Annex: Ofcom's response to DCMS questions

Our recent discussion papers on our future approach to mobile markets and meeting future demand for mobile data set out our strategic thinking on the future of mobile markets and demand for mobile data. Your department asked Ofcom for its views on these matters for the purpose of its Wireless Infrastructure Strategy. We have drawn out the key points from these publications that we believe address your questions (in italics below), as well as signposting to the relevant sections for the underlying analysis. Alongside these documents, our work to implement our spectrum management strategy for the 2020s (July 2021) supports our response to your broader spectrum-related questions.

In line with our letter of 4 August, we are providing our preliminary view at this stage, which will be refined further following stakeholder responses and our ongoing work. We plan to further input later in 2022 when we publish our initial conclusions for these areas of work.

Future wireless connectivity needs: *Ofcom's assessment of the potential level of service that may need to be provided to meet the needs and expectations of consumers, businesses and sectors by 2030 in terms of speed, reliability and latency*

Mobile data traffic has grown by an average of 40% year on year in recent years, and we expect that growth to continue (acknowledging there is there is a high degree of uncertainty about the rate of growth, particularly beyond 2030). This is likely to be driven by people making greater use of data-hungry services such as streaming, video calling and newer technologies such as virtual and augmented reality as well as connected vehicles. New technologies are also likely to create new uses for industry (such as robotics), many of which will be provided through private networks. In addition, we may see new uses in the public sector, for example smart cities and remote monitoring and diagnosis in healthcare.

In Section 4 of our 'Future approach to mobile markets' paper, we set out our initial assessment that quality of experience, whilst patchy in places, is generally good in the UK, based on our current definition of a good mobile service as one that provides a download speed of 2 Mbit/s. We note in Section 6 that we know that customer needs are likely to evolve over the next ten years and that some uses will require higher quality connections on the go. New online services enabled by new technology, including standalone 5G, may also require different types of mobile internet access, and in different types of places, to those we see today. Therefore, we believe that a metric for quality of experience based solely on speed and coverage is unlikely to reflect the full range of expectations and needs of customers. Factors such as reliability and latency will be important to build a full picture of quality of experience.

At present however, it is difficult to say exactly what customer needs will be and what improved quality of experience will be required over the next decade – nor is it clear whether a single definition of good quality of experience is helpful in representing the diversity of future uses and needs. Ofcom is undertaking a dedicated project of work to consider how we can better understand and report on quality of experience in mobile networks, and we expect to report on this by the end of the year.

In addition, given the growing importance of quality, and the challenges that exist in measuring it, we want to develop a richer understanding of how well quality of experience outcomes meet the needs of people and society. In Section 5 of our 'Future approach to mobile markets' paper we acknowledge that, while MNOs have incentives to compete on network quality, there are potential challenges for consumers evaluating the comparative quality of networks, and that the benefits to an MNO of competing through improving quality of service may be less strong than they could be if there were better information available to consumers to make informed choices. We will therefore continue our work to develop improved data through Ofcom's Mobile Reporting Project which, alongside developing new metrics for reporting on the availability of 5G, is exploring new approaches to report on the quality of mobile performance to present a consistent picture across 4G and 5G. This will help inform customers' choice of provider, as well as future policy.

We also recognise that there may be wider benefits to society in having a more widespread or faster rollout of higher quality mobile networks than is delivered by the market alone. Better infrastructure has the potential to enable economic growth and innovation, promote social inclusion and bring environmental benefits. We are therefore inviting further input from stakeholders on the potential benefits that might warrant intervention.

The availability of secure and reliable mobile networks – and the digital services that rely on them – provide the backbone of much of the working, educational and social lives of individuals across the UK. Telecoms operators have invested heavily in improving the resilience of their networks, because they have an incentive to avoid outages which will result in increased costs to resolve, as well as increased customer churn and reputational impact. However, operators clearly have to balance these demands against broader commercial pressures. The recent events arising from Storms Arwen, Malik and Corrie have emphasised the need to continue working closely with government to ensure our networks continue to deliver the reliability we need into the future, in the face of growing dependence of consumers and businesses on connectivity.

