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Promoting investment and competition in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26

Annexes 1-26

Non-confidential version – redacted for publication [✂]

STATEMENT:

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Contents

Annex

A1. Regulatory framework

A1.1 This annex provides an overview of the regulatory framework relevant to the market review process, to give some additional context to the matters discussed in this document, including the legal instruments published in Volume 7.

A1.2 Market review regulation is technical and complex; and requires us to apply legislation. We may also have regard to a number of relevant recommendations and guidelines. This overview identifies some of the key aspects of materials relevant to this market review but does not purport to give a full and exhaustive account of all materials that we have considered in reaching our decision for these markets.

A1.3 Since the publication of the consultation in January 2020 the regulatory framework relevant for market reviews has been amended. In particular the Communications Act (2003)[1] ("the Act") was amended in December 2020 to reflect the transposition of the relevant provisions of the European Electronic Communications Code ("the EECC") and the end of the Brexit transition period.[2] By virtue of section 2(1) of the European Union (Withdrawal) Act 2018, the Act continues to have effect in UK law as it did prior to the UK's departure from the European Union.

Market review concept

A1.4 A market review is a process by which, at regular intervals, we identify relevant markets and carry out analyses of these markets to determine whether they are effectively competitive. Where an operator has significant market power (SMP) in a market, we impose appropriate remedies, known as SMP obligations or conditions, to address this. We explain the concept of SMP below.

A1.5 In carrying out this work, we act in our capacity as the sector-specific regulator for the UK communications industries, including telecommunications. Our functions in this regard are to be found in Part 2 of the Act. The Act requires Ofcom carry out reviews of competition in communications markets[3] to ensure that SMP regulation remains appropriate and proportionate in the light of changing market conditions.

A1.6 Each market review normally involves three analytical stages:

- the identification and definition of the relevant markets (the market definition stage);
- the assessment of competition in each market, in particular whether the relevant market is effectively competitive (the market analysis stage); and
- the assessment of appropriate regulatory obligations (the remedies stage).

[1] http://www.legislation.gov.uk/ukpga/2003/21/contents
[2] The EECC, established by Directive EU 2018/1972, entered into force on 20 December 2018. In July 2020, following public consultation, the UK government set out its approach to implementing the EECC into national law: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/902879/Government_response_EECC.pdf
[3] Section 84(A) of the Act.

Market definition

Relevant markets

A1.7 The Act provides that, before making a market power determination[4], we must identify "the markets which in [our] opinion are the ones which in the circumstances of the United Kingdom are the markets in relation to which it is appropriate to consider whether to make such a determination"[5] and analyse those markets.

A1.8 In identifying or analysing markets, the Act provides that we may have regard to EECC materials relating to market identification and analysis[6], such as the 2020 Recommendation on Relevant Markets (2020 EC Recommendation)[7]

A1.9 We may only identify a market for the purpose of assessing market power where we consider the three criteria set out in section 79(2B) of the Act (the three criteria test) are met.

A1.10 The three criteria, which are cumulative, are:

- the presence of high and non-transitory structural, legal or regulatory barriers to entry;
- a market structure which does not tend towards effective competition within the relevant time horizon[8], having regard to the state of infrastructure-based and other competition behind the barriers to entry; and
- competition law alone is insufficient to adequately address the identified market failure(s).

A1.11 The 2020 EC Recommendation, which we may have regard to, identifies a set of product and service markets within the electronic communications sector in which *ex ante* regulation may be warranted within the EU. These are the markets which the European Commission has found to meet the three criteria test[9], after observing overall trends across the EU. This provides a useful indicator of the markets which exhibit competition issues in neighbouring countries (and those which do not) and a consideration of the reasons for this and the trends observed, which may also be relevant to UK circumstances. We make clear in the relevant sections of this Statement where we have had regard to the 2020 EC Recommendation.

A1.12 The fact that we identify product and service markets that meet the three-criteria test does not automatically mean that regulation is warranted. Market definition is not an end in itself but rather one input into assessing effective competition.

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[4] The market power determination concept is used in the Act to refer to a determination that a person has SMP in an identified services market.

[5] Section 79(1) of the Act.

[6] Section 79(2ZA). Section 79(6A) of the Act defines EECC materials as "recommendations or guidelines published by the European Commission, and guidelines published by BEREC, under the Framework Directive or EECC Directive (including those published after IP completion day" i.e. after 31 December 2020.

[7] Commission Recommendation of 18 December 2020 on relevant product and service markets within the electronic communications sector susceptible to *ex ante* regulation in accordance with Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Code.

[8] Such time period as we determine to be appropriate in relation to the review.

[9] The three criteria test applied by the European Commission is equivalent to that set out in section 79(2B) of the Act.

Sufficiency of competition law

A1.13 In considering the third limb of the three criteria test, that competition law alone is insufficient to adequately address the identified market failure(s), we bear in mind the specific characteristics of the relevant markets we have defined. Generally, the case for *ex ante* regulation is based on the existence of market failures which, by themselves or in combination, mean that the establishment of effective competition might not be possible if the regulator relied solely on *ex post* competition law powers which are not specifically tailored to the sector. Therefore, it may be appropriate for *ex ante* regulation to be used to address such market failures along with any entry barriers that might otherwise prevent effective competition from becoming established within the relevant markets we have defined. By imposing *ex ante* regulation that promotes competition, it may be possible to reduce such regulation over time as markets become more competitive, allowing greater reliance on *ex post* competition law.

A1.14 *Ex post* competition law is also unlikely in itself to bring about (or promote) effective competition, as it prohibits the abuse of dominance rather than the holding of a dominant position itself. In contrast, *ex ante* regulation is normally aimed at actively promoting the development of competition through attempting to reduce the level of market power (or dominance) in the identified relevant markets, thereby encouraging the establishment of effective competition.

A1.15 We generally take the view that *ex ante* regulation provides additional legal certainty for the market under review and may also better enable us to intervene in a timely manner. We also consider that certain obligations are needed as competition law would not remedy the particular market failure, or that the specific clarity and detail of the obligation is required to achieve a particular result.

Forward look

A1.16 Market definition is not a mechanical or abstract process. It requires an analysis of any available evidence of past market behaviour and an overall understanding of the mechanics of a given market sector. The Act requires that Ofcom must conduct a forward-looking assessment of the market, taking into account expected or foreseeable developments that may affect competition in the market.[10]

Approach to market analysis and Modified Greenfield

A1.17 When identifying and analysing markets, we apply the following two principles.

A1.18 First, when identifying wholesale markets for the purposes of section 79(1) of the Act, we start with an analysis of corresponding retail (or other downstream) market(s). We do not formally define the retail market(s), but consider if it is (they are) prospectively competitive in the

[10] S79(1A) the Act

absence of wholesale regulation based on a finding of SMP, and therefore whether any lack of effective competition is durable.[11]

A1.19 If the underlying retail market(s) is (are) prospectively competitive under these circumstances, we would conclude that regulation is no longer needed at the wholesale level. If the underlying retail market(s) is (are) not prospectively competitive, then we identify the corresponding wholesale market(s). Where wholesale markets are vertically linked, we identify and analyse the most upstream market first, followed by a subsequent analysis of the markets that are downstream, to determine whether they would be effectively competitive in the presence of regulation upstream.

A1.20 Second, when identifying and analysing a market, we assume that no SMP regulation exists in that particular market. This avoids the risk of circularity in our assessment – i.e. a finding of no SMP in a market which is predicated on pre-existing *ex ante* regulation of that market (this is often referred to as the 'Modified Greenfield approach').[12]

A1.21 We note that this approach is consistent with that set out in the EC SMP Guidelines.[13]

Product and geographic dimensions

A1.22 We use competition law methodologies in the market review analysis. In particular, there are two dimensions to the definition of a relevant market: the relevant products to be included in the same market and the geographic extent of the market.

A1.23 The boundaries between markets are determined by identifying competitive constraints on the price setting behaviour of firms. There are two main constraints to consider:

- to what extent it is possible for a customer to substitute other services for those in question in response to a price increase (demand-side substitution); and
- to what extent suppliers can switch, or increase, production to supply the relevant products or services in response to a price increase (supply-side substitution).

A1.24 The hypothetical monopolist test is a tool used to identify good demand-side and supply-side substitutes. In this test, a product is considered to constitute a separate market if the hypothetical monopolist supplier could impose a small but significant non-transitory increase in price (SSNIP) above the competitive level without losing sales to such a degree as to make this price rise unprofitable. If such a price rise would be unprofitable, because consumers would switch to other products or because suppliers of other products would begin to compete with the hypothetical monopolist, then the market definition should be expanded to include the substitute products.

[11] Our analysis takes into account the effects of other types of (sector-specific) regulation, decisions or legislation applicable to the relevant retail and related wholesale market(s) during the relevant period.
[12] Hutchison 3G UK Ltd v The Office of Communications [2009] EWCA Civ 683 https://www.catribunal.org.uk/sites/default/files/1083_Hutchison_CoA_160709.pdf, paragraphs 64-66.
[13] Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services (2018/C 159/01), paragraphs 15-18.

A1.25 The starting point for the application of hypothetical monopolist test can be referred to as the 'focal product',[14] and typically starts from the narrowest potential market definition.[15]

A1.26 We may consider both demand-side substitution and supply-side substitution possibilities to consider whether either provide additional constraints on the pricing behaviour of the hypothetical monopolist. In this assessment, supply-side substitution is considered to be a low-cost form of entry which can take place within a reasonable timeframe (e.g. up to 12 months). For supply-side substitution to be relevant not only must suppliers be able, in theory, to enter the market quickly and at low cost by virtue of their existing position in the supply of other products or geographic areas, but there must also be an additional competitive constraint arising from such entry into the supply of the service in question.

A1.27 In relation to defining the relevant geographic markets, this comprises an area in which the undertakings concerned are involved in the supply and demand of the relevant products or services, in which the conditions of competition are sufficiently homogeneous, and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are significantly different. Areas in which the conditions of competition are heterogeneous do not constitute a uniform market.

A1.28 Our approach to market definition follows that used by the UK competition authorities and is consistent with the EC SMP Guidelines. We make clear in the relevant sections of this statement how we have regard to the EC SMP Guidelines.

Relationship with ex post competition law

A1.29 While competition law methodologies are used in identifying the relevant markets *ex ante*, the markets identified will not necessarily be identical to markets defined in *ex post* competition law cases, especially as (i) the markets identified *ex ante* are based on an overall forward-looking assessment of the structure and the functioning of the market under examination, and (ii) as noted above, in carrying out an *ex ante* assessment, we assume there is no SMP regulation in place in the market under examination. Accordingly, the economic analysis carried out for the purpose of this review, including the markets we have identified, is without prejudice to any analysis that may be carried out in relation to any investigation pursuant to the Competition Act 1998[16] (relating to the application of the Chapter I or II prohibitions) or the Enterprise Act 2002.[17]

[14] This reflects the terminology used by UK competition authorities (see OFT, Market definition, December 2004, OFT403, www.oft.gov.uk/shared_oft/business_leaflets/ca98_guidelines/oft403.pdf, which has subsequently been adopted by the CMA Board).
[15] Paragraph 3.2 of the OFT Market Definition Guidelines explains that 'previous experience and common sense will normally indicate the narrowest potential market definition, which will be taken as the starting point for the analysis'.
[16] http://www.legislation.gov.uk/ukpga/1998/41/contents
[17] Enterprise Act 2002, Chapter 40.

Market analysis

Effective competition

A1.30 The Act requires that we carry out market analyses of identified markets for the purpose of making or reviewing market power determinations. The Act requires that such analyses are normally to be carried out within five years from the publication of a previous market power determination relating to that market. Exceptionally, the five-year period may be extended for up to one additional year.[18]

A1.31 In carrying out a market analysis, the key issue for Ofcom is to determine whether any one or more operator(s) has SMP.

A1.32 The definition of SMP is equivalent to the concept of dominance as defined in competition law.[19] In essence, it means that an undertaking in the relevant market is in a position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers, and ultimately consumers.

A1.33 The Act provides that, in considering whether to make or revise a market power determination, we may have regard to EECC materials relating to market analysis or the determination of what constitutes significant market power, such as the EC SMP Guidelines.[20]

A1.34 The EC SMP Guidelines consider the specific application of competition law principles to the electronic communications sector. They reflect our understanding of the factors driving competitive conditions in the markets we are reviewing. We have therefore had regard to the EC SMP Guidelines in considering whether to make or revise market power determinations in this Statement.

A1.35 In line with the EC SMP Guidelines we consider that market shares provide a useful first indicator of competitive conditions in the market, and that they should however be interpreted in light of the relevant market conditions.[21] The Guidelines note that, according to established case law, a market share in excess of 50% is itself evidence of a dominant position, save in exceptional circumstances.[22] On this point, we have also had regard to the judgment of the Competition Appeal Tribunal in BCMR 2019. The Tribunal confirmed that the existence of a high market share is to be a trigger for a full assessment, but not to be determinative in itself.[23]

A1.36 The EC SMP Guidelines set out, additionally to market shares, criteria that can be used to measure the power of an operator to behave to an appreciable extent independently of its competitors, customers, and consumers, including:

- barriers to entry;
- barriers to expansion;

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[18] Section 84A of the Act.

[19] Section 78(1) of the Act. References in section 78 to dominance of a market are to be construed, so far as it is appropriate to do so, in the same way as the reference in section 18(1) of the Competition Act 1998 to a dominant position in a market.

[20] Section 79(2BA) of the Act.

[21] EC SMP Guidelines, paragraph 54.

[22] EC SMP Guidelines, paragraph 55.

[23] *TalkTalk Telecom Group plc and Vodafone Limited v Ofcom (BCMR 2019)*, Judgment of 5 March 2020 [2020] CAT 8, at paragraphs 163-171 and 282-283.

- absolute and relative size of the undertaking;
- control of infrastructure not easily duplicated;
- technological and commercial advantages or superiority;
- absence of or low countervailing buying power;
- easy or privileged access to capital markets/financial resources;
- product/services diversification (for example, bundled products or services);
- economies of scale and economies of scope;
- direct and indirect network effects;
- vertical integration;
- a highly developed distribution and sales network;
- conclusion of long-term and sustainable access agreements;
- engagement in contractual relations with other market players that could lead to market foreclosure; and
- absence of potential competition.[24]

A1.37 A dominant position can derive from a combination of these criteria which when taken separately may not necessarily be determinative.

Remedies

Powers and legal tests

A1.38 Section 87(1) of the Act provides that where we have made a determination that a person has SMP in an identified services market, we shall set such SMP conditions authorised by section 87 as they consider it appropriate to apply to that person in respect of the relevant network or relevant facilities.[25]

A1.39 The Act identifies a number of SMP obligations, including transparency, non-discrimination, accounting separation, access to and use of specific network elements and facilities, price control and cost accounting.[26]

A1.40 For each and every SMP obligation, we explain why it satisfies the requirement in section 47(2) of the Act that the obligation is:

a) objectively justifiable in relation to the networks, services, facilities, apparatus or directories to which it relates;

b) not such so as to discriminate unduly against particular persons or against a particular description of persons;

c) proportionate to what the condition or modification is intended to achieve; and

d) transparent in relation to what is intended to be achieved.

[24] EC SMP Guidelines, paragraph 58.
[25] Section 84(4) of the Act provides that where OFCOM determine that an undertaking to whom any SMP conditions apply is no longer a person with significant market power in that market, Ofcom must revoke every SMP services condition applied to that person by reference to the market power determination made on the basis of the earlier analysis.
[26] Sections 87 and 88 of the Act.

A1.41 As part of ensuring that an SMP obligation meets this requirement, we consider whether it is based on the nature of the competition problem(s) we have identified in our market analysis.

A1.42 Additional legal requirements may also need to be satisfied depending on the SMP obligation in question. For example, we are subject to additional requirements when imposing price controls and cost recovery obligations.

A1.43 Specifically, we explain why any such SMP obligation satisfies the requirements of section 88 of the Act. Namely:

a) our analysis indicates a risk that the telecoms provider concerned might fix and maintain prices at an excessively high level or impose a price squeeze so as to have adverse consequences for end-users of public electronic communications services;

b) we consider the setting of the obligation is appropriate for the purposes of:

- promoting efficiency;
- promoting sustainable competition;
- conferring the greatest possible benefits on the end-users of public electronic communications services having regard where relevant to the market analysis, to the long term interests of end-users in the use of next-generation networks; and
- where relevant to the market analysis, promoting the availability and use of new and enhanced networks.[27] In setting such an SMP condition we also take account of:
  - the extent of investment by the telecoms provider in the matters to which the SMP obligation relates;
  - where the condition involves price controls on the provision of network access to existing network elements, the benefits of predicable and stable whole prices in ensuring:
  - efficient market entry; and
  - sufficient incentives for all undertakings to bring into operation new and enhanced networks.[28]

A1.44 Where an obligation to provide third parties with network access is considered appropriate, we take into account factors including:

a) the feasibility of the provision of the proposed network access,

b) the technical and economic viability, having regard to the state of market development, of installing and using facilities that would make the network access unnecessary,

c) any technological developments that, in our opinion, are likely to affect the design and management of the relevant network or facilities;

d) the need to ensure that the provision of the proposed network access does not have the effect of favouring one form of technology over another in relation to the design and management of the electronic communications networks;

[27] Section 88(1) of the Act.
[28] Section 88(2) of the Act.

e) the investment of the network operator who is required to provide access (taking account of any public investment made);

f) the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long term and to support innovative business models that support sustainable competition; and

g) any rights to intellectual property that are relevant to our proposals.[29]

A1.45 We demonstrate the application of the relevant requirements to the SMP obligations we are imposing, in this Statement. In doing so, we also set out our assessment of how, in our opinion, the performance of our general duties under section 3 of the Act will be secured or furthered by our regulatory intervention, and that it is in accordance with the six requirements in section 4 of the Act (see below). This is also relevant to our assessment of the likely impact of implementing our decisions.

