Appendices and glossary

Appendices

A: Terms of reference and conduct of the inquiry

B: Industry regulation and background

C: Wholesale leased lines: other suppliers of mobile backhaul

D: Wholesale leased lines: comparison between dark fibre and active leased lines

E: Wholesale leased lines: MNOs' contractual protections

F: Wholesale leased lines: background to the Project Beacon network sharing arrangements

G: Wholesale leased lines: vertical arithmetic analysis of supply withdrawal

H: Approach to internal documents

I: Wholesale mobile: evidence from internal documents on competition between MNO and strategies

J: Wholesale mobile: recent fixed-MVNO tender processes

K: Wholesale mobile: MNO network capacity and quality

L: Wholesale mobile: assessment of quantitative evidence in relation to unbundling and switching

M: Wholesale mobile vertical arithmetic analysis

N: Wholesale mobile: evidence on take-up and benefits of fixed-mobile bundles

Glossary

Appendix A: Terms of reference and conduct of the inquiry

Terms of reference

1. In exercise of its duty under section 33(1) of the Enterprise Act 2002 (the **Act**) the Competition and Markets Authority (**CMA**) believes that it is or may be the case that:

   (a) arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation, in that:

      (i) enterprises carried on by Liberty Global plc will cease to be distinct from enterprises carried on by Telefónica S.A.; and

      (ii) the condition specified in section 23(1)(b) of the Act is satisfied; and

   (b) the creation of that situation may be expected to result in a substantial lessening of competition within a market or markets in the United Kingdom for goods or services, including as a result of input foreclosure in relation to the supply of: (i) wholesale access and call origination on public mobile networks to mobile virtual network operators in the UK; and (ii) passive fibre leased lines to mobile network operators, at each of the access and aggregation layers on a local basis.

2. Therefore, in exercise of its duty under section 33(1) of the Act, the CMA hereby makes a reference to its chair for the constitution of a group under Schedule 4 to the Enterprise and Regulatory Reform Act 2013 in order that the group may investigate and report, within a period ending on 27 May 2021, on the following questions in accordance with section 36(1) of the Act:

   (a) whether arrangements are in progress or in contemplation which, if carried into effect, will result in the creation of a relevant merger situation; and

   (b) if so, whether the creation of that situation may be expected to result in a substantial lessening of competition within any market or markets in the United Kingdom for goods or services.

Joel Bamford
Senior Director, Mergers
Competition and Markets Authority
11 December 2020

Conduct of the inquiry

3. On 11 December 2020, the CMA referred the anticipated joint venture between Liberty Global Plc and Telefónica S.A. (the Parties) for an in-depth Phase 2 inquiry.

4. We published the biographies of the members of the group conducting the inquiry on the inquiry webpage on 11 December 2020 and the relevant administrative timetable was published on the inquiry webpage on 21 December 2020.

5. We invited interested parties to comment on the anticipated joint venture. We sent detailed questionnaires to 28 of the Parties' competitors and customers, and a number of these also provided us with further information by videoconference calls as well as by responding to supplementary written questions. Evidence submitted to the European Commission during its inquiry[1] and to the CMA during Phase 1 was also considered in Phase 2.

6. We received written evidence from the Parties in the form of submissions and responses to information requests.

7. On 21 January 2021, the CMA published an Issues Statement on the inquiry webpage setting out the areas on which the Phase 2 inquiry would focus. A non-confidential version of the Parties' response, along with two other responses, were published on the inquiry webpage on 24 February 2021.

8. On 14 and 15 January 2021 members of the inquiry group, accompanied by CMA staff, attended virtual 'site visits' with the Parties and their advisers held via video conference. These arrangements were made because of the COVID-19 pandemic and the Government's associated guidelines.

9. During our inquiry, we sent the Parties a number of working papers for comment. We also provided the Parties and third parties with extracts from our working papers for comments on accuracy and confidentiality. The Parties were also sent an annotated issues statement, which outlined our emerging thinking to date prior to their respective main party hearings, which were held separately with each Party on 18 March 2021.

[1] The CMA's Phase 1 investigation was launched on 19 November 2020, following the European Commission's decision to refer the anticipated joint venture to the UK under article 9(3)(b) of the EC Merger Regulation.

10. A non-confidential version of our provisional findings report has been published on the inquiry webpage. Interested parties are invited to comment on this document.

11. We would like to thank all those who have assisted in our inquiry so far.

Appendix B: Industry regulation and background

Regulation

1. Communications networks and services are regulated in the UK by the Office of Communications (Ofcom). Ofcom has various powers and functions, with the ones most relevant to this inquiry being:

   (a) Sections 84 and 84A of the Communications Act 2003 (CA03) require Ofcom to review competition in certain communications markets every five years.[1] When conducting a market review, Ofcom must determine whether the following three criteria are met in relation to the market in question: it has high barriers to entry; it does not tend towards effective competition within an appropriate period; and competition law is insufficient to address the market failure identified by Ofcom. Ofcom may only proceed to identify a market in order to make a market power determination and impose appropriate remedies if all three criteria are met. Ofcom must carry out a forward-looking assessment of the market, taking account of any expected or foreseeable developments which may affect competition. Ofcom must set such remedies which it considers appropriate and proportionate and which are authorised under sections 87 – 93 CA03.

   (b) Ofcom is responsible (under the Wireless Telegraphy Act 2006) for managing and licensing the use of spectrum ('airwaves'). Its regulatory functions include allocation and assignment of mobile and wireless broadband spectrum through licensing. As part of this, it undertakes competition assessments and conducts auctions with the aim of ensuring that spectrum allocation meets market needs and to promote competition in retail and wholesale mobile markets.

2. Ofcom also has concurrent competition powers with the CMA under the Competition Act 1998 and the Enterprise Act 2002 (EA02).

Regulatory and policy developments

3. In 2005, Ofcom accepted undertakings from BT to give all communications providers equality of access to BT's critical infrastructure and secure the

[1] Where Ofcom has made a market power determination under s79 CA03, they must (s84A) carry out further analysis and review within a specified period. Under s84A (7) the specified period is five years from the publication of the market power determination but is extendable under s87A (8) by an additional year.

functional separation of BT's infrastructure business, Openreach, from the rest of BT. [2]

4. Ofcom's regulation of fixed telecoms markets initially focused on promoting competition at the retail level through regulated access by Openreach to BT's copper networks. Following Ofcom's 2016 Strategic Review of Digital Communications,[3] it focused on supporting investment in fibre networks by promoting network-based competition.[4, 5, 6]

5. Significant regulatory developments and remedies include those described in Table 1 below:

[2] Following Ofcom's 2004 Strategic Review of Telecommunications.
[3] Ofcom 2016 Digital Communications Review – Initial Conclusions.
[4] Ofcom, in its 2016 Strategic Review of Digital Communications, set out its competition concerns about BT's incentive and ability to favour its own retail business when making strategic decisions about new network investments by Openreach. In March 2017, Ofcom accepted commitments from BT, agreeing to the legal separation of Openreach within the BT group with its own Board, management, employees and strategy.
[5] Ofcom website news releases, 2016 Digital Communication Review.
[6] Ofcom website news release, BT agrees to legal separation of Openreach, 10 March 2017.

Table 1: Significant regulatory developments and remedies

Year	*Development*
2005	Openreach established as functionally separate from BT (see Statement: Ofcom accepts undertakings from Board of BT Group plc on operational separation).
2009	Retail fixed voice markets (other than in the Hull area) deregulated (see Statement: Ofcom deregulates retail telecoms market).
2016	Ofcom published conclusions of its Strategic Review of Digital Communications (see Ofcom 2016 Digital Communications Review – Initial Conclusions) which included a strategic shift to support investment and innovation in ultrafast broadband networks.
2017	BT gives Ofcom commitments, agreeing to implement the legal separation of Openreach, which establishes it as a distinct company (see BT agrees to legal separation of Openreach). UK government launched £1.1 billion digital connectivity package, which included a £400 million Digital Infrastructure Investment Fund to support the growth of the ultrafast broadband industry (see UK Digital Strategy 2017)
2018	UK government published The Future Telecoms Infrastructure Review (see Future Telecoms Infrastructure Review) setting targets for the availability of full fibre and 5G networks by 2025-2033. Wholesale Local Access (WLA) Market Review 2018 (see Wholesale local access market review - Ofcom): Ofcom introduced a Physical Infrastructure Access (PIA) remedy giving improved access to BT ducts and poles, to support competing network build by reducing cost/time. The PIA access remedy was made available for “mixed use” purposes albeit for operators delivering primarily broadband connections. Price caps set to encourage competing network investment, among other objectives.
2019	Physical Infrastructure Market Review (PIMR) 2019 (see Statement: Promoting competition and investment in fibre networks – review of the physical infrastructure and business connectivity markets - Ofcom): Ofcom introduced an ‘unrestricted’ physical infrastructure access (PIA) remedy, requiring BT to give access to other providers with no restrictions on usage. Business Connectivity Market Review (BCMR) 2019 remedies (see Statement: Promoting competition and investment in fibre networks – review of the physical infrastructure and business connectivity markets - Ofcom).
2020	MNOs agree to specific geographic coverage thresholds for mobile voice and data services by 2024-2026 (see Statement: Mobile coverage obligations).
2021	Wholesale Fixed Telecoms Market Review 2021 (see Statement: Promoting investment and competition in fibre networks) (see Chapter 7 – The role of Ofcom’s regulatory conditions). Spectrum auction held in March 2021(5G) (see Statement: Award of 700 MHz and 3.6-3.8 GHz spectrum by auction).

Source: CMA analysis

Industry background

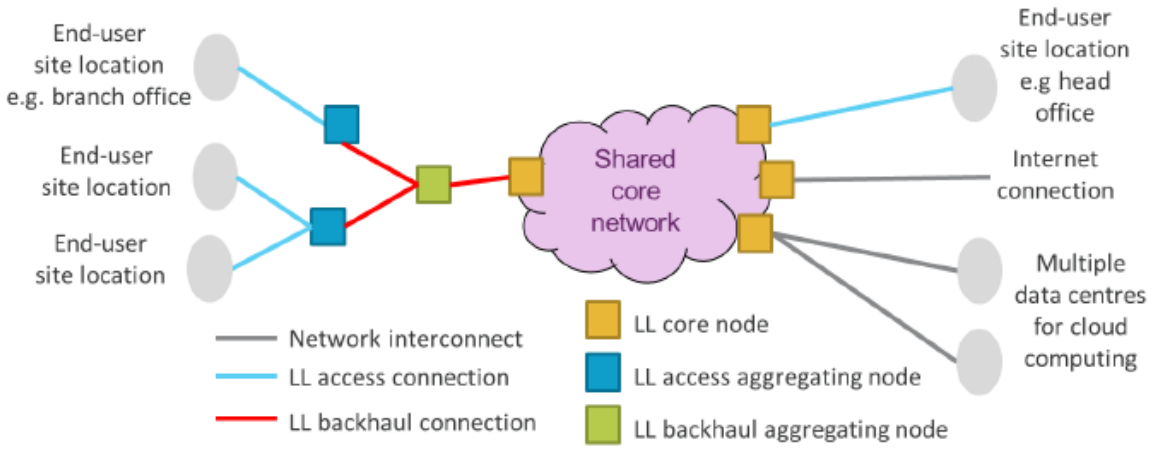
Leased lines

6. Leased lines are used to provide a variety of retail and wholesale connectivity. This includes business end-to-end connectivity, business access connectivity to virtual private networks (VPNs) the internet and cloud computing, mobile

network connectivity (mobile backhaul), broadband network connectivity (fixed broadband backhaul) and voice.

7. A stylised shared business connectivity network is shown in Figure 1.

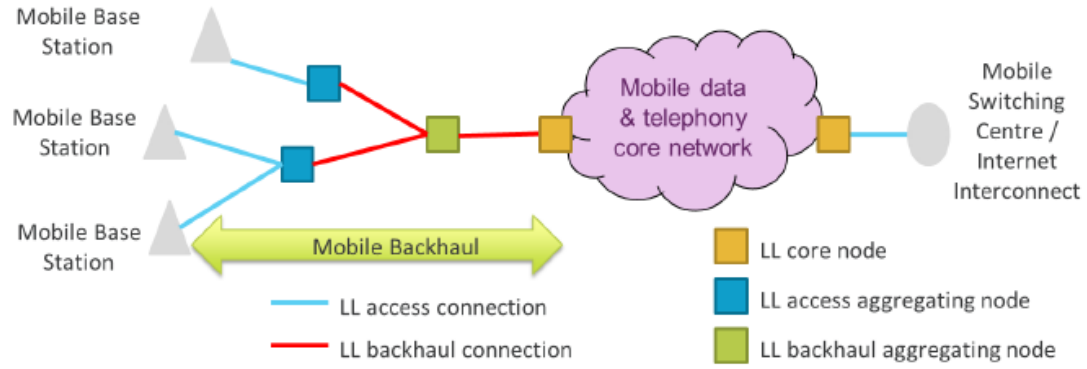
Figure 1: Shared business connectivity network (VPN, internet and cloud computing)



Source: Ofcom BCMR 2019, Figure 3.4.

8. MNOs also use leased lines, in their own networks, to connect their radio base stations, using access and backhaul connections, to their core network nodes. The term 'mobile backhaul' is commonly used to refer to the combination of access and backhaul connections at the access and aggregation layers. A stylised mobile connectivity (mobile backhaul) network is shown in Figure 2.

Figure 2: Mobile network connectivity



Source: Ofcom BCMR 2019, Figure 3.5.

Fixed telecoms retail price and revenue trends

Fixed voice revenues

9. Total fixed telecoms revenues fell by £0.6bn in 2019 on prior year levels, or 4%, in real terms to £13.4bn in 2019. The 2020 Communications Market Report (CMR) attributes this decrease to the falling use of fixed voice services and declining fixed broadband prices.

10. The total fixed telecoms revenues for 2013 to 2019 can be found at Table 2 below.

Table 2: Fixed telecoms (voice and data services) revenue (£bn)

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Retail fixed	13.8	13.9	14.3	14.9	14.9	14.0	13.4

Source: Ofcom Communications Market Report 2020 – Interactive data, slide 15, Telecoms industry: fixed

11. The average monthly household spend on fixed voice and data services increased from £37.36 in 2012 to £39.59 in 2018, then decreased to £37.25 in 2019. [7]

Retail demand for fixed data

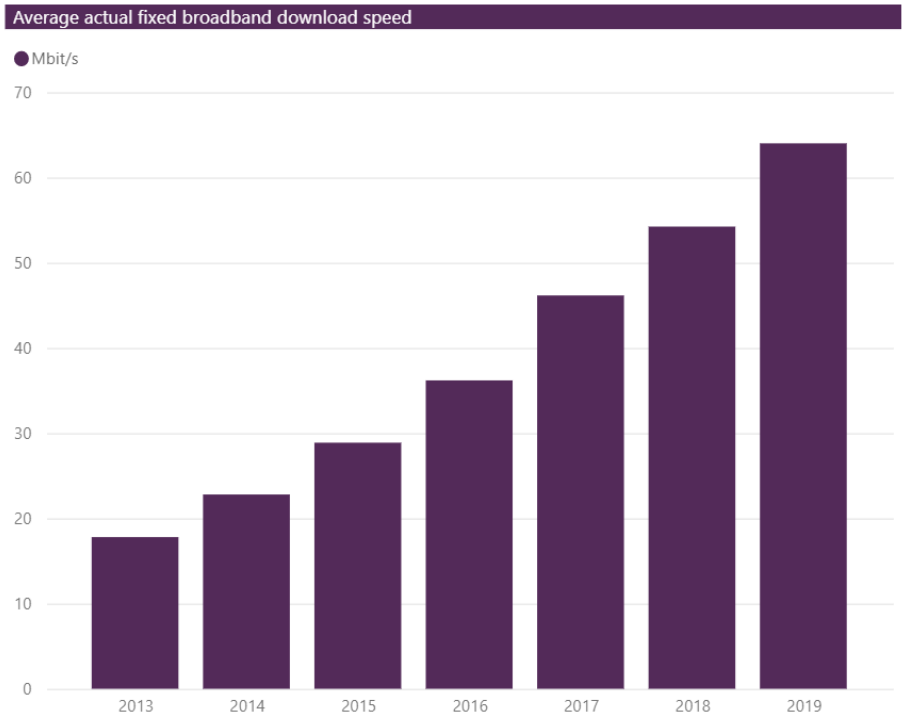
12. The 2020 CMR found that the speed of internet connections has increased, supporting the use of more data. However, despite these factors, average household spend on telecoms decreased. In 2019, 69% of all residential broadband lines were 'superfast', ie with speeds of over 30Mbits/s.

[7] Ofcom Summary of UK telecoms metrics 2020, rows 14 to 19.

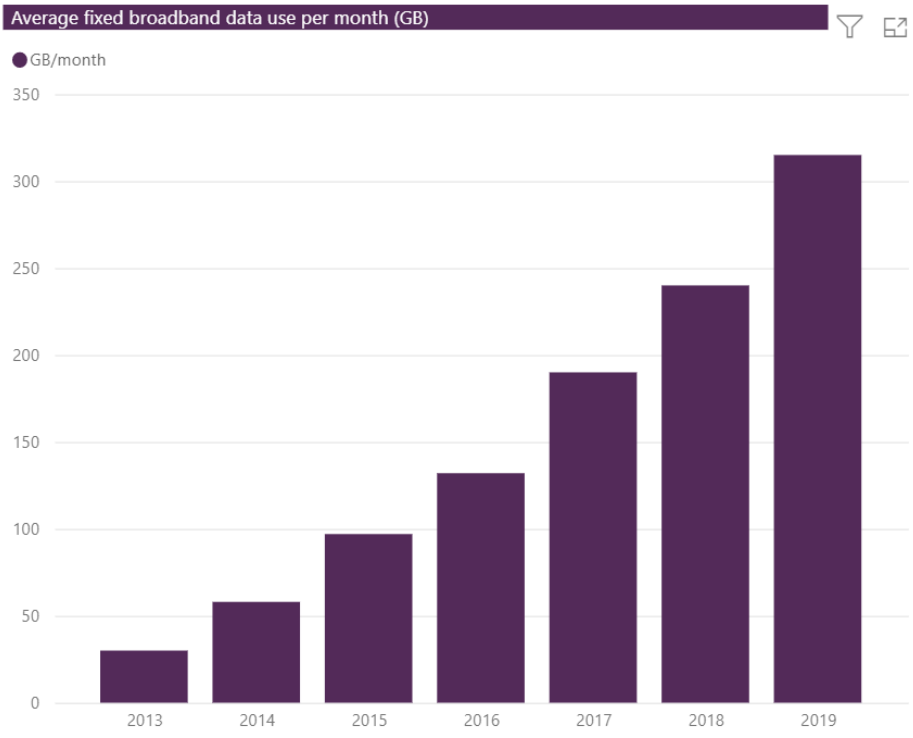
13. Much of the increase in data use was driven by viewing online video. Ofcom noted that the volume of content available on subscription video-on-demand platforms (SVoD) grew, as did subscriptions to these services.

14. As shown in Figure 3 below, the average actual fixed broadband download speed has increased from 17.8Mbit/s in 2013 to 64Mbit/s in 2019. By the end of 2019 the proportion of all UK lines delivering average speeds of 30 Mbit/s or more (superfast connections) reached 67%. Similarly, demand for fixed broadband data increased by 75GB/month from 2018 to 2019.

Figure 3: Average actual fixed broadband download speed (Mbit/s) and average fixed broadband data use per month



Source: Ofcom / operators Note: Measurements taken in Q4 of each year



Source: Ofcom / operators

Source: Ofcom Communications Market Report 2020 – Interactive data, slide 15, Telecoms industry: fixed (Broadband speeds) and slide 15, Telecoms industry: fixed (Volumes, Average fixed broadband data use per month (GB))

Mobile telecoms retail price and revenue trends

Mobile connections

15. At the end of 2019 there were 94.2 million active mobile connections in the UK, comprising handsets, dedicated mobile data connections[8][9] and machine to machine connections,[10] an increase of 0.1% from 2017.[11]

16. The highest proportion of active mobile connections is from mobile handsets, which grew slightly from 79.9 million in 2012 to 80.2 million in 2019. The number of machine to machine connections grew much faster (from 5.0 million to 9.5 million between 2012 and 2019 respectively) while the number of dedicated mobile data connection fell by 9.8% over the same period to 4.5 million connections in 2019.[12]

4G subscribers

17. The proportion of mobile connections with access to 4G services increased from 3.1% in 2013 to 75.6% in 2019, as can be seen in Table 3 below.

