Ofcom (2022), Ofcom's Plan of Work 2022/23.
[87] See "Net neutrality" on page 44 of Ofcom (2022), Ofcom's Plan of Work 2022/23.
[88] See "Improving consumer information on mobile coverage and performance" on page 45 of Ofcom (2022), Ofcom's Plan of Work 2022/23.
[89] See "Developing Ofcom's understanding of the technologies used to deliver online services" on page 53 of Ofcom (2022), Ofcom's Plan of Work 2022/23.
[90] See "Enabling growing demand for the use of drones" on page 49 of Ofcom (2022), Ofcom's Plan of Work 2022/23.

Appendix A Answers to Ofcom's questions

#	Question	BT response
1	Do you agree that the key potential market developments over the next five to ten years are those set out in Section 5? Are there any other key developments we should consider?	We agree that the key potential market developments over the next five to ten years are those Ofcom has identified, however as we set out in sections 2 and 3 we think Ofcom's assessment is too superficial for Ofcom to be able to draw sufficiently meaningful conclusions on the need for policy and regulatory change.
2	Do you agree that competition among MNOs is likely to continue to play a key role in the delivery of good outcomes, as outlined in Section 6?	Competition is the right mechanism to drive investment but we think industry structure today does not deliver this. We set out our reasons for this in section 1.2, 2 and 4.1.
3	Do you consider that there are likely to be significant wider external benefits (externalities) from a quicker or more widespread rollout of high-quality networks than that which the market is likely to deliver, as discussed in Section 6? If so, please provide clear examples to help explain your answer.	Please see Appendix F for some examples of externalities specifically associated with 5G.
4	Do you agree with our views on how competition across the value chain may evolve over the next ten years, and the potential implications for the delivery of good outcomes, as outlined in Section 6?	We think Ofcom's analysis is insufficiently robust to draw the conclusions about good consumer outcomes and investment. See sections 1.2, 2, and 4.
5	As set out in Section 6, do you agree that quality of experience will become more important in the future? Do you agree that developing better information on quality of experience for customers will help further the delivery of good outcomes?	Yes, we agree that quality of experience will become more important over time (see Appendix C). Reforming Net Neutrality rules (as we set out in section 4.3 above is critical to this. Better information on quality of experience would be helpful if they reflect customers' needs and give a snapshot of true end user experience, as explained in Appendix C.
6	Do you think there is more that could be done to reduce barriers to customers receiving good indoor coverage (see Section 6)? If so, please outline what steps	Please see the final part of Appendix C for what Ofcom could do to reduce barriers to good indoor coverage.

	could be taken and what impact those steps would be likely to have.	
7	Do you agree that clarifying our future regulatory approach will help encourage investment, as outlined in Section 7?	We believe Ofcom needs to go further than the clarifications it has outlined as we set out in section 4.
8	Are there any other potential barriers to the delivery of good outcomes over the next five to ten years that we have not considered? If so, please outline what these are likely to be, with supporting examples/evidence where possible, and any suggestions for how they might be reduced.	None besides those we have listed above.

Appendix B Spectrum assets in Ofcom's profitability assessment

Accounting ROCE is calculated by Ofcom as operating profit/(net book value of assets). Ofcom notes that "*[o]n an accounting [ROCE] basis, taking all the capital employed as given (including historical amounts paid for spectrum and any goodwill associated with previous acquisitions), average industry ROCE has been below the cost of capital.*" Ofcom also notes, "*we recognise that investors may consider goodwill when evaluating how successful management has been at investing historically and inferring the likely future direction of returns and thus rely on something closer to accounting ROCE*."[91]

As we set out in section 2.1 of the main document, we consider Ofcom errs in not including goodwill in economic ROCE.[92]

Economic ROCE is calculated by Ofcom as (operating profit excluding amortisation of spectrum) / (current value of spectrum assets) and reflects replacement cost of spectrum assets and excludes goodwill. This is Ofcom's preferred measure of returns. Ofcom explains that to derive economic ROCE from accounting ROCE "*the two main components of the MNOs' balance sheets, where accounting values may require adjustment, are* ***goodwill*** *and* ***spectrum.***"[93,94] We explain in detail below where we think Ofcom have erred in valuing our spectrum and where we seek further clarification.