Ofcom's general duties – section 3 of the Act

A1.46 Under the Act, our principal duty in carrying out our functions is to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A1.47 In doing so, we are required to secure a number of specific objectives and to have regard to a number of matters set out in section 3 of the Act.

A1.48 In performing our duties, we are also required to have regard to a range of other considerations, as appear to us to be relevant in the circumstances. For the purpose of this review, we consider that a number of such considerations are relevant, in particular:

- the desirability of promoting competition in relevant markets;
- the desirability of encouraging investment and innovation in relevant markets;
- the desirability of encouraging the availability and use of high-speed data transfer services throughout the UK; and
- the desirability of ensuring that relevant markets facilitate end-to-end connectivity in the interests of consumers in those markets.

A1.49 We are also required to have regard to the principles under which regulatory activities should be transparent, accountable, proportionate, consistent, and targeted only at cases in which action is needed, as well as to the interest of consumers in respect of choice, price, quality of service and value for money.

A1.50 However, we have a wide measure of discretion in balancing our statutory duties and objectives. In doing so, we take account of all relevant considerations, including responses received during our consultation process, in reaching our conclusions.

[29] Section 87 of the Act.

Section 4 of the Act – duties for the purposes of fulfilling obligations

A1.51 Section 4 of the Act requires us, when carrying out our market review functions, to act in accordance with six requirements for regulation which are in summary:[30]

a) to promote competition in the provision of electronic communications networks and services, associated facilities and the supply of directories;

b) to promote the interests of all members of the public in the United Kingdom;

c) to take account of the desirability of Ofcom's carrying out of its functions in a manner which, so far as practicable, does not favour one form of or means of providing electronic communications networks, services or associated facilities over another (i.e. to be technologically neutral);

d) to encourage, to such extent as Ofcom considers appropriate the provision of network access and service interoperability for the purpose of securing: efficient and sustainable competition; efficient investment and innovation; and the maximum benefit for customers of telecoms providers and of persons who make associated facilities available;

e) to encourage compliance with certain standards in order to facilitate service interoperability, end-to-end connectivity, and secure freedom of choice for the customers of telecoms providers; and

f) to promote connectivity and access to very high capacity networks[31] by members of the public and businesses in the United Kingdom.

A1.52 We consider that the first, second, third, fourth and sixth of those requirements are of particular relevance to the matters under review and that no conflict arises in this regard with those specific objectives in section 3 of the Act that we consider are particularly relevant in this context.

Section 4A of the Act – taking account of EC recommendations

A1.53 Section 4A of the Act provides that in carrying out certain of our functions (including, among others, our functions in relation to market reviews), we may take account of recommendations issued by the EC under Article 19(1) of the Framework Directive or Article 38(1) of the EECC Directive if the recommendations appear to us to be relevant to those functions.

[31] A *"very high capacity network"* is set out in the Act as meaning "an electronic communications network which—

(a) consists wholly of optical fibre elements at least up to the distribution point at the serving location; or

(b) is capable of delivering, under usual peak-time conditions, network performance that, in OFCOM's opinion, is similar, in terms of available downlink and uplink bandwidth, resilience, error-related parameters and latency and its variation, to the network performance of a network falling within paragraph (a)."

Impact assessment – section 7 of the Act

A1.54 The analysis presented in the January 2020 Consultation and the subsequent supplemental consultations entitled:

a) Promoting competition and investment in fibre networks – BT Regulatory Financial Reporting, published 6 February 2020;

b) Copper retirement – process for determining when copper regulation can be removed, published 25 June 2020;

c) Promoting competition and investment in fibre networks: Wholesale Fixed Telecoms Market Review 2021-2026, Pricing wholesale local access services in Geographic Area 3 with a BT Commitment to deploy a fibre network, published 29 July 2020;

d) Copper retirement – conditions under which copper regulation could be completely withdrawn in ultrafast exchanges, published 15 October 2020;

e) Wholesale Fixed Telecoms Market Review – Openreach Quality of Service, published 23 October 2020; and

f) Wholesale Fixed Telecoms Market Review 2021-26: Further consultation on certain proposed remedies, published 6 November 2020,

represent an impact assessment, as defined in section 7 of the Act.

A1.55 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Act, which means that generally we have to carry out impact assessments where there is likely to be a significant effect on businesses or the general public, or when there is a major change in our activities. However, as a matter of policy, Ofcom is committed to carrying out and publishing impact assessments in relation to the majority of its policy decisions.[32]

A1.56 Specifically, pursuant to section 7, an impact assessment must set out how, in our opinion, the performance of our general duties (within the meaning of section 3 of the Act) is secured or furthered by or in relation to the regulation we impose.

A1.57 We are separately required by statute to assess the potential impact of all our functions, policies, projects, and practices on equality.[33] This assessment is set out in Annex 23.

UK Government's Statement of Strategic Priorities

A1.58 Under section 2B(2) of the Act, when exercising our functions relating to telecoms, management of radio spectrum and postal services, we are required to have regard to the UK Government's Statement of Strategic Priorities (SSP).[34] The SSP for telecommunications, the

[32] For further information about Ofcom's approach to impact assessments, see the guidelines, Better Policy Making: Ofcom's approach to Impact Assessment.
[33] Ofcom has a general duty under the 2010 Equality Act to advance equality of opportunity in relation to age, disability, sex, gender reassignment, pregnancy and maternity, race, religion or belief, and sexual orientation.
[34] https://www.gov.uk/government/publications/statement-of-strategic-priorities

management of radio spectrum, and postal services was designated on 29 October 2019, having been laid in draft before Parliament on 18 July 2019. We set out in Section 1 of Volume 3 further details of how we have done this.

Regulated entity

A1.59 The power in the Act to impose an SMP obligation by means of an SMP services condition provides that it is to be applied only to a "person" whom we have determined to be a person having SMP in a specific market for electronic communications networks, electronic communications services or associated facilities (i.e. the "services market")[35].

A1.60 We consider it appropriate to prevent a dominant provider to whom an SMP services condition is applied, which is part of a group of companies, exploiting the principle of corporate separation. The dominant provider should not use another member of its group to carry out activities or to fail to comply with a condition, which would otherwise render the dominant provider in breach of its obligations.

A1.61 To secure that aim, we apply the SMP conditions to the person in relation to which we have made the market power determination in question by reference to the so-called "Dominant Provider", which we define as "[X plc], whose registered company number is [000] and any [X plc] subsidiary or holding company, or any subsidiary of that holding company, all as defined in section 1159 of the Companies Act 2006".

[35] Section 46(8) of the Act.

A2. Overview of telecoms networks

A2.1 This annex provides an overview of access, backhaul, and core networks – how they are configured, and the technologies used to connect customers so they can access their mobile and fixed telecoms services. Although the annex focuses on fixed networks, it also includes a subsection on fixed wireless access – mobile and satellite.

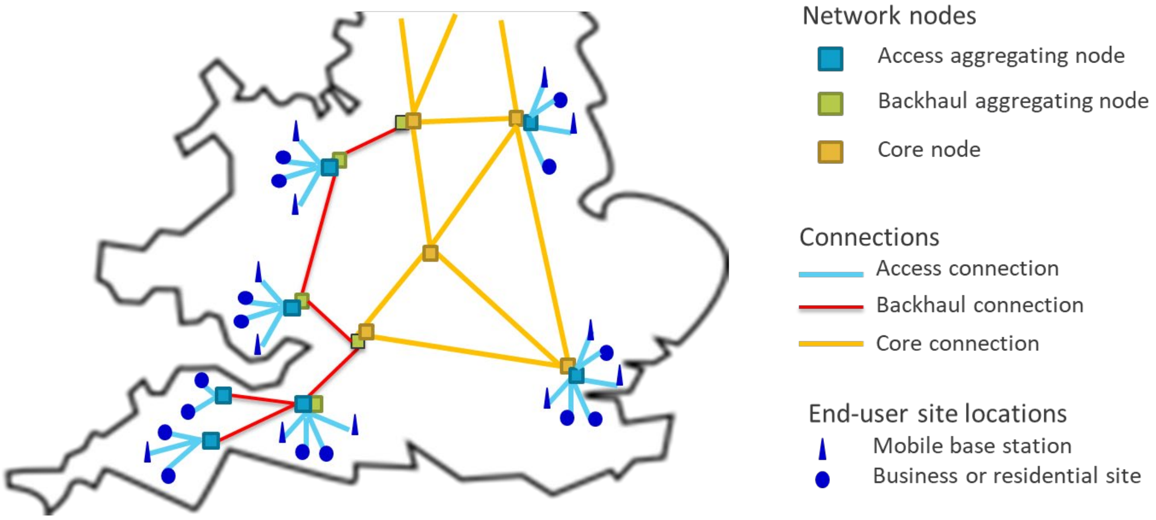
General overview

A2.2 A communications network provides the services that enable end-users to exchange information and is comprised of several elements:

- access connections;
- backhaul and core connections; and
- network nodes which house equipment.

A2.3 Figure A2.1 below sets out a high-level view of how the different network nodes and logical connections can be used to create a national communications network. It also shows where the different types of network node may be located (or co-located) geographically. These connections and network nodes are described in more detail below.

Figure A2.1: Illustration of a logical and geographic arrangement of a communications network



Source: Ofcom.

A2.4 Each end-user site is connected to one of the network's access aggregating nodes.[36] This is referred to as the 'access connection'. Each access node is connected to at least one core node, either directly or indirectly, via a backhaul aggregating node using a backhaul connection.[37]

[36] Access aggregating nodes (access nodes) aggregate the traffic from multiple access connections. They may be connected to one or more network nodes to create a more resilient network in the event of a failure in the network equipment or connection.
[37] Backhaul aggregating nodes (backhaul nodes) combine the traffic from multiple access nodes onto a single backhaul connection. They are then connected to other backhaul or core nodes or to several if resilience is required.

Core nodes are then connected to one or more core nodes to form a core network.[38] In general, there are more access nodes than backhaul nodes and more backhaul nodes than core nodes.

A2.5 This structure is common to networks used to provide most voice and data telecoms services – including telephony, fixed broadband, mobile, and leased lines. These networks differ in scale (numbers of each type of node), the number of stages of access and backhaul aggregation (zero, one, two or more), and the structure of the core.

A2.6 Access nodes are generally placed where customers are grouped most closely and can be easily reached (such as the centre of cities, towns, and villages) and are used to connect customers, using access connections, to the network.[39]

A2.7 For residential broadband services, the point-of-handover is likely to be near to the entrance of a residential home.[40] For leased lines, the point-of-handover for the access connection at the end-user site can be located in, for example, the communications room of a business, in the basement of a multi dwelling unit (MDU), or within a suitable enclosure at a mobile base station site.

A2.8 Backhaul nodes have higher capacity as they aggregate traffic from multiple access nodes and can act as the point of connection between access nodes which can be many kilometres apart. Backhaul connections will have higher capacity than access connections as they aggregate traffic from multiple customers and services.

A2.9 Core connections (and nodes) transport multiple telecoms services aggregated from all the services provided to customers and generally have higher capacity than backhaul connections (and nodes). Core nodes are used to route (or switch) traffic from backhaul connections onto the core network, or between backhaul nodes or other core nodes.

A2.10 Core nodes are often located in a city of significant population within the geographic area covered by the network. These can then be linked to other core nodes to create a national core network. For example, a UK wide network may have core nodes located in key cities such as London, Bristol, Birmingham, Manchester, Leeds, Glasgow, and Edinburgh.[41]

A2.11 Most locations or sites housing core nodes also contain backhaul and access aggregating nodes, the latter for serving the area immediately surrounding the site.[42] Similarly, a site containing a backhaul node may also contain one or more access nodes to provide connectivity to the surrounding area. More remote network sites may only contain an access node.

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[38] Core nodes are used to route or switch traffic between other core nodes and may often link to backhaul aggregation nodes. Most core nodes have at least two connections between them using separate physical routes to provide resilience.

[39] The access connection may be transmitted over radio, fibre, or copper.

[40] A point-of-handover is where the customer can 'plug in' a connection between their own equipment, such as a customer's fixed or wireless router, and the network terminating equipment.

[41] Core nodes and backhaul nodes may also be tiered, with the highest tier carrying the most traffic and connected to give high levels of resilience. For example, a network may have an inner core (sometimes referred to as a backbone network) and an outer core, together with a backhaul network also being tiered. Tiering is useful in managing capacity and resilience in national networks with many end-users.

[42] Aggregation nodes (access, backhaul, and core) can be sited in, for example, a telecoms provider's operational building, in a BT exchange, or in a data centre. Some sites may have more than one type of aggregation node at the same location.

A2.12 To enable end-users on different networks to communicate with each other or to access services,[43] networks are usually interconnected between or near to core nodes. The network-to-network interconnect may be at a site (point-of-handover) where both networks are present, such as at a BT exchange, at a data centre, or at an internet peering site.[44] In some instances where two networks are not co-located, interconnect may be achieved using a dedicated point-to-point connection between the two network sites.[45]

Data centres

A2.13 Data centres are secure buildings that house computing facilities for cloud-based services such as data storage, application hosting, and data processing. Data centres may also house network nodes which can include core and backhaul aggregation and traffic routing functionality and be used as points of interconnect to other networks.

A2.14 Most data centres require reliable high-capacity connections, often to several different telecoms providers. This capacity is needed to support many telecoms services and to support multiple customers across multiple end-user sites.

A2.15 Some data centres have multiple tenants and may be owned and operated by telecoms providers or run by third-party providers. In this latter case they are known as 'carrier neutral data centres'.

A2.16 Other data centres may be owned by a single customer, such as a large enterprise, providing services over a virtual private network at their own customer site rather than in a network operator's operational building. Being dedicated to a single customer, these are generally not used for aggregation and onward routing of third-party traffic.

Fixed broadband and telephony for residential/SME customers

A2.17 Networks that supply broadband and telephony services to residential, small office/home offices (SOHOs), and small and medium sized enterprises (SMEs) need to be able to deliver connections to new customers reasonably quickly on request and for a relatively low cost. So that providers can connect customers quickly, these networks need to be deployed with access points very close to prospective customers to minimise any infrastructure build to make the final connection.

Access network overview

A2.18 Access networks provide the connection to the end-customer site. The connection to the site from the access node may be realised all, or in part, using fixed connectivity (fibre, copper, coaxial cables) or using wireless connectivity.

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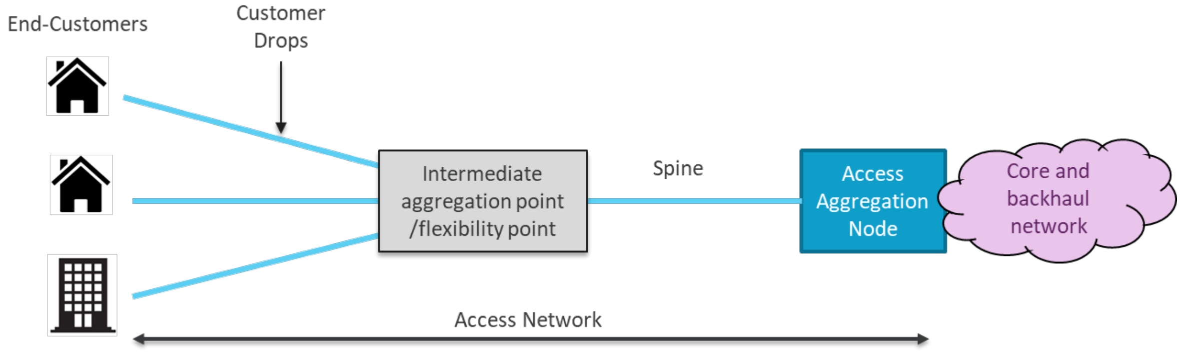
[43] Interconnect can be used to enable connections between two different end-users, or between an end-user and a service such as a web page server in a data centre.
[44] Internet peering is a method that allows two or more network operators to interconnect and exchange traffic directly without having to pay a third party to carry traffic across the Internet.
[45] For example, Openreach provides products to connect between nodes located within a BT exchange (internal cablelink) and to connect to other networks nearby (external cablelink).