Table 3: Mobile connections with access to 4G services (%)

	2013	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Proportion of all active mobile connections	3.1%	26.3%	43.0%	57.2%	65.8%	72.0%	75.6%

Source: Ofcom Communications Market Report 2020 – Interactive data, slide 16, Telecoms industry: mobile

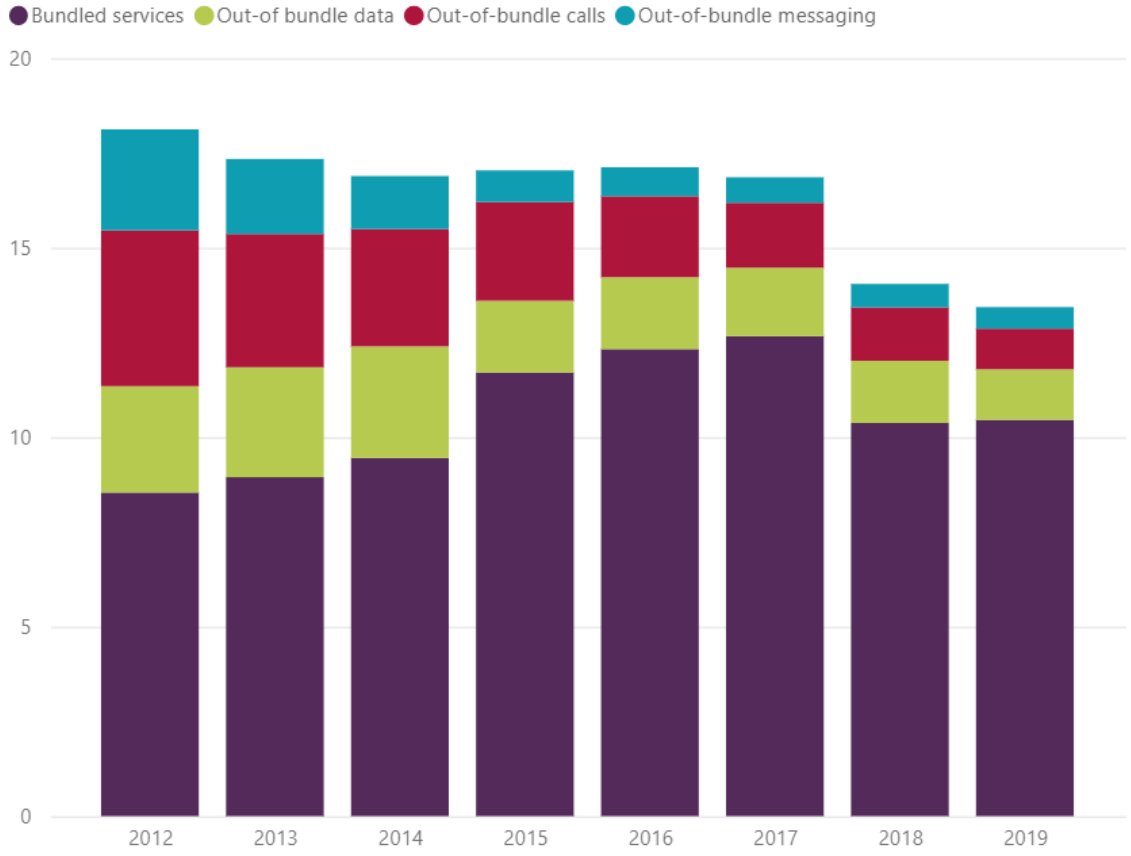
Retail mobile price trends

18. Figure 4, below, shows retail mobile revenue by service type, from 2012 to 2019. It refers to bundled services, which means bundles of mobile services (minutes, texts and/or data for a fixed price).

---

[8] Ofcom Communications Market Report 2020 – Interactive data, slide 16, Telecoms industry: mobile.
[9] Ofcom defines mobile broadband as access to a mobile data network via a USB stick or dongle, or built-in connectivity in a laptop/netbook/tablet with a SIM, tethering (via mobile phone internet connection on a laptop/tablet), and MiFi mobile broadband wireless router. See Ofcom CMR (2015), p268.
[10] M2M refers to the automated transmission of data between mechanical or electronic devices.
[11] Total active mobile subscriptions include active mobile handsets, dedicated mobile data subscriptions such as mobile broadband dongles and data-only SIMs, and M2M connections. Ofcom's definition of M2M generally refers to a connection, often wireless, in which human input is not necessarily required. It includes examples such as smart electricity meters (where the meter reports energy usage back to a central billing database) or a burglar alarm, which may contain a SIM card to enable communication with monitoring offices. Vending machines are another common example, as some may use M2M technology to keep a central computer up to date with stock levels. See Ofcom CMR (2015), p295.
[12] Ofcom Communications Market Report 2020 – Interactive data, slide 16, Telecoms industry: mobile.

Figure 4: Retail mobile revenue, by service type (£bn)



Source: Ofcom / operators Notes: In 2015 one of the major operators redefined how it reported bundled and out-of-bundle revenues, so figures not directly comparable before 2015; from 2018, bundled revenues are reported according to the new IFRS15 accounting standard and do not include any device revenues; includes estimates where Ofcom does not receive data from providers; adjusted for CPI (2019 prices).

Source: Ofcom Communications Market Report 2020 – Interactive data, slide 16, Telecoms industry: mobile

19. Total retail mobile revenue decreased from £14.04 billion in 2018 to £13.43 billion in 2019, of which 78% of revenue came from bundled services. In the CMR, Ofcom noted that from 2018, mobile bundle revenues are reported under the new IFRS 15[13] accounting standard and do not include revenues derived from devices such as mobile handsets. As such retail mobile revenues from 2018 are not comparable to earlier years.

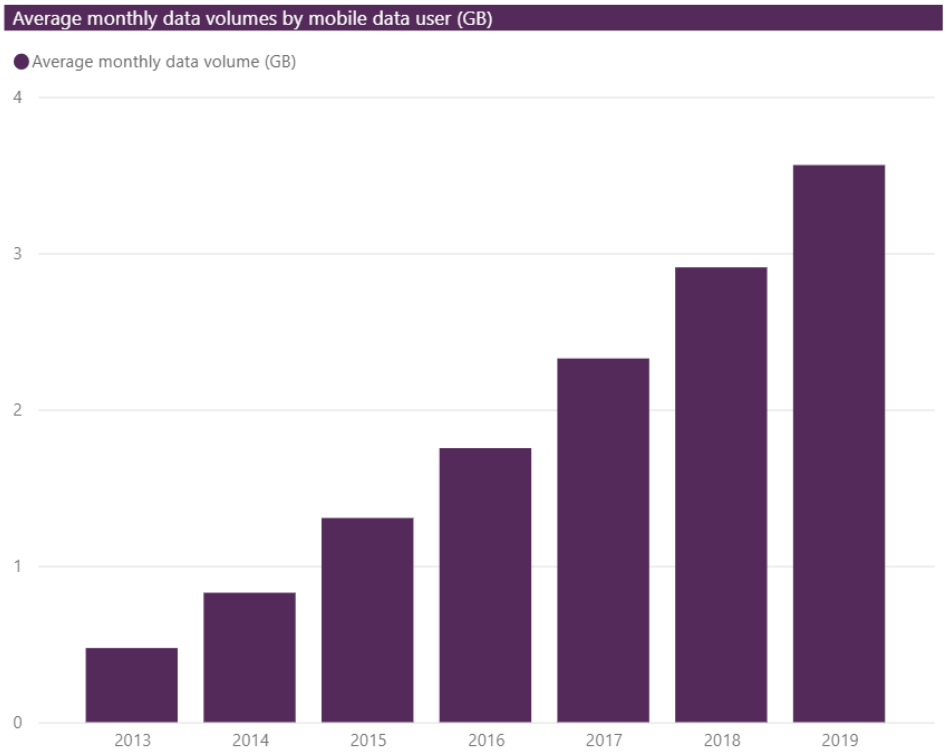
Demand for mobile data

20. In 2019 the volume of data used (for mobile connections) grew by 34.3% from the prior year.[14]

[13] IFRS 15: Revenue Recognition is the International Financial Reporting Standard used by companies reporting under International Financial Reporting Standards (IFRS).
[14] Ofcom CMR – Telecoms: Mobile section – Data/messaging – Total mobile data use, by subscription type (PB).

21. Demand for mobile data increased by 0.7GB/month from 2018 to 2019 (see Figure 5 below). This was fuelled by growing use of video streaming services. Mobile data use continued to increase in 2019.

Figure 5: Average monthly data volumes by mobile data user (GB/month)

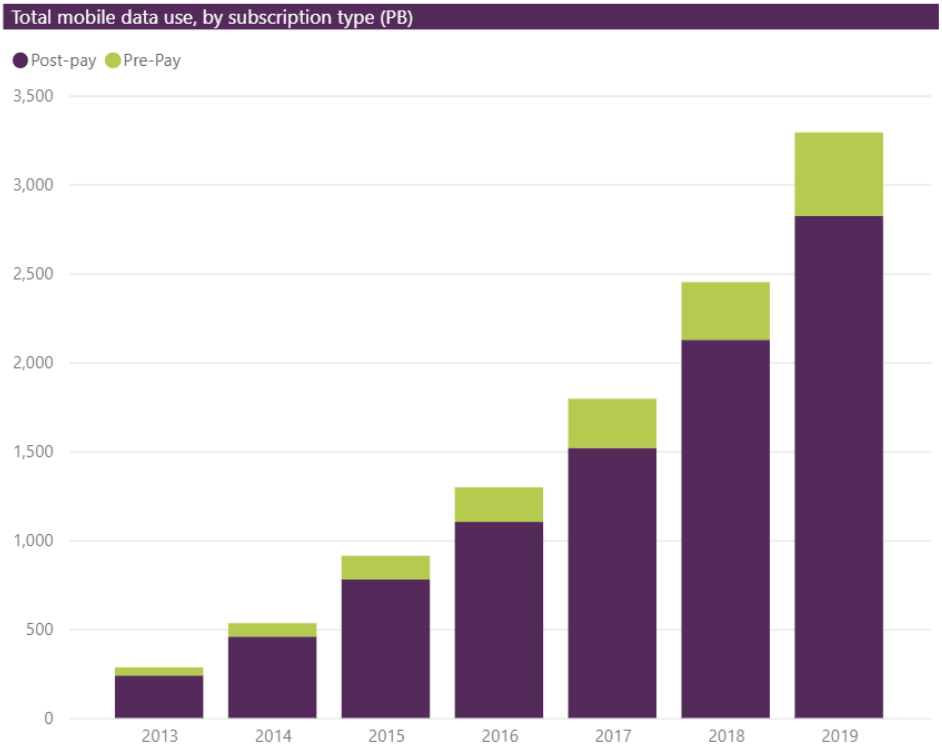


Source: Ofcom / operators Note: Includes estimates where Ofcom does not receive data from operators.

Source: Ofcom Communications Market Report 2020 – Interactive data, slide 16, Telecoms industry: mobile (Data/Messages, Average monthly data volumes by mobile data user (GB))

22. Figure 6 shows that data usage on post-pay mobile contracts increased by 32.8% in 2019, compared to 2018.

Figure 6: Total mobile data use, by subscription type (GB)



Source: Ofcom / operators Note: Includes estimates where Ofcom does not receive data from operators.

Source: Ofcom Communications Market Report 2020 – Interactive data, slide 16, Telecoms industry: mobile (Data/Messages, Total mobile data use, by subscription type (GB))

Appendix C: Wholesale leased lines: other suppliers of mobile backhaul

CityFibre

1. CityFibre offers full fibre broadband to business customers and backhaul solutions for other networks, including mobile ones. It told us that, whilst it provides all types of leased line product for general connectivity, its solutions for mobile backhaul are only dark fibre.[1]

2. [✂].

3. According to information published by Ofcom, CityFibre's network as at September 2020 had a coverage of 0.4 million premises.[2] CityFibre considers itself to be 'the UK's third national digital infrastructure platform'[3] and it states that it is present in over sixty UK towns and cities.

4. Three told us that CityFibre is not present in London or other large cities where Virgin is present, and that CityFibre instead targets mid-sized towns and cities.

5. A [✂] and [✂].

6. The Parties consider CityFibre to be quite a strong option for supplying mobile backhaul:

   (a) The Parties submitted that CityFibre has secured backing from major financial investors to support a £4bn investment plan to expand its network to cover 'nearly one-third of the UK market' by 2025. The Parties further submitted that the importance of CityFibre as a competitor is evidenced by its success in the tender for Three's first phase of its 5G backhaul network, [✂]. The Parties further submitted that CityFibre won circuits also in areas in which it currently does not have a network and that it appears to be able to credibly build out its network rapidly on the basis of PIA.

   (b) A Liberty Global internal document describes CityFibre [✂]; and

   (c) A Telefónica internal document notes that [✂].

---

[1] [✂]
[2] 2021 WFTMR Volume 2: Market analysis (ofcom.org.uk), Table 1.1 [public document].
[3] About us - CityFibre.

7. [✂] considers CityFibre to be increasing its ability to supply mobile backhaul, saying that CityFibre has been 'rolling out quite aggressively off the back of various digital initiatives' and that it 'could deliver a complete (mobile backhaul) solution' because of this.

8. MNOs have stated quite different views on the extent to which CityFibre can be used to provide mobile backhaul for their purposes:

   (a) Vodafone said that CityFibre is able to 'provide connectivity to a [✂].

   (b) Three said that CityFibre was '[✂] and [Three's] preferred supplier [✂]'. Three has also forecast CityFibre [✂].

9. CityFibre told us that it is well-resourced to provide MNO backhaul connectivity and that this [✂].

10. Ofcom notes that CityFibre has announced plans to cover eight million premises by 2026.[4]

11. CityFibre further submitted that its ambition is to expand from covering 60 towns and cities to 80, which would mean coverage of between 25-33% of all UK properties. Press releases from CityFibre suggest that locations it will include in this expansion are larger cities like Glasgow and Nottingham and smaller towns like Solihull, Crawley and Barnsley.[5]

12. Information published by Ofcom on the total coverage of Virgin's and CityFibre's planned networks and the extent to which they overlap further indicates that CityFibre's planned network by 2026 will overlap with about one third of Virgin's planned network.[6]

Neos Networks (previously known as SSE Telecommunications)

13. Neos Networks offers leased lines for a variety of purposes in the UK, with all three of the product types (dark fibre, WDM and Ethernet) available for MNO customers as mobile backhaul.

---

[4] 2021 WFTMR Volume 2: Market analysis (ofcom.org.uk), paragraph 1.18 [public document].
[5] CityFibre reveals 36 more towns and cities to benefit from full fibre as rollout accelerates - CityFibre.
[6] Figures based on the total number of premises in the postcode sectors where Virgin and/or CityFibre are deemed to be present, not the number of premises passed by the network. A value of one third is obtained as follows: the information published by Ofcom shows that there are 6.9m premises where both are present and 14.8m where only one is present. Given CityFibre's plan to cover 8m premises, this implies that there are 1.1m premises where only CityFibre is present (8m minus 6.9m) and 13.7m premises where only Virgin is present (14.8m minus 1.1m). City Fibre's overlap with Virgin is then obtained by diving the number of premises where both are present (6.9m) with the number of premises where Virgin is present (13.7m plus 6.9m). 2021 WFTMR Volume 2: Market analysis (ofcom.org.uk), paragraph 1.18 and Table 7.3 [public document].

14. Neos Networks is considered by Ofcom to be a 'network aggregator' as well as a network operator, meaning that it sometimes buys services from other suppliers and then re-sells these to the end users such as MNOs.

15. Dark fibre is available from Neos Networks in both the access and aggregation layers. Neos Networks sells dark fibre long routes across its national core fibre network and also offers individual MNO dark fibre networks in Central London and some areas of Scotland. The forecast for Neos Networks' revenue from dark fibre in 2021 is fairly substantial, [✂].[7]

16. A Telefónica internal document on O2's Fibre & Aggregation strategy states that Neos Networks has a '[✂]'.

17. A Liberty Global internal document calls Neos Networks [✂].

18. The Parties also told us that Three has partnered with Neos Networks for fibre backhaul in the aggregation layer.

19. Neos Networks said that it has already deployed dark fibre for a core network in West London for Three and O2.[8]

20. Neos Networks told us that it is 'willing and planning to invest in building more fibre network for MNO backhaul, and it has plans in place to support the future rollout of 5G by providing several dark fibre solutions around the country. This includes metro networks in [✂] UK cities, access network for [✂] major cities with Telefónica UK,[9] [✂].

Zayo

21. Zayo offers leased lines for a number of different purposes and makes all three types of product available for use as mobile backhaul.

22. Liberty Global considers Zayo [✂].

23. Telefónica told us that [✂] with [✂], and [✂].

24. TalkTalk submitted that Zayo is focussed on the aggregation layer.

[7] [✂]. The Scottish areas are Aberdeenshire and Perthshire and Kinross.
[8] [✂]. Also see SSE press release, 2019 for more details.
[9] [✂].

Colt

25. Colt offers three leased line products, with a dark fibre offering for either metro dark fibre or long-haul dark fibre.[10] Its WDM and Ethernet offering is similar to other suppliers, having options from 10Mbit/s to 100Gbit/s.

26. [✂].

27. A Liberty Global internal document [✂].

28. In terms of geographic presence, a Telefónica internal document on O2's strategy states that Colt is [✂].

29. Three said that 'Colt… have limited or no presence outside of London'.

30. A Telefónica internal document notes that [✂].

31. TalkTalk said that Colt was an example of a supplier focussed on the access layer.

32. Colt submitted that its plans for rollout would 'continue to be customer driven' and that customer numbers will increase in 2021. Colt further submitted that it has plans to expand its provision of wholesale leased lines in Scotland.

euNetworks

33. euNetworks supplies both long-haul and metro leased lines in the UK, with the metro lines being used as a dark fibre product for mobile backhaul. This operation for euNetworks is small however, [✂]. Its geographical presence for this product is limited to only London and Manchester.

34. O2 [✂].

35. In terms of expansion, euNetworks suggest that it has plans to roll out [✂], which would mean installing fibre for the specific purpose of mobile backhaul. [✂].

[10] The Colt website says that around Europe they cover 51 metropolitan areas with 'highly dense coverage in key business areas', and that this is 'interconnected by our 38,000km network'.

Appendix D: Wholesale leased lines - comparison between dark fibre and active leased lines

1. This appendix sets out further evidence relating to the comparison between dark fibre and active services and is structured as follows:

   (a) Ofcom's evidence on trends in Openreach's leased line prices;

   (b) Evidence on the current significance of the difference between dark fibre and active services;

   (c) Evidence on whether the significance of that difference is likely to change in the future;

   (d) Challenges when comparing the costs of active services and dark fibre;

   (e) Evidence on the costs of Openreach's active products and Virgin's dark fibre in the access layer;

   (f) Our methodology for estimating costs in the access layer; and

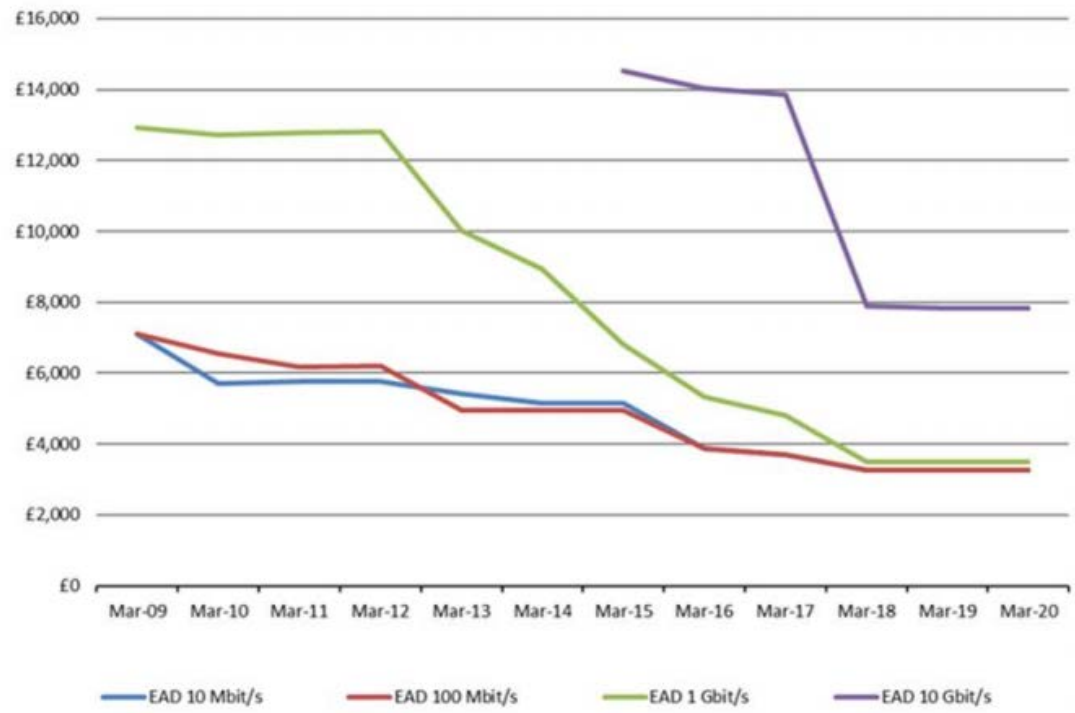
   (g) Evidence on cost differences in the aggregation layer.

Ofcom evidence on trends in Openreach's leased line prices

2. Ofcom submitted that Openreach's very high bandwidth (VHB) prices are markedly higher than prices for lower bandwidth products - the so-called 'bandwidth gradient'. Ofcom also submitted that Openreach earns markedly higher returns on VHB services.

3. Over time, Openreach's Ethernet prices have been declining and the price gap across bandwidths has been narrowing, making the bandwidth gradient flatter and more cost reflective (see Figure 1).

Figure 1: Evolution of Openreach's Ethernet charges: annualised total cost of ownership



Note: EAD (Ethernet Access Direct) is a brand name for Openreach's Ethernet leased lines.

Source: Ofcom [✂].

4. Ofcom submitted that Openreach's leased line prices are influenced by a number of factors, including competition from other network operators, customers' willingness to pay and the potential for customers to substitute (migrate) between products offering different speeds.

5. In addition, Ofcom considered that regulatory differences are likely to have contributed to the bandwidth gradient. Until 2019, Openreach's VHB prices were unregulated while services up to and including 1Gbit/s were regulated down to cost in most of the country.[1]

6. Ofcom also told us that Openreach's competitors were more successful at winning VHB customers, which have higher margins, [✂].

7. Ofcom submitted that other network operators generally compete by undercutting Openreach's prices. Using 2017 data, Ofcom calculated that Openreach's share of supply in VHB services was between 51% and 60% compared to between 71% and 80% for lower bandwidth services.[2]

[1] [✂]. Note that regulating lower bandwidth leased line prices down to cost may indirectly constrain VHB services, given the potential for customers to migrate between products offering different speeds.
[2] These are non-confidential brackets set out in Ofcom, 2019 PIMR and BCMR Statement: Annexes 1-25 of 26, 28 June 2019, Table A7.4.