Ofcom estimates spectrum asset values for the MNOs based on current (intrinsic) market value.[95] While we do not object in principle to this approach, Ofcom exclude elements of 5G spectrum from their analysis.[96] However, mobile ROCE – at least from 2021 - must include investments in 5G

[91] Ofcom discussion paper, paragraph 6.15.

[92] We have not undertaken a detailed review of Ofcom's accounting ROCE estimates for BT/EE or other MNOs and therefore do not comment on these values in our response.

[93] Ofcom discussion paper, paragraph A6.10

[94] Ofcom discussion paper, paragraph A6.12.

[95] Ofcom states "*To understand the significance of revaluing spectrum on ROCE, we estimated the current market value for each spectrum band, drawing on evidence from recent auctions and Ofcom's decisions on annual licence fees. We assumed a constant value for spectrum for the full period of our analysis, with no amortisation over the period (effectively assuming the spectrum has an indefinite asset life). This is a simplified approach, however, we are primarily interested in the directional impact of adjusting for spectrum values, rather than a precise figure*. Ofcom discussion paper, paragraph A6.13.

[96] Ofcom states: "*Our analysis covers the four years to December 2020 / March 2021 (depending on operator). Therefore, we excluded spectrum bands which have been purchased to deliver 5G (i.e.700 MHz, 3.4 GHz and 3.6-3.8 GHz), as we do*

spectrum made that are required to maintain existing levels of operating profit on a forward-looking basis. Without undertaking this investment, BT/EE would be at a competitive disadvantage as not investing in 5G spectrum would impact our ability to maintain existing customers and revenue streams.

We also seek further clarification from Ofcom in relation to their detailed calculations on BT/EE's spectrum asset values to support their economic ROCE estimates.

- Ofcom has estimated the 700 MHz spectrum value incorrectly by valuing 20 MHz of 700 MHz SDL at the same £14m/MHz as for the 20 MHz FDD. Only 20 MHz FDD was sold at this price of £14m/MHz. The 20 MHz of SDL was sold for £4m for 20 MHz.
- It appears that £202m of 4G spectrum is being deducted in the reference to the cells B147:F147 on the Assets and Capex sheet. If Ofcom is only intending to subtract 5G spectrum the £202m should not be included. See cell AA27 in the ROCE calculations sheet.
- We would be grateful if Ofcom could provide a further explanation for why it has omitted 3.4/3.6 GHz spectrum values for EE in the Spectrum Valuation sheet. We consider that all such mobile spectrum should be considered in capital employed as 5G is required to maintain existing customers and revenue streams.

Appendix C Network quality

We support Ofcom's ambitions to monitor network performance quality

We support Ofcom's ambitions to develop better information for customers so they can make more informed choices about their provider. We agree it's important that customers and policy makers have reliable information on whether network operators meet their needs. We will continue to work with Ofcom through the Mobile Reporting Working Group to help provide customers with further information on network quality.

In our view, the starting point is to identify customers' needs. These will help identify the right metrics. Our understanding of customers' needs is as follows:

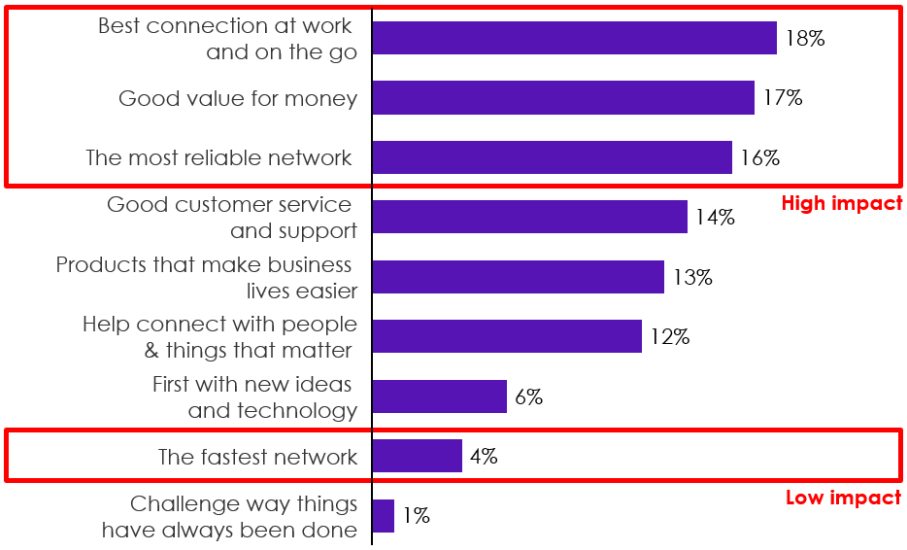
- **Contrary to a few years ago, consumers expect 'always-on connectivity'**. Connectivity is central to almost every moment of everyday life. People have become dependent on having a connection: they no longer plan ahead – they just assume they will be connected – and they are increasingly ill-equipped to cope without it. When connections are working, they are generally excellent, but they don't work all the time and there are pain points both in-home and out-of-home.
- **Consumers aren't interested in how they stay connected – they just want to be connected, without worry.** Whether the connection is via 4G, 5G, fixed or Wi-Fi matters less than quality and reliability. Only when something goes wrong do people feel forced to think about the technology behind it. People generally don't know – or care – how networks work. And "reliability" comes out on top during customer discussions, as shown below.

not expect this spectrum to have generated any meaningful profit over our analysis period." Ofcom discussion paper, footnote 68.

Figure 6: "Reliability" comes out on top during customer discussions[97]

- **Businesses prioritise the consistency, value and reliability of connections, placing far less weight on speed.** Business consideration is driven by consistent connection and better value perceptions, as shown by the chart below. Consistent signal strength, maximum coverage in all areas and low downtime are the key levers of consideration. Being the most reliable network is more impactful in driving consideration than being only the fastest. Continuous demonstration of value in product offerings has higher impact on consideration than only being a market disruptor.

Figure 7: Overall impact of customer network quality aspects on consideration[98]



- **Overall, customers value reliability and service experiences more than speed.** So they would care most about factors such as whether their video buffers, whether their web page loads, whether their download/upload completed, whether their call drops and so on.

If metrics are to support these needs, we believe there are some principles that must be followed:

- They should be rooted in real customer experience (not modelled).
- They should be less about peaks of network performance, more about consistency of actual customer experience.

[97] BT/EE Network Positioning Research (2020).
[98] Horizon Research (2019). OLS regression model predicting strength of Consideration for a rated brand.

- They should be technology agnostic – customers care about the experience, not how we deliver it.
- They should be used as a framework for network leadership advertising claims going forward, increasing the likelihood that competition is more likely to drive differentiation on quality rather than focus on price.
- They should be flexible enough to deal with future innovations/lifting of performance standards/new use cases.

We therefore believe that independent field testing (Umlaut/RootMetrics style approach) should form the main part of any performance quality metrics. This will give a true snapshot of end user experience using an independent methodology. The tests must reflect customers' needs and must therefore include both 4G and 5G (rather than 5G only) and be spread geographically i.e. reflecting both rural and urban areas.

We made these points to Ofcom when we met them on 18 January 2021. Ofcom understood our points but felt its performance metrics needed to be sufficiently geographically granular to appear on a coverage-style map. This, in practice, mostly limits Ofcom's approach to measuring cell throughput, which (i) could favour networks which run their network 'hot' (unlike, say, 'headroom' as a metric), (ii) doesn't easily map to real-life customer network experience (which, amongst other things, depends on consistency and reliability) and (iii) will struggle to capture latency (a key part of 5G).