Finally, we expect competition to continue to drive investment in improvements in mobile networks over the next few years. In particular, we expect it to be effective in delivering additional capacity in national mobile networks where required. We also expect it to be effective in delivering site-specific private networks and industrial applications for business customers by a wide range of players (as noted below). We note in Section 6 of our 'Future approach to mobile markets' paper that, based on the network deployment plans we have seen, MNOs are on track to meet the Government's target for 5G coverage in the majority of the country by 2027. Longer term, given the potential for significant change across the value chain, there is a risk that competition becomes more complex and that MNOs no longer have the same incentives to compete to deliver value for money or to invest. We will monitor market developments carefully to assess any key risks that might affect the delivery of good outcomes, ready to engage and take action where necessary.

Market developments: *Ofcom's assessment of the changes and trends impacting the UK mobile market, the impact these changes are likely to have on competition in the market and investment in new technologies. These might include, for example: changes in the MVNO market, the growth of over the top services, network convergence, the emergence of new players such as neutral host providers, hyperscalers, systems integrators / private network operators, localised MNOs; and changes to network design such as softwarisation and open networks.*

Over the past ten years there has been a huge shift towards the use of mobile devices in our everyday lives, at home and at work. Most calls are now made from mobile phones rather than landlines and UK adults now spend on average two hours a day online on their smartphones. As noted above, this trend is set to continue with greater use of existing services, as well as new use cases.

The mobile market has served the UK well over the past ten years, driven by competition among four mobile network operators (MNOs). But increasingly, mobile networks are part of a range of different wireless technologies people use to meet their needs at different times, whether that is using Wi-Fi at home or work, or mobile networks when we are on the go. In the future, we expect to see an increased role for other companies in providing private networks or network infrastructure to MNOs and other network providers, selling mobile internet access and providing online services.

Some changes in the mobile market we may expect to see include:

- further rollout of 5G non-standalone to provide additional capacity in high demand areas, and the deployment of 5G standalone to further improve mobile networks;
- MNOs continuing to separate out infrastructure, and we may see greater sharing of infrastructure, or new network sharing and ownership models emerge;
- greater use of cloud, which will bring efficiency benefits to MNOs, and also increase the role of hyperscalers in the provision of networks;
- Open RAN growing alongside traditional RAN architecture and allowing MNOs to diversify their equipment vendors; and
- growth in the use of private networks, supported by MNOs and a range of alternative providers.

We may also see a growing role for Apple and Google. They may leverage their strong position in mobile ecosystems to play a larger role in the provision of mobile services. It is possible, for example, that Apple and Google could become platforms on which customers choose their mobile provider, and under certain circumstances, this could result in weaker competition.

Section 6 of our 'Future approach to mobile markets' discussion paper sets out our initial views on the key developments that may impact UK mobile markets, and Section 7 sets out our initial views on the implications of these changes. Following an assessment of the views and evidence provided by stakeholders, we plan to set out our conclusions by end 2022.

Spectrum*: given the criticality of spectrum to future wireless networks:*

a. *Ofcom's assessment of whether the UK spectrum management framework will remain fit for purpose to enable the best outcomes for the UK, and any changes to the framework that may need to be considered, given the emerging and anticipated changes in the MNO and private network markets, networks, technology and industry ecosystem;*

Ofcom has key spectrum management functions across the UK, which we carry out in accordance with our principal duty to further the interests of citizens and consumers, where appropriate by promoting competition, and our duty to secure the optimal use of spectrum. Our goal is to drive

efficiency and competition, and support innovation, ensuring this invisible, essential and finite resource is used effectively.

We share the Government's view that spectrum is a critical national asset, and as such Ofcom is consistently working to ensure that our spectrum management framework is fit for purpose. In July 2021, Ofcom published its spectrum management strategy for the 2020s. In it, we outline how we will enable further innovation by promoting more flexible and efficient use and increased sharing of spectrum while meeting the requirements of local and national services and how we will drive long-term changes that will provide the foundation for new and improved services for people throughout the UK. Our spectrum management vision is comprised of four objectives:

- Continued improvements in the wireless communications used by everyone, wherever and wherever they use them.
- Businesses, public sector and other organisations with specialised requirements to be able to access the right wireless communication or spectrum options for them.
- Increased flexibility in spectrum use to support innovation, with appropriate assurances for continued use.
- Sustained improvements in the efficiency of spectrum use.

Delivering that vision will require us to monitor trends affecting the evolving market and changing technology context, in order to adapt and respond flexibly – including the market trends identified in the response above. Our December discussion paper on Terahertz spectrum demonstrates our strategy in action – clearly stating our goal to maximise the value of this spectrum through greater spectrum sharing, taking advantage of the unique properties of the band and emerging technologies.