8. Ofcom added that, while Openreach has responded by reducing VHB prices over time, [✂].

9. Ofcom expects increasing competitive pressure on prices and price differentials between bandwidths over the next few years. The reasons for this include:

   (a) Competition from alternative networks, partially facilitated by its PIA remedy, which supports investment in alternative networks;

   (b) Competition from dark fibre offered by alternative networks; and

   (c) Potential changes in customer demand: one constraint on the steepness of the bandwidth gradient is that relatively high VHB prices can discourage customers from upgrading, for example from a 1Gbit/s connection to 10Gbit/s. If the number of customers that would consider migrating to a higher bandwidth product grows (as is likely the case) then this can place additional pressure on VHB prices. This constraint is potentially significant given that VHB volumes are considerably smaller than 1Gbit/s volumes. Evidence gathered for Ofcom's 2019 market review supports the existence of this constraint.

10. With respect to point (c), Ofcom's BCMR 2019 statement mentioned that demand for VHB services is evolving, driven by growing demand for bandwidth among leased line customers. Ofcom considered that this is consistent with an early product lifecycle where demand is low at the beginning (when early adopters take up the product), then increases as the product becomes mass-market and late adopters begin to take it up. Ofcom expected VHB demand to accelerate rapidly mainly driven by mobile customers, due to the move to 5G. Demand for VHB circuits from enterprises is also expected to grow, albeit it will be lower than the demand from MNOs.[3]

11. Ofcom added that evidence suggests that Openreach started focusing on winning business for VHB services over the last few years and has radically changed its service offering, partially in response to the growing demand for these services. In particular, Ofcom referred to the following evidence:

   (a) Prior to September 2015, Openreach had a limited range of WDM products for access services. In March 2015, an OSA 10Gbit/s circuit cost over £30,000 p.a.

[3] Ofcom, 2019 PIMR and BCMR Statement: Annexes 1-25 of 26, 28 June 2019, paragraph A14.31.

(b) In September 2015, Openreach launched the EAD 10Gbit/s service at nearly half the wholesale charge of its previous single service 10Gbit/s Ethernet product (c.£16,000 p.a.).

(c) In April 2018, Openreach reduced the price of its leading VHB products. For example, the price of EAD LA 10Gbit/s fell by nearly 40% to just under £7,000 p.a.[4]

(d) Openreach also introduced OSA FC at a price around 30% cheaper than its standard OSA 10Gbit/s product. This product includes a 10Gbit/s circuit, but also allows the purchaser to upgrade bandwidth at very low incremental cost.[5]

Evidence on the current significance of the differences between dark fibre and active services

12. Below we summarise evidence from the Parties, Vodafone and Three.

The Parties

13. With respect to the [✂], Telefónica submitted that, [✂].

14. Telefónica further submitted that the two criteria considered by O2 [✂] were:

(a) [✂]; and

(b) [✂].

15. [✂].

16. We have also considered evidence from internal documents submitted by Telefónica. These discuss what O2 considered with respect to switching to dark fibre and indicate that its [✂] were [✂]. For example:

(a) One internal document is a draft of an internal O2 report [✂], which explains that the [✂]:

[✂].

(b) Another internal document, which presented [✂], sets out that:

[✂].

[4] EAD LA is a variant of Openreach's EAD product. LA refers to Local Access.
[5] Ofcom, 2019 PIMR and BCMR Statement: Annexes 1-25 of 26, 28 June 2019, paragraph A14,37.

(c) A third document [✂] notes that [✂].

(e) An O2 internal presentation [✂] notes that [✂].

(f) The same document explains that [✂]:

[✂].

17. With respect to the above, the Parties submitted that O2's internal documents [✂].

18. O2's internal documents also indicate that [✂].

(a) A Telefónica UK [✂] notes that [✂]. The presentation also notes that [✂].

(b) An O2 [✂].

(c) An O2 [✂] presentation states that [✂].

19. With respect to the above, the Parties submitted that [✂].

20. Finally, as discussed in paragraphs 53 and 66 (a) below, the Parties identified Openreach's EAD 10Gbit/s product as a likely substitute for dark fibre (and [✂]).

Vodafone

21. Vodafone submitted [✂]:

(a) [✂].

(b) [✂].

(c) [✂].

(d) [✂].

22. Vodafone submitted [✂].

23. Vodafone's [✂].

24. Vodafone submitted [✂]:

(a) [✂].

(b) [✂].

25. Vodafone stated [✂].

Three

26. In relation to Openreach's Ethernet products, Three submitted that:

    (a) 1Gbit/s EAD has 'limited functionality'.[6] Three further submitted that 1Gbit/s is only a limited amount of capacity and that [✂].

    (b) 10Gbit/s EAD is suitable for standard 4G/5G RAN configurations. Three submitted that it [✂], with reasons including [✂].

27. [✂] is Three's preferred option. Its preference is supported by evidence from recent tenders, which suggest that the main reason is [✂]:

    (a) [✂]

    (b) Three submitted that the criteria it uses when awarding mobile backhaul contracts are [✂] in the access layer and [✂] in the aggregation layer.

28. Three submitted that, without dark fibre, it would need to [✂]. Three stated that for standard 4G/5G RAN sites, it can usually deliver a competitive experience for customers with 10Gbit/s backhaul.

Ofcom

29. Ofcom submitted that MNOs' responses to the WFTMR consultation give an indication of the importance they attach to regulated dark fibre:

    (a) Vodafone referred to equipment duplication when using active services and to the benefits of 'greater control over services and its impact on the cost base'. It advocated the introduction of regulated dark fibre nationally.

    (b) Three emphasised the very low cost of upgrading dark fibre circuits to higher bandwidths. It advocated the introduction of regulated dark fibre in additional areas.

    (c) O2 said that dark fibre offers more flexibility to decide on electronic equipment and bandwidth. However, its preferred regulatory remedy was to postpone the introduction of regulated dark fibre and instead impose tighter charge controls on Openreach's active services.

---

[6] To operate properly, telecommunications networks require the clocks in equipment at different sites to be synchronised. There are a number of different ways this can be achieved. Three submitted that for 1Gbit/s EAD, only frequency synchronisation is supported and therefore the MNO must deploy its own synchronisation (this involves a GPS receiver at the RAN site).

Evidence on whether the significance of the differences between dark fibre and active services is likely to change in the future

30. Below we summarise evidence from the Parties, Three, Ofcom and BT. Some of the evidence relates to WDM services, such as the OSA FC product supplied by Openreach.

The Parties

31. As discussed in Chapter 7, the Parties submitted that MNOs do not currently require speeds above 10Gbit/s in the access layer [✂]. The Parties thus did not consider [✂] to be relevant to the access layer. They also submitted that the price of active products (and thus their attractiveness) is likely to change over time, that new product specifications might be expected to emerge and that it can be expected that future active products are likely to be competitively priced compared to dark fibre.

Three

32. Three stated that it expects to require more than 10Gbit/s backhaul at some sites. For these sites, an Openreach Ethernet 10Gbit/s circuit would offer insufficient capacity.[7] Three also submitted that more advanced network configurations (such as CRAN) are required in high traffic areas in the medium term.[8] 10Gbit/s EAD cannot be used for these configurations as they require higher speed connections (25Gbit/s or more).

33. Three submitted that BT Enterprise's OSA product is more scalable than EAD but Three [✂].

    (a) Three submitted cost calculations showing that, if a site is expected to require [✂], then using dark fibre from the outset is the cheapest option. In terms of active products, [✂].

    (b) In relation to BT Enterprise's OSA products, Three submitted [✂].[9] As a result, Three would have to source its own synchronisation.

    (c) Three also stated that the future availability of OSA FC is unclear. [✂].[10]

---

[7] Three submitted that urban sites with all the available spectrum deployed will need more than 10Gbit/s of backhaul. Three also referred to 5G 'hub' sites that aggregate traffic from multiple other sites. [✂].
[8] [✂]. Further details on Three's plans are set out in the discussion of future developments in Chapter 7.
[9] Three also submitted that only a [✂] would be available from Openreach and that, [✂], it does not include a synchronisation option. [✂].
[10] [✂].

34. In relation to the second of these points, we understand that while Three might prefer not to source its own synchronisation, it is feasible for it to do so.[11] In relation to the third of these points, we understand that BT Enterprise and Openreach may be able to vary the configurations of the particular WDM products they offer. However, we understand that Ofcom specifically requires Openreach to supply WDM services.[12]

Ofcom

35. In the 2019 BCMR, Vodafone stated that MNOs require dark fibre from a technical point of view to deliver the full benefits of 4G and 5G services eg, because it would support a CRAN 'fronthaul' configuration. Three and O2 did not raise any technical need for dark fibre for 5G at the time.

36. Ofcom agreed with Vodafone that dark fibre may have some technical benefits but concluded that it was not essential to support 5G rollout during the period covered by that review (2019-2021).

37. Ofcom told us that it has revisited these specific technical points. It submitted that it continues to believe that, while dark fibre has some technical benefits, it is not essential from a technical standpoint for 5G rollout, particularly given the availability of alternatives such as WDM services. It also notes that, in the context of the WFTMR, Vodafone has not reiterated these technical arguments.

BT

38. BT submitted that any move towards CRAN will drive the need for 25Gbit/s access circuits. However, as set out in Chapter 7, it considered that mobile backhaul needs will not exceed 10Gbit/s for the foreseeable future (and certainly for the next three years).

39. Openreach submitted that its WDM products support mobile network synchronisation solutions. Openreach also stated that OSA FC is a suitable alternative to dark fibre for mobile backhaul. [✂].

[11] Openreach's price list indicates that, for the XG210 variant of OSA FC, synchronisation can be added for £500 - see Price List (openreach.co.uk). Synchronisation can also be achieved using GPS equipment at cell sites. [✂].
[12] Ofcom, 2021 WFTMR Volume 7: Legal instruments, Schedule 1, Part 3, Condition 2.4(b) on page 33.

Challenges when comparing the costs of active products and dark fibre

40. The Parties, Vodafone and Ofcom highlighted various challenges when comparing the costs of active products and dark fibre. These are set out below.

41. The Parties submitted that cost comparisons are sensitive to the discount rate used.

42. Vodafone submitted that comparing total costs of ownership (TCOs) can be difficult, especially when comparing products from Virgin with products from Openreach. In particular:

    (a) [✂].

    (b) Openreach's prices are subject to regulatory change and therefore cannot be forecast with as much accuracy.

43. According to Ofcom, analysing dark fibre prices and comparing them with prices for active products may not be straightforward. Ofcom considered that a network operator's average dark fibre price is likely to be an unreliable guide to the constraint exerted by that operator when serving a particular customer, for two reasons:

    (a) The structure of prices can vary in terms of duration, upfront and ongoing charges. For example, the Parties stated that Virgin offers IRU dark fibre, with [✂] of the costs invoiced at the time of order. In contrast, the balance between upfront and ongoing charges for an active product from Openreach (say) is different; the price also depends on the minimum contract term.

    (b) Even for an individual supplier, there is likely to be a wide variation in the dark fibre prices it charges.[13]

44. On the second point, Ofcom submitted that in September 2019, it gathered data on dark fibre charges for both access and aggregation circuits. It asked suppliers for the maximum, minimum and average rental and connection charges per circuit in 2018 or 2018/19. Ofcom submitted that responses

[13] Ofcom noted that the market is also changing. Demand for bandwidth is rising, including from MNOs. Related to this, use of dark fibre is also rising meaning that the profile of future dark fibre users is likely to differ from past users. This diminishes the relevance of historic dark fibre prices when conducting a forward-looking competition assessment.

varied between suppliers. Even for an individual supplier, charges varied considerably between circuits. For example:

(a) For some respondents the maximum rental charge for access circuits was around double the average; for others, it was more than five times the average. Similarly, the minimum rental charge for access circuits was typically well below the average.

(b) For connection charges, the spread was even wider: several respondents reported a minimum connection charge for access circuits of £0 and the maximum connection charge was many multiples of the average.

(c) Similarly, charges for aggregation circuits exhibited a broad spread around the average.

(d) Even for the same supplier, there was a considerable difference in the average revenue per line it earned from different customers.

45. As a result, Ofcom considered that a supplier's average dark fibre price is likely to be a poor guide to the price of a particular dark fibre connection. It considered this to be unsurprising given that the costs of serving a customer site will vary significantly, in particular depending on how far the network needs to be extended to reach that site.

46. Ofcom considered that this wide variation in a supplier's dark fibre prices also means that it is difficult to compare prices between suppliers. The average price will reflect each operator's pre-existing customer portfolio, rather than the price it could offer to a new potential customer.

Evidence on the costs of Openreach's active products in the access layer

47. Below, we set out the evidence we have received about the costs of Openreach's active products, including estimates submitted by the Parties, [✂] and Three.

Openreach's pricing strategy for active products

48. The charges paid by MNOs to Openreach for active Ethernet services are made up of a one-off upfront connection charge,[14] annual rentals and (for

[14] The connection charge is a one-off charge to install the circuit, including the cost of Openreach's equipment. Openreach may charge Excess Construction Charges (ECCs) in addition to normal connection charges where additional infrastructure is provided to connect a customer. ECCs only apply to new customer sites and are regulated by Ofcom.

some circuits) a main link charge. For OSA, various customisation options to the base product are available. The OSA price is also structured as an upfront connection charge, annual rental charges and (for some circuits) a main link charge.

49. Main link is an annual distance-related charge that applies to Openreach's Non-local Access circuits. Local Access is available where the MNO is present at the first exchange the RAN site is connected to. Non-local access is required where the MNO is not present at that exchange, and therefore needs a main link (for which the MNO pays a charge per metre) to provide an onward connection from the intermediate exchange to the exchange where the MNO is present.

50. As mentioned in Chapter 7, in markets where Openreach has been found to have SMP, it has a regulatory obligation to publish prices and an obligation to offer the same prices to all customers.[15] Openreach submitted that its published prices are the actual prices it currently charges for Ethernet and WDM services to all customers (including MNOs) in all of the UK, except for a limited time offer on the connection charge for 1Gbit/s service in the CLA and HNR areas.[16]

51. Openreach's standard prices are generally for 12-month contracts. However, it also provides discounted longer-term contracts for 3 years, 5 years and 7 years.

52. According to Ofcom, [✂].

TCO estimates for Openreach's 10Gbit/s EAD services in the access layer

53. The Parties identified Openreach's EAD 10Gbit/s Ethernet product as a likely substitute for dark fibre sold to Three [✂]in the access layer, as mobile operators are expected to upgrade to 10Gbit/s lines. They submitted that [✂].

54. The Parties estimated the average (undiscounted) TCO over the relevant contract terms for Ethernet 10Gbit/s connection for [✂] Three [✂]. The TCO included a [✂].This is calculated over a time horizon comparable to a dark fibre contract term.

55. [✂]:

[15] Openreach EAD Price List, Openreach OSA Price List, Openreach Street Access Price List.
[16] Openreach submitted that the offer was put in place to respond to competitive pricing. For a definition of HNR areas and the CLA, see the summary of Ofcom's regulatory conditions in Chapter 7.

(a) [✂].[17]

(b) [✂].

(c) [✂].[18]

56. [✂]:

(a) [✂].

(b) [✂]:

(i) [✂];

(ii) [✂];

(iii) [✂];

(iv) [✂].

57. Three uses a different methodology to that used by the Parties, which yields a significantly higher estimate:

(a) Three estimates TCO based on NPV and over [✂] years ([✂]). Three uses [✂]% as its internal estimate of the weighted average cost of capital (WACC).[19]

(b) In addition to Openreach's charges (connection charge, annual rental and main link charge), Three includes various other costs, some of which are incurred for both active and dark fibre services. These are phase sync,[20] Excess Construction Charges (ECCs), wayleaves, small works contractors and equipment costs for Three.

(c) Three assumes the EAD price reflects a five-year term. This is higher than the EAD price with a seven-year minimum term.[21]

58. We summarise the methodology and input assumptions used by the Parties, [✂] and Three in Table 1 below.

---

[17] [✂].
[18] [✂].
[19] Three mentioned that for comparison, [✂]. Three added that its NPV calculations are not overly sensitive to the WACC but using [✂] would increase even further the relative cost of BT products in comparison with dark fibre. [✂].
[20] [✂].
[21] The annual rental charge for a 10Gbit/s EAD circuit is £4,380 with a five-year term and £3,100 with a seven-year term; for 10Gbit/s EAD LA the rental charges are £3,648 and £2,600 respectively. Openreach price list.

Table 1: Submitted methodology and assumptions for EAD 10Gbit/s TCO

	Virgin (cost to Three)	*Three*	*[✂]**	*[✂]*
Methodology				
- Cost items [✂]				
- Time horizon (years)	[✂]†	[✂]	[✂]‡	[✂]
- Discounting	[✂]	[✂]	[✂]	[✂]
Assumptions				
- Active service	[✂]	[✂]	[✂]	[✂]
- EAD LA:EAD mix	[✂]	[✂]	[✂]	[✂]
- Main link distance	[✂]	[✂]	[✂]	[✂]

Source: Liberty Global and third parties, CMA estimates. [✂].
* [✂].
†The contract with [✂].
‡ This to have a comparable time horizon for [✂].

TCO estimates for Openreach's [✂] service

59. Three provided an estimate of the cost of an [✂].[✂]. These estimates are set out in Table 2 below.

Table 2: Three estimates of the cost of [✂]. in the access layer

	BT Enterprise (shared)	*BT Enterprise (unilateral)*
Upfront cost	[✂]	[✂]
Annual cost	[✂]	[✂]
TCO ([✂] years, discounted)	[✂]	[✂]

Source: [✂].

60. Similar to Three's assessment of 10Gbit/s Ethernet circuits, the TCO reflects a [✂] discount rate. The TCO for a [✂]. reflects [✂].. It also reflects various other costs ([✂].). Three inferred the TCO of a [✂].from the costs of a [✂].[22]

61. Three submitted that [✂].

62. [✂].[23]

Table 3: [✂]

[✂]

Source: [✂].

63. [✂].[24]

[22] [✂].
[23] [✂].
[24] [✂].

Evidence on the costs of Virgin's dark fibre

Virgin's pricing strategy for dark fibre

64. Virgin offers dark fibre on two payment bases, namely IRU and non-IRU (lease). In the case of IRU, the majority of the cost is invoiced at the time of installation, while for non-IRU more of the cost is spread over the contract term. The non-IRU cost profile is more similar to the payment profile for Openreach's active services.

65. Liberty Global submitted that Virgin's pricing for mobile backhaul services is [✂]. It stated that the key inputs that form part of its pricing strategy are:

(a) [✂].

(b) [✂].

(c) [✂].

66. [✂]. According to the Vodafone Backhaul Contracts:[25]

(a) [✂].[26]

(b) [✂].

(c) [✂].

67. This is broadly consistent with Vodafone's submissions that its agreement with Virgin includes [✂].[27]

68. In relation to Three's agreement with Virgin, Three submitted that its [✂].[28] Current agreements with Three involve the provision of dark fibre circuits in the access layer [✂].

TCO estimates for Virgin's dark fibre

69. The Parties calculated the TCO for Virgin's dark fibre by using the contract value as the starting point and adding fibre tax and the additional equipment costs they consider that dark fibre users incur.

---

[25] Virgin currently holds a contract with Vodafone for the [✂] and with Three for the access layer. We set out the contract terms, including pricing in Appendix E. [✂].
[26] [✂].
[27] [✂].
[28] Three entered into a [✂] with Virgin [✂]. These are set out in more detail in Appendix E.

(a) Three purchases [✂] and the Parties' TCO estimate is based on Three's undiscounted contract value. They estimate the TCO over [✂], which includes [✂] undiscounted contract value for [✂] plus [✂] fibre tax and [✂] equipment cost ([✂]per connection).[29,30]

(b) The Parties, similar to their approach for the TCO of active products, did not apply a discount rate for Three. They noted that, [✂], this approach implies that the resulting difference in TCO between active products and dark fibre is overstated (ie the difference would decrease if any positive discount rate were applied).

(c) Vodafone purchases [✂]. The Parties estimate the undiscounted contract value for Vodafone by converting all the dark fibre purchases in Vodafone's contract into [✂].[31] The Parties add fibre tax and equipment cost to the undiscounted contract value.[32]

70. Three and Vodafone submitted different methodologies compared to the Parties. In particular:[33]

(a) Three and Vodafone [✂].

(b) Three and Vodafone [✂]. Three submitted that [✂].

(c) [✂].[34] [✂].

(d) [✂].[35] Three did not include any [✂]it receives from [✂].[36]

71. [✂]. In relation to equipment costs:

(a) [✂].[37] [✂].

(b) Three mentioned that it must deploy its own equipment at the cell site and BT exchange for active Ethernet services. This equipment is the same as the equipment used for dark fibre.[38]

72. In relation to other costs:

---

[29] [✂].
[30] The Parties also referred to the extra equipment costs associated with dark fibre in [✂].
[31] According to [✂].
[32] [✂].
[33] [✂].
[34] [✂]. Three's TCO estimate for dark fibre includes [✂].
[35] [✂].
[36] Three submitted that [✂].
[37] [✂].
[38] There is a small difference in the [✂] costs ([✂])Three assumed in its TCO calculations for different products. [✂].

(a) [✂].

(b) [✂].[39]

(c) Three submitted that for network management, while Openreach provides capacity and will repair faults, other services are generally for Three to either outsource or manage much in the same way that it would for a dark fibre connection.