We continue to believe that independent field testing should form the main part of any performance quality metrics. This approach should reflect what really matters to customers, based on a broad range of measures for customer experience. As we discussed with Ofcom on 22 June 2021, since mobile users are mobile, having high quality on the go should matter more to customers than quality at any one location. Therefore, the downsides of not being able to identify quality on a map should be limited.

What Ofcom could do to reduce barriers to good indoor coverage

Indoor mobile coverage can be achieved from "outside-in" or from base stations or access points located inside buildings. Both methods can be important depending on the scenario. In some circumstances "outside-in" coverage is essential as other solutions are not feasible. In this case the quality of coverage within buildings will be particularly dependent on the amount of sub-1GHz spectrum available as these frequencies have favourable propagation characteristics to penetrate more deeply into buildings compared to higher frequency bands. Availability of 600 MHz spectrum in future would enable better quality of in-building coverage and is therefore something that we encourage Ofcom to actively pursue.

Where indoor coverage solutions are feasible these can efficiently provide high quality mobile coverage. As Ofcom has noted, Wi-Fi calling is widely used today and will remain an important indoor coverage solution. Adequate spectrum has been made available for Wi-Fi and we welcome the availability of the Lower 6 GHz band that recently significantly increased the amount of spectrum available for Wi-Fi. In other cases, dedicated mobile network infrastructure can be built to provide good quality coverage and commercial arrangements can be put in place for this.

For private networks, Ofcom has made shared spectrum available, which seems sufficient for the demand that has been observed so far.

Appendix D Telecoms sector productivity and value for money for consumers

Historic productivity gains in the UK telecoms sector have been found to be significant particularly following the ONS' major review of its methodology for estimating telecoms services deflators used in the production of the national accounts. These findings followed an independent review of UK

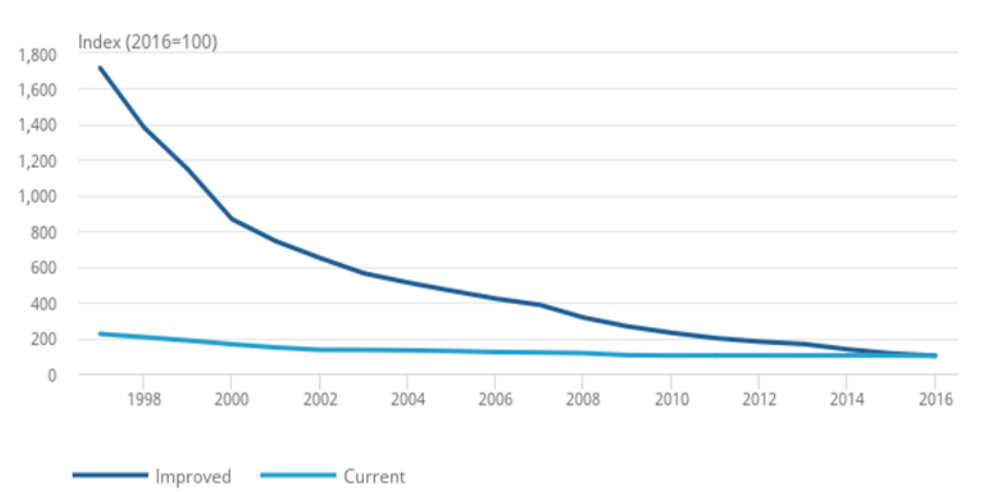
economic statistics in 2016. The review was prompted by the growing difficulty of measuring output and productivity accurately in a modern, dynamic and increasingly diverse and digital economy and lead to the ONS revising telecoms deflators that were published shortly thereafter.[99,100,101]

Specifically, the ONS has sought to capture changes in quality more effectively in fast-changing industries such as telecoms. The ONS now considers that previous official telecoms services deflators were flawed and understated 'true' declines in the price of such products, and therefore will have understated real sector productivity growth (arising from improvements in the quality of telecoms services including larger mobile data bundles).