Figure A2.2: Generic fixed access network



Source: Ofcom.

A2.19 While there are a number of different types of access network, all share certain common attributes which make up the access connection between end-customer sites and an access aggregation node, such as customer drops, intermediate aggregation/flexibility points, and spine links. Figure A2.2 illustrates how these constituent elements relate to one another.

A2.20 Customer drops, or lead-ins, are the dedicated physical bearer (or radio links in the case of wireless networks) connecting an end-customer's equipment (called customer premises equipment (CPE)) to a network over which the customer's data is carried.

A2.21 Intermediate aggregation or flexibility points can connect to several customer drops and are often placed near to the end-customer's premise. Their purpose is to aggregate these multiple drops into a smaller number of bearers (spine links) which are then taken back to the main access node within a local area.[46] A main access aggregation node is likely be connected to multiple intermediate aggregation or flexibility points in a given area.

A2.22 In some cases, intermediate points use active electronics which aggregate traffic from several customer connections. This aggregated traffic is then carried over a dedicated circuit back to the main access node (see Figure A2.4 'FTTC' as an example). The alternative is to physically connect individual end-customer connections to a multi-strand spine cable. This gives a physical connection from the end-customer site all the way to the main access node where it can be connected to network equipment.

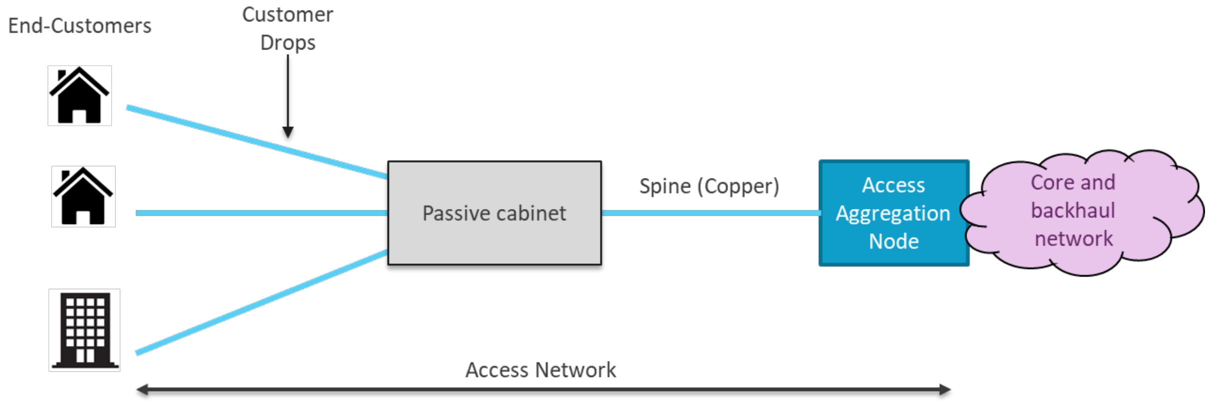
Copper access network

A2.23 Networks were initially deployed using copper connections to the customer premises as shown in Figure A2.3. These copper networks were initially deployed to provide telephony services using a multi-strand cable to a cabinet, connecting directly to end-customers using individual copper connections ('drops').[47]

[46] Intermediate aggregation points may be linked directly back to a main aggregation node or as part of a 'daisy chain' (such as cabinets as part of a ring within the cable access network as illustrated in Figure A2.13).

[47] We refer to the cabinet as 'passive' as it uses simple physical copper connections to connect between the spine cable and customer drop rather than using electronics.

Figure A2.3: Copper access network



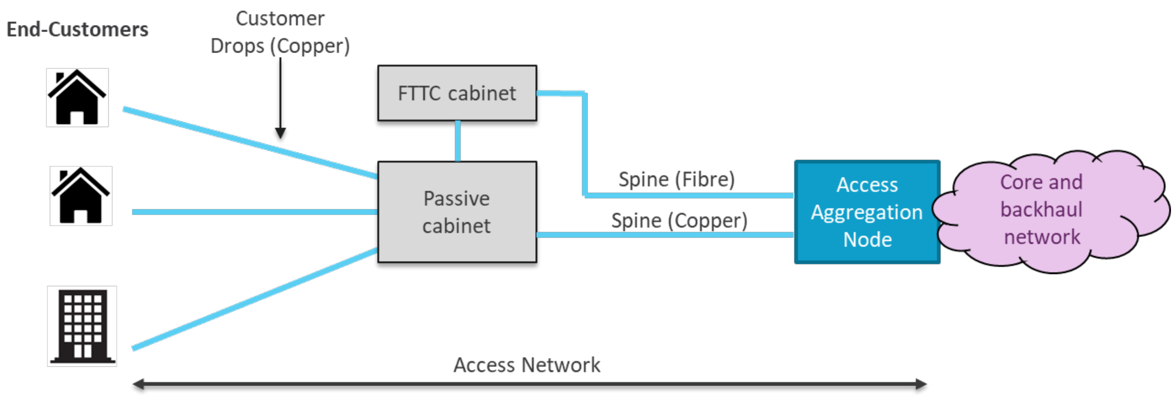
Source: Ofcom.

A2.24 Initially, broadband services were added by providing broadband equipment at the local exchange using ADSL technology.[48] The characteristics of this equipment and the copper line limited the speed available on the network, with speeds of up to 24Mbit/s using ADSL2+ (customers typically experience less than this with speeds diminishing with distance). The copper network is also more affected by faults than modern fibre networks, in part due to the age of the network which can also be affected by the weather.

Fibre to the cabinet (FTTC) access network

A2.25 Many copper networks, such as BT's, have been upgraded to support higher speeds by deploying broadband equipment (electronics) nearer to the customer, at a cabinet rather than in the exchange (Figure A2.4). The broadband equipment is then connected to the end-customer copper connection via the existing 'passive' cabinet which is located nearby, and to the access aggregation node using a fibre connection. This design is known as 'fibre to the cabinet' (FTTC).

Figure A2.4: Fibre to the cabinet access network



Source: Ofcom.

[48] ADSL – asynchronous digital subscriber line. This is a technology for transmitting data over copper lines to an end-user and is part of a family of technologies e.g. ADSL, ADSL2+, SDSL (symmetric DSL), and VDSL (very high bit rate DSL).

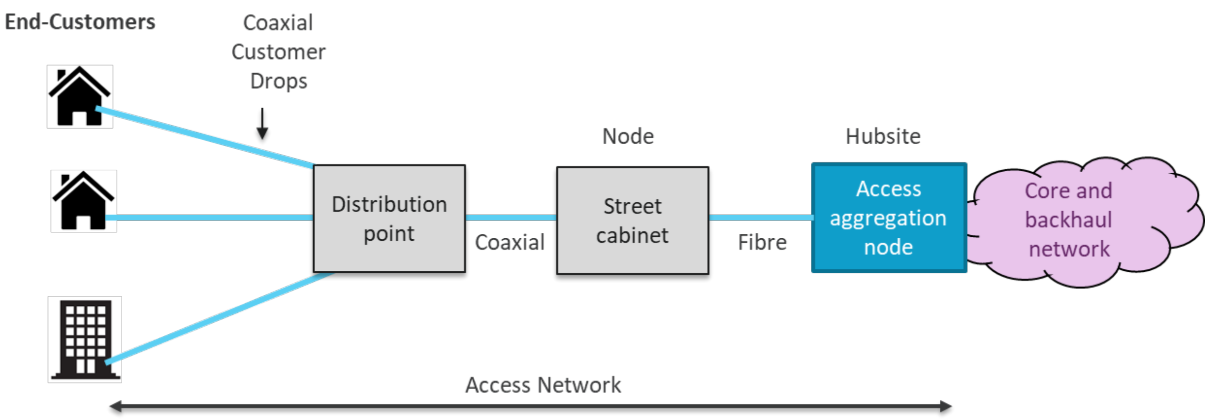
A2.26 FTTC networks can provide broadband services with speeds of up to 80Mbit/s downstream depending on the length of the copper line between the customer and the cabinet. [49] These higher speeds are achieved using VDSL technology over shorter copper connections (compared to exchange based broadband), which is why the VDSL equipment is placed in street cabinets rather than further away in an exchange building.

A2.27 It is possible to provide even faster speeds over copper connections using G.fast technology.[50] For example, Openreach has deployed G.fast equipment at selected street cabinets and offers services at up to 330Mbit/s. G.fast equipment can be placed even closer to the customer, such as at the final distribution point (e.g. a pole or footway box), to reach more end-customers and provide speeds of up to 900Mbit/s.

A2.28 Copper access networks are in the process of being superseded by fibre to the premises (FTTP), which is currently being rolled out across the UK by many network operators.

Cable access networks

Figure A2.5: Cable access network



Source: Ofcom.

A2.29 Virgin Media operates a cable network available across much of the UK, using a hybrid fibre-coaxial (HFC) cable system as shown in Figure A2.5. Fibre is used between the hubsite and the street cabinet where, using electronics, it is connected to the copper coaxial cable for connection, via a distribution point, to the end customer. Some HFC systems connect fibre to the distribution point before using coaxial cable for the final customer drop.

A2.30 The cable network was originally deployed to provide TV services. Broadband services were subsequently introduced by adding broadband equipment supporting data over cable service interface specification (DOCSIS). DOCSIS equipment is located at the hubsite which connects to the hybrid copper fibre cable access network. This hubsite also aggregates traffic from other street cabinets within a local area.

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[49] For example, Openreach, 2020. Price list: Generic Ethernet Access (FTTC), "up to 80Mbit/s" variant [accessed 12 January 2021].

[50] A technique known as vectoring can be used to maximise the performance of DSL technologies and to minimise the interference between end-users' circuits. Vectoring is necessary where G.fast is used alongside circuits using VDSL to avoid such interference.

A2.31 The speed over a cable connection depends on the version of DOCSIS being used, with speeds of up to 516Mbit/s currently available from Virgin Media using DOCSIS 3.0. [51] The cable network is in the process of being upgraded to DOCSIS 3.1 with roll-out expected to be completed by the end of 2021.[52] This has the potential to support speeds up to 10Gbit/s downstream and 1-2Gbit/s upstream.[54] However, download speeds are expected to be lower than this in practice as it depends on factors such as how the network is configured and the capabilities of the DOCIS modems installed at the customer site. For example, Virgin Media's offering is currently configured to deliver download speeds of 1Gbit/s using DOCSIS 3.1, although higher speeds are being trialled.[53]

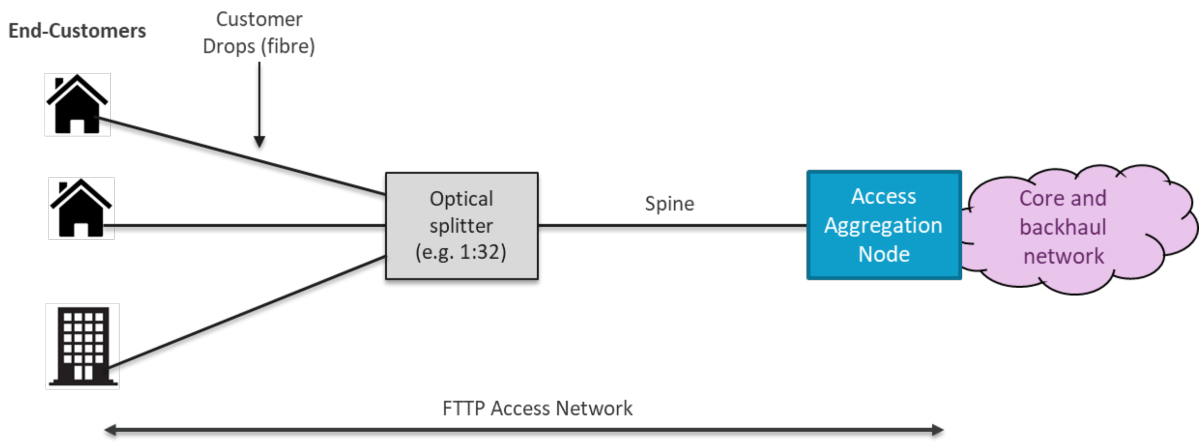
A2.32 Virgin Media is also installing FTTP PON (passive optical network) systems (we discuss this next), using fibre rather than coaxial cable used for the final customer drop. Both HFC and DOCSIS over PON are expected be upgradable in the future as new standards become available, such as DOCSIS 4.0 which supports download speeds of 10Gbit/s and upstream speeds of 6Gbit/s.[54]

Fibre to the premises (FTTP) access networks

A2.33 FTTP networks can be provided in two main ways:

- Shared passive optical networks (PON), which we discuss below; or
- Dedicated point to point fibres, which we cover later under leased lines.

Figure A2.6: Fibre to the premises access network using a PON



Source: Ofcom.

A2.34 A PON is a shared fibre network (see Figure A2.6). Each customer has a dedicated fibre connecting to an optical splitter which then connects to optical line terminal (OLT) equipment

[51] Virgin Media, 2020. Estimated broadband speeds. Customers taking the highest specification of package delivered over hybrid fibre coaxial cable include TV and telephony services which can get a 516Mbit/s 'M500' service, with a guaranteed minimum download speed of 258 Mbps [accessed 11 March 2021].
[52] BroadbandInternetUK.com, December 2020. *When Is The Virgin Media 1Gbps Speed Upgrade 2020 Coming To My Area?* [accessed 11 March 2021].
[53] ISPReview, September 2020. *Virgin Media UK Trials 2.2Gbps Broadband to Homes in Berkshire* [accessed 20 December 2020].
[54] Cablelabs, 2020. DOCSIS 4.0 technology [accessed 20 December 2020].

at the access aggregation node. As several customers are connected to the same splitter (e.g. 8, 16 or 32), the capacity for each PON connected to the OLT is shared between them.

A2.35 Initial PON deployments generally use gigabit PON technology (GPON), with speeds of 2.5Gbit/s downstream and 1Gbit/s upstream. While the majority of FTTP deployments are GPONs, the expectation is that these can be upgraded fairly straightforwardly to faster 10Gbit/s systems (e.g. XG-PON).[55] This can be done as demand for faster speeds grows and as equipment costs fall and without the need to replace the optical fibres and splitters.

A2.36 GPON capacity is shared, so although peak speeds (typically 1Gbit/s as seen by the customer) may be achieved in short bursts (peak speeds), the average capacity available to an end customer may be less. The maximum average speed depends on the number of active users on the network at any one time. For example, the Openreach FTTP 1000/220 GPON product offers peak speeds of 1Gbit/s downstream – 220Mbit/s upstream, although the average speed at peak times is likely to be nearer the prioritised rate of 330Mbit/s downstream – 110Mbit/s upstream.[56] Other FTTP networks may be configured to have fewer users connected and so can offer higher average speeds.

A2.37 To take advantage of these high-speed high capacity access networks, the backhaul and core networks must be configured to provide sufficient capacity at peak times. Similarly, any services being accessed such as data storage at a data centre must be configured to provide the capacity and speeds needed to meet user demand and avoid capacity bottlenecks in delivering an end-to-end service.

A2.38 GPON systems can also be used to carry, as an overlay, the same DOCSIS signals used in the hybrid fibre cable systems described earlier. This uses a technique referred to as radio frequency over glass (RFOG). This is the approach used by Virgin Media as it rolls out its FTTP PON network and has an advantage of using the same customer equipment (e.g. routers) in the customer premises for both HFC and FTTP technologies.[57]

A2.39 FTTP networks, although often used to denote PON networks, can also be deployed using a dedicated point-to-point fibre connection rather than shared across multiple end-customers as used in a PON. These point-to-point connections are covered in more detail in the following description of leased lines, and although they can be used to connect to residential customers with high speed requirements, they are generally used to connect to businesses.

Leased lines connectivity for business customers

A2.40 Traditionally, businesses (including mobile operators) have used leased lines to connect their sites to a telecom provider’s network using high capacity point-to-point, symmetric, dedicated circuits for use by a single customer (i.e. provides uncontended capacity). Leased lines can be

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[55] Faster PON systems such as XG-PON and XGS-PON offer 10Gbit/s downstream (X i.e. 10) and 2.5Gbit/s upstream, with XGS-PON also being able to be configured to provide 10Gbit/s symmetric services (S for symmetric). 10G-EPON is an alternative PON system providing 10Gbit/s downstream and is an alternative to, but not compatible with, XG-PON.

[56] The average speed per end-user is often more than the PON capacity divided by the number of users. This is because users with large demands at a point in time can use capacity from users with low demand at that moment - a process known as statistical multiplexing.