(d) [✂].[40] [✂].[41]

Our methodology for assessing TCO

73. Given that the balance between upfront and ongoing costs varies between products, we consider that the net present value (NPV) of the TCO should be used. We recognise that TCOs are imprecise, particularly when assessed over long periods (as is the case here) eg, since the price of active products or bandwidth requirements may change in the future. Nonetheless we consider that the NPV of the TCO is the best available metric for comparing the cost of different products.[42]

74. In overview, our methodology for calculating the NPV of the TCO is as follows:[43]

(a) We model the TCO of upfront and annual costs for active and dark fibre products over a comparable period. We use [✂] years as this is Three and Vodafone's existing contract term for [✂] from Virgin.[44] While Vodafone's [✂] contract term is [✂] years, we apply [✂] years in the analysis for consistency, which [✂].

(b) We calculate the NPV by applying the following discount rates:

(i) For Three, we use a discount rate of [✂]%, which Three considers represents its internal WACC.

---

[39] [✂].
[40] Namely wayleaves, ECCs, small works contractors and migration. Three estimates that the cost of small works contractor [✂]. [✂]. Three also estimates that the costs of [✂] are lower than for other products [✂].
[41] [✂]. Three explained that on dark fibre, [✂].
[42] In the light of this imprecision, in our vertical arithmetic model we have run a sensitivity analysis using different percentage cost increases – see Chapter 8.
[43] In its TCO estimates Three included various additional one-off cost elements (wayleaves, migration charges, excess construction charges, small works contractors, equipment). [✂]. For consistency, we have largely excluded these (the exception is [✂]).
[44] Liberty Global submitted that its dark fibre contracts usually allow for [✂], implying a total potential term of [✂]. We have not assessed the TCO over a longer horizon since we consider this would detract from the reliability of the estimates. In particular, it would exacerbate the consequences of our assumption that the price of active products does not change.

(ii) For Vodafone, we use a [✂] discount rate, which reflects [✂].[45]

75. With respect to active products, we estimate the TCO for Openreach's Ethernet 10Gbit/s products as follows:

(a) Both Three and Vodafone would require a mix of (i) EAD circuits and (ii) EAD LA circuits. For EAD, the TCO includes rental, connection, and main link charges.[46] For EAD LA, the TCO also includes rental and connection, but no main link charge.

(b) For the EAD/EAD LA split and the main link charges, we use the relevant inputs submitted by Three and Vodafone as we consider them to represent their existing network profile and hence an appropriate estimate of the actual cost they may incur.

(c) We use Openreach's current prices for EAD and EAD LA based on a seven-year contract term. A seven-year contract term offers the cheapest price currently available. We consider that this represents a reasonable estimate of the costs that an MNO would incur if it needed to use Openreach's active products (eg, because the Merged Entity engaged in foreclosure).[47] We assume that these prices do not change over the [✂]-year period that the TCO relates to.

76. We also present results for OSA FC as an illustration of the cost of using an active service in the access layer at those sites that may need more than 10Gbit/s bandwidth. [✂].[48]

77. With respect to Virgin's dark fibre, we estimate the discounted contract value and add fibre tax.[49] For Three, we took into account that the one-off capex costs of dark fibre are spread over years [✂].[50] Given Vodafone's and Three's submission that [✂], we assume that they will not incur significant additional equipment costs when using dark fibre instead of active products.[51]

---

[45] [✂].
[46] [✂].
[47] Three told us that in practice they purchase EAD 10Gbit/s on a five-year term ([✂]). We consider that this implies that the additional flexibility offered by a shorter term (eg, the potential to recontract at a lower price) is valued more than the extra discounts associated with a seven-year contract. Our TCO calculation (which is based on a seven-year term) may thus overstate the costs of using an active product.
[48] [✂].
[49] We assumed fibre tax is £180/year. This is the figure the Parties used in their vertical arithmetic. [✂]. It is similar to the £[✂] to £[✂] range provided by Three. [✂].
[50] [✂] of this cost is incurred in [✂]and [✂]in each of years [✂[.]✂].
[51] The Parties submitted that dark fibre users incur additional equipment costs. We discuss this point in Chapter

8.

For example, Vodafone estimates that the equipment cost for dark fibre is [✂].[52]

78. There are other potential costs for active and dark fibre services, which are not included in our TCO estimate (eg, power and space costs for Openreach's active equipment or managing the dark fibre). However, they are unlikely to have a material impact and [✂].[53]

Cost differences in the aggregation layer

79. In relation to the cost of WDM circuits in the aggregation layer:

(a) [✂].

(b) Three submitted that it only purchases managed services in the aggregation layer. It did not provide an estimate of the cost of an OSA circuit in this layer.

(c) O2's OSA links [✂]. The costs of these circuits are set out in Table 4 below.

Table 4: O2 estimates of the cost of aggregation circuits

	Connection charge	*Annual rental charge*	*ECCs/time related charges*
Openreach OSA FC: first example	[✂]	[✂]	[✂]
Openreach OSA FC: second example	[✂]	[✂]	[✂]
Expansion links (20Gbit/s OSA links)	[✂]	[✂]	

Source: O2

80. In relation to the cost of dark fibre from Virgin in the aggregation layer:

(a) The Parties submitted that Virgin charges [✂]. [✂].

(b) [✂] dark fibre from Virgin in the [✂]. [✂].

Table 5: [✂].

	[✂]	[✂]
Upfront cost	[✂]	[✂]
Annual cost	[✂]	[✂]

Source: [✂]

(c) Three submitted that it does not buy dark fibre in the aggregation layer and thus did not provide a cost estimate.

[52] [✂].
[53] Similarly, we have not included any vouchers that suppliers might sometimes offer as a form of additional discount. [✂] (see footnotes 22 and 36). [✂].

Appendix E: Wholesale leased lines: MNOs' contractual protections

Three contractual protections

1. Three entered into a [✂] with Virgin in [✂]. Within the overall framework [✂]. ([✂] we refer to [✂]as the 'Three Contracts'):

   (a) [✂];and

   (b) [✂].

2. [✂].

3. The number of dark fibre circuits that Three anticipates to source from Virgin [✂]. In particular, Three [✂]. This includes [✂] dark fibre connections that Three submitted it has already contracted Virgin to deliver.

Strategy 1: Withdraw supply of dark fibre

4. The Parties submitted that the Three Contracts provide that [✂].

5. While Three submitted that Virgin can simply refuse to agree new work packages for additional backhaul circuits in the future, Three has not indicated that Virgin would be able to withdraw dark fibre for already contracted circuits.

6. We have assessed the contractual terms set out in the Three Contracts. In doing so, we distinguish between orders which have already been agreed ([✂]) and orders for new connections [✂].

7. The terms and conditions [✂]. This provides a high degree of contractual certainty for agreed orders[1] for [✂] years.

8. Virgin [✂].

9. The Three Contracts include [✂].[2] [✂] has [✂]. This provides a high level of protection from withdrawal of the agreed dark fibre supply to Three for orders already placed under the [✂] and for planned future orders falling within the [✂].

[1] Agreed orders comprise those orders already placed and forthcoming monthly orders under the [✂].
[2] [✂].

10. In relation to new orders, [✂]. Whether any new orders would be accepted and placed under the [✂] may depend on the negotiating strength of both Virgin and Three at the relevant time.

11. [✂].

12. [✂].[3] If the Merged Entity did not respect the current contractual obligations Three could seek damages under this provision, with [✂]. However, it is unclear whether such damages would be sufficient to deter Virgin from abandoning the contract.[4]

Strategy 2: Increase prices for dark fibre

13. The Parties submitted that [✂]. The Parties further submitted that attempting to breach the contracts to force price increases would be a particularly flagrant breach that would expose the JV to significant wider costs.[5]

14. Three submitted that while [✂], Virgin could simply refuse to agree new work packages for additional backhaul circuits in the future.

15. We have assessed the [✂] included as part of the Three Contracts. As part [✂], Virgin and Three agreed [✂].[6] [✂].

16. [✂]. The initial term for these charges [✂] years.

Strategy 3: Decrease quality (by delaying roll-out and/or repairs)

17. The Parties submitted that [✂].

18. Three submitted that its contract with Virgin [✂]. Three submitted that while Virgin [✂]. Three also submitted that it has – since the Proposed Merger was announced – [✂].

19. We have assessed the service level protection offered by the Three Contracts against a decrease in quality for already contracted work packages.[7] The key parameters through which Virgin could decrease quality of dark fibre are

[3] [✂].
[4] Three submitted that the original (undiscounted) contract value for dark fibre provision with Virgin was £[✂]m over [✂] years, and the additional [✂] were added for an additional £[✂]m over the same term ([✂]).
[5] [✂]
[6] [✂].
[7] Given that, as explained in section 'Strategy 1: Withdraw supply of dark fibre' above, the agreement does not offer protection for new work packages, we do not consider it relevant to assess the quality protection for new work packages, given that Virgin could simply refuse to supply new work packages and force a new negotiation.

(i) late delivery of a connection (ie delaying fibre roll-out) and (ii) delaying repairs following service disruption.

20. With respect to delaying roll-out, the Three Contracts provide protection in the form of [✂].

(a) [✂].[8]

Table 1: [✂].

[✂]

Source: [✂].

(b) [✂].

Table 2: [✂].

[✂]

Source: [✂]

(c) Under the [✂], Three is entitled to [✂].[9]

21. [✂].[10] [✂].

22. [✂][11]. [✂],

(a) [✂];

(b) [✂]; and

(c) [✂].

Table 3: [✂].

[✂]

Source: [✂]

23. [✂].

24. According to Three, [✂] have already been delivered, such that Virgin would not be able to delay roll-out for these connections (and any further connections that are delivered prior to the Proposed Merger).

[8] [✂].
[9] [✂].
[10] [✂].
[11] [✂].

25. Moreover, we consider that decreasing quality, either by delaying roll-out (of non-delivered connections) or repair of disrupted service, would be a relatively costly strategy for Virgin.

(a) The [✂]. This is equal to approximately [✂] of the average total price per connection over the [✂].

(b) The [✂].

(c) The circumstances where [✂] are relatively limited and specific, [✂].

26. However, we note that Three submitted that Virgin has missed the 2020 year-end target for [✂]% of the [✂] planned connections. On the one hand, [✂]. On the other hand, we do not hold further information on what the reasons for the delays were, including the extent to which Virgin was able (but did not choose to) ensure a timely delivery.

27. In terms of the impact of delays on Three, we note the following:

(a) We understand that any delays would only impact the specific RAN site that the connection connects (as opposed to leading to wider network outrages). This indicates that the effect of delays on Three is primarily localised.

(b) With respect to delays in roll-out of dark fibre, Three told us that such delays would [✂].

(c) With respect to repairs, we note that these are only necessary if there is a fibre break. Three told us that while fibre breaks are fairly common, they are not something that occurs ‘numerous times every day’. Three further submitted that it predicts that the average monthly number of fibre breaks will [✂].

Vodafone contractual protections

28. Vodafone has [✂] agreements with Virgin:

(a) [✂] and

(b) [✂] (together, the ‘Vodafone Backhaul Contracts’). [✂].

29. While [✂].

30. [✂]:

(a) [✂];

(b) [✂];

(c) [✂]; and

(d) [✂].

31. The total contract value [✂].[12]

32. Table 4 below outlines the total contract value of the services Vodafone committed to [✂].

Table 4: [✂].

[✂]

Source: [✂].

33. We note [✂]. We therefore consider that [✂] from the contract for the purpose of our assessment of an input foreclosure theory of harm with respect to mobile backhaul.[13] The total contract value of the services [✂] amounts to [✂].

34. [✂].

Strategy 1: Withdraw supply of dark fibre

35. The Parties submitted that Virgin and Vodafone [✂]. Additionally, the Parties submitted that Virgin has [✂] which would be put at risk if Virgin breached its contract with reference to backhaul supply.

36. [✂]. The Parties also submitted that [✂].

37. Vodafone submitted that there is a risk that [✂], although it is not clear whether this concern relates to dark fibre circuits under the current [✂] or to additional future requirements. [✂].

38. With respect to the Parties' submission on [✂], we do not consider that this willingness provides sufficient evidence to show that Virgin would not breach the contract. With respect to the Parties' submission on [✂], we note that a breach of the Vodafone Backhaul Contracts would not automatically imply that Virgin would lose this business.

---

[12] [✂]
[13] While O2 is active in the supply of business connectivity to retail customers, its position is too small for the Proposed Merger to raise any concerns regarding input foreclosure of wholesale leased lines for business connectivity. [✂].

39. We have also assessed the contractual terms set out in the Vodafone Backhaul Contracts. In doing so, we have distinguished between [✂].

40. [✂].

41. We understand that [✂] Table 5 [✂]:[14]

Table 5: [✂].

[✂]

Source: [✂]
[✂].

42. Vodafone [✂].[15]

43. The [✂] provides a high level of protection to Vodafone from withdrawal of dark fibre for orders that have already been placed and installed.

44. [✂].[16] [✂].

45. [✂]. However, it is unclear how much leeway and discretion Virgin has [✂] and we cannot exclude that [✂].

46. We understand that [✂]. It is unclear whether this would be the only consequence or whether Vodafone would also be able to claim damages based on a breach of the Vodafone Backhaul Contracts.

Strategy 2: Increase prices for dark fibre

47. The Parties submitted that the Vodafone Backhaul Contracts [✂]. The Parties further submitted that [✂].

48. Vodafone submitted that [✂].

49. We have assessed the [✂]included as part of the Vodafone Backhaul Contracts. [✂].[17]

Table 6: [✂].

[✂]

Source: [✂].

50. Under the Vodafone Backhaul Contracts, [✂].

---

[14] [✂].
[15] [✂].
[16] [✂].
[17] For completeness, we note that [✂].

51. We consider that [✂] and we further consider that the time period [✂]. Regarding the question whether the [✂] might be affected by the Proposed Merger (ie [✂]), we note that the evidence suggests that [✂].

Strategy 3: Decrease quality (by delaying roll-out and/or repairs)

52. The Parties submitted that the Vodafone Backhaul Contracts [✂]. The Parties also submitted that dark fibre enables Vodafone to use its own lightning equipment and layer L2+ services (which we understand relates to the transmission protocol), which allow Vodafone to control quality themselves.

53. Vodafone submitted that [✂].

54. We have assessed the [✂] offered by the Vodafone Backhaul Contracts, [✂].

55. According to the contractual terms set out in the, [✂].

Table 7: [✂].

[✂]

Source: [✂].

56. With respect to repairs, [✂].

Table 8: [✂].

[✂]

Source: [✂]

57. We consider that decreasing quality, either by delaying roll-out or repairs, would be a costly strategy for Virgin.

(a) [✂].

(b) [✂].

(c) While there is some uncertainty with respect to the scope for Virgin to submit that [✂], we consider it unlikely that Virgin would be able to extensively rely on such a strategy.

58. In terms of the impact of delays on Vodafone, we note that the same points raised with respect to Three (see paragraph 26) are likely to apply.

Appendix F: Wholesale leased lines: background to the Project Beacon network sharing arrangements

1. Vodafone and O2 are party to a network sharing arrangement which comprises:

   (a) Cornerstone Telecommunications Infrastructure Limited (CTIL), [✂] joint venture between O2 group companies and Vodafone [✂]; and

   (b) the Beacon contractual arrangements, [✂].

2. [✂].

3. [✂].

4. In terms of the number of sites that fall under each category:

   (a) [✂].

   (b) [✂].

5. It is not clear to us what is driving the differences in the number of sites submitted by the Parties and Vodafone. However, in high-level terms, there is agreement that [✂] sites and that there are [✂] falling under each of [✂].

Appendix G: Wholesale leased lines: vertical arithmetic analysis of supply withdrawal

The Parties' submission

1. The Parties have undertaken a vertical arithmetic analysis of input foreclosure in the supply of wholesale leased lines for mobile backhaul.

2. The Parties have submitted that:

   (a) The Merged Entity would not have the ability to foreclose MNOs with respect to backhaul circuits covered by existing contracts with Virgin. These circuits, therefore, have not been included in the vertical arithmetic analysis.

   (b) Given the [✂] nature of the existing contract as regards pricing terms, the indefinite time [✂] for pricing provisions [✂]. Vodafone is therefore not considered in the Parties' vertical arithmetic analysis.[1]

   (c) The Parties expect Three [✂].

3. The Parties' analysis assesses whether the Merged Entity would have an incentive to refuse to supply Three with the [✂] backhaul connections that Virgin would be supplying absent the Proposed Merger. Their analysis suggests that such incentive would not be present.

Our analysis

4. The vertical arithmetic analysis submitted by the Parties is based on the methodology adopted by the CMA in the BT/EE merger investigation.[2] We consider the approach to be suitable for the analysis of the Merged Entity's incentive to foreclose and have followed it with some adjustments.

5. We have focused the analysis on the possibility for the Merged Entity to withdraw supply of dark fibre to Three and Vodafone.[3] As BT can self-supply [✂] EE's backhaul connections, we have not considered it in the analysis.

6. In developing the analysis, we have made the following assumptions:

---

[1] [✂].
[2] [✂].
[3] In Chapter 8 we also discuss the Merged Entity's incentive to increase the price of dark fibre supplied to Three and Vodafone.

(a) Although Virgin has signed contracts with both Three and Vodafone specifying the number of connections to be delivered and their price, we have included connections covered by the contract but not yet delivered in our analysis. Contractual protections can be interpreted as imposing costs on the Merged Entity in case it decided to breach their terms. It is therefore possible to consider the Merged Entity's incentive to withdraw supply of dark fibre, while taking into account the additional costs from breaching the existing contractual terms. For example, a moderate incentive to withdraw supply if contracts were not in place may be offset by the additional costs that the Merged Entity would incur for breaching the contracts.[4]

(b) We treat mobile backhaul costs as fully variable. In reality, part of these costs is likely to be fixed in nature. An increase in fixed costs would not have a direct impact on the retail prices of the foreclosed MNOs, and therefore would induce a smaller loss of retail customers, reducing the Merged Entity's incentive to foreclose. Therefore, considering all mobile backhaul costs as variable is likely to overestimate the incentive to foreclose and is, therefore, a conservative assumption.

7. The analysis is based on a comparison between the customer losses at Three and Vodafone required to make supply withdrawal profitable for the Merged Entity and the customer losses predicted to occur following withdrawal of supply.

8. The calculation can be separated into five steps, dealing with the estimates of:

(a) The Merged Entity's wholesale losses from not supplying Three or Vodafone;

(b) the required retail customer acquisition by the Merged Entity to compensate for those wholesale losses;

(c) the required retail customer losses of Three and Vodafone to obtain the necessary customer gains (that is, Three's and Vodafone's critical customer losses);

(d) the increase in Three's and Vodafone's mobile backhaul costs following the Merged Entity's withdrawal of supply; and

[4] Given that our analysis indicates that, even absent any contractual protections, the Merged Entity would not have an incentive to withdraw the supply of mobile backhaul, we do not consider it necessary to assess the impact of the cost of breaching the existing agreements and/or contracts, as these costs would make a foreclosure strategy even more costly for the Merged Entity.

(e) the fall in Three's and Vodafone's customer numbers as a result of the mobile backhaul cost increase (that is, Three's and Vodafone's predicted customer losses).

The Merged Entity's wholesale losses

9. The Merged Entity's wholesale losses in case of total foreclosure would correspond to the expected profits from mobile backhaul sales covered by Virgin's current contracts with Three and Vodafone and from any future sales beyond the volumes already contracted for.

Foreclosure of Three

10. Three's current contract with Virgin covers [✂] access circuits. Although some of them may have already been delivered, we assume for simplicity that the entire volume could potentially be affected by a foreclosure strategy.

11. In addition, Three is likely to require additional dark fibre connections to complete its 5G network and, in the counterfactual, some of them would be sourced from Virgin. Three submitted that, by 2025, [✂]. This would be an increment of [✂] over the volume covered by the current contract. We have therefore included these additional connections in our analysis.

12. The Parties provided an estimate of the surplus cash flow they expect Virgin to generate in the course of the current contract with Three. In order to include the additional connections, we have assumed that those would generate a similar surplus cash flow starting from 2023, three years after the current contract (proportionally reduced to reflect the lower number of connections).[5] We have then computed the net present value (NPV) of the combined cash flow. In order to convert this value into an annual cost, we have computed the equivalent undiscounted annual value of the NPV over an [✂]-year period (corresponding to the [✂]-year length of the lease contracts plus a three-year difference from the start of the current contract and the assumed delivery of the additional connections).[6]

13. The resulting annual value depends on the discount factor adopted to compute the NPV. The Parties used a [✂] discount factor, [✂]. This is a relatively high value for the cost of capital; it is [✂].

[5] This is equivalent to assuming that the additional connection will be supplied based on the same terms as in the current contract.
[6] The results of the analysis do not change if different assumptions are made on the timing of delivery of the additional connections.

14. Depending on the discount factor used, the Merged Entity's yearly wholesale losses range between £[✂] (with a [✂] discount factor) and £[✂] (with a [✂] discount factor).

Foreclosure of Vodafone

15. In the case of Vodafone, we have no evidence that the MNO was planning to source from Virgin more connections that those stipulated in the current contract.

16. The Parties provided an estimate of the surplus cash flow they expect Virgin to generate in the course of the contract for those connections that have not yet been delivered.

17. Using the same methodology adopted in the case of Three, we have computed the NPV of this cash flow and the equivalent undiscounted annual value over a [✂]-year period (where [✂] years represent the time during which the cash flow will be generated).

18. Using the same range of discount factors as above, the Merged Entity's yearly wholesale losses range between £[✂] (with a [✂] discount factor) and £[✂] (with a [✂] discount factor).

The compensating retail customer acquisition

19. We have then estimated how many new retail mobile customers the Merged Entity would need to acquire to compensate for the losses sustained at wholesale level.

20. Following the approach adopted in the BT/EE investigation, we have assumed that the proportion of post-pay, pre-pay and business new customers reflects the corresponding proportion in the customer population of the foreclosed MNO. That is, we estimate how many 'typical' customers would be lost by the foreclosed MNOs; for consistency, we need to consider the margin that the Merged Entity can gain from these 'typical' customers.