The improved telecommunication services deflator better accounts for the technological changes that occurred in this industry over the past two decades. Reflecting this, Figure 8 shows the more accurate telecommunication services deflator has a stronger price decline (c. 95% between 1997 and 2016), because it accounts for the technological and associated quality changes that occurred in this industry over the past two decades.

Other studies of these deflators find similar trends.[102,103, 104]

Figure 8: Improved telecommunication services deflator has a stronger price decline[105]



The effect of the new deflator will be to increase the volume of output of the telecommunications sector and may increase the headline measure of GDP.[106]

Appendix E The cumulative impact of regulation

As explained in section 4.5, whilst we welcome Ofcom's proposal to set out more explicitly how we have considered investment when making policy decisions, we believe this is not sufficient. Recent and forthcoming regulations and Government policy decisions are expected to result in annual

[99] Professor Sir Charles Bean (2016), Independent Review of UK Economic Statistics.
[100] Financial Times (2018), ONS's crossed telecom wires raise questions over inflation figures.
[101] ONS (2020), Improvements to the measurement of UK GDP.
[102] Financial Times (2020), UK's growth rate could be revised after large revisions to official data.
[103] ONS (2020), Improvements to the measurement of UK GDP.
[104] Similarly, a recent research paper has also shown that a volume weighted index (measuring price changes through the average price per unit of data) suggests telecommunications services prices fell between 37% and 96% from 2010 to 2017, considerably more than the current deflator (based on a revenue weighted index). See A Comparison of Deflators for Telecommunications Services Output, Mo Abdirahman, Diane Coyle, Richard Heys and Will Stewart (2020), ECONOMIE ET STATISTIQUE / ECONOMICS AND STATISTICS N° 517-518-519, Figures 1 and 6.
[105] Office for National Statistics (2020), Improvements to the measurement of UK GDP: an update on progress, Figure 1.
[106] The ONS' latest communications sector GVA multiplier for 2018 is 1.342. ONS (2022) UK input-output analytical tables.

costs to BT alone of c. £200-300m, around a third to a half of our mobile capex, as explained at the end of this appendix.

In an increasingly challenging investment environment, care must be taken when considering interventions and how they drive operator costs. We consider that Ofcom should commit to reviewing the cumulative burden of regulation regularly and consider the impact this has on the industry's investment capacity in aggregate, as well as the level playing field with providers of digital services who do not face similar burdens. It is not sufficient to consider the incremental benefit and cost of each regulatory proposal on its own. For example:

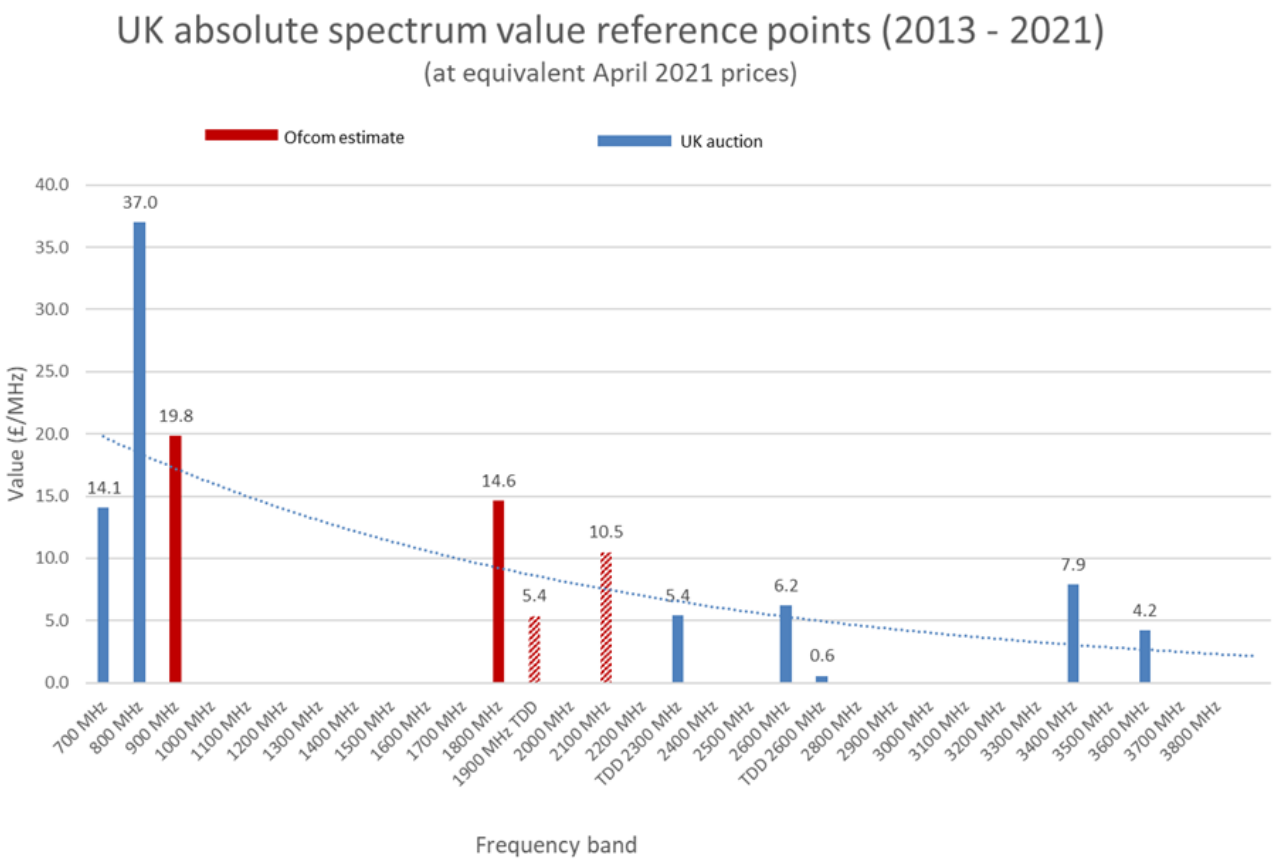
- **Annual Licence Fees:** We find that, where mobile spectrum licences are tradeable, ALFs[107] have not promoted efficiency. Instead, they are likely to disincentivise investment, thereby ultimately harming consumers. ALFs represent a significant financial burden on the mobile sector of c. £350m p.a. that negatively impacts free cash flow and profitability. This, in turn, is likely to suppress investment capacity. [✂]
- **High Risk Vendor restrictions**. We have publicly announced that the Huawei ban will cost us c. £500m to 2027. Although this covers both our fixed and mobile networks, a significant proportion of these costs relate to mobile again impacting the sector's capacity to invest. In addition, we are awaiting final decisions on the Designated Vendor Direction, so there is the potential that these costs may climb further.
- **Fairness for Customers**. We continue to do more on Fairness for Customers than some of our competitors across fixed and mobile overall, which has a significant commercial impact on us. Whilst these have been voluntary commitments, we consider that Ofcom would have likely formally intervened had we not made these voluntary commitments. The reduction in our mobile handset contract prices for customer who become out of contract is expected to cost c. [✂] every year between 2020 and 2025. However, the cost of our broadband Fairness measures is estimated to be as high as [✂] over five years from 2019/20 to 2023/24, and this can have a direct impact on both fixed and mobile investment.
- **Security and Resilience**. Notwithstanding the size of BT's business or our policy of operating industry-leading levels of network security to date, we anticipate that the incremental capital cost of compliance with the new Telecoms Security Requirements will be significant, particularly if it requires BT to change how it is able to manage compliance centrally (including, where appropriate, from a discrete number of global centres). Given the size of our business, even relatively small adjustments that we would need to make to ensure compliance will likely drive significant change programmes and therefore cost – as is evident in our response to the DCMS Telecoms Security Requirements business impact survey from March 2021.[108] Any new resilience requirements are likely to substantially increase network costs even further, and so we believe there should be no further resilience requirements in the mobile space without public funding, unless the costs can be shared with the largest organisations monetising our networks.
- **Artificial scarcity in the 2018 5G spectrum auction**. The 2018 3.4 GHz auction was conducted in an environment of limited available spectrum suitable for 5G (an average of 37 MHz per MNO) as Ofcom chose not to award the full band in a single auction. The amount of spectrum in the 3.4 GHz auction was artificially constrained to 150 MHz and was 'must have' for three operators that realistically needed to secure at least 40-80 MHz each to launch 5G in the UK and be competitive with Three which already held such spectrum. The 'premium' paid for 3.4 GHz spectrum during the 2018 auction, relative to the trend implied by other spectrum bands, is indicated in the following chart. This chart also suggests that the "premium" paid for 3.4 GHz