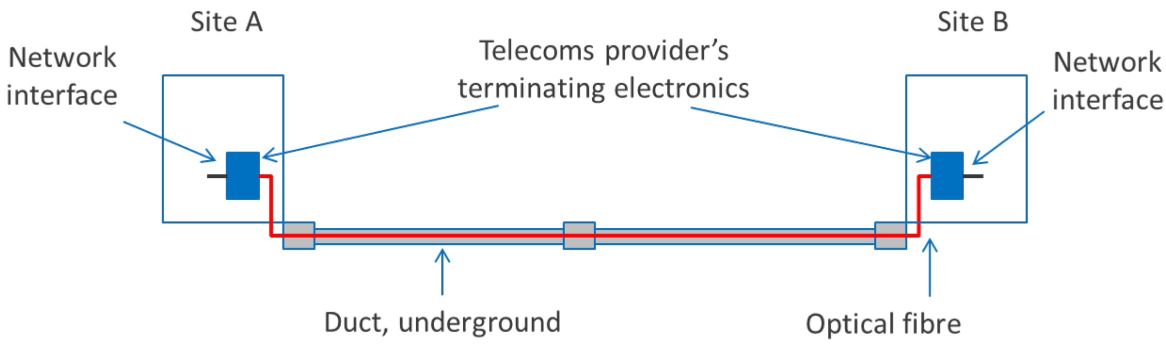
[57] ISPReview, July 2020. *Virgin Media Start UK Rollout of Remote Phy to Improve Network* [accessed 7 December 2020].

significantly more expensive per end-user than broadband services as they are provided over dedicated infrastructure rather than the infrastructure, and costs, being shared by multiple customers.

Leased line overview

A2.41 Leased lines generally use optical fibre to make the physical connection between two points or, increasingly less common, using copper. These connections can be buried directly in the ground, carried overhead, or run as a multi-strand cable inside a duct (as illustrated in Figure A2.7).

Figure A2.7: Structure of a typical leased line[58]



Source: Ofcom.

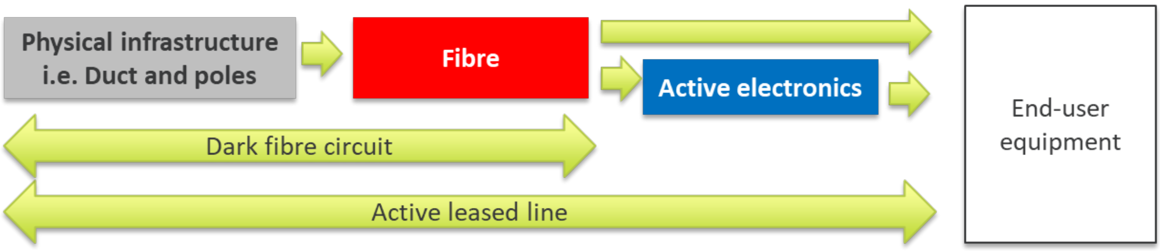
A2.42 Leased lines can be provided by a supplier with or without active electronics. The electronics, whether provided by the supplier or end-customer, can use several different technologies such as Ethernet and wavelength division multiplexing (WDM).[59] These technologies are covered in more detail in Section 2 of Volume 2.

A2.43 A circuit without active electronics is often referred to as a dark fibre (DF) connection.[60] For DF, the customer creates an active leased line by connecting the DF into their own electronic equipment, eliminating the need for intermediate electronics in the end-to-end circuit. This can give technical benefits such as improved reliability and reduced latency. Customers using DF will need expertise to specify, install, and manage the end-user equipment and fault management on the dark fibre connection.

A2.44 A leased line can also be created by using third-party physical infrastructure, with the network provider supplying its own fibre cables and electronics to connect to an end-user. The relationship between the building blocks used to provide a dark fibre circuit and an active leased line is shown in Figure A2.8.

[58] The route between two points in a network can be referred to interchangeably as circuits or connections.
[59] These types of technologies have also been referred to as contemporary interface (CI) in previous market reviews
[60] Dark fibre is a term used to describe a fibre optic cable that has not been connected to any electronic equipment. It is called a 'dark fibre' product as the electronic equipment which 'lights' the fibre and enables the circuit to receive and transmit data is not included as part of the dark fibre connection.

Figure A2.8: Main building blocks of a leased line



Source: Ofcom.

Leased line networks

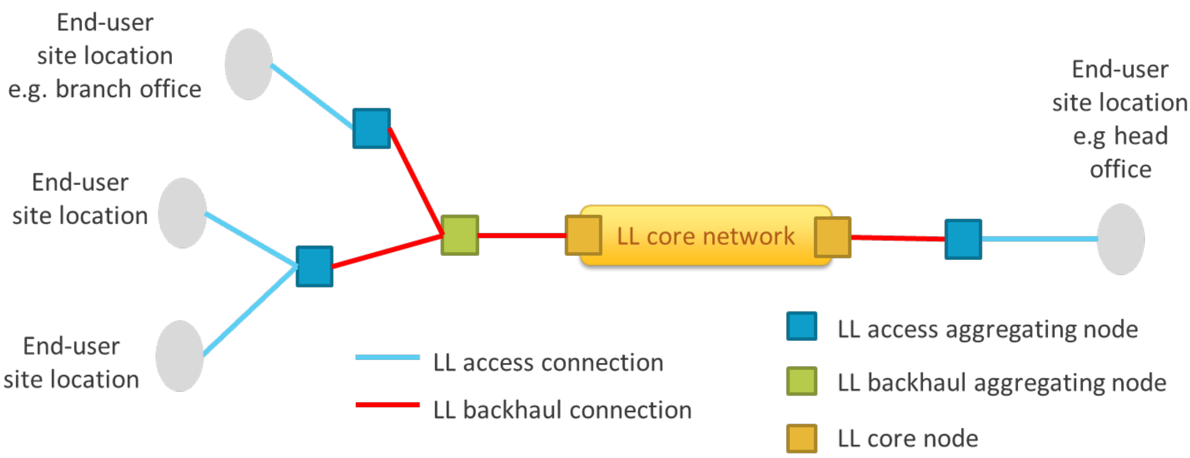
A2.45 A leased line network can be configured in several ways, using leased lines as the building blocks, to create an end-to-end service which can be optimised to meet a particular service requirement. We cover the following example configurations:

- a dedicated leased line network;
- business virtual private networks (VPNs);
- mobile leased line networks; and
- broadband leased line networks.

Dedicated leased line network

A2.46 A dedicated leased line network (see Figure A2.9) provides dedicated end-to-end connectivity used as a closed network i.e. circuits are not shared. This model is becoming less common but may still be used when security or network features, such as low end-to-end latency, are a key concern. These networks have mainly been superseded by VPNs (see Figure A2.10).

Figure A2.9: Dedicated end-to-end connectivity



Source: Ofcom. LL is short for leased line.

Business VPNs

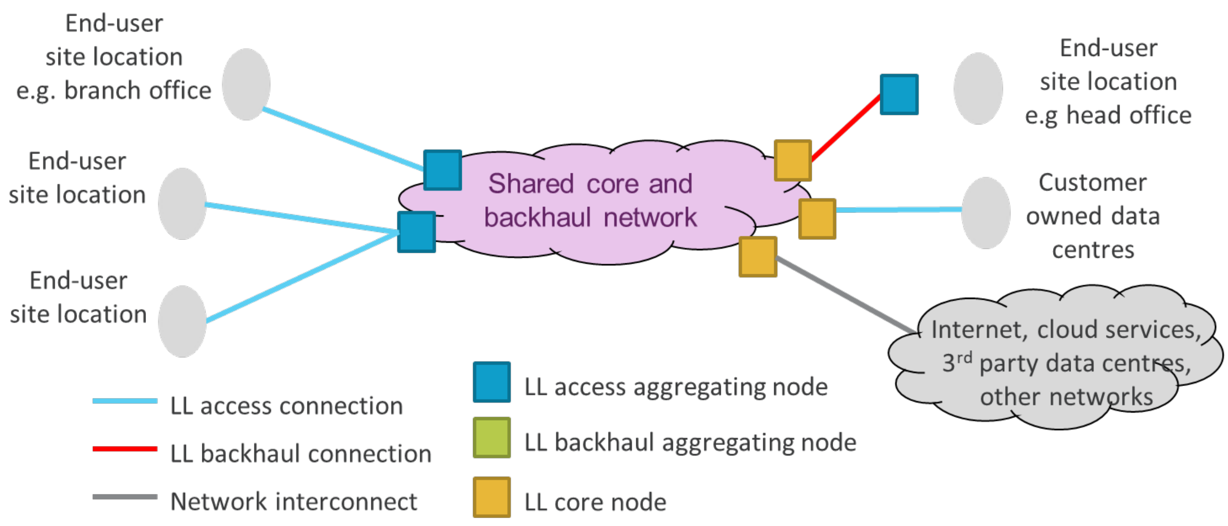
A2.47 Business VPNs provide any-to-any connections between multiple business sites which can be spread over a wide geographic area (see Figure A2.10). These networks are likely to include internet connectivity and connections to outsourced cloud computing services.

A2.48 Figure A2.10 also shows the end-user sites connected with leased lines to provide high speed dedicated capacity. Although not shown, end-user sites can also be connected using a business broadband connection where a high-speed high-quality connection may be of less importance – such as to a small branch office.

A2.49 Unlike a dedicated leased line network, a VPN shares backhaul and core capacity across multiple business customers. The same core and backhaul network may also be used to carry traffic for other services such as broadband and mobile. The data for each customer is separated using virtual paths on a shared physical connection, and so appears as a 'private' network from a customer's perspective.

A2.50 Access to cloud-based services such as data storage, application hosting, and data processing can also be provided as part of an overall service. Although Figure A2.10 shows a single connection to this cloud, these services can be placed nearer to the customers' access connections (such as at core nodes) to improve reliability, reduce core capacity requirements, and speed up response times. This can be referred to as edge or distributed computing.[61]

Figure A2.10: Business VPN with internet & cloud computing connectivity



Source: Ofcom. LL is short for leased line.

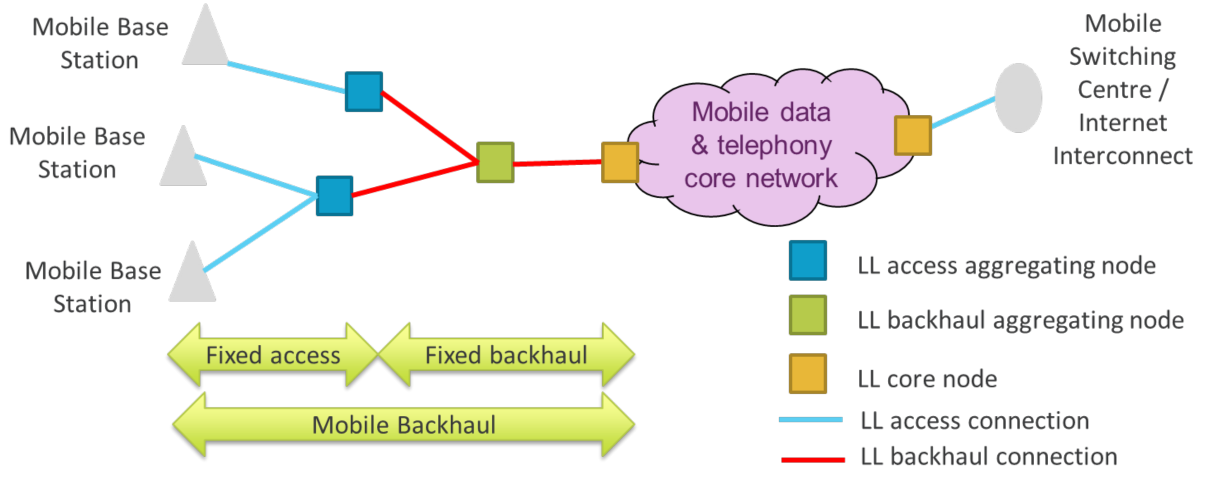
Mobile leased line networks

A2.51 Leased lines can be used by mobile network operators (MNOs) to connect their base stations[62] to their core network nodes using access and backhaul connections (see Figure A2.11).[63] The term 'mobile backhaul' is often used to refer to the combination of access and backhaul leased line connections between the mobile base station and the mobile core node. MNOs may also

[61] Content distribution networks for video streaming as part of a broadband network is another example where network access is placed nearer to the customer rather than being centralised.
[62] These are the radio masts that provide the communications between the mobile handset and the fixed mobile network.
[63] In this example, the baseband mobile controllers (or baseband units) are placed at the mobile base station i.e. a distributed radio access network (DRAN) typical of 4G architectures. Where the baseband controller is placed away from the base station, say at an aggregation node, the link between the more centralised baseband controller and the mobile base station site antenna is known as 'fronthaul' forming part of a centralised radio access network (CRAN) architecture.

use leased lines to provide connectivity between their core sites, and connections to the internet and other networks, to support mobile services.

Figure A2.11: Mobile network connectivity



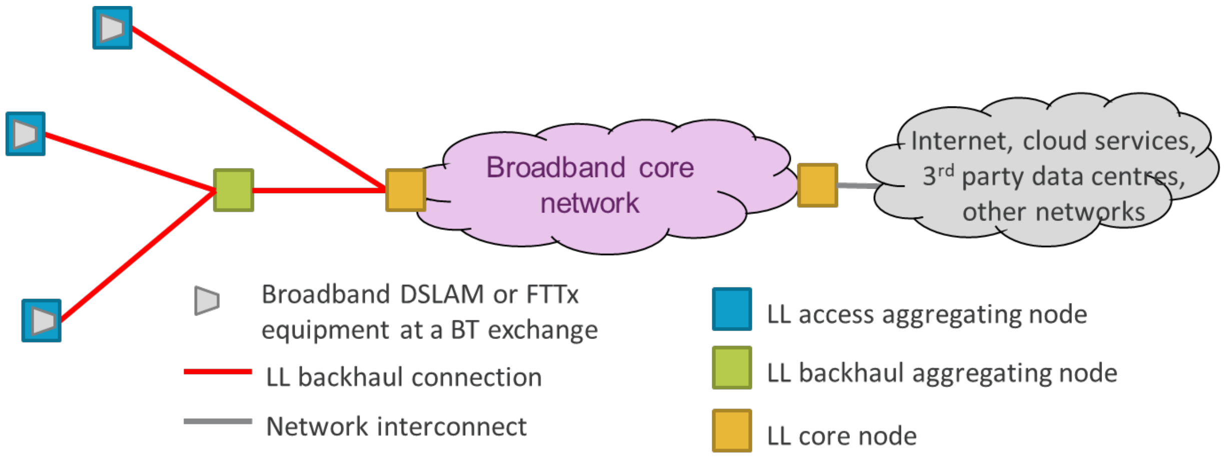
Source: Ofcom. LL is short for leased line.

A2.52 The term 'mobile backhaul' can be a source of confusion. 'Mobile backhaul' is often used by MNOs to refer to both the fixed access *and* fixed backhaul leased line connections (i.e. the arrow labelled 'mobile backhaul' in Figure A2.11). For other fixed network customers, backhaul is used to refer to the connections from fixed access aggregation nodes to, or between, backhaul aggregation nodes (i.e. the arrow labelled 'fixed backhaul').

Broadband leased line networks

A2.53 Fixed broadband operators can build their own broadband network using leased lines to create core and backhaul networks which are then connected to broadband access connections. This is sometimes referred to as local loop unbundling (LLU) backhaul. An operator may choose to build their own access connections (for example Virgin Media's network) or use access network connections owned by another operator such as BT.

Figure A2.12: Broadband network connectivity

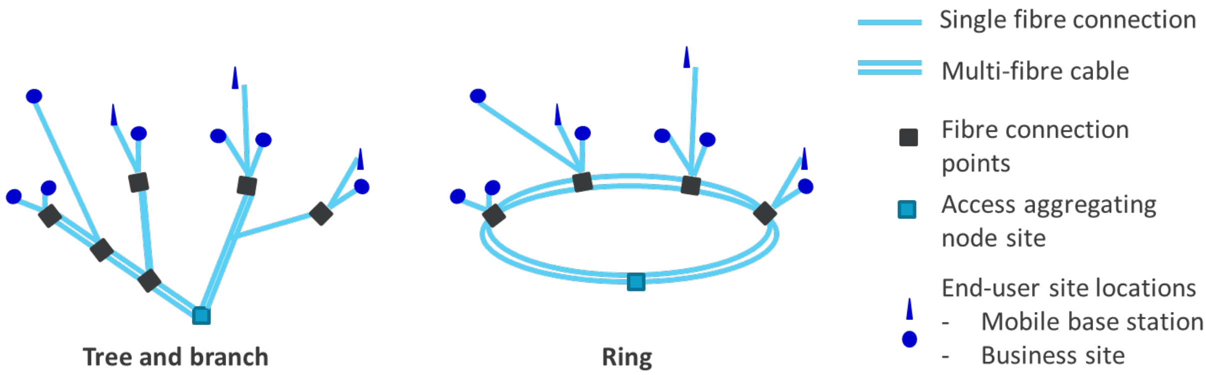


Source: Ofcom. LL is short for leased line.

A2.54 For example, a broadband operator may site their network equipment to connect to BT's access network (i.e. their access aggregating node) at a BT local exchange. These are then connected to a core and backhaul network which can be connected to the internet at suitable locations to provide an end-to-end broadband service. This is illustrated in Figure A2.12. As with VPNs earlier, the core and backhaul network may also carry traffic for other access services such as high-quality leased line services.