21. The following table shows the Parties' average retail mobile margins, and the percentage of Three's and Vodafone's pre-pay, post-pay and business customers.

Table 1: Retail margins and customer split

	Pre-pay	*Post-pay*	*Business*
The Parties' annual average variable margin	[✂]	[✂]	[✂]
Three customer split	[✂]	[✂]	[✂]
Vodafone customer split	[✂]	[✂]	[✂]

Source: The Parties, Three and Vodafone (The Parties' overall incremental margins are calculated from data in 'Annex – CRA Vertical arithmetic mobile backhaul.xlsx', submitted on 5 February 2021; [✂].

22. Following the approach used in the BT/EE investigation, we have increased the average margins implied by the data in Table 1 by [✂] in order to account for the additional margin that the Merged Entity may earn by cross-selling fixed products to the captured mobile customers.

23. Using the figures in Table 1 and increasing the result by [✂], the expected incremental margin the Merged Entity would gain from a customer switching from Three can be estimated at £[✂] per year.

24. Similarly, the expected incremental margin from a customer switching from Vodafone is estimated at £[✂] per year.

25. An alternative approach to this adjustment could be to augment the Parties' average mobile margins by the additional expected margin on fixed products, using O2's own estimate of cross-sell conversion ([✂]).

26. The Parties estimated a monthly margin of £[✂] on fixed-mobile bundles. They noted that this is a conservative assumption for the margin, as the value is based on Virgin's quad-play bundles; the margin would be lower for triple-play bundles.

27. Table 2 shows the expected average margins when the estimated fixed-mobile margin is applied to a proportion of customers. The results are very similar to those obtained through a [✂] margin increase.

Table 2: Estimated yearly average incremental gain per customer

Customer type	*[✂]% adjustment*	*[✂]% conversion*	*[✂]% conversion*
Customers switching from Three	[✂]	[✂]	[✂]
Customers switching from Vodafone	[✂]	[✂]	[✂]

Source: CMA calculations using data from the Parties.

28. We can use the estimated average incremental margin to compute the number of new customers that would compensate the Merged Entity's wholesale losses from foreclosure. Depending on the estimated losses (see paragraphs 14 and 18 above), the minimum number of recaptured customers that would make foreclosure profitable is between [✂] and [✂] in the case of Three and between [✂] and [✂] in the case of Vodafone.

The required loss of retail customers from foreclosed MNOs

29. In order for the above number of retail customers to switch to the Merged Entity, the foreclosed MNOs must lose a larger number of customers, as not all of the lost customers can be expected to switch to the Merged Entity. In order to estimate the necessary churn for the foreclosed MNOs, we have used diversion ratios based on mobile number portability data.

30. In the BT/EE inquiry, the CMA assumed that customers switching away from a foreclosed MNO would not divert to another foreclosed MNO. In this case, this would mean that customers switching from Three would not divert to Vodafone (and vice versa). The last column of the table adjusts the diversion ratios based on this assumption. This represents an upper bound for the diversion to the Parties in the case of foreclosure.

Table 3: Mobile diversion ratios from Three and Vodafone to the Parties

Diversion from	*MNP data*	*MNP data excluding the other foreclosable MNO*
Three	[✂]%	[✂]%
Vodafone	[✂]%	[✂]%

Source: Three and Vodafone.

31. Using the upper bounds for diversion to the Parties and the estimated minimum number of recaptured customers (see paragraph 28 above), the minimum number of customers that Three would have to lose in order to make foreclosure profitable is between 179,000 and 261,000. The corresponding number for Vodafone is between 139,000 and 186,000.

The increase in Three's and Vodafone's mobile backhaul costs

32. Estimating the increase in mobile backhaul costs for the foreclosed MNOs requires two elements:

    (a) Determining the cost of mobile backhaul sourced from Virgin in the counterfactual; and

    (b) estimating the cost difference between Virgin's dark fibre and the closest alternative product.

Foreclosure of Three

33. Through the analysis discussed in Chapter 8, we have estimated NPV for Three of a dark fibre connection sourced from Virgin under the current contract at £[✂].

34. In order to compute the overall cost of the connections to be sourced from Virgin, we have assumed that all the connections covered by the current

contracts are delivered now, while any additional connections are delivered three years later. Under this simplifying assumption, we have computed the NPV of the overall [✂] connections and the equivalent undiscounted annual value over an [✂]-year period (corresponding to the [✂]-year length of the lease contracts plus a three-year difference from the start of the current contract and the assumed delivery of the additional connections).[7] The resulting estimated annual cost to Three is approximately £[✂] million.

35. Based on current prices, the analysis in Chapter 8 indicates that, for Three, the NPV of EAD 10Gbit/s is [✂] greater than that of Virgin's dark fibre. This implies that foreclosure would lead to an annual increase in Three's backhaul costs of approximately £[✂].

Foreclosure of Vodafone

36. Through the analysis discussed in Chapter 8, we have estimated the NPV for Vodafone of a dark fibre [✂].[8]

37. The contract between Vodafone and Virgin stipulates [✂].

38. In our model, we follow the Parties in assuming that [✂].

39. By applying the NPVs set out above to the resulting number of connections, and computing the equivalent undiscounted annual value over a [✂]-year period (corresponding to the [✂]-year length of the lease contracts plus a [✂]-year period during which the connections are actually delivered), the annual cost to Vodafone is approximately £[✂].

40. Based on current prices, the analysis in Chapter 8 indicates that, for Vodafone, the NPVs of [✂]. [✂], although a precise comparison is difficult.[9] To account for the uncertainty in our estimates, for the purpose of the vertical arithmetic analysis we have assumed that, as a result of foreclosure, Vodafone would experience a [✂] increase in backhaul costs. This would imply an annual cost increase of approximately £[✂].

[7] The results of the analysis do not change if different assumptions are made on the timing of delivery of the additional connections.
[8] [✂]
[9] [✂].

The expected decrease in Three's and Vodafone's customer numbers

41. How MNOs would change retail prices following an increase in the cost of mobile backhaul and how their customers would respond, depend on the characteristics of the demand MNOs face.

42. Following the approach in the BT/EE investigation, we have performed the same analysis using first a linear demand function, then an isoelastic demand function. Both linear and isoelastic demand functions represent simplified models and the 'true' demand functions are likely to be somewhere between these two cases.

Variable costs and price elasticity of demand

43. Our analysis is based on a simple model in which each MNO sells a single retail product and faces a single demand function. We make the simplifying assumption that marginal costs are constant, so that marginal costs equal variable costs. Finally, we assume that MNOs are currently maximising their profits, which implies that current variable margins are related to the price elasticity of the demand faced by MNOs by the following relation:

$$margin = \frac{\hat{R} - \hat{C}}{\hat{R}} = \frac{\hat{p} - \hat{c}}{\hat{p}} = \frac{1}{\hat{\varepsilon}}$$

where $\hat{R}$ is the current level of revenues, $\hat{C}$ the current level of variable costs, $\hat{p}$ the current price level, $\hat{c}$ the current level of variable costs per customer, and $\hat{\varepsilon}$ the (absolute value of) the price elasticity of demand at current prices.[10]

44. Using this relationship, we can estimate the price elasticity of demand from data on the MNOs' average incremental margin. We have assumed that Three and Vodafone would have the same percentage margin as the Parties [✂].[11] This implies a price elasticity of approximately [✂]. This constitutes our base case for the vertical arithmetic analysis. We also consider a range of values (between [✂] and [✂]) as a sensitivity test.

[10] The elasticity implied by this formula is a firm elasticity. In a scenario in which multiple MNOs (and their hosted MVNOs) are simultaneously foreclosed, the relevant elasticity would be between the firm elasticity and the lower industry elasticity.
[11] Three and Vodafone submitted estimates of their margins using different methodologies. Their estimates are significantly higher than the estimate from the Parties. In our model, higher margins correspond to lower elasticity of demand, implying in reduced churn in response to price increases and, as a result, making foreclosure even less profitable.

Linear demand

45. We first consider a demand function of the form

$$Q = K - h * p$$

where Q is the number of retail customers and p the yearly price of retail mobile services. Using the current values for retail revenues ($\hat{R}$) and number of customers ($\hat{Q}$), and the elasticity of demand $\hat{\varepsilon}$ estimated as in paragraph 44, we can estimate the parameters of the demand function (ie its slope h and intercept K).

Using the definition of price elasticity, and defining $\hat{p} = \hat{R}/\hat{Q}$,

$$\hat{\varepsilon} = -\frac{dQ}{dp}\frac{\hat{p}}{\hat{Q}} = h\frac{\hat{p}}{\hat{Q}} \Longrightarrow h = \hat{\varepsilon}\frac{\hat{Q}}{\hat{p}}$$

$$\hat{Q} = K - h * \hat{p} \Longrightarrow K = \hat{Q} + h * \hat{p}$$

With the demand parameters so estimated, we can then find the price level that maximises the firm's profits for a given increase in per-customer marginal costs Δc, by solving

$$\max_{p}(K - h * p)(p - \hat{c} - \Delta c)$$

The solution is given by

$$p^* = \frac{h * (\hat{c} + \Delta c) + K}{2 * h}$$

The new price p^* can then be used to estimate demand after the cost increase.[12] The analysis can be repeated for different values of $\hat{c}$ and Δc. As shown in paragraph 28, different values of $\hat{c}$ correspond to different values of $\hat{\varepsilon}$.

46. The following table shows the results of our analysis under linear demand. Under no scenario is the expected decrease in customer number as large as the level that would be required to make foreclosure profitable – which is at least 179,000 for Three and at least 139,000 for Vodafone.[13]

[12] The expression for p^* implies a pass-through of ½, which is always the case with a linear demand function.
[13] Foreclosure remains unprofitable even assuming a significantly higher value for the Merged Entity's retail margin.

Table 4: Estimated loss of retail mobile customers under linear demand

	MNO's demand elasticity					
	2.3	*2.8*	*3.3*	*3.8*	*4.3*	*4.8*
	MNO's implied margin					
	43%	*36%*	*30%*	*26%*	*23%*	*21%*
Estimated customer loss for Three	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Estimated customer loss for Vodafone	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: CMA calculations.

Isoelastic demand

47. As an alternative, we now assume that the MNOs face an isoelastic demand, of the form

$$Q = K * p^{-\varepsilon}$$

where ε is the (absolute value of) price elasticity of demand. In this case, elasticity is constant and equal to the value $\hat{\varepsilon}$ estimated above; the multiplicative parameter *K* is then determined from the following equation:

$$\hat{Q} = K * \hat{p}^{-\hat{\varepsilon}} \Longrightarrow K = \hat{Q} * \hat{p}^{\hat{\varepsilon}}$$

48. With the demand parameters so estimated, we can then find the price level that maximises the firm's profits for a given increase in per-customer marginal costs Δc, by solving

$$\max_{p}(K * p^{-\hat{\varepsilon}})(p - \hat{c} - \Delta c)$$

49. The solution is given by

$$p^* = (\hat{c} + \Delta c)\frac{\hat{\varepsilon}}{\hat{\varepsilon} - 1}$$

50. The new price p^* can then be used to estimate demand after the cost increase.[14] As in the previous case, the analysis can be repeated for different values of $\hat{c}$ and Δc.

51. The following table shows the results of our analysis under isoelastic demand. Under no scenario is the expected decrease in customer number as large as the level that would be required to make foreclosure profitable – which is at least 179,000 for Three and at least 139,000 for Vodafone.[15]

[14] The expression for p^* implies a pass-through of $\hat{\varepsilon}/(\hat{\varepsilon} - 1)$, which is higher than 1, as is always the case with isoelastic demand.
[15] Foreclosure remains unprofitable even assuming a significantly higher value for the Merged Entity's retail margin.

Table 5: Estimated loss of retail mobile customers under linear demand

	MNO's demand elasticity					
	2.3	*2.8*	*3.3*	*3.8*	*4.3*	*4.8*
	MNO's implied margin					
	43%	*36%*	*30%*	*26%*	*23%*	*21%*
Estimated customer loss for Three	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Estimated customer loss for Vodafone	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: CMA calculations.

Appendix H: Approach to internal documents

Overview

1. We have used evidence in the form of internal documents from the Parties and third parties in several different respects:

   (a) In relation to wholesale leased lines, we consider that internal documents that comment on the current or future possible competition for the provision of mobile backhaul provide important insights into both the extent to which different types of mobile backhaul products compete with each other and the perceived strength of different suppliers. Additionally, internal documents on Virgin's strategic considerations with respect to mobile backhaul can be informative to understand its plans and incentives for the provision of mobile backhaul.

   (b) In relation to wholesale mobile, we consider that documents produced to inform business strategies, planning, and evaluating MVNO opportunities or MNO bids provide important insights into wholesale competition between MNOs and the options available to MVNOs. In addition, internal documents can also be informative of the Parties' and third parties' perception of the scope for increased uptake of fixed-mobile bundles in the future. In that context, we have reviewed internal documents supplied by the Parties and third parties to understand their internal assessments of retail mobile competition, wholesale mobile competition, and the outlook for uptake of fixed-mobile bundles.

Our approach

Documents received

2. We received approximately 12,000 internal documents from the Parties.

3. We received internal documents from the following third parties: BT, Vodafone, Three and Sky.

Prioritisation of review

4. We reviewed documents received from the Parties and third parties. With regard to the Parties' documents, we prioritised our review of documents supplied by O2 and Liberty Global in response to our request under s.109(2) of the Enterprise Act as follows.

Wholesale leased lines

5. In relation to the mobile backhaul theory of harm, we prioritised our review as follows:

   (a) For internal documents received from Liberty Global, we prioritised documents in relation to: (i) the current or future possible competition for the provision of mobile backhaul; (ii) the profitability of Virgin supplying dark fibre vs. active lines; and (iii) Virgin's strategy relating to the provision of mobile backhaul going forward.

   (b) For internal documents received from O2, we prioritised documents in relation to the current or future possible competition for the provision of mobile backhaul.

6. Given the large number of documents responsive to questions related to these matters, we prioritised the review of board documents because this allowed us to focus on the Parties' views, strategies, proposals and plans which were at an advanced stage and receiving senior consideration. We considered documents at this level would give us good evidence of the Parties' strategy and decision-making and reasoning.

7. In order to identify board documents, we took the following approach:

   (a) For internal documents received from Liberty Global, we selected those documents that included the word 'board' in the 'purpose of the document' that Liberty Global provided us with for each document.

   (b) For internal documents received from O2, we selected those documents that contained the word 'board' anywhere in the body of the document.

8. In addition to these internal documents, we reviewed the following documents relating to competitive tender processes that the Parties had participated in:

   (i) O2 submitted tender documents relating to its 2019 tender for the supply of fibre links for its access and aggregation networks.

   (ii) Three provided tender documents for its [✂] tender [✂] in the access layer, its [✂] tender for the supply of mobile backhaul in the aggregation layer [✂].

   (iii) Vodafone told us that its backhaul requirements [✂].

Wholesale Mobile

9. In relation to the wholesale mobile theory of harm, we prioritised our review of documents received in response to our s.109 request as follows:

   (a) For internal documents received from O2, we prioritised documents relating to: (i) the outlook for uptake of fixed-mobile bundles; (ii) wholesale competition; and (iii) competition between MVNO retail customers and O2's retail customers.

   (b) For Liberty Global, we prioritised documents relating to: (i) the outlook for uptake of fixed-mobile bundles; and (ii) wholesale competition.

10. Given the large number of documents responsive to questions related to these matters, we prioritised the review in order to focus on board documents. As noted in paragraph 6, by prioritising board documents, we were able to focus on the Parties' strategies, proposals, decisions and plans which were at an advanced stage and receiving senior consideration.

11. In order to identify board documents, we took the following approach:

   (a) For internal documents received from Liberty Global relating to wholesale competition, we selected those documents that included the word 'board' in the 'purpose of the document' that Liberty Global provided us with for each document. For those relating to the outlook for uptake of fixed-mobile bundles, we reviewed all documents provided by Liberty Global that were responsive to all parts of our question.[1]

   (b) For internal documents received from O2, we selected those documents that contained the word 'board' anywhere in the body of the document.[2]

12. In addition to these documents, we reviewed:

   (a) All documents supplied by O2 and Liberty Global provided in response to our RFIs. These predominately related to past tender opportunities or processes; and,

   (b) All documents received from third parties: BT, Vodafone, Three and Sky.

[1] [✂]
[2] In relation to documents relating to fixed-mobile convergence, due to the large number of documents containing the word 'board', we only reviewed those documents that were responsive to every subpart of the question [✂].

(i) For MNOs we reviewed documents relating to competition in retail mobile, competition in fixed-mobile bundles, competition between MNOs in hosting MVNOs and current strategies in hosting MVNOs.

(ii) For Sky, we reviewed documents relating to competition in retail mobile, competition in fixed-mobile bundles, and the tender process for supply of wholesale mobile services.

Our assessment of internal documents

13. In assessing the content and the evidential weight of an internal document, we have taken into account the purpose for which it was prepared and the context in which it appears.

14. In particular, we typically have placed greater weight on documents prepared to inform decision making by senior management as these are likely to be most reflective of the Parties' strategic thinking.

15. We have reviewed internal documents in which O2 or other MNOs speculate on the strategies of other MNOs. We typically place greater weight on documents (or statements) that discuss a provider's own strategy compared with documents (or statements) which speculate on others' strategies. However, we note that such speculative documents (or statements) can provide evidence as to one MNO's view of another MNO.

Appendix I: Wholesale mobile: evidence from internal documents on competition between MNO and strategies

1. This appendix summarises the evidence from internal documents supplied by O2, BT (owner of EE), Vodafone, and Three in relation to competition between MNOs to host MVNOs, and their strategies in hosting MVNOs.

Evidence relating to MNO competition

O2

2. An internal document produced by O2 considers that [✂].

3. O2 told us that [✂].This document was produced by [✂].

Figure 1: [✂]

[✂]

Source: O2, [✂].

4. An internal document from O2 recognises [✂]. This document was produced for [✂].

Figure 2: Excerpt from [✂].

[✂]

Source: Telefónica, [✂].

5. A document from O2 notes that [✂]. This document was produced by O2's wholesale mobile team and presented to O2's Chief Financial Officer [✂].

Figure 3: Excerpt from [✂].

[✂]

Source: Telefónica, [✂].

BT

6. BT noted in an internal document relating to the Virgin 2019 opportunity [✂].

7. [✂]:

   (a) [✂];

   (b) [✂];

   (c) [✂].

8. [✂].

Figure 4: [✂]

[✂]

Source: [✂].

9. An internal document from BT [✂].

Vodafone

10. [✂]. Vodafone states that this document was produced in order to set out Vodafone's view of [✂].

Figure 5: [✂]

[✂]

Source:[✂].

Three

11. Three notes the following in relation to its rival MNOs: [✂].[1] Three states that the [✂].

Figure 6: [✂]

[✂]

Source: Three, [✂].

Evidence relating to MNO strategies

O2

12. Internal documents from O2 show that [✂]. In particular:

    (a) Figure 7 [✂]. This document was produced for [✂].

    (b) Figure 8 [✂].This document was produced by the Telefonica UK (TUK) Team for [✂].

    (c) Figure 9 [✂]. This document was produced by [✂].

    (d) Figure 10 [✂]. This document states that it was produced by [✂].

13. Our review of O2's internal documents (as described in Appendix H) indicates that the comments highlighted above generally reappear within other O2

[1] [✂].

internal documents that we have reviewed. We have not identified documents containing statements to the contrary.

Figure 7: [✂].

[✂]

Source: Telefónica[✂].

Figure 8: [✂]

[✂]

Source: Telefónica [✂].

Figure 9: [✂]

[✂]

Source: Telefónica [✂].

Figure 10: [✂]

[✂]

Source: Telefónica, [✂].

BT

14. [✂]:

(a) [✂];

(b) [✂];

(c) [✂];[2]

(d) [✂].[3]

15. [✂]:

(a) [✂].

(b) [✂].

16. Analysis produced on behalf of BT, below in Figure 11, [✂].

[2] [✂].
[3] [✂].

Figure 11: [✂]

[✂]

Source: BT, [✂].

17. We note the following observations from other MNOs in relation to EE's strategy/strengths as an MNO:

    (a) Vodafone states that [✂] (see Figure 5) [✂]. Vodafone states that this document was produced in order to set out Vodafone's view of [✂].

    (b) Three notes that, [✂](see Figure 6). Three states that the document [✂].

    (c) [✂].

Vodafone

18. We have reviewed all internal documents supplied by Vodafone and included the evidence relevant to their strategy below. Vodafone states that the document described below was produced for a senior management meeting. Vodafone's internal documents show that:

    (a) Vodafone [✂].

Figure 12: [✂]

[✂]

Source: [✂]

    (b) Figure 13 [✂].

Figure 13: [✂]

[✂]

Source: [✂].

Three

19. Three states that the document referred to below is their current comprehensive working strategy for the UK mobile wholesale market. Three's internal documents indicate:

    (a) Three has a strategy [✂].

Figure 14: [✂]

[✂]

Source: Three, [✂].

(b) Amongst the opportunities that Three identifies as [✂].

Figure 15: [✂]

[✂]

Source: Three, [✂].

Appendix J: Wholesale mobile: recent fixed-MVNO tender processes

1. This appendix sets out the evidence we have gathered in relation to recent fixed-MVNO tender processes.

Virgin Mobile (2016)

2. Virgin engaged in an official RFP process in 2016. [✂] participated in this tender process.

3. Liberty Global stated that, of the participating MNOs, [✂]. Virgin decided to remain with its existing supplier, EE. Liberty Global stated that: [✂].

4. Internal documents submitted by Liberty Global [✂]:

   (a) [✂].

   (b) [✂].

   (c) [✂].

Sky Mobile (2018)

5. In 2018 Sky negotiated a new [✂] deal with O2.

6. Sky stated that: [✂].

7. [✂].