This continuous improvement and tailoring of our approach to developments in the ecosystem characterise Ofcom's approach to spectrum management. Our upcoming Spectrum Roadmap will set out the work we are already doing to deliver on our spectrum vision, how we are using the full range of tools at our disposal, and how we are preparing for the future challenges and opportunities that lie ahead. This work will also inform our international position in preparation for the World Radiocommunications Conference (WRC) 2023.

b. *Ofcom's preliminary assessment of the potential spectrum requirements over the coming 15 years for mobile networks and how, in terms of spectrum bands and mechanisms, these might be accommodated;*

In our 'Meeting future demand for mobile data' discussion paper, we set out our thinking on the growth of UK demand for mobile data, and the potential spectrum requirements for mobile networks to 2035, to evolve to meet future demand and deliver the quality of experience needed by consumers and businesses. In Section 4 we discuss how mobile data traffic is expected to continue to grow, but that the pace is uncertain, in particular beyond 2030. A large number of variables will be important here including the development and uptake of new applications and devices and the extent to which businesses and people opt to use alternative technologies such as Wi-Fi for some of their connectivity needs. The implications for mobile networks could vary quite substantially according to the eventual growth rate and where the growth arises.

In Section 5 of the paper, we set out our initial assessment that existing mobile spectrum holdings and spectrum already planned for release (such as millimetre wave) are likely to be broadly sufficient to meet future demand to 2030, if MNOs were to utilise the tools available to them such as:

- more extensive deployment of existing spectrum holdings and planned future spectrum for mobile e.g. in the millimetre wave (mmWave) bands. We will consult on our approach to making mmWave spectrum available shortly;
- using technology upgrades to increase the efficiency of the spectrum they use; and
- network densification – deploying more cell sites – in particular, using small cells to leverage the capacity offered by the large bandwidths available from mmWave spectrum.

There is a greater level of uncertainty in the period beyond 2030. Additional new mobile spectrum beyond the existing pipeline of spectrum could help facilitate the provision of additional capacity, but on its own would not be sufficient to meet future mobile data traffic growth in all areas.

We are using our discussion paper to seek stakeholder inputs on whether there are specific frequency ranges which should be considered for mobile access to support capacity provision in the future, including opportunities for mobile networks to share spectrum with other users, for example through more localised access or lower power use. Making additional spectrum available for high-power outdoor mobile use would likely require clearing bands of existing users. This process usually takes around 6-8 years; it would be subject to consultation and may require an impact assessment of the costs, benefits and risks involved. We would need to take account of relevant factors such as the on-going value to the UK of existing uses of the frequencies, and the potential value of alternative non-mobile uses which could use the spectrum.

c. *Efficient use of spectrum: Ofcom's assessment of whether there is scope to improve the effectiveness of spectrum use in existing licensed spectrum holdings, and Ofcom's assessment of the options to do this. Ofcom's assessment of what new technological capabilities and innovations can be used to improve and modernise spectrum access and licensing, and Ofcom's plans for implementing these.*

In respect of current MNO spectrum holdings we note that operators may choose to trade spectrum holdings if they believe this will enable them to realise benefits e.g. in spectral efficiency, subject to the Mobile Trading Regulations and Guidance. Furthermore, our Local Access licence framework which provides a route for others to make use of MNO spectrum holdings where a MNO does not currently use a band, or plan to do so in the near term.

We have also made spectrum which supports mobile technology (including the 3.8-4.2 GHz 5G band) available on a local basis through our Shared Access licence framework. Here spectrum is shared by range of users operating different services.

We aim to promote innovation by lowering barriers of access for spectrum, and by reviewing and addressing stakeholder feedback on our approaches. We are also making it easier for existing and interested spectrum users to access spectrum by upgrading our spectrum information tools, and by modernising our spectrum licensing platform, leading to a single system for most Ofcom spectrum licences. This will deliver an improved user experience for licensees; and technology that will

enhance the quality of online licensing and simplify and align information across licence products for licensees. We expect users to start to see the benefits of this programme this year. We are also considering the potential role automated assignment databases could play in meeting future spectrum management challenges and will seek input on the potential range of solutions, challenges and benefits of this later this year.

Complementing these changes, we will continue to ensure that there are appropriate assurances for continued use of spectrum, both to support existing benefits from wireless services and to provide conditions for future investment. We will also continue to work closely with government to ensure efficient use of public sector spectrum.