Network design choices

Figure A2.13: Illustration of an access leased line 'tree and branch' and 'ring' architecture



Source: Ofcom.

A2.55 There are many ways a network operator can choose to connect the nodes that make up its network in addition to a 'tree and branch' layout illustrated in the previous diagrams. For example, nodes may be connected in a ring architecture as illustrated in Figure A2.13. This is the preferred design for operators such as CityFibre. The 'tree and branch' layout is generally used by BT, partially due to history where originally copper lines went from a central exchange, down streets, and then into individual homes and business premises. A combination of both layouts can also be used.

A2.56 Figure A2.13 shows, for a tree and branch architecture, how individual fibres are taken from an end-user site and connected to a multi-fibre cable (or access 'spine' cable) at fibre connection points (also referred to network flexibility points). These multi-fibre cables are then connected to equipment at an operator's site to aggregate the traffic from the fibres connected to the end-user sites.

A2.57 For a ring architecture, the network can be set up to let traffic travel either clockwise or anti-clockwise around the ring. This means that if there is a problem at one part of the network, traffic can be rerouted in the opposite direction (automatically if suitable electronics are in place) i.e. the ring architecture provides extra resilience. This is not readily possible in a 'tree and branch' architecture where there is only one route from an end-user site to the access aggregating node. To get around this, 'tree and branch' networks may provide extra resilience by adding a second circuit with a different ('diverse') routing to the end-user site using the same or an alternative supplier.

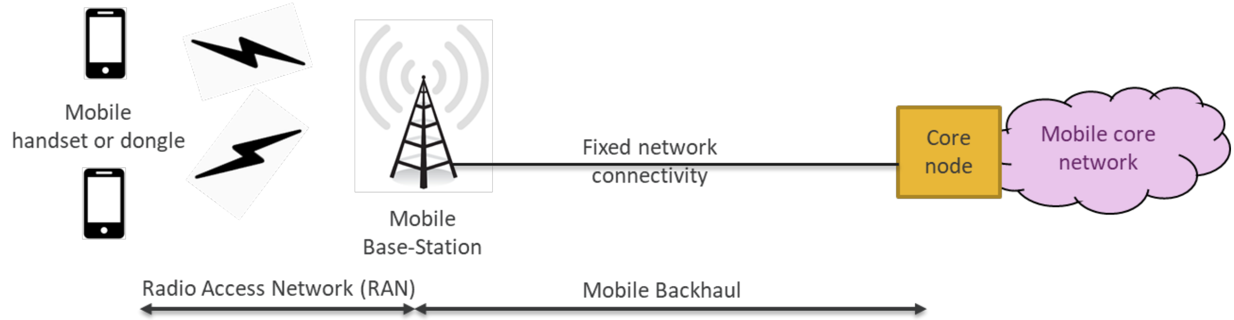
Wireless technologies

A2.58 The previous discussion describes networks that provide services at a fixed end-user location using a wired (either copper, coaxial cable or fibre) connection all the way. Services can also be connected to end-users using wireless technology: mobile, fixed wireless access (FWA), and satellite which we discuss below.

Internet access over a mobile network

A2.59 Use of mobile data services can be a convenient way for customers to access the internet and can be used as an alternative to fixed broadband. Customers in this category can connect to a 4G or 5G mobile network using their mobile phone, a dongle or similar equipment (Figure A2.14).

Figure A2.14: Typical mobile network topology



Source: Ofcom.

A2.60 While very high speeds are possible, due to the shared nature of the network and the fact that speed will depend on the quality of signal being received, speeds are likely to be much lower in many cases. On a 4G network, these are currently around 30Mbit/s on average, and on a 5G network, around 150Mbit/s.[64]

A2.61 Mobile coverage is another factor that needs to be considered, with coverage poorest in more rural areas. Although 91% of the UK has good 4G coverage from at least one operator, 5G is not as widespread yet. 5G has been launched by all four main MNOs in 2019. However, even though the 5G footprint is being expanded, it currently has limited reach, with operators making it first available in select areas of the biggest cities in the UK.

FWA

A2.62 FWA networks use a wireless link for the final connection to a fixed point at the customer's site. This avoids the need to install a cable (a fixed access connection) between the customer and a broadband or leased line network. It is therefore suited to, for example, situations where a fixed access connection is not available or is relatively expensive to provide.

A2.63 FWA services can be grouped into two broad categories:

[64] Ofcom, December 2020. Connected Nations 2020 UK Report [accessed 20 December 2020].

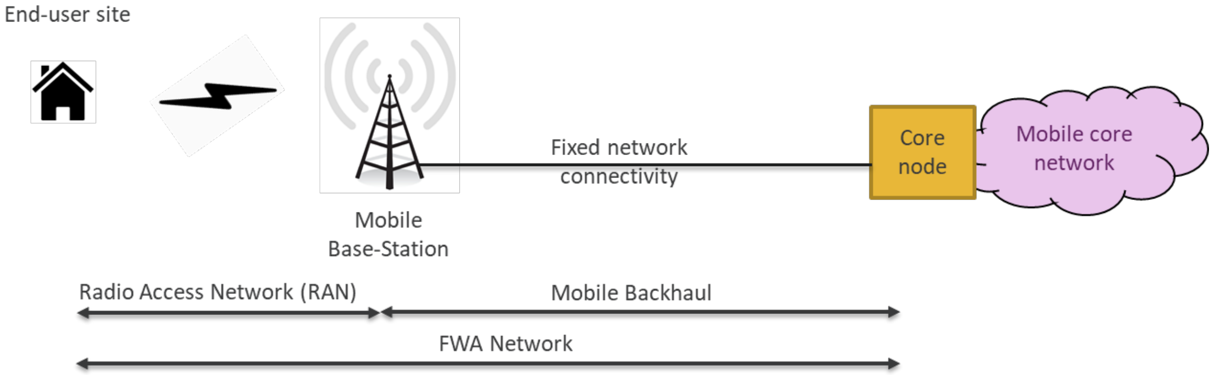
- services using existing licensed 4G and 5G mobile spectrum (i.e. over a mobile 4G/5G network), provided alongside other ***point-to-multipoint*** mobile voice and internet services. These tend to be used for residential customers or for small businesses where price and convenience are likely to be the main considerations.
- services using light-licensed and license-exempt spectrum using ***standalone point-to-point, point to multi-point connections, or multipoint mesh connections***.[65,66] These types of connections are particularly useful in more remote, difficult to reach areas where fixed network coverage may be poor and where FWA can be an attractive solution. For example, they can be used to provide residential broadband connections, connections to business sites, and connections to (and between) mobile base stations.

4G/5G FWA

A2.64 FWA over 4G/5G provides a connection between a mobile base station and receiving equipment at the customers' sites (Figure A2.15). This type of service shares many of the characteristics with mobile broadband described in the previous text but optimised for home usage. For example, the receiving equipment can be placed at a suitable fixed location within a customer's site to allow connections to customer equipment (e.g. smart TVs, computers) and to enable WiFi connectivity.

A2.65 The receiving equipment is usually mains powered and provide a better in-home WiFi experience compared to a smaller portable mobile WiFi router. These powered routers generally use an integral internal antenna for receiving the 4G/5G signal, although many routers have the option for connecting to an external router if required.

Figure A2.15: Typical 4G/5G FWA network topology



Source: Ofcom.

A2.66 As discussed for mobile internet access, depending on traffic and capacity in the network, speeds can vary and are currently around 30Mbit/s for 4G and 150Mbit/s for 5G for an average user experience. In addition (also discussed earlier), coverage for 4G services is poorest in rural areas and 5G coverage, although expanding, has limited reach.

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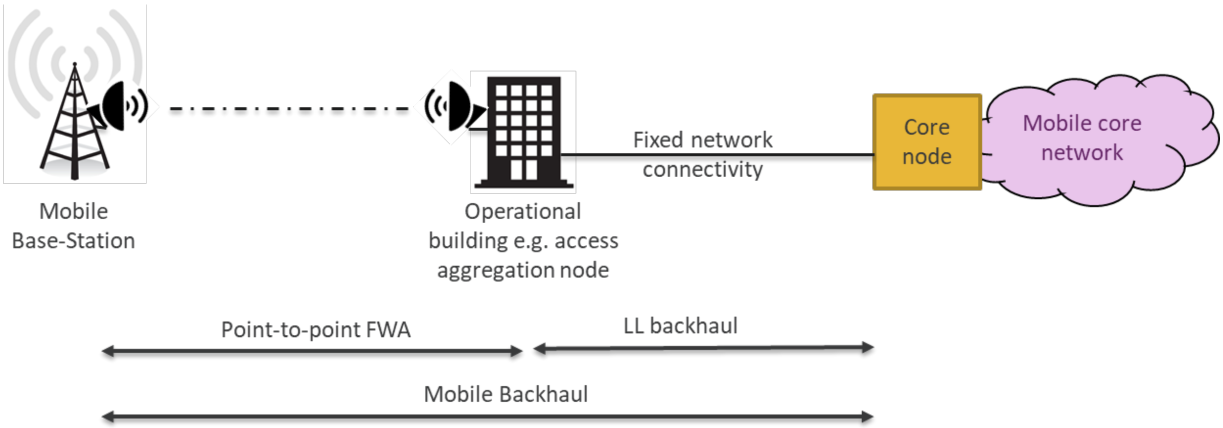
[65] Point-to-point FWA connections are sometimes referred to as microwave links.
[66] Ofcom, 2018. *Statement: Review of spectrum used by fixed wireless services* [accessed 17 December 2020].

Point-to-point and point-to-multipoint FWA

A2.67 Point-to-point and point-to-multipoint FWA services can be provided using lightly-licensed and license-exempt spectrum such as the 5 GHz, 23-26 GHz and more recently, the 65 GHz bands.[67] These services are 'line of sight' between the network and end-customer and so can be difficult to deploy in built up areas. As a result, this type of FWA service are less likely to be found in built up areas such as city centres.

A2.68 Figure A2.16 shows a point-to-point FWA being used for connecting a mobile base station to an access aggregation node as part of mobile backhaul network.[68] These point-to-point connections tend to be used for higher speed connections, using the spectrum bands above 5Ghz. For point-to multipoint service, an antenna array at the operational building (which can serve multiple customers) is used to connect to fixed external antennas at the end-user site and tend to rely on the 5Ghz license exempt spectrum.

Figure A2.16: Example of point-to-point FWA used for mobile backhaul



Source: Ofcom. LL is short for leased line.

A2.69 Using an FWA microwave link for connecting base stations to a mobile network can be a useful alternative to a fixed access connection, particularly in more remote, difficult to reach areas where coverage may be poor. FWA can also be used in other situations, such as residential broadband connections – particularly using point-to-multipoint equipment - and connections to business sites. These residential point-to-multipoint services tend to be supplied by specialists, sometimes referred to as 'WISPs' (wholesale internet service providers).

A2.70 Higher speed FWA connections typically use the 23-26 GHz band for links of up to 1Gbit/s and are generally used in a point-to-point configuration. The more recent 65 GHz band can potentially offer speeds of 10Gbit/s. However, compared to a leased line, microwave links have several limitations such as:[69]

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[67] 26Ghz is used currently for point to point FWA services, noting is Ofcom is working towards making 26 GHz band available as a 'global pioneer' band for 5G. Users of FWA should therefore consider alternative fixed wireless link bands to meet their requirements where possible. This is set out in Ofcom's 2018 *Statement: Review of spectrum used by fixed wireless services* [accessed 17 December 2020].

[68] Connections from a mobile base station to one or more remote base stations can also be configured as a 'daisy-chain', as part of a resilient ring.

[69] BCMR 2019 Statement, Annex 9, Assessment of mobile backhaul [accessed 17 November 2020].

- ability to support lower capacity links compared to fibre based backhaul;
- requirement for line of sight connectivity;
- significantly lower transmission range than fibre-based backhaul links; and
- higher risk of failure because microwave antennas are exposed.

A2.71 As highlighted, FWA is distance limited compared to a fixed access connection, decreasing as frequencies (and signal attenuation) increases. In addition, lower bands, such as 5GHz, are commonly prone to interference from nearby services, such as WiFi, operating on the same frequencies. Higher frequencies (e.g. above 11GHz) also can also be affected by environmental conditions (e.g. rain, ice).

A2.72 Residential and small office offerings are also available offering speeds up to 50Mbit/s using point-to-multipoint 5Ghz technology. Most packages have data caps, although more expensive packages offer higher or unlimited data. These FWA services usually come with setup fees which can vary quite significantly (e.g. £30-200 depending on the service used and the provider).

Multipoint mesh FWA

A2.73 Multipoint mesh FWA services can be provided using the 57-64 GHz band license-exempt spectrum, which is sometimes simply referred to as the 60Ghz band.[70,71] These type of services use a number of small base stations connected wirelessly along with a shared fixed connection to provide internet access.[72]

A2.74 The availability and deployment of the equipment using mesh FWA services has generally been limited in the UK. Recent market developments include the recent release of equipment for the 60GHz band by Cambium Networks, a vendor used by many WISPs. The Cambium solution uses wireless meshing technology developed by Facebook's Terragraph project service with the potential to deliver gigabit speeds.[73,74]

A2.75 Although trials have taken place using this mesh technology, such as in Bath and Wales,[75,76] it is still in early stage of development as a service compared with other existing wireless technologies.

Satellite

A2.76 Satellite coverage is available almost everywhere in the UK, offering an alternative for customers that receive poor broadband, such as those located in remote rural areas.

A2.77 There are two main types of satellite broadband, either a GEO (geostationary earth orbit) satellite or a LEO (low earth orbit) satellite. GEO satellites are fixed at a position on the geostationary belt moving with the Earth as it rotates. They are positioned at a very large

[70] Ofcom 2018. *Statement: Review of spectrum used by fixed wireless services* [accessed 17 December 2020].
[71] 60Ghz Wireless Networks, 2019. 60GHz Band Regulation [accessed 23 February 2021].
[72] CCS, 2019. Unlicensed, unlimited 60 GHz mmWave [accessed 23 February 2021].
[73] ISPreview, 2020. Cambium Networks Launch 60GHz multi-Gigabit Wireless Tech [accessed 23 February 2021].
[74] Ofcom, 2020. Connected Nations 2020 UK Report [accessed 20 December 2020].
[75] ISPReview, 2019. Rural wales wireless broadband trial hits near gigabit speeds [accessed 23 February 2021].
[76] Cambridge Wireless, 2018. CCS 60GHz mmWave trial goes live in city of Bath [accessed 23 February 2021].

distance from the Earth, being able to cover large areas. This results in delays in response times and slow speeds.

A2.78 LEO satellites, on the other hand, are positioned much closer to the Earth, covering smaller areas than the GEO ones and allowing for faster connections. As they are not at a fixed location, a network of hundreds of constantly moving satellites is necessary to provide consistent and constant coverage. In order to track and connect to the best satellite as they move overhead, user terminals require expensive antennas compared to, for example, fixed broadband network terminating equipment (e.g. routers).

A2.79 Satellite services tend to offer services with lower bandwidth than fixed broadband services, typically 30Mbit/s or less for GEO. In addition, traditional GEO satellite services have higher latency than fixed broadband services.[77] This could affect some users who have requirements for low latency, e.g. customers wishing to make VoIP calls or gamers.

A2.80 Performance could be improved with the use of LEO satellites. Although not currently available as a commercial service, companies like SpaceX, OneWeb and Telesat have already launched LEO constellations for broadband. For example, Space X had launched 422 LEO satellites by April 2020, with its Starlink services being trialled in the UK and expected to be available for widespread use from 2022.[78] In theory, LEO satellites will offer low latency and higher speeds compared to GEO services, ranging from 100Mbit/s to gigabits per second.

A2.81 Compared to GEO services, upfront charges for equipment are likely to be similar for LEO services, with customer terminal costs of £400-£600, but with higher rental prices.[79,80] Whilst the new LEO satellites are expected to deliver increased performance compared to traditional satellite broadband, it is not yet clear that whether it will be sufficient to move from being a valuable solution for some customers, such as in hard to reach areas, to being a mainstream service and alternative to fixed broadband.[80]

[77] Latency refers to the time taken for data to traverse the network. Geo-stationary satellites tend to have high latency due to the signal having to travel the long distance to and from the satellite.
[78] McKinsey, May 2020. *Large LEO satellite constellations: Will it be different this time?* [accessed 24 November 2020].
[79] Freedomsat, 2021. Satellite broadband for the home [accessed 12 January 2021].
[80] BBC News, January 2021. Elon Musk's Starlink given green light in UK , with initial pricing of "£439 for the gear [the consumer 'terminal'] and a further £84 a month". [accessed 12 January 2021].

A3. Network build and the use of PIA

A3.1 This annex sets out our assessment of the prospects of fixed network build including the potential use of physical infrastructure access (PIA) over the period of this market review (2021 to 2026).