8. Sky stated that it [✂].

9. [✂].

10. [✂].

Table 1: [✂]

[✂]

Source: [✂]
Notes: [✂]

11. [✂].

12. [✂].

13. [✂].

14. [✂].

Virgin Mobile (2019)

15. Virgin ran an RFP process in early 2019, [✂].

16. [✂].

17. Liberty Global submitted that Virgin set out a set of requirements that it intended to obtain and a structured response mechanism which was to be used by the bidders. According to Liberty Global, all [✂] participating MNOs submitted responses in July 2019.

18. According to documents submitted by Liberty Global:

    (a) [✂].[1]

    (b) [✂].

    (c) [✂].[2]

19. Liberty Global told us that [✂]. Liberty Global submitted that [✂].

20. Liberty Global stated that: [✂]. In an internal document submitted by Liberty Global, Virgin recommended to [✂].

21. Virgin ultimately signed a wholesale mobile access agreement with Vodafone. [✂].

[✂]

22. [✂].

23. [✂].

24. [✂].

25. [✂]:

    (a) [✂].[3]

    (b) [✂]

---

[1] [✂].
[2] [✂]. While Liberty Global's [✂]states that [✂].
[3] [✂].

(c) [✂].

26. [✂]:

(a) [✂].

(b) [✂].

Figure 1: [✂]

[✂]

Source: [✂].

27. [✂].

28. [✂].

Appendix K: Wholesale mobile: MNO network capacity and quality

1. This appendix summarises evidence in relation to MNOs' network capacity and quality.

Capacity

2. Capacity of a mobile network can be differentiated in:

   (a) Capacity of its radio access network (RAN): the RAN connects individual devices to other parts of a network through radio connections;[1] and,

   (b) Capacity of its core network: the core network manages the provision of mobile services.

3. Ofcom has stated that lead-times for increased core capacity 'are rarely a critical factor in the provision of new capacity'. The following section therefore focuses on RAN capacity.

Current spectrum holdings

4. RAN capacity is a function of the number of sites (or site sectors), the spectrum used on those sites, and the technology used on each spectrum band. As such, the spectrum holdings of MNOs are relevant to our assessment of the level of RAN capacity.

5. MNOs acquire new spectrum through auctions held by Ofcom. Additionally, MNOs can increase their spectrum holdings through the acquisition of another company, eg Three's acquisition of UK Broadband Ltd.

6. In March 2020, the shares of overall usable mobile spectrum holdings by MNOs were:

   (a) EE: [✂];

   (b) Three: [✂];

   (c) Vodafone: [✂]; and

   (d) O2: [✂].

[1] See, for example, Vodafone's explanation of RAN.

7. In March 2021, Ofcom published the results of the Principal Stage of the auction of the 700MHz and 3.6-3.8 GHz spectrum bands.[2] This shows that EE won 8x3.6 GHz lots, 4x700 MHz individual frequency lots and 2x700 MHz paired frequency lots. Three won 2x700 MHz paired frequency lots. O2 won 8x3.6 GHz lots and 2x700 MHz paired frequency lots. Vodafone won 8x3.6 GHz lots. All spectrum lots offered were sold.[3]

8. MNOs use their current holdings in the 3.4-3.8 GHz band to deliver 5G services, and their holdings in other bands to deliver 4G, 3G and 2G services. This means that certain spectrum can be deployed immediately, as it is already supported by mobile phones (3G, 4G, etc.), while other spectrum acquisitions are more forward looking as they are not currently supported by most phones.

9. A large proportion of Three's spectrum is not currently supported by most phones and will be used to support the deployment of 5G. Three told us that it [✂]. Three stated that it [✂].

10. In relation to 5G spectrum, Three submitted that [✂]. Three noted: [✂].

MNOs' ability to host new MVNOs

11. A study conducted by Ofcom showed that mobile traffic grew by 38% in 2019 and by 42% in 2020.[4] These figures are in line with submissions made by the Parties, as well as by MNOs.[5]

12. Given this growth, MNOs are continuously increasing their capacity. MNOs made £1.5bn in investments in UK mobile infrastructure in 2019 as well as an additional £0.7bn in investments in infrastructure providing both fixed and mobile services.[6]

13. As such, Ofcom submitted that the four MNOs 'would have sufficient capacity to host a new MVNO without adversely harming the service they offer'. If a new MVNO opportunity were to arise, and an interested MNO did not currently have enough spare capacity to on-board the MVNO without leading to capacity constraints and service degradation, it would be likely to have

---

[2] Award of the 700 MHz and 3.6-3.8 GHz spectrum bands – Publication of the results of the Principal Stage of the auction under regulation 49 of the Wireless Telegraphy (Licence Award) Regulations 2020, Ofcom, 17 March 2021.
[3] Award of the 700 MHz and 3.6-3.8 GHz spectrum bands – Publication of the results of the Principal Stage of the auction under regulation 49 of the Wireless Telegraphy (Licence Award) Regulations 2020, Ofcom, 17 March 2021.
[4] Connected Nations 2020: UK report, Ofcom, 17 December 2020 (Connected Nations 2020), Figure 20.
[5] [✂].
[6] [✂]. Also see Connected Nations 2020: UK report, Ofcom, 17 December 2020 (Connected Nations 2020, page 46).

capacity expansion/investment plans and processes that could be brought forward or accelerated.

14. Ofcom submitted that '[t]he additional capacity required to support a new MVNO should be seen in the context of this 'business as usual' network capacity expansion and is unlikely to be greater than the equivalent of a few months' BAU network capacity expansion'. For example, Ofcom submitted that, even if Sky Mobile continues to grow, hosting it on an MNO's network would only represent a 'modest increase' in the number of the MNO's customers: around [✂]% for EE and Vodafone and slightly over [✂]% for Three.

15. Ofcom has noted that MNOs may face constraints in their IT services and ability to on-board new MVNOs.

    (a) On-boarding an MVNO requires the MNO to set up the pass-through of customer information, eg who the customers are, who they are calling, how much data they are using etc. Additionally, the MNO's systems need to be configured to allow for identification and tracking of MVNO customers as well as to keep them separate from other MVNO's customers and/or the host MNO's own customers.

    (b) Due to these specialist, resource-intensive processes, MNOs might face IT resource capacity constraints if they were to on-board multiple MVNOs simultaneously. This could lead to delays, increased costs and reputational damage.

16. The Parties have noted that post-merger there will be only one fixed-MVNO of sufficient size where any on-boarding issues could conceivably arise: Sky. The Parties note that Sky is an established full MVNO (and as such does not require billing or customer relationship management services from its MNO host), limiting the resources required for on-boarding. Furthermore, [✂].

Quality

17. Ofcom has told us of various ways through which network quality might be measured. These are:

    (a) Ofcom's 'Customer Satisfaction Tracker'. This tracker includes questions such as 'satisfaction with overall service' and 'satisfaction with reception or signal strength';

    (b) Measures of network reliability and speed by a third party, RootMetrics. RootMetrics carries out UK-wide tests, assessing MNO network

performance based on reliability, speed, data, calls and texts. These are then combined in an overall score (out of 100);

(c) Measures of speed by another third party, OpenSignal. OpenSignal conducts various average speed tests as part of its 'UK Mobile Network Experience Report'; and,

(d) Ofcom coverage data: analysis of voice and data coverage.

18. Ofcom summarised the main outcomes of the recent network quality analyses as described above:

(a) Customer satisfaction: Ofcom noted that generally, retail customer satisfaction is high across all networks, but that overall satisfaction, and satisfaction specifically with regard to reception or signal strength were lower than average among Three customers.

Table 1: Ofcom customer satisfaction tracker, 2020

Metric	*Average*	*EE*	*Giffgaff*	*O2*	*Tesco*	*Three*	*Virgin*	*Vodafone*
								%
Satisfaction with overall service	93	93	95	93	97	89	93	90
Satisfaction with reception or signal strength	85	84	86	85	92	75	84	89
Satisfaction with value for money	87	84	96	87	97	87	n/a	83

Source: Ofcom [✂].

(b) RootMetrics analysis: Ofcom stated that this shows that overall EE had the fastest and most reliable network in 2019, followed by Vodafone, Three and O2.

Table 2: Rootmetrics data on network speed and reliability, August 2018 and August 2019

Category	*BT/EE*		*O2*		*H3G*		*Vodafone*	
	1H 2018	*1H 2019*	*1H 2018*	*1H 2019*	*1H 2018*	*1H 2019*	*1H 2018*	*1H 2019*
Overall	96.0	96.1	86.6	90.5	93.0	92.1	93.0	95.2
Reliability	97.6	97.5	91.6	94.7	96.5	95.7	96.5	96.8
Speed	91.8	93.1	73.1	78.5	82.9	81.9	82.9	91.9
Data	96.0	96.8	86.4	89.9	92.1	91.4	92.1	96.1
Call	95.6	94.9	85.6	90.3	93.8	92.5	93.8	93.5
Text	99.1	99.2	96.6	97.7	96.8	96.8	96.8	99.2

Source: Rootmetrics, August 2018 and August 2019. Ofcom [✂]

(c) OpenSignal analysis: Ofcom stated that this shows that, ranked by overall network speed, EE comes first, followed by Vodafone, Three and O2.

Table 3: OpenSignal data on network speed, October 2018 and October 2019

Mbps

Category	*BT/EE*		*O2*		*H3G*		*Vodafone*	
	Oct 2018	*Oct 2019*	*Oct 2018*	*Oct 2019*	*Oct 2018*	*Oct 2019*	*Oct 2018*	*Oct 2019*
Download Speed – Overall	25.9	31.5	12.8	15.1	15.6	18.2	18.4	22.0
Download Speed – 4G	28.9	33.7	14.6	16.9	18.8	21.6	21.9	25.1
Download Speed – 3G	7.2	5.5	4.6	5.3	7.8	8.2	4.6	5.0

Source: OpenSignal, October 2018 and October 2019. Ofcom [✂].

(d) Ofcom voice and data coverage analyses: Ofcom stated that:

(i) O2 and Vodafone out-perform EE and Three in terms of voice coverage;

(ii) EE significantly outperforms all other MNOs in terms of data coverage across landmass; and,

(iii) O2 and Vodafone are better in terms of data coverage across indoor premises.

Table 4: Ofcom analysis of voice coverage, November 2019

%

	Landmass	*Outdoor Premises*	*Indoor Premises*
BT/EE	86.0	99.6	96.3
O2	91.4	99.9	99.2
H3G	85.4	99.5	95.6
Vodafone	91.3	99.8	98.8

Source: Ofcom [✂].

Table 5: Ofcom analysis of data coverage, November 2019

%

	Landmass	*Outdoor Premises*	*Indoor Premises*
BT/EE	83.9	99.3	92.1
O2	76.4	99.1	95.1
H3G	79.3	98.5	89.1
Vodafone	80.6	99.1	94.1

Source: Ofcom [✂].

19. We have summarised relevant additional evidence from internal documents supplied by the Parties and third parties below:

(a) Liberty Global submitted [✂].

(b) Liberty Global submitted [✂].

(c) Additionally, [✂].

(d) [✂]Virgin noted that [✂]. Virgin also noted that [✂]. On [✂]. It also stated that [✂]. See Figure 1.

Figure 1: [✂].

[✂]

Source: Liberty Global, [✂].

(e) [✂].

(f) Vodafone [✂].

(g) Figure 2 and Figure 3 [✂].

Figure 2: Excerpt from [✂].

[✂]

Source: [✂].

Figure 3: Excerpt from [✂].

[✂]

Source: [✂]

Appendix L: Wholesale mobile: assessment of quantitative evidence in relation to unbundling and switching

1. This appendix summarises the quantitative evidence that we have gathered in relation to unbundling and switching rates.

Quantitative evidence relating to unbundling

2. The Parties have defined the unbundling rate as the number of fixed-mobile customers that, in response to an increase in the price of the mobile element of the bundle, would switch away the mobile element only, expressed as a percentage of all fixed-mobile customers that would switch away the mobile element (including those customers that would also drop the fixed elements).[1]

3. This is the definition of the unbundling rate that we have used as an input to our quantitative analysis (see Appendix M).

4. Due to data availability and the nature of the evidence submitted to us, some of our estimates of unbundling are measured in a different way to that defined by the Parties and used in our quantitative analysis. In particular, certain measures assess unbundling by calculating the percentage of current fixed-mobile customers who remove a mobile element of the bundle. Assessing unbundling on this basis will produce lower estimates of the unbundling rate because the base of customers over which we make our assessment is much wider, as it includes all fixed-mobile customers, not just those who would respond to a change in the price or quality of the mobile aspect of their fixed-mobile bundle.

5. In our discussion of our views of the various unbundling measures we will identify those measures that use a different definition of unbundling to that defined by the Parties and used in our quantitative analysis.

Data from fixed-MVNOs on unbundling

6. We have reviewed data on current unbundling rates: that is, evidence on whether customers of fixed-MVNOs increase or reduce the range of services they purchase from their provider.

[1] [✂].

(a) In 2019, around [✂]% of Sky's mobile-only customers added fixed services, and around [✂]% of Sky's fixed-only customers added a mobile component.

(b) Sky customers also removed services from their fixed-mobile bundles. Around [✂]% of Sky's fixed-mobile customers became mobile-only, and around [✂]% became fixed-only in 2019. We note that this could be an underestimate, as Sky's mobile base is relatively new and Sky Mobile customers may be in their initial contract phase, so they would be less likely to unbundle and become fixed-only customers during this time.

(c) In 2019, around [✂]% of Virgin's dual-play (fixed-only) customers added mobile services to their bundle and around [✂]% of triple-play (fixed-only) customers added mobile services to their bundle.

(d) Virgin's customers also removed services from their fixed-mobile bundles. Around [✂]% of quad-play fixed-mobile customers removed mobile services from their bundle and around [✂]% of triple-play fixed-mobile customers removed the mobile component from their bundle.

Unbundling in response to a SSNIP

7. We also assessed the extent of unbundling with evidence on how customers of bundles would respond to a SSNIP for fixed-mobile bundles.

8. Third parties were asked: "if the price of… [certain]… FMC packages permanently increases by 10% across the whole market (i.e. all suppliers increase the price), while the price of the respective mobile and fixed components remains constant in the case of separate purchase, what proportion of the customers (in % of total customers) would likely substitute multiple play packages with their respective underlying standalone components (or a combination of some of them)?"

9. We received the following submissions:

(a) Utility Warehouse considered that a 10% increase in the price of fixed-mobile bundles would lead to more than [✂] of customers switching to purchasing their respective components separately where the bundle does not include pay-TV and more than [✂] of customers switching to purchasing their respective components separately where the bundle includes pay-TV. Utility Warehouse noted that this was due to the 'very competitive field of fixed telephony, internet and mobile providers to choose from' with 'more limited' choices in relation to pay-TV.

(b) Vodafone considered that less than [✂] of customers purchasing fixed voice and mobile and fixed voice, broadband, and mobile customers would switch to purchasing their respective components separately in response to a [✂] increase in the price of bundles.[2]

Data from Ofcom's 2020 Core Switching Tracker

10. Ofcom's 2020 Core Switching Tracker[3] provides evidence of customers' views on whether they see the products they purchase as part of a package of services or as individual services.[4]

11. The following table sets out the number of customers with a fixed-mobile bundle and the proportion that regard the services as supplied as a package, rather than as individual services.

Table 1: Proportion of customers who consider themselves to be purchasing a package

	Sky	*Virgin*	*BT/EE*	*Simple average across providers*
Total number of respondents with mobile	123	197	743	
Of which, total number of respondents with mobile and at least one fixed service	90	125	180	
Of which, total number who consider the mobile component to be part of a package	41	74	109	
% who consider themselves to be in a package	46%	59%	61%	55%

Source: CMA analysis of Ofcom's 2020 Core Switching Tracker.
Notes: Responses are unweighted (sample sizes are small, which is more evident in the presentation of unweighted results; weighting results does not make a material difference to the results).

12. On this basis, the unbundling rate could be 45% if we assumed that customers who do not consider themselves to be purchasing a package would unbundle (in response to a price rise or quality reduction in the mobile aspect of their fixed-mobile bundle).

Parties' estimates of unbundling rates

13. The Parties estimated unbundling rates based on the following sources of evidence: [✂] and [✂]. We note that the [✂] and [✂] provide estimates of unbundling based on the Parties' definition of unbundling rate, as set out in paragraph 2.

---

[2] [✂]. Vodafone did not provide details as to why it considered this to be the case and noted that it was its 'best approximation.'
[3] In Chapter 10 we describe this survey.
[4] The survey asked customers who purchased mobile and at least one fixed service from the same provider, "Thinking about these services, do you regard them as a package of services or as individual services?" Ofcom 2020 Core Switching Tracker, question 8A.

[✂]

14. Liberty Global told us [✂].

15. [✂].

[✂]

16. Liberty Global also estimated an unbundling rate from [✂]. This figure was in the range of [✂]. This range was based [✂].

17. Liberty Global considered that the unbundling rate suggested by [✂] ([✂]%) is a better representation of the likely actual unbundling rate and should be preferred to the [✂] range, because [✂].

[✂]

18. The Parties commissioned [✂] a consumer survey specifically designed to examine the likely unbundling rate of Sky fixed-mobile customers.[5]

19. The Parties estimated unbundling rates based on two hypothetical scenarios, (i) a 10% increase in Sky's mobile prices, and (ii) a complete withdrawal of Sky's mobile services.

20. In the first hypothetical scenario, the results of the survey suggest unbundling rates in a range from [✂], depending on the number and type of fixed services in the subscriber's bundle.

21. In the hypothetical second scenario, the results of the survey suggest unbundling rates in the range from [✂], depending on the number and type of fixed services in the subscriber's bundle. In both cases, the Parties applied two filters to estimate unbundling rates.[6] As a sensitivity, the Parties computed the estimates without the filters. In the price rise scenario, not applying the filters gives unbundling rates in the range from [✂]. In the complete withdrawal scenario, not applying the filters gives unbundling rates in the range from [✂].

22. Based on the results of this survey, the Parties submitted that "unbundling rates closer to [✂] and certainly at least [✂] are realistic."

---

[5] [✂].
[6] [✂].

Our views on the estimates of unbundling rates

Data from fixed-MVNOs on unbundling

23. The evidence from fixed-MVNOs on unbundling indicates that customers of fixed-MVNOs can add and remove services from their bundles.

24. Given that these unbundling rates reflect the actual behaviour of customers in removing the mobile aspect from a fixed-mobile bundle, we consider it appropriate to place weight on them. However, we note that these levels of unbundling are not necessarily as a result of a price increase or reduction in quality, and as such the estimates could be higher. Furthermore, these estimates are based on a definition of unbundling which will underestimate the rate of unbundling compared with a definition of unbundling as used by the Parties and in our quantitative analysis.

Unbundling in response to a SSNIP

25. We consider it appropriate to place weight on this evidence, as it provides third party views of the proportion of fixed-mobile customers that would unbundle in response to a price increase in a fixed-mobile bundle.

26. Whilst one third party provided some justification for their estimation, the other did not. However, these estimates are based on a definition of unbundling which will underestimate the rate of unbundling compared with a definition of unbundling as used by the Parties and in our quantitative analysis (given that they ask for the percentage of customers who would unbundle out of all customers, and not just those who would switch).

Data from Ofcom's 2020 Core Switching Tracker

27. We consider it appropriate to place weight on this evidence as we consider it conveys useful information about customers' views on their purchases of fixed-mobile bundles.

28. However, we note that this data does not provide direct evidence of how customers would react to a price increase, or reduction in the quality of, the mobile element of their fixed-mobile bundle.

Parties' estimates of unbundling rates

29. We have assessed the Parties' estimates from [✂] survey of Sky fixed-mobile customers, [✂].

30. The [✂] are derived from non-random online panels which we generally consider to be insufficiently robust for use as evidence in merger cases.[7] Furthermore, we note that surveys relating to the telecommunications sector that have used both online panel and random sample face-to-face methodologies in parallel have produced different results depending on the methodology.[8]

31. In addition, in relation to the [✂] we consider that the estimates derived from the analysis are sensitive to the way in which the switching analysis is defined. In particular, the switching analysis defines attributes of a 'base case' offering of Virgin such as the levels of prices of different services. Different calibrations of these levels, particularly of the price of fixed services, will generate different estimates of the proportion of unbundling.

32. As described above, [✂] survey of Sky fixed-mobile customers, are based on non-random online panels. The Parties state that the CMA's criticisms of non-randomised samples in relation to online panels is misguided and the Parties give several reasons for this:

    (a) There is a trade-off between the response rate of a survey and the sampling method employed;

    (b) if the recruitment of a non-probabilistic panel is sufficiently representative of the population of interest there is no justification to reject its findings; and,

    (c) there is no evidence that the sampling strategy used [✂] has any specific bias.

33. In response to these points:

    (a) The trade-off between response rate and sampling methodology implies that response rates are higher in non-random online panel surveys than surveys with random probability samples. However, while the proportion of online panel members who respond to an invitation to participate in an individual survey may be high, this does not take account of the non-response already incurred in the setting up of the panel – the large numbers of people that are given the opportunity to join the panel, but choose not to do so. Panel recruitment joining rates are not provided by

[7] CMA, Good practice in the design and presentation of survey evidence in merger cases, 2018, paragraphs 2.27–2.30.
[8] Barbers, Chilvers & Kaul, 'Moving an established survey online – or not?', International Journal of Market Research, Vol 55, No 2, 2013.

market research agencies that run non-random online panels, but are an additional, and possibly the main, source of potential 'non-response' bias;

(b) there is no evidence that non-probabilistic panels are sufficiently representative. They may be fully representative with respect to the demographic characteristics controlled for in the panel recruitment, but this does not make the sample representative with respect to anything else. For example, the proportion of 25-29 year old men in the panel may be in line with the proportion in the general population, but without random sampling the methodology does not give any reassurance that the panel members in this group are representative of young men in the general population. Furthermore, market research agencies who manage online panels are not sufficiently transparent about their methods of recruitment onto panels to enable users of their statistics to make their own judgements about fitness for purpose of survey findings based on them; and,

(c) there is specific empirical evidence that survey findings of non-random online panels may be particularly misleading in the telecoms sector, as referenced in paragraph 30.