[107] ALFs are currently set by Ofcom to reflect full market value as required by the 2010 Direction.

[108] Provided to Ofcom in response to its Statutory Information Request titled "Mobile Strategy Review and Mobile Spectrum Demand Review: Notice requiring the provision of information under section 32A of the Wireless Telegraphy Act 2006" (as attachments to our response to question 10 of that Statutory Information Request). Commercially confidential.

spectrum was **not** subsequently offset by below-trend 3.6 GHz prices: the price paid for 3.6 GHz spectrum is far from below trend in the chart below. [✂]

Figure 9: UK absolute spectrum value reference points since 2013[109]



- **Government requirements for greater geographic coverage**: The Government has regularly sought more ambitious UK geographic coverage targets from mobile operators to meet wider policy objectives, including to ensure coverage in rural areas and to prevent a digital divide emerging across the UK. Recent initiatives include the 90% geographic coverage obligation agreed between MNOs and Government in 2014[110] where industry committed to £5bn investment to deliver by 2017, and the SRN[111] agreement in 2020 where MNOs committed to spend c. £500m to close partial not-spots and individually reach 88% coverage by 2024. BT/EE fully supports these initiatives, while highlighting the commercial cost to achieve these targets given that public funding does not fully cover the cost of deployments.
- **Shared spectrum access rights**: Spectrum policy changes have provided significant opportunity for private network operators to enter the market and access spectrum at very low cost, which can be positive for the market and consumers. According to Ofcom's Wireless Telegraphy Register, by February 2022, Ofcom had issued over 300 licences to 48 licensees in the shared 3.8-4.2 GHz band that is suitable for 5G, many of which are for Fixed Wireless Access (FWA) or private networks. The growth in private networks has been forecast to increase rapidly by analysts. For example, Analysys Mason have forecast over 20,000 networks worldwide by 2026.[112]

[109] BT analysis of Ofcom (2018), Annual Licence Fees for 900 MHz and 1800 MHz frequency bands: Statement and various individual Ofcom spectrum auction results.
[110] See GOV.UK (2014), Government secures landmark deal for UK mobile phone users.
[111] In the case of both initiatives, mobile operators – including BT/EE – voluntarily agreed to variations in their licence conditions.
[112] Analysys Mason (2021), Spend on private LTE/5G networks will be small but an important opportunity for future IoT growth.

However, for positive consumer outcomes to be maintained, Ofcom must continue to be vigilant so that opportunity cost is not imposed on existing spectrum licence holders or can be suitably compensated for in commercial agreements, such as leasing arrangements.