A3.2 We set out our assessment in the following order:

- networks providing services at fixed locations;
- differences between network architectures and their substitutability;
- investment in new network build and the use of PIA;
- investment by operators of leased lines-only networks and the use of PIA;
- evidence gathered from Openreach on PIA orders; and
- evidence on the impact of PIA on the cost and time of network build.

A3.3 In summary, the evidence we have suggests that:

- there will be substantial investment in fibre and gigabit-capable network build to rival BT during the review period and beyond;
- much of this investment is in building new or expanding existing networks in more urban areas to provide broadband and leased line services;
- some investment is in building new fibre networks focused on providing broadband services to homes and businesses in more rural areas;
- the re-use of existing physical infrastructure (almost always using PIA) is a significant factor in many network investment plans;
- the use of PIA will increase significantly over the period to 2026 to facilitate network roll-out; and
- actual take-up of PIA remains in the early phases and we have yet to see the impact of large-scale use.

Networks providing services at fixed locations

BT

A3.4 BT's network coverage is ubiquitous providing broadband services and leased lines at fixed locations almost anywhere across the UK. [81,82] Traditionally, it has provided leased lines over dedicated fibre cables run through ducts that are shared wherever possible with its other services. Until recently, services (at least in the access network) other than leased lines were based on copper (originally provided for telephone services). When BT upgraded its network to offer superfast broadband services using fibre-to-the-cabinet (FTTC), it deployed new fibre cables to connect to the cabinets. In its deployment of fibre-to-the-premises (FTTP) using passive optical network (PON) technology (see Annex 2), we understand BT is now installing

[81] Excluding the Hull Area where KCOM is the incumbent provider operating a municipal FTTP network.
[82] BT’s fixed network is run by Openreach Limited, a legally separate company but a wholly owned subsidiary of BT plc.

fibre cables with spare fibres so that leased lines can use these new cables.[83] This is particularly relevant in the spine connections (i.e. those parts of the network closer to the exchange).

A3.5 Until recently competition to BT's network has mainly come from:

a) Virgin Media's network deployed in and between many UK towns and cities providing broadband services and leased lines; and

b) several telecoms providers operating fibre networks typically providing coverage in and between the central business districts of larger cities providing only leased lines.

Virgin Media

A3.6 Virgin Media's network currently reaches around 15m homes and businesses in towns and cities; around half of all premises in the UK. Virgin Media currently uses this extensive network to offer retail and wholesale leased lines and retail broadband services to fixed locations.

A3.7 Broadband services are mainly provided over a hybrid fibre coaxial (HFC) network (originally provided to support cable TV) although Virgin Media is now also deploying some PON based FTTP to deliver the same services.[84] In areas of HFC, Virgin Media considers the [✂] to provide a leased line business connection. Where areas of [✂] are not directly suitable for a business connection this may, in any case, be provided from nearby cabinets.[85,86] Virgin Media also supplies leased lines outside its residential network footprint, for example in central business districts such as the CLA.

Operators of networks providing only leased lines

A3.8 There are several leased lines-only networks, including those operated by Colt, Verizon, Zayo, CenturyLink and Vodafone.[87]

A3.9 These networks are generally focused on connecting areas where there is a higher density of large business premises (such as in city centres). They have expanded their network footprints to connect to data centres (as these become more important to the support of business-critical applications) and to access nodes to provide backhaul services.[88]

A3.10 Providers of leased lines, whether network operators themselves or intermediate wholesalers, may supply them in different forms including as managed services such as bandwidth-specific ethernet products, optical products such as leased capacity over wavelengths, or dark fibre.

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[83] Openreach's Fibre First programme.
[84] The FTTP rollout as part of Project Lightning has a shared fibre to a splitter and then dedicated connections to customers. However, the broadband service uses a technology called radio frequency over glass (RFOG) which allows the fibre to be used in the same way as the cable network running data over cable service interface specification (DOCSIS) and overlaid over existing PON technologies such as GPON (see Annex 2 for more detail).
[85] Virgin Media response dated 29 May 2020 to the s.135 notice dated 3 March 2020, covering email.
[86] Virgin Media response dated 8 September 2020 to the s.135 notice dated 22 Jul 2020, page 7, covering letter.
[87] Vodafone has coverage in areas with high density of business premises like other leased lines networks, but also has greater presence outside of the city centres than other leased lines-only providers.
[88] Some of these providers publish network maps on their websites. They show locations (often major city centres) where they have patches of dense coverage (sometimes described as metro networks) and the long-distance routes which connect them. For example, see Colt [accessed 24 February 2021], euNetworks [accessed 24 February 2021] and Zayo [accessed 24 February 2021].

Operators of leased lines-only networks typically supply leased lines to meet access, backhaul or core connectivity requirements.

Differences between network architectures and their substitutability

A3.11 Access networks designed to provide residential and business broadband services are usually built with flexibility points very close to each potential customer's premises.[89] When a customer first orders a broadband service, the network operator usually builds the final connection from its nearby flexibility point into the customer's premises.

A3.12 Networks built to provide only leased lines usually deploy flexibility points close to groups of potential customers (for example, in footway boxes around the financial and commercial areas of a large city or around a large business park). The costs and timescales to build the final connection to the customer's premises can be significant and may vary by site. Leased line access connections to customer sites may therefore be provided using a mix of self-supply (including running fibre through leased access to third party physical infrastructure, e.g. PIA) and leased connections from third party wholesale suppliers like Openreach.

A3.13 Given these architectural differences, it is difficult for a leased line-only network to switch to providing broadband services at scale – in particular, the absence of dense network coverage near sites of broadband demand, such as residential areas. Conversely, an operator of a network focused on supplying broadband services is likely to be able to provide leased lines to fixed locations within its network footprint.[90]

A3.14 Switching from the supply of leased lines to the supply of broadband services or vice versa is also likely to require changes to the workforce and other operational and customer support functions.[91] Some of these impacts may be lessened if services are only sold at the wholesale level as retail ISPs undertake many of these activities.[92]

Investment in new network build and use of PIA

A3.15 Gigabit-capable broadband can be delivered over full fibre networks and the latest versions of HFC cable networks (see Annex 2). Investment in these networks is being made by established operators such as BT and Virgin Media as well as others, including new entrants. These investments are numerous and vary considerably in terms of location and scale.[93]

A3.16 We provisionally concluded in our January 2020 Consultation that there are high prospects of commercial build by rival fixed network providers to BT by 2026; however, there are

[89] This allows new customers to be connected to the network quickly at a relatively low cost. Doing so avoids needing to build significant network for a new customer connection and allows all customers within the network footprint to be offered services on standard terms and conditions (including connection charges).
[90] Spare fibre in the spine network is likely to be available to splice a dedicated fibre connection from the cabinet to the customer site (or close to it) subject to available duct.
[91] The workforce of an operator running a leased line-only network is likely to be more highly skilled and capable of supporting demanding service levels. A broadband workforce may be geared toward more civil work (laying access lines from the street into homes) and provisioning of a standard configured network termination point and router.
[92] E.g. sales, marketing and other customer service functions.
[93] By way of illustration, ISPReview has been tracking the progress of around 80 firms building FTTP networks to homes and businesses and reporting this https://www.ispreview.co.uk/index.php/2020/04/summary-of-full-fibre-build-progress-across-uk-broadband-isps.html/2 [accessed 26 January 2021].

uncertainties around where and when it will be deployed. Since then, we have engaged with stakeholders to further understand their different business models and build plans as well as gathered information using our statutory powers.

A3.17 We have found that BT has raised its fibre rollout plan to 20m premises as Virgin Media continues to expand its reach toward 17m premises and upgrade its whole network to be able to supply gigabit broadband speeds by the end of 2021. CityFibre acquired TalkTalk's FibreNation network in 2020 and announced that it has expanded its city-wide rollout plan from 5m to 8m premises by 2026. In London and other cities, operators including Hyperoptic, Community Fibre and G.Network plan to extend their coverage of targeted locations such as multi-occupancy buildings. Outside of UK cities, we have seen an increasing number of operators with plans to build fibre networks covering regional towns and villages including in some remote rural locations.

A3.18 Whilst network build plans are subject to change, the evidence points firmly to a high likelihood of substantial investment in fibre and gigabit-capable network build during the review period and beyond. Moreover, the re-use of existing physical infrastructure (mostly access to BT's ducts and poles) is a significant factor in many network investment plans to reduce dig costs and speed up roll-out.[94] Apart from a few small operators who do not use PIA in their deployment plans, the majority that do generally expect to be using PIA for more of their network deployment looking ahead to 2026.[95]

A3.19 In support of this general appreciation, we set out below further detail on the prospects for gigabit capable network build and, separately, leased line-only networks, over this review period.

BT

A3.20 In May 2020, BT announced a rapid acceleration of its then FTTP coverage of 2.6m premises, setting a target of reaching 20m premises by the mid to late 2020s.[96] In July 2020, Openreach announced that 3.2m premises of BT's £12bn investment would be in parts of the UK which we had provisionally defined as Area 3 in our January 2020 Consultation.[97]

A3.21 Openreach aims to make FTTP available to 4.5m homes and businesses by the end of March 2021. It publishes information about the locations it plans to build out to on its website.[98]

A3.22 In its Q3 2020/21 trading update, BT reported having passed 4.1m premises with FTTP as at the end of December 2020 (passing 42k premises per week on average) and that Openreach was on-track to reach 4.5m by the end of Q4 2020/21.[99]

[94] As are innovative construction techniques such as micro-trenching.
[95] A few operators forecast no change in their use of PIA from current levels.
[96] BT, 2020. *Results for the full year to 31 March 2020* [accessed 25 January 2021].
[97] Openreach, 2020. *Openreach commits to the largest full-fibre broadband build in the hardest to reach 'final third' of the UK – boosting the country's post-Covid economic recovery* [accessed 3 March 2021].
[98] See https://www.openreach.com/fibre-broadband/fibre-first/ [accessed 26 January 2021].
[99] BT, 2021. *Q3 2020/21 trading update* [accessed 4 February 2021].

KCOM

A3.23 KCOM operates an FTTP network in Hull where it (not BT) is the incumbent operator. KCOM offers retail and wholesale broadband services and leased lines across its network.[100] We are reviewing telecoms competition in the Hull Area in a separate review.[101]

A3.24 However, KCOM is investing in an expansion of its FTTP network outside of the Hull Area into East Yorkshire and North Lincolnshire.

A3.25 KCOM's plan was to deploy [✂]% of this expansion in its own physical infrastructure and to use [✂] for the remaining [✂]%. KCOM is now estimating to [✂] of its build.[102] KCOM considers that PIA is unlikely to be widely used to facilitate network build in Area 3 locations.[103]

A3.26 As at August 2020, KCOM covered [✂] premises outside of the Hull Area and expects to cover nearly [✂] by 2026.[104,105]

Virgin Media

A3.27 Since 2015, Virgin Media has been expanding its network. Project Lightning was announced then as a £3bn investment to extend Virgin Media's network reach to 4m more homes and businesses, increasing its total coverage to nearly 17m premises.[106] As at September 2020, Project Lightning had passed [✂] premises.[107] Some of this new network expansion is FTTP.[108] Liberty Global (who own Virgin Media) reported recently that take-up within the Project Lightning footprint had now reached 35%.[109]

A3.28 To date physical infrastructure to support Virgin Media's network expansion has been mainly [✂]. But, [✂].[110]

A3.29 Virgin Media's network expansion can be broadly considered [✂][111]. [✂][112], [✂].[113] Using our statutory powers we asked Virgin Media to provide us with its latest build plans and coverage forecast as at October 2020. We found [✂].[114] Virgin Media also confirmed to us that Virgin Media Business does not [✂].[115]

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[100] See https://www.kcom.com/about-us/our-business/ [accessed 30 January 2021].
[101] Ofcom, 2020. *Consultation: Promoting competition in fibre networks – Hull Area Wholesale Fixed Telecoms Market Review 2021-26*.
[102] KCOM response dated 9 October 2020 to the s.135 notice dated 18 September 2020, page 5, covering letter.
[103] KCOM response to the January 2020 Consultation, paragraph 2.3.
[104] KCOM response dated 21 January 2021 to the s.135 notice dated 18 September 2020, email.
[105] KCOM response dated 9 October 2020 to the s.135 notice dated 18 September 2020, page 9, covering letter.
[106] Virgin Media, 2015. *Virgin Media and Liberty Global announce largest investment in UK's internet infrastructure for more than a decade*. https://www.virginmedia.com/corporate/media-centre/press-releases/virgin-media-and-liberty-global-announce-largest-investment-in-uks-internet-infrastructure-for-more-than-a-decade [accessed 25 January 2021].
[107] Virgin Media response dated 10 September 2020 to the s.135 notice dated 20 August 2020, page 3, covering letter.
[108] Coverage data collected from Virgin Media for our Connected Nations 2020 report indicates that, as at September 2020, it could connect just under [✂] premises with FTTP.
[109] Liberty Global, 2021. *Investor call, Q4 2020*, slide 15 [accessed 17 February 2021].
[110] Virgin Media response dated 12 August 2020 to the s.135 notice dated 12 June 2020, page 4, covering letter.
[111] Virgin Media response dated 12 August 2020 to the s.135 notice dated 12 June 2020, page 4, covering letter.
[112] [✂].
[113] Virgin Media response dated 30 August 2019 to the s.135 notice dated 1 August 2019, page 4, covering letter.
[114] Virgin Media response dated 10 September 2020 to the s.135 notice dated 20 August 2020, page 2, covering letter.
[115] Virgin Media response dated 12 August 2020 to the s.135 notice dated 12 June 2020, page 3, covering letter.

A3.30 As well as expanding its network coverage, Virgin Media is also upgrading its entire network to be capable of providing gigabit internet speeds by the end of 2021.[116] As at January 2021, Virgin Media had announced having enabled gigabit connectivity to 7m premises.[117]

A3.31 This upgrade alone (i.e. excluding other full fibre build outside of Virgin Media's network footprint) should see gigabit coverage rising rapidly over the coming months to over 50% of UK premises by 2022.

A3.32 In May 2020, Liberty Global and Telefonica announced an agreement to merge their UK operating businesses – Virgin Media and O2 – to a 50:50 joint venture.[118] This anticipated merger is currently being investigated by the Competition and Markets Authority (CMA).[119] After the merger has closed, Liberty Global plans to discuss with Telefonica the pace of the Project Lightning build and ambitions to expand the Virgin Media fixed network beyond the Lightning footprint.[120]

CityFibre

A3.33 CityFibre provides wholesale broadband and leased line connectivity to business and consumer service providers, local authorities and mobile operators. Its network deployments are focused on entire contiguous areas of a town or city where it builds a fibre network which can serve the vast majority of premises in that town or city.[121]

A3.34 CityFibre's choice of towns and cities had been influenced on securing an anchor tenant to de-risk its initial network build. This initial build will focus on deploying connectivity to the anchor tenant's locations such as local authority sites, businesses and/or mobile cell sites, but will also build a central spine network.[122]

A3.35 More recently, CityFibre have sought to make extensive usage of Openreach's PIA product to significantly reduce both the cost and time for deploying fibre.[123] As of March 2020, they were making use of [✂].[124] CityFibre estimate using around [✂]% PIA for its fibre access network deployment by March 2026. As at June 2020, around [✂]% of its access network was deployed in its own physical infrastructure reducing to just under [✂]% for new network build since 1 July 2019. For the former FibreNation network build, now owned by CityFibre, PIA accounted for [✂]% of its network deployment as at June 2020. This increased to [✂]% for new build since 1 July 2019.[125]

[116] Liberty Global, 2019. *Virgin Media to bring gigabit internet to millions of homes* [accessed 25 January 2021].
[117] Liberty Global, 2021. *Virgin Media brings gigabit broadband to Wales* [accessed 25 January 2021].
[118] Liberty Global, 2020. *Liberty Global and Telefonica to Merge their UK Operations* [accessed 26 January 2021].
[119] CMA, 2020. *Liberty Global plc / Telefónica S.A. merger inquiry* [accessed 30 January 2021].
[120] Liberty Global plc full-year 2020 earnings call, Tuesday, 16 February 2021 at 2:00 PM GMT.
[121] CityFibre response to the January 2020 Consultation, Annex 3, paragraph 2.3.
[122] CityFibre response to the January 2020 Consultation, Annex 3, paragraph 2.4.
[123] CityFibre response to the January 2020 Consultation, Annex 3, paragraph 2.5.
[124] CityFibre response to the January 2020 Consultation, paragraph 3.21.
[125] CityFibre response dated 21 August 2020 to the s.135 notice dated 12 June 2020, Annex 2 Physical Infrastructure (FINAL).