34. The Parties note the CMA's criticism that the Parties' [✂] estimates are sensitive to the calibration of attribute levels in the 'base case'. They suggest that the CMA could focus on the range of "base prices" closest to the present Virgin offering and those that the JV is expected to offer, but do not provide such estimates themselves. We consider that [✂] is complex and, given the CMA's concerns about the robustness of the online panel survey data on which the [✂] choice models are based, we did not consider it appropriate to assess this model further.

35. Given the above, we do not consider it appropriate to place weight on the Parties' estimates of unbundling from [✂] survey of Sky fixed-mobile customers, [✂]. We note that whilst the three sources of evidence outlined above produce higher estimated rates of unbundling than other estimates on which we have placed weight, the results of our quantitative analysis suggests that foreclosure is not profitable even at very low levels of unbundling. As such, use of higher rates of unbundling would not change our provisional findings in relation to the incentive to foreclose.

Quantitative evidence relating to switching from Sky to Virgin

Mobile switching

36. Although the focus of our assessment relates to switching in fixed-mobile bundles, given that certain analysis relating to switching in fixed-mobile bundles is derived from estimates of mobile diversion we have considered the evidence relating to mobile diversion.

37. Sky told us that it uses port-out data to [✂]. This includes information on [✂].

38. The port-out data can therefore be used to estimate mobile diversion from Sky to other providers, as it captures the proportion of customers leaving Sky who then purchase mobile services from other providers such as Virgin. We consider that diversion estimated from port-out volume data should be preferred to diversion estimated from other sources because port-out volume data shows revealed, rather than stated, consumer preferences.[9] Furthermore, we note that port-out data is relatively comprehensive, with [✂]. Sky submitted port-out-volume data for 2019 which showed that [✂]% of customers leaving Sky Mobile switched to Virgin, and [✂]% switched to O2 brands.

Fixed-mobile bundle switching

39. We have received and analysed a range of evidence estimating potential fixed-mobile bundle diversion from Sky to the Merged Entity:

    (a) Liberty Global used [✂] to estimate past diversion from Sky fixed broadband customers to a fixed-mobile bundle supplied by another provider. The evidence shows that [✂].

    (b) The Parties also estimated diversion to Virgin by Sky's fixed-mobile customers that would switch their fixed as well as mobile services with residual market shares. This approach assumes that diversion is proportional to market shares. The Parties told us that [✂] of customers leaving Sky in this way would switch to Virgin.

[9] We have received other sources of evidence from the Parties estimating mobile diversion from Sky to Virgin for the year 2019. Liberty Global used [✂] (refer to caveats in paragraph 30) and estimated that mobile diversion from Sky to Virgin was [✂]%. The Parties also estimated mobile diversion from [✂] and an [✂] conducted by the market research firm [✂]. The estimates from these surveys were [✂] and [✂] respectively. (O2, Liberty Global, [✂])

(c) We have used Sky's 2019 port-out mobile data to calculate potential bundle diversion from Sky to the Merged Entity[10] and estimated that around [✂] of customers leaving Sky's fixed-mobile bundles would switch whole bundles to the Merged Entity.

(d) Further, Sky stated that [✂], this may suggest that [✂] of Sky fixed-mobile customers who choose to switch their bundles away from Sky would divert to the Merged Entity.

Our views on the estimates of the switching rate

40. In estimating diversion in fixed-mobile bundles from Sky to the Merged Entity, we place more weight on the evidence outlined in relation to diversion of fixed-mobile bundles as opposed to mobile-only diversion.

41. In relation to [✂], we consider that the caveats set out in paragraph 30 apply and as such we will not give this piece of evidence weight.

42. Residual market share analysis assumes that diversion is proportional to market share and may be used as an indicator of diversion. We consider it appropriate to place some weight on this evidence. However, we note that this approach may not reflect actual switching behaviour.

43. Using Sky's 2019 port-out mobile data to calculate diversion in fixed-mobile bundles uses data which directly measures diversion from Sky Mobile customers to the Merged Entity, so we have considered it appropriate to place some weight on this evidence. However, we note that there is some uncertainty around the true diversion estimate as we have made the assumption that fixed-mobile customers behave similarly to mobile-only customers.

44. In relation to Sky's submission, [✂]. We therefore consider it appropriate to place some weight on this evidence. We also note that this is likely to be an overestimate since currently Virgin only offers fixed services to c. [✂] of UK premises[11] and therefore a significant proportion of customers leaving Sky bundles are unlikely to be able to switch to the Merged Entity.[12]

---

[10] By dividing the porting out volumes to Virgin and O2 over the porting out volumes to providers of fixed-mobile post-merger (ie Virgin, BT/EE, Vodafone, and O2). We note this estimate relies on the possibility of diversion in fixed-mobile bundles from Sky to O2 (and as such it assumes (i) that O2 will develop a fixed-mobile bundle offering and (ii) diversion from Sky to O2 in fixed-mobile bundles will be the same as diversion from Sky to O2 in mobile-only).
[11] Information was accurate as of May 2020; [✂].
[12] We note that Sky can offer fixed services in all areas where Openreach operates.

Appendix M: Wholesale mobile: vertical arithmetic analysis

The Parties' submission

1. The Parties submitted a vertical arithmetic analysis of the Merged Entity's incentive to foreclose MVNOs.

2. The Parties' analysis considers the simultaneous foreclosure of both Lycamobile and Sky and assesses two possible strategies:

   (a) The Merged Entity refusing to bid for a new MVNO contract (total foreclosure); and

   (a) the Merged Entity bidding less aggressively than O2 would have done absent the Proposed Merger (partial foreclosure).

3. In both cases, the methodology is based on a comparison of the upstream losses that the Merged Entity would incur as a result of a foreclosure strategy and the downstream gains that it would generate.

4. Given the uncertainty around the value of several parameters used in the model, the Parties estimated it under thousands of possible scenarios.

5. The Parties' analysis suggests that the Merged Entity would not have an incentive to foreclose Lycamobile and Sky, either totally or partially, as the upstream losses resulting from these foreclosure strategies would be larger than the associated downstream gains under any of the scenarios considered.

Our analysis

6. The vertical arithmetic analysis submitted by the Parties is based on the methodology adopted by the CMA in its BT/EE merger investigation.[1] We consider the approach to be suitable for the analysis of the Merged Entity's incentive to foreclose MVNOs and have followed it with some adjustments. As our theory of harm relates to input foreclosure of fixed-MVNOs, and given that Lycamobile is a mobile-only MVNO, we have focused our analysis on the possibility for the Merged Entity to foreclose Sky.

7. The estimation of downstream gains follows the same steps for both total and partial foreclosure:

[1] Final report on the on the anticipated acquisition by BT Group plc of EE Limited, Appendix I.

(a) Estimating the wholesale price increase that Sky would face in the event of foreclosure and the resulting increase in Sky's retail prices;

(b) assessing how Sky's retail customers would respond to the price increase; that is, how many customers would switch away from Sky and, if so, whether they would look for a new supplier only for mobile services or for both mobile and fixed services; and

(c) estimating the proportion of switching customers that would be captured by the Merged Entity and the profits that the Merged Entity would generate from them.

8. The size of upstream losses varies depending on the foreclosure strategy adopted:

(a) Total foreclosure would result in the loss of wholesale profits from Sky in their entirety;

(b) under partial foreclosure, however, the Merged Entity would still have a positive probability of renewing the contract with Sky, so that, in expectation, wholesale losses would be lower.

Downstream gains

9. In the following paragraphs we describe the different steps in the estimation of the downstream gains from foreclosure and the main assumptions we have made at each step.

Wholesale and retail price increase

10. The first step for the calculation of downstream gains from foreclosure is estimating the wholesale price increase that Sky would face.

11. In their submission, the Parties used a range between [✂] and [✂]. Based on evidence [✂], the upper bound of this range appears conservative.

12. As discussed in Appendix J, [✂].[2]

13. [✂].

14. [✂], a reasonable estimate of the cost is between [✂] and [✂]. We have used this range in our calculations.

[2] [✂].

15. The impact of a wholesale price increase on retail prices would depend on Sky's cost pass-through rate. The Parties considered three possible options for this rate – [✂]. We consider this range to be reasonable and have retained it in our calculations.

Retail customers' response

16. Sky's customers would respond differently to a retail price increase depending on the product they are purchasing from it: that is, mobile-only services or a fixed-mobile bundle and, in the case of fixed-mobile customers, on whether they would unbundle the mobile component.

17. We have, therefore, estimated the proportion of Sky's customers that currently purchase fixed-mobile bundles and considered different scenarios on the probability of them unbundling.

18. In their submission, the Parties used three possible values for the unbundling rate: [✂]. The Parties, however, submitted that these values are 'implausibly low'.

19. We note that these values are well below our upper bound estimate of [✂]%. To reflect the range of possible values for the unbundling rate, we have used a range between 10% and 50%.

20. We have defined two categories of Sky's customers: those that, in case of diversion, would only switch their mobile contract (the mobile-only customers and the unbundling fixed-mobile customers), and those that would switch a fixed-mobile bundle (the non-unbundling fixed-mobile customers).

21. We have estimated the number of Sky's customers in the two groups using the number of Sky's mobile-only and fixed-mobile customers in January 2021 and our assumption on the unbundling rate.

22. To assess their expected response to a price increase, we have then estimated the percentage retail price increase that each group would face and the elasticity of demand.

23. Based on data from January 2021, [✂]% of Sky's mobile subscribers also buy fixed services (any combination of broadband, voice and pay-TV) from it. Subscribers are viewed here as households, where each household may sign more than one mobile subscription.

24. On a household basis, the average monthly spend on mobile services is approximately £[✂] ([✂]), while the average spend on fixed-mobile bundles

is around £[✂]. In the same month, Sky's wholesale payment to O2 corresponded to [✂] per household.

25. It is useful to consider the percentage price increase that Sky's customers could face in the case of foreclosure. Assuming a wholesale cost increase of [✂] and a pass-through rate of 100%, mobile-only customers (and the fixed-mobile customers who would unbundle) would be facing an increase of around [✂]% on the retail price of their mobile subscriptions, while non-unbundling fixed-mobile customers would see a price increase of approximately [✂]% for the fixed-mobile bundle.

26. The number of customers who would switch provider in response to this price increase depends on the elasticity of demand. In their analysis, the Parties used a range of elasticities between [✂] (possibly different between the two groups of customers). This is a large range and we have retained it in our analysis.

Retail diversion to the Merged Entity and retail margins

27. Only some of the customers switching away from Sky would divert to the Merged Entity. This number is obtained by multiplying the total number of switching customers by the appropriate diversion ratio from Sky to O2 or Virgin.

28. For mobile-only diversion, we have used estimates based on Sky port-out data, as show in Table 1.

Table 1: Diversion ratios from Sky

	O2	*giffgaff*	*Tesco Mobile*	*Virgin*
Sky's port-out data	[✂]	[✂]	[✂]	[✂]

Source: Sky.

29. We note that this approach might over-estimate the diversion to Virgin of customers switching only their mobile services. Sky's port-out data is likely to be an average between customers switching only their mobile contract and customers also switching fixed services. To the extent that fixed-mobile customers have a higher probability of switching to Virgin, this would result in overestimating mobile-only diversion.

30. For fixed-mobile diversion, the Parties' estimate based on residual market shares ([✂], see Appendix L for further details) is similar to our estimate of potential bundle diversion ([✂], see Appendix L for further details). One other estimate of diversion that we have considered is likely to be an overestimate,

as discussed in Appendix L. Therefore, for the purpose of the vertical analysis calculation, we have maintained the Parties' estimate.

31. We have used the Parties' estimate of their retail margins. However, as Sky's data is based on households rather than on individual mobile subscriptions, we have multiplied the Parties' mobile margins by the average number of mobile subscriptions per Sky's subscriber household.

Upstream losses

Total foreclosure

32. In the calculation of upstream losses from total foreclosure, the Parties have assumed that, in the counterfactual, O2 would win Sky's contract with probability 1.

33. In the BT/EE investigation, when modelling total foreclosure, the CMA assumed that the probability of EE winning MVNO contracts in the counterfactual would have been lower than 1.[3] Reducing the probability of winning the contract in the counterfactual would result in a lower wholesale loss from a foreclosure strategy.

34. In the present case, to determine the appropriate value of the parameter, we need to assess the probability that, absent the merger, Sky would continue to be hosted on O2's network after the end of the current contract.

35. While it is difficult to assess what competition between MNOs would look like [✂], there are reasons to believe that O2 would have a high probability of successfully renewing a contract with Sky. First, O2 would have an advantage as the incumbent host. Second, and most importantly, [✂].

36. Based on this evidence, we consider it appropriate to assume that in the counterfactual O2 would retain the contract with Sky.

37. We have therefore assumed upstream losses corresponding to O2's wholesale margin under the current contract with Sky. This is estimated at approximately £[✂] million per month.

[3] Final report on the on the anticipated acquisition by BT Group plc of EE Limited, Appendix I.

Partial foreclosure

38. In the case of partial foreclosure, upstream losses depend on the probability that the Merged Entity would still win the contract with Sky despite bidding more weakly.

39. The Merged Entity's wholesale profits in case of partial foreclosure would therefore be zero if the contract is not won but would be larger than current profits if the contract is won, as the wholesale price would be higher. The upstream loss is then computed as the difference between pre-foreclosure wholesale profits and the expected post-foreclosure wholesale profits.

40. To determine the appropriate range on the value of the probability that O2 would still win the contract, we have considered the following evidence:

    (a) As mentioned above, [✂].

    (b) The offers from [✂].

41. Based on this evidence, if O2 were to offer significantly worse terms (corresponding to an increased wholesale cost of [✂]%), [✂]. This would lead to a probability of winning the contract between 33% and 50%. We have therefore used this range in our calculations.

Appendix N: Wholesale mobile: evidence on take-up and benefits of fixed-mobile bundles

1. This appendix summarises evidence on fixed-mobile bundles.

2. We present evidence relating to:

   (a) The current shares of supply for different fixed-mobile bundle combinations;

   (b) the current focus of the different fixed-mobile suppliers;

   (c) the stated benefits of fixed-mobile bundles to providers and consumers;

   (d) the uptake of fixed-mobile bundles in other European countries; and,

   (e) planned fixed-mobile propositions and projected take-up.

Shares of supply of fixed mobile bundles

3. We gathered data from six providers of fixed-mobile bundles.

4. Table 1, below, shows the shares of supply for these six providers for any type of fixed-mobile bundle.

Table 1: Estimated shares of all fixed-mobile bundles, 2019

	Total Fixed / Mobile	*Share of Supply, %*
BT	[✂]	[30-40]
Virgin	[✂]	[20-30]
Vodafone	[✂]	[10-20]
Sky	[✂]	[10-20]
Utility Warehouse	[✂]	[0-5]
TalkTalk	[✂]	[0-5]
Total	4,520,565	100

Source: CMA Analysis of RFI responses from fixed-mobile providers.

5. This shows that:

   (a) BT currently has the largest share of supply of all fixed-mobile bundles. However, it is unclear if this share represents an underlying demand for fixed-mobile bundles supplied by BT. A proportion of these customers may have purchased mobile services from EE and fixed services from BT prior to their merger in 2016 and become fixed-mobile customers as a result of that merger.

   (b) Virgin has a share of supply of [✂] [20%-30%] of all fixed-mobile bundles, making it the second largest provider behind BT.

(c) Virgin has a larger share of supply than Sky and Vodafone (both of whom have a share of supply of [✂] [10%-20%]). We note that the Merged Entity's share will increase as a result of the Proposed Merger as customers who are currently fixed customers of Virgin and mobile customers of O2 will become fixed-mobile customers of the Merged Entity.[1]

(d) Vodafone has the [✂] highest number of fixed-mobile customers with [✂] fixed-mobile customers.

(e) [✂] [70-80%] of fixed-mobile customers are served by either Virgin, BT or Vodafone.

6. Of the other providers:

(a) Sky has a share of supply of [✂] [10-20%] and has been growing rapidly having not had a mobile offering until 2017.

(b) TalkTalk and Utility Warehouse together make up only around [✂] [5%-10%] of fixed-mobile supply.

7. Of the 4.5 million customers who purchase fixed-mobile bundles, 4.2 million purchase either a quad-play bundle (with mobile, fixed voice, broadband and pay-TV) or a triple-play bundle (which includes mobile, fixed voice and broadband).

8. We next consider the shares of supply for these two most commonly purchased bundles.

Quad-play bundles: mobile, fixed voice, broadband and pay-TV

9. Table 2 shows the share of supply, in 2019, for quad-play fixed-mobile bundles. These are bundles that include all four services: mobile, pay-TV, broadband and fixed voice.

[1] In strategy documents analysing the impact of the merger it is estimated [✂] of O2 customers already purchase fixed services from Virgin. ([✂]). Telefónica (including O2, Giffgaff and Tesco) have almost [✂] customers ([✂]) The impact of the merger could therefore be [✂] of the customer base who currently have fixed and mobile services supplied by the same provider to around [✂] and increase the merged entities' share of supply to fixed-mobile customers to over [✂]%.

Table 2: Shares of supply for quad-play bundles, 2019

	Customers	*% Share*
Virgin	[✂]	[50-60] [✂]
Sky	[✂]	[30-40] [✂]
BT/EE	[✂]	[10-20] [✂]
TalkTalk	[✂]	[0-5%] [✂]
Total	1,821,631	100%

Source: CMA Analysis of RFI responses

10. The table shows that in 2019 there were four providers of quad play services, with Virgin holding the largest share of supply, followed by Sky.

Triple-play bundles: fixed voice, internet and mobile

11. Table 3 shows the share of supply in 2019 for triple-play fixed-mobile bundles that include mobile, broadband and fixed voice.

Table 3: Shares of supply for triple-play (fixed voice, broadband and mobile) bundles, 2019

	Customers	*% Share*
BT	[✂]	[40-50] [✂]
Vodafone	[✂]	[30-40] [✂]
Utility Warehouse	[✂]	[5-10] [✂]
Virgin	[✂]	[5-10] [✂]
TalkTalk	[✂]	[0-5] [✂]
Sky	[✂]	[0-5] [✂]
Total	2,405,313	100%

Source: CMA Analysis of RFI responses

12. Currently BT has the largest share of supply [40%-50%] ([✂]) of customers for this type of bundle with Vodafone the next largest share ([✂]) [30%-40%].

Focus of suppliers

13. This section includes analysis of the customer numbers of the different fixed-mobile suppliers and the extent to which these customers purchase multiple products from that provider or on a stand-alone basis.

14. Figure 1 shows, for each fixed-mobile supplier, the number of customers split between mobile-only, fixed-only and fixed-mobile customers in 2019.

Figure 1: [✂].

[✂]

Source: [✂]

15. Figure 1 shows that:

(a) For all providers (with the exception of [✂]) fixed-mobile customers account for a relatively small proportion of their customer base; and

(b) of the remaining providers, [✂].

Virgin

16. Figure 2 shows the breakdown of Virgin's customer base into its different product types with the overlaps demonstrating the proportion of customers choosing bundles.

Figure 2: [✂].

[✂]

Source: [✂]

17. This figure shows that:

(a) [✂];

(b) [✂] of Virgin's customers subscribe only to mobile;

(c) a smaller proportion of customers subscribe to fixed services on a stand-alone basis [✂]; and,

(d) [✂] the quad-play bundle which represents [✂] of Virgin's overall customer base.

18. We estimate that [✂]of Virgin's customers purchase broadband [✂].

19. Of these broadband customers, we estimate that [✂] also purchase fixed voice, and [✂] of broadband customers also purchase a pay-TV package.

20. Just under [✂]of Virgin's customers are estimated to be mobile customers. [✂] of Virgin's mobile customers use another product.

Sky

21. Figure 3 shows the breakdown of Sky's customer base into its different product types with the overlaps demonstrating the proportion of customers choosing bundles.

Figure 3: [✂].

[✂]

Source: [✂].

22. This figure shows that:

(a) The most common product combination for Sky [✂];

(b) [✂] of Sky's customers subscribe only to mobile;

(c) [✂] subscribe to fixed services on a stand-alone basis, particularly pay-TV ([✂]). Fixed voice and broadband are [✂]; and,

(d) the most common fixed-mobile bundle for Sky [✂].

23. We estimate [✂] of Sky's customers purchase pay-TV making it Sky's [✂]. Of these TV customers, we estimate that [✂] also purchase fixed voice and broadband.

24. We estimate that [✂] of Sky's customers are mobile customers making it a [✂] of its current offering. [✂] of Sky's mobile customers hold another product.

BT/EE

25. Figure 4 shows the breakdown of BT's customer base into its different product types with the overlaps demonstrating the proportion of customers choosing bundles.

Figure 4: [✂].

[✂]

Source: [✂].

26. This figure shows that:

(a) [✂] of BT's customers only subscribe to mobile, [✂] subscribing to fixed services on a stand-alone basis. [✂] of customers only purchase fixed voice, whereas pay-TV and broadband are only sold along fixed voice services;

(b) the most commonly purchased fixed-mobile bundle is [✂] which represents [✂] of BT's overall customer base; and,

(c) the most common product grouping for BT is [✂] which was purchased by [✂] of customers.

27. We estimate [✂] BT's customers purchase mobile [✂]. Of these mobile customers, we estimate that [✂] also purchase fixed voice and internet, and [✂] also purchase a pay-TV package.

28. We estimate that fixed voice is the [✂] of BT's customers subscribing. The [✂] of these customers ([✂]) also have broadband.