As noted in at the start of this appendix, the total cost to BT alone of recent and forthcoming regulations and Government policy decisions is c. £200-300m per year, which is around a third to a half of our mobile capex. The breakdown of this c. £200-300m per year estimate, which includes only some large-impact decisions, is as follows:

- Annual License Fees (ALFs) (c. £100m per year[113])
- Huawei ban (c. £70m – £80m per year[114])
- Fairness for Customers ([✂][115])
- Telecoms Security Requirements (see our response to DCMS' Telecoms Security Requirements business impact survey[116])

Appendix F 5G externalities – further evidence

There are likely to be significant benefits of 5G networks to UK consumers and the wider economy:

- 5G networks are being built with the **environment** in mind: 5G networks are up to 90 per cent more energy efficient per unit of traffic than legacy 4G networks, according to both Ericsson and Nokia.[117,118] The ITU has also released recommendations for optimising 5G wireless network energy consumption, including (i) putting radio frequency units "into deep sleep" during periods of extremely low traffic and (ii) using enhanced AI-driven energy-saving solutions to direct users from less power-efficient spectrum bands to more power-efficient spectrum bands.[119] These environmental benefits are not considered by 5G customers when making their purchasing decisions but could still bring significant benefits to society as a whole depending on 5G usage, thereby meeting Ofcom's criteria for consideration as a 5G externality. What's more, digitisation has the potential to help other industries meet net zero targets, bringing even wider societal benefits. Finally, such environmental benefits can be amplified through the retirement of legacy (3G) networks, adding to an overall decrease in energy demand of 10% to 2030[120].
- Also, an EC commissioned report found that "*One of the key benefits (€10.5 bn) identified in rural areas [of the then EU28 is the] ability of 5G to address the **digital divide** and overcome difficulties in providing broadband connectivity in more rural areas where current fixed networks struggle to provide adequate service*" (emphasis added).[121] Whilst 4G may be sufficient to support today's Broadband Universal Service Obligation, this report appears to envisage that Universal Service Obligations of the future may require 5G as data usage and use cases evolve, implying that 'addressing the digital divide of the future' could meet Ofcom's criteria for a 5G externality.
- Furthermore, it is also highly likely that improvements in **road safety and efficiency** enabled by 5G – including services providing information to drivers about imminent dangers such as red-light violations, hazard, collision, and traffic jam warnings – will also generate significant wider benefits

[113] c. £75m per year for 1800 MHz spectrum and c. £22m per year for paired 2100 MHz spectrum, rising with inflation.

[114] The Huawei ban will cost BT c. £500m for 2020-27 i.e. c. £70m – £80m per year on average. The majority of this will be for mobile.

[115] [✂]

[116] Provided to Ofcom in response to its Statutory Information Request titled "Mobile Strategy Review and Mobile Spectrum Demand Review: Notice requiring the provision of information under section 32A of the Wireless Telegraphy Act 2006" (as attachments to our response to question 10 of that Statutory Information Request). Commercially confidential.

[117] Ericsson (2021), Sustainability and Corporate Responsibility report 2021.

[118] Nokia (2022), Nokia confirms 5G as 90 percent more energy efficient.

[119] International Telecommunication Union (2021), Recommendation L.Sup43: Smart energy saving of 5G base stations: Traffic forecasting and strategy optimization of 5G wireless network energy consumption based on artificial intelligence and other emerging technologies.

[120] Accenture (2021), Harnessing data to empower a sustainable future, page 10.

[121] Publication Office of the European Union (2017), Identification and quantification of key socio-economic data to support strategic planning for the introduction of 5G in Europe, page 9.

to society given that, for example, those drivers who purchase such information services are unlikely to fully account for safety benefits that such services provide to other road users (in addition to themselves).

Appendix G Deloitte's report on the mobile and wider communications value chain

Please see the link below for a report by Deloitte on the future of the mobile and wider communications value chain. This report drives home that the investment challenge in mobile is significant and that there is a substantial risk that the market will not deliver enough investment to meet the needs of UK plc in the absence of supportive regulation and public policy.

https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/financial-advisory/deloitte-uk-future-of-the-uk-mobile-value-chain-feb-2022.pdf

Appendix H BT Response – DCMS Wireless Infrastructure Strategy Call for Evidence

Submitted as a separate document (commercially confidential).

Find out more at bt.com

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