A3.36 When extending its fibre network to provide residential broadband, CityFibre's design provides capability to provide leased line services (i.e. by including flexibility points and spare capacity near potential customers such as business parks and mobile mast sites).[126]

A3.37 CityFibre has reported the following developments since our January 2020 Consultation:

a) In February 2020, CityFibre announced that it had been selected by the mobile network operator, Three, as its preferred supplier of backhaul connectivity outside of London.[127]

b) In March 2020, CityFibre announced the completion of its acquisition of the FibreNation FTTP network from TalkTalk with coverage in York and construction underway in Dewsbury, Harrogate, Knaresborough and Ripon. The acquisition of FibreNation was followed by CityFibre increasing its rollout ambition from 5m to up to 8m premises, supporting an investment programme of up to £4bn.[128] TalkTalk joined Vodafone and others in entering into wholesale arrangements with CityFibre.[129]

c) CityFibre has announced plans to build to over 60 cities (but not London) so far which are published on its website.[130]

A3.38 As at January 2021, CityFibre's latest plan reported to us amounted to a network deployment covering [✂] premises which it considers will likely be completed by 2026.[131]

A3.39 We are also aware that CityFibre may [✂][132] [✂].[133]

Hyperoptic

A3.40 Hyperoptic has been providing gigabit full fibre broadband for many years mainly targeting MDUs. Initially, it connected to the MDUs via a leased line purchased from Openreach. More recently it has also started making use of PIA to provide its own connectivity.[134] This also allows it to address some targeted single dwelling units (SDUs). Hyperoptic retails home and business broadband packages as well as dedicated fibre connectivity.[135]

A3.41 As at August 2020, Hyperoptic had passed nearly [✂] premises mainly in London but also in other towns and cities and a funded plan to cover a further [✂] premises.[136] Its plans are to reach 2m premises passed by 2022 and 5m by 2025.[137]

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[126] CityFibre response dated 21 August 2020 to the s.135 notice dated 12 June 2020, page 3, Explanatory Note: CityFibre's Response to Ofcom's 'Tranche 2' Section 135 Information Request.
[127] CityFibre, 2020. *CityFibre chosen as a preferred provider of full fibre capacity for Three's 5G rollout nationwide* [accessed 26 January 2021].
[128] CityFibre, 2020. *CityFibre completes its acquisition of FibreNation increasing its rollout plans to pass up to 8 million premises* [accessed 26 January 2021].
[129] Vodafone, 2017. *Vodafone and Cityfibre bring gigabit-speed fibre to the UK* [accessed 26 January 2021].
[130] See https://www.cityfibre.com/gigabit-cities/ [accessed 26 January 2021].
[131] CityFibre response dated 13 January 2021 to the s.135 notice dated 13 January 2021, covering letter.
[132] [✂].
[133] CityFibre response dated 21 October 2020 to the s.135 notice dated 15 October 2020, page 2.
[134] This interest is reflected in the Hyperoptic PIA focused response to our January 2020 Consultation.
[135] See https://hyperoptic.com [assessed 29 January 2021].
[136] Hyperoptic response dated 13 October 2020 to the s.135 notice dated 19 August 2020, email response to question 4.
[137] Hyperoptic response to the January 2020 Consultation, page 2.

Gigaclear

A3.42 Gigaclear has been building out to rural areas for several years. It initially targeted areas where customers would pre-commit to purchase service and, where enough customers committed, it built its network. It has since also won state aid funding to build network.

A3.43 Gigaclear has largely built its own infrastructure, with very limited use of PIA thus far (less than [✂]% of its network deployment). However, it forecasts increasing utilisation of PIA (to around [✂]% by March 2026) to support its access network expansion, specifically into remoter rural areas where the economics of network build are more challenging.[138,139]

A3.44 Gigaclear has network coverage in the rural areas of many counties across the South West, the Midlands and South East of England. It retails a range of home and business broadband packages with speeds up to 900Mbit/s.[140]

A3.45 Since providing us with details of build plans in August 2019, Gigaclear is now [✂]. As at August 2020, Gigaclear had built to just under [✂] premises with plans to reach around [✂] by 2025/26.[141]

Axione

A3.46 Axione plans to target small towns and villages [✂]. Axione estimates [✂].[142] Axione's business model is wholesale only and relies on establishing commercial relationships with ISPs. As at August 2020, Axione has an [✂].[143,144]

B4RN

A3.47 B4RN builds in rural areas, with support from the community to be served (in terms of pre-commitment, provision of services to build the network, etc). It builds its own network without relying on PIA [✂].[145] As at August 2020, B4RN had reached over [✂] premises mainly in the North West of England and a smaller presence in East Anglia. By March 2026, B4RN expect to cover over [✂].[146] B4RN offers homes and businesses a standard 1Gbit/s broadband service but can offer upgrades to 10Gbit/s.[147]

Community Fibre

A3.48 Community Fibre has deployed full fibre to council owned MDUs in parts of London and is also targeting [✂]. As at the end of July 2020, Community Fibre had passed around [✂] premises with funding to reach [✂] premises by the end 2023.

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[138] Gigaclear response to the January 2020 Consultation, paragraph 104.
[139] Gigaclear response dated 8 October 2020 to the s.135 notice dated 20 August 2020, Annex 1, Table 2.
[140] See https://www.gigaclear.com/ [accessed 30 January 2021].
[141] Gigaclear response dated 8 October 2020 to the s.135 notice dated 20 August 2020, covering email and Annex 5.
[142] Axione response dated 21 September 2020 to the s.135 notice dated 20 August 2020, Annex 2, Table 2 and [✂].
[143] See https://www.axione.co.uk/about-us/about-axione [accessed 30 January 2021].
[144] Axione response dated 21 September 2020 to the s.135 notice dated 20 August 2020, page 13.
[145] B4RN response dated 4 September 2020 to the s.135 notice dated 14 August 2020, page 4.
[146] B4RN response dated 4 September 2020 to the s.135 notice dated 14 August 2020, page 6.
[147] See https://b4rn.org.uk/b4rn-service/ [accessed 24 February 2020].

A3.49 Community Fibre estimates that around [✂]% of its network connectivity to reach MDU sites currently uses Openreach infrastructure and forecasts this proportion to remain the same over the review period.[148]

County Broadband

A3.50 County Broadband builds in rural villages in the East of England investing £46m on FTTP in counties including Norfolk, Essex and Cambridgeshire.[149] As at September 2020, County Broadband had completed build to just over [✂] premises with plans to cover [✂] premises by March 2026.[150]

A3.51 County Broadband uses PIA extensively in its network design and deployment to reduce its average cost per premises passed and enable more rapid deployment.[151] County Broadband is using, and expects to continue using, PIA for about [✂]% of its network deployment. PIA is often not available for customer lead-ins in rural areas (utilisation is around [✂]%).[152]

Jurassic Fibre

A3.52 Jurassic Fibre is building an FTTP network to towns and villages [✂] in the South West of England. It plans to cover over [✂] premises by March 2026 retailing up to 950Mbit/s residential and business offerings and up to 10Gbit/s dedicated internet access.[153,154]

A3.53 Jurassic Fibre is using [✂]. It forecasts that around [✂]% of its access network will be deployed in Openreach ducts and poles by the end of the review period.[155]

Swish Fibre

A3.54 Swish Fibre plans to build a fibre network in the Home Counties.[156] It is aiming to target homes and businesses in [✂]. As at August 2020, Swish Fibre had begun its initial build to reach [✂] homes and businesses. It plans to cover more than [✂] premises over the period to March 2026.[157]

A3.55 Swish Fibre is expecting to use PIA for just over [✂]% of its access network deployment excluding customer lead-ins but forecasts this increasing to almost [✂]% by March 2026.[158]

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[148] Community Fibre response dated 10 September 2020 to the s.135 notice dated 20 August 2020, page 5 and Annex 2, Table 2.
[149] See https://countybroadband.co.uk/ [accessed 29 January 2021].
[150] County Broadband response dated 25 September 2020 to the s.135 notice dated 4 September 2020, page 6, network investment plan.
[151] County Broadband response to the January 2020 Consultation, paragraph 29.
[152] County Broadband response dated 25 September 2020 to the s.135 notice dated 4 September 2020, page 4, Ofcom build information and Annex 2, Table 2.
[153] See https://jurassic-fibre.com/ [accessed 29 January 2021].
[154] Jurassic Fibre response dated 29 September 2020 to the s.135 notice dated 18 August 2020, page 5.
[155] Jurassic Fibre response dated 29 September 2020 to the s.135 notice dated 18 August 2020, Annex 2, Tale 2.
[156] The counties surrounding Greater London. Swish Fibre have published a list of places that they plan to build to on their website at https://www.swishfibre.com/fullbuildplans [accessed 2 February 2021].
[157] Swish Fibre response dated 28 September 2020 to the s.135 notice dated 17 August 2020, page 6 and 8, response note.
[158] Swish Fibre response dated 28 September 2020 to the s.135 notice dated 17 August 2020, Annex 2, Table 2.

Toob

A3.56 Toob is currently building its fibre network in Southampton. Over the next few years, Toob plan to be deploying their network in Aldershot, Ash, Camberley, Farnborough, Frimley, Frimley Green, Guildford, Mytchett, West Byfleet and Woking. Toob offers 900Mbit/s broadband packages for homes and businesses.[159] As at August 2020, Toob had passed just over [✂] premises.[160] Toob projects building out to nearly [✂] premises by December 2026 with current funding to complete around [✂].

A3.57 Toob's plan to [✂] include maximising the use of existing infrastructure, in particular BT ducts and poles and local council assets, to minimise new dig.[161] Toob forecasts that [✂]% of its access network will be deployed using PIA, between the access network flexibility point and a network access aggregation node. The network build Toob have completed to date has been slightly better than this. Toob's business case assumes [✂]% use of BT infrastructure on the customer lead in, even though experience to date has also been higher. Toob has only had to construct [✂]% of the physical infrastructure to support its core and backhaul network. For the remaining [✂]% Toob have been able to deploy fibre in third party ducts. Toob expect [✂] as they are assuming existing assets are not as readily available as they have been in Southampton.[162,163]

Truespeed

A3.58 Truespeed is targeting its fibre network build in rural areas in the South West of England. Truespeed pre-market in local communities offering retail packages with speeds up to 900Mbit/s, asking for registrations of interest and pre-sales.[164] As at August 2020, Truespeed had reached over [✂] premises with funding to reach over [✂]. Subject to further funding it had plans to extend its coverage to over [✂].[165]

A3.59 Truespeed are currently using PIA for about [✂]% of their access network deployment (less customer lead-ins) but forecast this to increase to [✂]% by the end of the market review period. Utilisation of PIA for lead-ins is expected to be [✂].[166]

Zzoomm

A3.60 Zzoomm is targeting fibre build in [✂]. As at August 2020, Zzoomm had completed build to around [✂] premises in Henley-on-Thames and plans to cover over [✂] by March 2026.[167]

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[159] See https://www.toob.co.uk [accessed 30 January 2021].
[160] And [✂] premises in MDUs requiring wayleaves.
[161] Toob response dated 20 September 2020 to the s.135 notice dated 1 September 2020, page 9, [✂].
[162] Toob response dated 20 September 2020 to the s.135 notice dated 1 September 2020, page 2 and 3, [✂] submission.
[163] Toob response dated 20 September 2020 to the s.135 notice dated 1 September 2020, Annex 2, Table 2.
[164] See https://www.truespeed.com [accessed 30 January 2021].
[165] Truespeed response dated 30 October 2020 to the s.135 notice dated 19 August 2020, page 8, covering letter.
[166] Truespeed response dated 30 October 2020 to the s.135 notice dated 19 August 2020, Annex 2, Table 2.
[167] Zzoomm response dated 28 September 2020 to the s.135 notice dated 17 August 2020, Annex 2, checklist.

Zzoomm advertises home and business broadband retail offerings with speeds from 100Mbit/s to 2Gbit/s as well as dedicated fibre.[168] Zzoomm has [✂].[169]

Other entrants

A3.61 The above is not exhaustive. There are other similar investments in fibre network deployment currently active including those by Airband[170], G.Network[171], Trooli[172] and WightFibre.[173]

Investment by operators of leased lines-only networks and use of PIA

A3.62 We also used our statutory powers to request details from operators of leased line-only network providers about network investment plans and use of PIA over the review period.

A3.63 The evidence we have gathered from leased line-only providers points to a more modest network investment outlook than that set out above. Several operators confirmed that they had no specific plans to proactively expand their networks beyond customer specific extensions in response to customer orders. However, some operators did report that they were planning to undertake network build projects in the short term (over the next 12 months or so) to expand their reach into new cities or carry out some network infill.

A3.64 Until April 2019, access to BT's physical infrastructure was limited to network build primarily focused on the provision of broadband services. PIA has only relatively recently been available to operators of networks providing only leased line services. The evidence we have gathered shows that leased line use cases are emerging, but the impact of PIA in LL Access and IEC markets over the review period remains uncertain.

A3.65 We set out further details below:

a) **CenturyLink:** In addition to [✂] which are in progress, CenturyLink is also [✂]. It also plans to [✂].[174] CenturyLink appear to have plans to use [✂] and, in respect of its core and backhaul routes, [✂] to facilitate its expansion plans although we are not clear that is in relation to access to physical infrastructure (i.e. it may be inclusive of leased fibre).[175]

b) **Colt:** Colt has current plans to [✂] to be able to connect BT exchanges, data centres as well as customer sites.[176] As at June 2019 [✂] of Colt's network was deployed in their own physical infrastructure. Colt forecast [✂]% of its access network being deployed in third party telecoms physical infrastructure by March 2026. Over the same period, Colt forecasts [✂]% of its core and backhaul network being deployed in third party physical infrastructure of which [✂]% is expected to be deployed in non-telecoms physical infrastructure.[177]

[168] See https://zzoomm.com [accessed 2 February 2021].
[169] Zzoomm response dated 28 September 2020 to the s.135 notice dated 17 August 2020, Annex 2, Table 2.
[170] See https://www.airband.co.uk [accessed 30 January 2021].
[171] See https://www.g.network [accessed 30 January 2021].
[172] See https://www.trooli.com [accessed 30 January 2021].
[173] See https://www.wightfibre.com/expanding-our-network [accessed 24 February 2021].
[174] CenturyLink response dated 25 September 2020 to s.135 notice dated 15 June 2020, Annex 2, Table 1.
[175] CenturyLink response dated 25 September 2020 to s.135 notice dated 15 June 2020, Annex 2, Table 2.
[176] Colt response dated 23 July 2020 to s.135 notice dated 12 June 2020, Colt Annex, Table 1.
[177] Colt response dated 23 July 2020 to s.135 notice dated 12 June 2020, Colt Annex, Table 2.

c) **Eircom UK:** Eircom UK provided details of intended investment in [✂] to expand its reach in [✂].[178] Eircom UK confirmed it had [✂] investing in its own network roll-out at this time.[179] Eircom UK are [✂].[180]

d) **euNetworks:** euNetworks has confirmed it has [✂].[181] euNetworks provided us with their [✂]. It showed [✂].[182]

e) **Fibrespeed:** Fibrespeed confirmed that it [✂]. Fibrespeed also pointed to [✂].[183] Fibrespeed do not currently [✂]. They use a mix of [✂] with the remainder [✂].[184]

f) **GTT:** GTT confirmed that [✂].[185]

g) **KCOM:** KCOM confirmed that it [✂].[186]

h) **MS3:** MS3's response specifically concerned the Hull Area which, as mentioned above, is not part of this assessment.[187]

i) **SSE:** SSE listed a number of [✂] where it had expanded its network presence since December 2019 to [✂].[188] SSE confirmed that they had [✂].[189] SSE's response to our request for information on its use of external cablelinks [✂].[190] SSE's use of [✂].[191]

j) **Verizon:** Verizon confirmed that it does [✂]. Verizon clarified that they generally operate on [✂]. Verizon further confirmed that they are currently [✂].[192]

k) **Vodafone:** Vodafone confirmed that it has [✂].[193] As at June 2020, almost [✂] of Vodafone's network utilises BT physical infrastructure.[194] Since the availability of PIA for business connectivity in 2019, Vodafone has [✂].[195] In relation to mobile backhaul specifically, Vodafone estimates that [✂] as at March 2026.[196] It has yet to [✂].[197]

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[178] Eircom UK response dated 24 August 2020 to the s.135 notice dated 15 June 2020, page 1, covering response and Annex 2, Table 1.
[179] Eircom UK response dated 24 August 2020 to the s.135 notice dated 15 June 2020, page 1, covering response.
[180] Eircom UK response dated 24 August 2020 to the s.135 notice dated 15 June 2020, page 1, covering response.
[181] euNetworks response dated 27 July 2020 to the s.135 notice dated 15 June 2020, Annex 2, Table 1.
[182] euNetworks response dated 27 July 2020 to the s.135 notice dated 15 June 2020, [✂].
[183] Fibrespeed response dated 27 July 2020 to the s.135 notice dated 15 June 2020, Annex 2, Table 1.
[184] Fibrespeed response dated 27 July 2020 to the s.135 notice dated 15 June 2020, Annex 2, Table 2.
[185] GTT response dated 8 September 2020 to the s.135 notice dated 15 June 2020, Annex 2, Table 1.
[186] KCOM response dated 14 August 2020 to the s.135 notice dated 15 June 2020, page 2 and 3, covering response to questions 1 to 5 and 7 and 8.
[187] MS3 response dated 22 October 2020 to the s.135 notice dated 15 June 2020, email.
[188] SSE response dated 7 September 2020 to the s.135 notice dated 15 June 2020, page 2, covering response and Annex 2, Table 1.
[189] SSE response dated 7 September 2020 to the s.135 notice dated 15 June 2020, page 2, covering response and Annex 2, Table 1.
[190] SSE response dated 15 January 2021 to the s.135 notice dated 19 November 2020, Annex 2.
[191] SSE response dated 7 September 2020 to the s.135 notice dated 15 June 2020, page 2 and 3, covering response.
[192] Verizon response dated 20 July 2020 to the s.135 notice dated 12 June 2020, page 2, covering response.
[193] Vodafone response dated 24 July 2020 to the s.135 notice dated 15 June 2020, page 1, covering letter.
[194] Vodafone response dated 24 July 2020 to the s.135 notice dated 15 June 2020, Annex 2, Table 2.
[195] Vodafone response to the January 2020 Consultation, Part 2, paragraph 7.2.
[196] Vodafone response dated 9 November 2020 to the s.135 notice dated 12 October 2020, Annex 3 update, Table 2.
[197] Vodafone response to the January 2020 Consultation, Part 2, paragraph 7.2.

l) **WPD:** WPD provided details of [✂].[198] WPD has only recently received [✂]. They are at [✂].[199]

m) **Zayo:** Zayo confirmed that it had several [✂] and [✂].[200] To date, Zayo has deployed around [✂]. A further [✂] is either in delivery or planning. The build on these routes is driven by [✂]. Future deployment [✂].[201]

Evidence gathered from Openreach on PIA orders

A3.66 In June 2020, we used our statutory powers to obtain detailed information from Openreach about orders placed with them for PIA since 1 April 2019.[202] Openreach has around 460,000km of duct and about 4m poles.