Vodafone

29. Figure 5 shows the breakdown of Vodafone's customer base into its different product types with the overlaps demonstrating the scale of customers choosing bundles.

Figure 5: [✂].

[✂]

Source: [✂].

30. This figure shows that:

(a) [✂] of Vodafone's customers only subscribe to mobile

(b) [✂] subscribing only to one fixed product and [✂] subscribing to broadband and voice; and

(c) the only fixed-mobile bundle offered by Vodafone is mobile together with broadband and voice and this accounts for [✂] of overall customers.

31. We estimate that [✂] of Vodafone's customers purchase mobile, [✂]. [✂] of Vodafone's customers purchase a fixed product with [✂] of these customers purchasing fixed services together with mobile.

Utility Warehouse

32. Figure 6 shows the breakdown of Utility Warehouse's customer base into its different product types with the overlaps demonstrating the scale of customers choosing bundles.

Figure 6: [✂].

[✂]

Source: [✂].

33. This figure shows that:

(a) [✂] of Utility Warehouse's customers only subscribe to mobile, with Utility warehouse [✂]; and

(b) the most common fixed-mobile bundle [✂] which represents [✂] of Utility Warehouse's overall customer base, with most of the remaining [✂] taking both broadband and voice.

34. We estimate that [✂] of Utility Warehouse's customers subscribe to mobile.

TalkTalk

35. Figure 7 shows the breakdown of TalkTalk's customer base into its different product types with the overlaps demonstrating the scale of customers choosing bundles.

Figure 7: [✂].

[✂]

Source: [✂].

36. This figure shows that:

(a) [✂] of TalkTalk's customers only subscribe to mobile, and around [✂] of TalkTalk's customers receive either only broadband or fixed voice on a stand-alone basis;

(b) the most common fixed-mobile bundles for TalkTalk [✂] represent [✂] of TalkTalk's overall customer base; and,

(c) the most common product grouping for TalkTalk [✂] which was purchased by [✂] of customers.

37. We estimate that [✂] of TalkTalk's customers purchase broadband or fixed voice [✂].

38. We estimate that [✂] of TalkTalk's customers are mobile customers. TalkTalk has mostly exited the mobile market and now has a reseller agreement with O2 to sell its mobile services.

Stated benefits of fixed-mobile bundles

39. In this section, we set out the benefits to providers of fixed-mobile bundles; and the benefits to customers of taking up fixed-mobile bundles.

Supply-side benefits of bundles

40. The Parties told us that a feature of communications markets is a strong correlation between customer loyalty and the number of different services a customer takes from a given provider.

41. Liberty Global said that the main benefits to it of selling fixed and mobile products together are [✂].

42. Further, an internal document submitted by the Parties which assesses the synergies of the proposed transaction estimated that [✂].

43. We also received the following further evidence from the Parties and third parties:

(a) Liberty Global provided evidence on churn rates for Virgin's cable customer base - these ranged from [✂] for single play cable customers to [✂] for quad-play customers in 2020.

(b) [✂] told us that customers who take broadband are generally 'stickier' than other customers given the reliance that consumers place on broadband access for a range of social, entertainment and work needs.

(c) [✂] submitted that it expects to see [✂]. [✂] told us that its churn rate ranged from [✂]% [✂].

(d) [✂] told us that [✂].

(e) [✂] said that [✂].

(f) [✂] said that [✂]. Evidence from [✂] indicates that it [✂].

44. The other potential benefits of offering fixed-mobile bundles stated by providers include:

(a) Lower costs to serve customers by increasing the use of common systems for selling and supporting the services (eg costs associated with running an online sales channel, physical retail sites, voice channels, etc);

(b) lower costs of managing a customer account (such as billing costs); and,

(c) efficiencies in marketing the products due to common infrastructure (eg existing customers can be contacted directly to cross-sell other products without having to pay commissions to external agencies).

Demand-side benefits of bundles

45. Many providers state that customers can benefit from purchasing all of their services from a single provider:

(a) Liberty Global and BT both said that an advantage for consumers of purchasing fixed-mobile bundles is the simplicity and convenience of single-provider billing and ease of purchase through a single sales channel;[2]

[2] [✂]; Liberty Global said this is confirmed by [✂]. An internal document submitted [✂].

(b) Liberty Global told us that Virgin's 'Oomph' bundles include a broadband speed upgrade that would typically (that is, excluding special promotions) cost about £6 per month to standalone customers;[3]

(c) Liberty Global also said that customers can only get unlimited mobile data plans if they purchase Virgin's 'Oomph' bundles. In particular, customers of its 'Ultimate Oomph' package, which is its top-end fixed-mobile package, get unlimited data SIMs included. This allows customers to gain access to wide range of pay-TV content including sports and cinema with the ability to use voice and data in the home or when mobile;

(d) BT offers unlimited mobile data to BT Halo customers as part of the "No Limits" plan and offers double mobile data to BT mobile customers choosing a Halo product;

(e) Sky told us that its online account (and MySky App) enable its customers to manage all their Sky services with a single log-in. Further, Sky TV customers with Sky Mobile can watch Sky TV and use any Sky apps on the go without using their Sky Mobile data allowance;

(f) Vodafone told us that its customers benefit from price reductions when they purchase mobile and broadband together (with a discount ranging from £2 to £3 per month, depending on the bundle type). In addition to beneficial pricing, Vodafone customers also get 50GB of mobile data allowance in the event of issues with their broadband service, a single point of contact for customer care and support, and single account and billing relationship; and,

(g) BT said that customers may also benefit from having a single point of contact to obtain product and customer support, optimised equipment delivery and/or installation (with products dispatched together) and a simpler understanding of the total costs of the services.

The uptake of fixed-mobile bundles in other European countries

46. This section considers the evidence from other European countries relating to the uptake of fixed-mobile bundles.

The Parties submissions

47. The Parties submitted that the Proposed Merger is part of a broader trend towards fixed-mobile convergence in Europe. The Parties stated that the take-

[3] [✂].

up of fixed-mobile bundles in the UK has been modest (around [✂] in 2019), compared to some other European markets (e.g. [✂] in Belgium, [✂] in Netherlands, [✂] in Portugal and [✂] in Spain).

Third Party submissions

48. [✂] stated that it has seen the focus of competition shift rapidly to fixed-mobile bundles in other European countries when the largest operators have both fixed and mobile networks.

49. Furthermore, [✂] stated that current UK offerings are not hard bundles like those in the Spanish market, rather, fixed customers taking out additional pay-monthly sims receive a discount.

50. [✂] stated that fixed-mobile providers in Europe are increasingly focused on developing fixed-mobile bundle strategies:

    (a) [✂] provided the example of Spain, where the purchase by Vodafone of the cable network ONO in 2014 and the purchase by Orange of Jazztel in 2015 led to a situation in which the three largest operators had both a fixed and a mobile network.

    (b) [✂] noted that competition between these operators focused on developing attractively priced fixed-mobile bundles and including exclusive services in those bundles, leading to a significant uptake of these bundles by consumers.

    (c) [✂] stated that the level of take up of fixed-mobile bundles in Spain is now greater than 70%.

51. [✂]stated that the increasing availability of fixed-mobile bundles is a direct strategy by providers of fixed-mobile services to offer unique, compelling services and customer experiences that cannot easily be replicated by mobile-only or fixed-only competitors (either at all or cost-effectively).

52. [✂] provided further examples relating to fixed-mobile bundles from Spain, Germany and Austria. [✂] stated that this evidence highlighted how fixed-mobile bundles can offer unique, compelling services and customer experiences that cannot be easily be replicated by mobile-only or fixed-only providers.

53. For example, [✂] noted that in addition to pricing discounts, fixed-mobile providers in other European countries offered:

    (a) Additional free mobile lines or larger data allowances;

(b) a single billing / contract system and a single point of access to customer service (often with preferential treatment);

(c) a single phone number for both mobile and landline;

(d) smart home offerings, such as “smart butler” concepts and IoT applications; and,

(e) a hybrid internet connection of mobile and landline bandwidth that allows users to secure better indoor wireless connectivity.

54. Vodafone stated that third party research group [✂] reported that the UK has had a slower uptake of convergence than continental Europe, but this is evolving as more operators offer fixed-mobile bundles to their customers.

Internal documents

55. In this section we summarise evidence from the Parties’ internal documents in relation to comparisons of the uptake of fixed-mobile bundles in different European countries.

56. A Telefónica document, produced in 2018, shown below in Figure 8, shows that compared to other European countries, fixed-mobile penetration in the UK is limited.[4] The document shows that:

(a) [✂] of UK consumers purchase fixed and mobile services from the same provider

(b) Spain has high fixed-mobile penetration, with [✂] of customers purchasing fixed and mobile services from a single provider;

(c) France, Germany and Italy also have higher fixed-mobile penetration than the UK, with France the next highest at [✂] penetration, Germany at [✂] penetration, and Italy at [✂] penetration.

Figure 8 – [✂].

[✂]

Source: Telefónica, [✂].

57. A document provided by Liberty Global also shows that in 2016 fixed-mobile convergence was lower in the UK compared with many other markets. The document indicates that:

[4] Telefónica, [✂].

(a) [✂];

(b) [✂].

(c) [✂].

Figure 9 - [✂].

[✂]

Source: [✂].

58. Another document provided by Liberty Global

59. A document provided by Liberty Global, below, shows the percentage of converged customers of total broadband customers for different telecoms companies across Europe. This document [✂]:

(a) [✂];

(b) [✂];

(c) [✂],

(d) [✂].

Figure 10- Parties [✂]

[✂]

Source: Virgin, [✂].

60. A Telefónica [✂] from February 2019 also highlighted some of the reasons why the UK may have lower levels of uptake of fixed-mobile bundles compared with other countries. It noted that there is limited consumer demand for fixed-mobile bundles. Furthermore, it said take-up is driven by the supply side, and, as the UK has some of the lowest margins in Europe it is more difficult for converged players to offer significant discounts to attract customers to fixed-mobile bundles.

Other third-party research

61. A report by Analysys Mason also highlights that fixed-mobile convergence is a common feature of European Markets.[5] It classified markets into four distinct groups:

[5] Analysys Mason, 2020, FMC penetration is increasing, aided by better wholesale rates (analysysmason.com) (downloaded 08/03/2020)

(a) Markets in which FMC adoption has been driven by up-selling fibre (France, Portugal and Spain);

(b) low-competition markets in which operators have used conservative discounts to consolidate their fixed–mobile user bases (Belgium and the Netherlands);

(c) markets in which FMC penetration remains limited by operator infrastructure (Italy, Germany, Poland and the UK); and,

(d) markets where convergence remains niche despite favourable infrastructure conditions (Romania and Turkey).

62. The report notes that for markets in which FMC penetration remains limited by operator infrastructure such as the UK, potential mergers (and improving wholesale conditions) could lead to an increase in fixed-mobile convergence.

63. The report also notes that the most mature fixed-mobile markets (Spain, Portugal and France) could provide an insight into how fixed-mobile markets can develop. The report highlights France as an interesting case study where the number of fixed-mobile accounts as a percentage of the number of fixed broadband connections is declining due to stronger price-competition in non-bundled offers.

Planned fixed-mobile propositions and projections

64. This section sets out the submissions from the Parties and third parties on planned fixed-mobile propositions and their views on the likelihood of overall growth.

The Parties

65. The Parties stated that the Proposed Merger will enable cross-selling of fixed-mobile converged products to O2's and Virgin's largely non-overlapping customer bases. The Parties said that they expect to offer customers additional discounts and services to achieve this.

Third party views

66. [✂] said that uptake of fixed-mobile bundles can be expected to increase as new, innovative, converged products come to market. [✂].

67. [✂] the Proposed Merger could result in fixed-mobile bundled propositions that are more popular with retail customers in the UK. The transaction may increase the uptake of fixed-mobile bundles in the UK [✂].

68. [✂] said that some telecoms operators may offer fixed-mobile deals with a discount for taking both fixed and mobile if this lowers churn [✂]. [✂].

69. [✂] said that on a forward-looking [✂]:

(a) [✂]

(b) [✂].

(c) [✂].

70. [✂] said that [✂].

71. [✂] stated that [✂].

72. [✂] said that, [✂].

73. [✂] said that [✂].

74. [✂] stated that the proposed Merger will create a strong convergent player in a market where convergence has already begun.

75. [✂] stated that BT has been relatively slow to push converged offers, but [✂].

76. [✂] said that take-up of fixed-mobile bundles is at an early stage of development. Most commonly, this includes quad-play bundles including voice, broadband, pay-TV and mobile.

77. [✂] said that BT/EE and Virgin/O2 intend to accelerate uptake of fixed-mobile bundles in the UK. It said that as the two largest communications providers in the UK, they are well-placed to achieve this aim.

78. [✂] said that, if the take-up of fixed-mobile bundles accelerates, the market for mobile-only players [✂]. It said that this would have the potential to [✂].

79. [✂] said that it [✂].

80. [✂] said it [✂].

81. [✂] said that, in relation to mobile, its strategy was to [✂].

82. [✂].

83. [✂] said that [✂]. [✂].

84. [✂] said that the Proposed Merger might accelerate uptake of fixed-mobile bundles. It said fixed-mobile bundles are already quite prevalent across the telecoms industry available through most of the large providers.

Internal documents

85. Internal documents from the Parties and third parties indicated that:

(a) Fixed-mobile bundles have been increasing over the last three years with the number of quad-play customers increasing from [✂] to [✂] between 2016 and 2019.[6]

(b) A survey conducted on behalf of [✂]found '[✂]' estimating that bundles of mobile and broadband had grown by [✂]% over the last three years, mobile and TV bundles had also grown by [✂]% over the last three years and bundles of mobile, TV, and broadband had grown by [✂]% over the last three years.[7]

(c) An O2 document projects [✂] fixed-mobile penetration (ie customers purchasing both mobile and broadband from the same provider) by 2022.

(d) Analysis by [✂] provided by [✂] suggest there will be a long-term effect from the Proposed Merger on increasing the adoption of bundled services.

[6] [✂]. See also [✂], and [✂].
[7] [✂].

Glossary of terms

4G	Fourth generation of mobile systems. Designed to provide faster data download and upload speeds on mobile networks.
5G	Fifth generation of mobile systems. Brings greater speed, capacity and functionality to mobile services.
Access Serving Node (ASN)	A type of BT local exchange that it has designated for backhaul aggregation.
Alternative Interface (AI)	Leased line services typically using an Ethernet interface.
Asymmetric Digital Subscriber Line (ADSL)	A variant of DSL that supports higher bandwidth on downlink transmissions, i.e. from the exchange to the end user, than from the end user to the exchange.
ALF	Annual licence fee (for radio spectrum).
Backhaul	Backhaul is the carriage of traffic from an exchange to a central point: transmission links used to connect local exchanges to each other and/or the core network. In the context of mobile networks, we use the term backhaul to denote the network connectivity between an **MNO**'s radio base stations (which make up the **RAN**) and its core network. Mobile backhaul usually includes a connection from the base station site to a local exchange and additional connectivity from a local exchange to the **MNO**'s core network.
Bandwidth	In digital telecommunications systems, the rate measured in bits per second (bit/s), at which information can be transferred.
BCMR	Ofcom's Business Connectivity Market Review: examines the market for leased lines in the UK. Most recent BCMR was 2019. Superseded by the **WFTMR**.
BT Enterprise	BT Enterprise is one of **BT**'s core business units. Through BT Enterprise, **BT** provides wholesale telecommunications services to businesses and other communications providers.
BT Group (**BT**)	British Telecommunications plc. Includes BT's core business units: Consumer, Enterprise, Global, and Technology, as well as **Openreach**.
CityFibre	CityFibre Infrastructure Holdings Limited.
CLA	Central London Area. A geographic market defined by Ofcom.

CMA	Competition and Markets Authority.
Core Network	Network containing a number of major nodes connected together by high bandwidth links.
CTIL	Cornerstone Telecommunications Infrastructure Limited. A joint venture between **Vodafone** and **O2**.
CRAN	Centralised RAN or Cloud RAN – a type of RAN configuration. See **RAN**.
Dark fibre	Referred to as **passive fibre leased lines**. Unconfigured optical fibre laid ready for users to install their own transmission equipment. Because no light source has been applied, it is 'dark'.
Dual-, triple-, or quad-play services	A package of retail services that includes two, three, or four of: fixed broadband, fixed voice, mobile, and pay-TV.
EAD	Ethernet Access Direct. A brand name for **Openreach**'s Ethernet leased lines.
EAD LA	Ethernet Access Direct Local Access. A variant of **Openreach**'s **EAD** product.
EE	EE Limited. An **MNO**, wholly owned by **BT**.
Equivalence of Inputs (EOI)	A strict form of non-discrimination requirement imposed by **Ofcom**. This requires **BT** to provide the same wholesale products to all communication providers including **BT**'s own downstream division on the same timescales, terms and conditions (including price and service levels) by means of the same systems and processes, and includes the provision to all communication providers (including **BT**) of the same commercial information about such products, services, systems and processes.
Ethernet	A packet-based technology originally developed for and still widely used in Local Area Networks. Developments of this technology known as Metro Ethernet or Carrier Ethernet are now being used in communications providers' networks to provide leased line and backhaul services.
Fibre-to–the-Cabinet (FTTC)	An access network structure in which the optical fibre extends from the exchange to the street cabinet. The street cabinet is usually located only a few hundred metres from the subscriber's premises. The remaining part of the access network from the cabinet to the customer is usually copper wire but could use another technology, such as wireless.

Fibre-to-the-Premises (FTTP)	An access network structure in which the optical fibre network runs from the local exchange to the end user's house or business premise. Sometimes also referred to as Fibre To The Home (FTTH).
Fixed-mobile bundle, or services	A package of retail services that includes mobile and one or more of fixed broadband and fixed voice. May also include pay-TV.
Fixed voice	Fixed telephone communication (ie not mobile communication).
Gigabits per second (Gbit/s)	A measure of bandwidth in a digital system (1 Gigabit = 1,000,000,000 bits).
High network reach (HNR) area	A geographic market defined by **Ofcom**. Areas where **BT** faces competition from two or more competitors in the supply of leased lines.
Inter-exchange connectivity (IEC)	A market defined by **Ofcom** for connections between BT exchanges in the aggregation layer.
IRU	Indefeasible right of use. A type of long-term contract that may be used for dark fibre, where the dark fibre is leased with a high share of rent paid upfront.
Leased line	A permanently connected communications link between two premises dedicated to the customers' exclusive use.
MBNL	Mobile Broadband Network Limited. A network sharing joint venture between **BT** and **Three**.
MEAS	Managed Ethernet Access Service. A **BT Enterprise** active leased lines product.
Megabits per second (Mbit/s)	A measure of bandwidth in a digital system (1 Megabit = 1,000,000 bits
Merged Entity	The post-Merger business of VMED O2 UK Holdco Limited.
MNO	Mobile Network Operator. A provider of mobile communications services which owns a radio access network.
MVNO	Mobile Virtual Network Operator. A provider of mobile communications services which does not own a national network itself, but instead provides all or part of its mobile phone services over network infrastructure owned by an **MNO**.
Liberty Global	Liberty Global plc.
O2	O2 Holdings Ltd, part of **Telefónica**.
Ofcom	Office of Communications, the communications sector regulator.

Openreach	Openreach Limited is a wholly-owned subsidiary of **BT** but is independently governed, in accordance with undertakings agreed with **Ofcom** in 2005. The purpose of the undertakings is to ensure that **BT** transacts with Openreach on the same terms as third party customers and that **BT** does not discriminate in favour of its own downstream wholesale and retail divisions.
OSA	Optical Spectrum Access. A brand name for **Openreach**'s WDM leased lines.
OSA FC	OSA Filter Connect. A particular WDM product supplied by **Openreach**.
Principal core operator (PCO)	A concept used by **Ofcom** when defining the IEC market. Refers to telecoms providers with substantial core infrastructure that can provide an effective constraint on Openreach. Virgin is a PCO.
PIA	Physical infrastructure access: an **Ofcom** remedy from 2019 which requires **BT** to give other telecoms providers access to its physical infrastructure to deploy their own networks.
RAN	Radio Access Network.
Sky	Sky UK Limited.
SLC	Substantial Lessening of Competition.
Significant market power (SMP)	A designation which can be used by **Ofcom** under the Communication Act and is equivalent to the competition law concept of dominance.
SRN	Shared rural network: an agreement between the four **MNOs** and UK government to bring 4G to rural areas.
TalkTalk	TalkTalk Telecom Group plc.
TCO	Total cost of ownership.
Telefónica	Telefónica S.A.
Telefonica UK Limited	Telefónica UK.
Tesco Mobile Limited	Tesco Mobile.
giffgaff Limited	giffgaff. **MVNO** owned and operated by O2.
The Act	The Enterprise Act 2002.

The Proposed Merger	The proposed joint venture between **Liberty Global** and **Telefónica** to merge their UK operating businesses, **Virgin** and **O2**.
The Parties	**Liberty Global** and **Telefónica** and their subsidiaries.
Three	Hutchison 3G UK Ltd; sometimes referred to as H3G.
UK	United Kingdom.
VHB	Very high bandwidth. Refers to connections with bandwidths above 1Gbit/s.
Virgin	Virgin Media Inc. the parent company of Virgin Media Ltd and Virgin Mobile Telecoms Ltd., part of **Liberty Global**.
Virgin Media	Virgin Media Ltd.
Virgin Mobile	Virgin Mobile Telecoms Ltd.
Vodafone	Vodafone Limited, part of Vodafone Group plc.
vRAN	Virtualized radio access network – a type of **RAN** configuration.
Wholesale Fixed Telecoms Market Review **(WFTMR)**	**Ofcom**'s market review. Examines various markets including for leased lines in the UK. Completed in 2021.
Wavelength division multiplexing (WDM)	A technology which is used to offer high capacity services on fixed networks.