A3.67 While the evidence above shows that most operators expect to use a lot of PIA over the review period, our analysis of orders since April 2019 showed that actual take-up of PIA remains in the early phases and we have yet to see the impact of large scale use of PIA.

A3.68 We found that:

a) The number of notices of intent (NOI) being acknowledged by Openreach grew steadily over the period reflecting the increasing interest of operators in consuming PIA. [✂] accounted for a third of these NOIs with a long tail of operators with a small number of NOIs.

b) Operators provide Openreach with an NOI notifying the locations of physical infrastructure required and equipment to be deployed. Once the order is placed, operators have a period of 12 months to install their network.[203] Those operators who had placed PIA orders at scale during this period, such as [✂] and [✂], were not yet showing high levels of activity in terms of works in-progress or completed. [✂], who we understand have been consuming the PIA product for some time to support their roll-out to targeted locations (e.g. buildings in multiple occupation and business parks), accounted for most of the build during the period.

A3.69 More recent data (as at end December 2020) provided by Openreach confirms that it has over 100 customers and c.23,000km of duct and c.140,000 poles are being used by providers to deploy their networks.[204]

Evidence on the impact of PIA on cost and time of network build

A3.70 The possible scale of the impact of PIA on the cost and time of network rollout is indicated by the evidence we gathered from network operators:

[198] WPD response dated 28 August 2020 to the s.135 notice dated 15 June 2020, Annex 2, Table 1.
[199] WPD response dated 28 August 2020 to the s.135 notice dated 15 June 2020, PIA internal documents.
[200] Zayo response dated 19 August 2020 to the s.135 notice dated 12 June 2020, Annex 2, Table 1.
[201] Zayo response dated 19 August 2020 to the s.135 notice dated 12 June 2020, email dated 26 August 2020.
[202] Openreach response dated 23 July 2020 to the s.135 notice dated 11 June 2020.
[203] Openreach response dated 23 July 2020 to the s.135 notice dated 11 June 2020, page 3 and 4, covering letter.
[204] Data confirmed by Openreach in an email to Ofcom dated 16 February 2021.

a) BT estimated a cost per premise of [✂].[205]

b) PIA reduces Virgin Media's standard build cost per premises by around £200.[206]

c) We understand that network build times could be significantly reduced using PIA.[207]

A3.71 We have already set out above the plans of many operators to make extensive use of PIA over the review period. We consider this to be a strong indicator of the potential of PIA to reduce the time and costs of building new network.

A3.72 Evidence set out in the 2019 BCMR Statement also showed that the ability to use BT's ducts and poles will significantly reduce the cost and time of network build to connect a leased line customer, compared to an operator undertaking civil infrastructure work to deploy its own network:[208]

a) Evidence of the impact of PIA on LL Access was based on data related to duct activity, the indicative costs of rolling out duct compared to a network for which duct is already in place, time to supply, and rivals' digging behaviour.[209] For example, the 2019 BCMR Statement included some cost modelling which indicates that where BT had an existing duct connection but not fibre, its cost to connect a customer was £1,700 lower than an operator who needed a 10m network extension. The mean time to provide a leased line circuit was also shown to increase where new duct needed to be built, and with the length of the network extension.[210]

b) The 2019 BCMR Statement also analysed the indicative costs of rollout and time to supply IEC services. In particular, the 2019 BCMR Statement noted that where a provider was looking to replicate the entire route between two exchanges, the distances would typically be longer than an access circuit.[211] Longer extensions are typically associated with more significant costs and a longer time to provide, as outlined above.

A3.73 We consider that the evidence from the above analysis remains pertinent to our reasoning and decisions in this review.

[205] [✂].
[206] Liberty Global, 2021. Investor call, Q4 2020, slide 15, accessed 17 February 2021.
[207] Meeting between Ofcom and [✂] of 24 July 2019.
[208] Ofcom, 2019. *Promoting competition and investment in fibre networks: review of the physical infrastructure and business connectivity markets. Volume 2: market analysis, SMP findings, and remedies for the Business Connectivity Market Review (BCMR).* Statement. https://www.ofcom.org.uk/consultations-and-statements/category-1/review-physical-infrastructure-and-business-connectivity-markets, paragraphs A6.28 to A6.34.
[209] 2019 BCMR Statement, paragraphs A6.20, A6.28-A6.32.
[210] 2019 BCMR Statement, paragraphs A6.21, A6.30.
[211] 2019 BCMR Statement, paragraphs A6.33.

A4. Methodology for geographic assessment of Virgin Media and CityFibre network coverage and WLA market shares

A4.1 In this annex we describe the input data and methodology that we use:

- to define Area 2 and Area 3 for the WLA and LL Access markets; and
- to calculate WLA market shares.

Network coverage

A4.2 In this subsection we describe how we mapped the geographic extent of Virgin Media's and CityFibre's expected coverage by 2026 taking into account existing and planned build. [212]

A4.3 Our discussion of stakeholder responses is covered in Volume 2, Section 7. As discussed in that section, we use postcode sectors as our geographic unit of analysis and a 50% coverage threshold. By 'coverage threshold', we mean the amount of coverage that Virgin Media or CityFibre need to have in a given geographic unit to be identified as 'present' by 2026.

Data on existing network coverage and planned build

Existing build data

A4.4 We use June 2020 Connected Nations (CN) data on existing network coverage from Virgin Media and CityFibre.[213]

A4.5 The CN dataset provides information on UK premises passed and connected by each operator.[214]

Planned build data

A4.6 We used our statutory powers to obtain data from Virgin Media and CityFibre on their forecast network coverage as at 31 March 2026.

A4.7 Virgin Media and CityFibre responses to our request for data differed in format and the level of detail provided on the location of their forecast network coverage.

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[212] In the January 2020 Consultation we explained the modelling steps and results of our proposed geographic assessment in Annex 8. In it we referred to 'multi-service networks (MSNs)' and 'broadband only networks'. We do not use these terms in this annex because, as set out in Volume 2, Section 7, we have decided to define Area 2 by reference to the existing and planned network coverage of Virgin Media and CityFibre.

[213] Responses to question 2 of our CN s.135 notice, referenced CN1905-F01 and dated 30 April 2019. Responses to this notice were received in June 2020. The CN dataset also includes data from other providers including BT, Sky, and Vodafone, which we have used when we assess take-up. We have not used the more recent CN data collected as at September 2020 for the Connected Nations 2020 annual report as it was not possible, in the time available, for us to process the planned build data we collected in July 2020. The more recent CN dataset also does not include details of take-up on different operators' networks.

[214] The statutory notices for CN reporting ask operators to provide data on which individual premises in the UK they are connected to, including individual apartments in blocks of flats, based on its unique premises reference number (UPRN).

Virgin Media's data on its network expansion plans

A4.8 For the January 2020 Consultation, we mapped Virgin Media's planned build using plans that it provided to us in 2019.[215] We asked for build plans down to full postcode level, and if not available, down to the lowest level of granularity available. However, for most of its build projects, Virgin Media provided us with the location name (e.g. the name of the town or region) of the project, a lead postcode and the number of premises it expected to cover in that area.[216, 217] The rest of its build projects related to a [✂], with a sub region, a postcode and a forecast of volumes out to 2026. To use the information provided by Virgin Media in our assessment of network presence we used a 'clustering' analysis. We describe this further below.[218]

A4.9 In August 2020 we asked Virgin Media if its plans had changed materially from what they had previously provided, and if so to provide us with an update (again down to full postcode level, and if not, to the lowest level of granularity available). Virgin Media provided us with similar information as in 2019 but with less detailed geographic information. In 2019 it identified a lead *postcode* for most of its future plans, however in 2020 it only provided a lead *postcode sector*.[219] We were unable to use Virgin Media's plans provided in 2020 as they were not granular enough for our purposes and we therefore decided to use its 2019 plans in our assessment. So again, to use Virgin Media's planned build information in our assessment we used our clustering analysis.[220]

CityFibre's data on its city-wide network roll out plans

A4.10 Since our January 2020 Consultation, CityFibre acquired FibreNation and announced an increase in its roll-out ambition from 5m to 8m premises. We discussed changes to CityFibre's build plans on several occasions during 2020. We used our statutory powers to obtain confirmation of its updated roll-out plans.

A4.11 CityFibre's plans go out to 2026 and provide data on coverage at the postcode sector level. As at January 2021, CityFibre's plans are to achieve coverage of [✂] premises by 2026.[221]

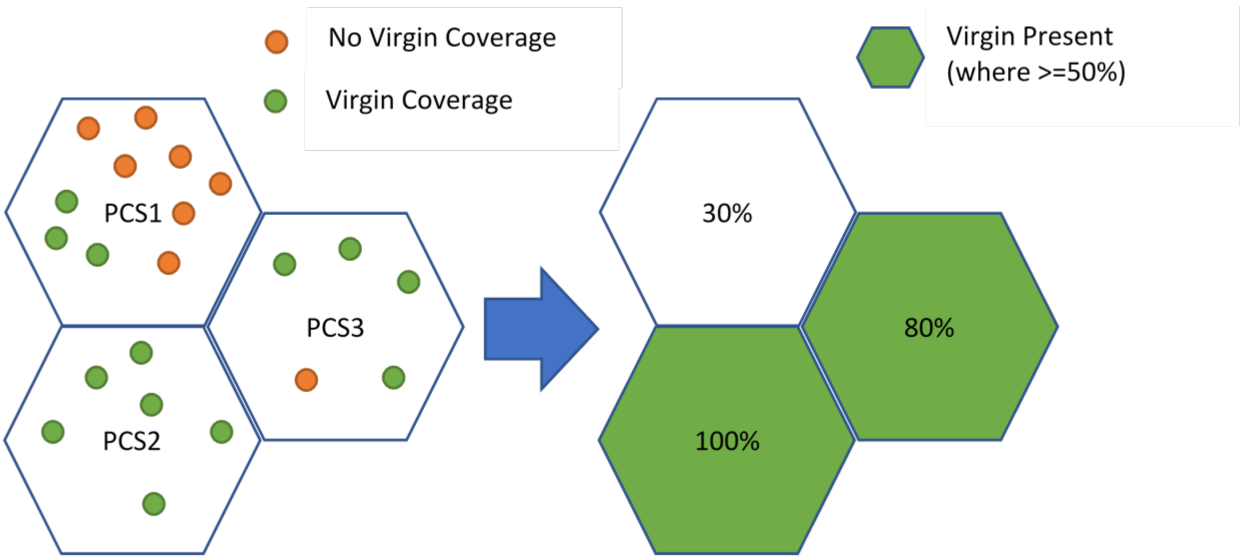
Approach to assessment of coverage

A4.12 As explained above, we identify CityFibre or Virgin Media as 'present' within a postcode sector if their network covers at least 50% of premises within the postcode sector. In doing this we used the same methodology as stated in our January 2020 Consultation.

[215] Virgin Media response dated 30 August 2019 to the s.135 notice dated 1 August 2019.
[216] Including other details such as the status of the project and the technology being deployed.
[217] Virgin Media said that a lead postcode would give an indication to Ofcom of the geographic build locations. Virgin Media response dated 30 August 2019 to the s.135 notice dated 1 August 2019.
[218] This does not include all of Virgin Media's build to 2026, although we consider that our clustering approach mitigates the impact of this. See paragraph A4.22.
[219] Virgin Media response dated 10 September 2020 to the s.135 notice dated 20 August 2020.
[220] We verified that Virgin Media's overall forecast of premises passed within the review period, [✂] than that reported to us in 2019, was broadly unchanged after accounting for actual build in the intervening period. We were also able to estimate that the large majority of the new build locations in the new data are in Area 2.
[221] CityFibre response dated 13 January 2021 to the s.135 notice dated 13 January 2021.

A4.13 To determine if CityFibre or Virgin Media is present, we assess each postcode sector separately, for each operator. For each postcode sector we determine how many premises are within it. For each operator we then determine how many premises within that postcode sector they are expected to cover by 2026 (summing existing and planned build). If an operator is expected to cover 50% or more of the premises in a postcode sector, then we conclude that they are present in that postcode sector. Figure A4.1 shows an illustration of this approach. The dots represent premises and the hexagons are postcode sectors.

Figure A4.1: Illustration of approach to existing build



Source: Ofcom.

Data cleaning and data format

A4.14 Below we set out how we cleaned Virgin Media and CityFibre's build plan data and then how we used each of Virgin Media's and CityFibre's plans.

A4.15 For CityFibre we were able to directly use their planned build in our model.

A4.16 For Virgin Media their data was not in a format that allowed this, so we used our clustering analysis approach, as used in the January 2020 Consultation, and explained below.

Data cleaning

A4.17 For Virgin Media we removed any entries where the information was blank and where the lead postcode or [✂] postcode was incomplete or could not be matched with the OS CodePoint data. We also did not count a small number of entries where the status of the planned build was listed as either 'job on hold' or blank.

A4.18 For CityFibre we removed a small number of postcode sectors where it was unclear what their coverage would be, i.e. where there was conflicting information for the same postcode sector.

A4.19 For Virgin Media, where the entry did not match our records of valid postcodes the related plans were excluded. Likewise, for CityFibre, where the entry did not match our records of valid postcode sectors, the related plans were excluded.

Data format: Virgin Media – clustering analysis

A4.20 We took the same clustering approach to mapping Virgin Media planned build as we had proposed at consultation. We have identified a set of clusters that we use to estimate the postcodes and postcode sectors that we believe are likely to be covered by Virgin Media when it plans to extend its network in a given town or city.

A4.21 The steps to identify these clusters are set out below.

a) We identify postcodes with an area of less than 100,000m^2. The purpose of this is to identify those postcodes that cover smaller geographic areas. These align to urban and suburban locations which Virgin Media are likely to target.[222]

b) Having identified these smaller postcodes, we group them into clusters. Postcodes that are next to each other are grouped together to create a cluster. This process resulted in the identification of 56,301 distinct clusters.

c) We identified the clusters where Virgin Media has plans to build.[223] For each of these clusters, we determine if Virgin Media has any existing coverage. We then add any existing coverage to the number of premises that Virgin Media plans to build to. If the resulting total coverage (existing plus planned) is 50% or more of the premises within the cluster, we mark the cluster as having Virgin Media 'present'. We removed double-counting of build that has happened in the interim.

d) Finally, we need to map the Virgin Media present clusters to postcode sectors and identify those postcode sectors where we consider Virgin Media to be present. We do this by identifying postcode sectors that correspond to these clusters. We consider Virgin Media to be present in a postcode sector where 50% or more of the premises within that postcode sector are also within the cluster.[224]

A4.22 Virgin Media's plans do not include all of the premises that they plan to build to by 2026. However, we consider that the cluster approach is likely to map reasonably well to these undefined premises, since Virgin Media's network expansion can be broadly considered [✂].[225]

Other points

A4.23 Where there is an inconsistency between the CN data on existing network coverage and the corresponding data provided by CityFibre or Virgin Media, we use the data provided by CityFibre or Virgin Media.

A4.24 We do not make any assumptions about the growth in the number of premises in a postcode sector, we use the number of premises that exist today.

[222] Figure 4.5 of the December 2018 Consultation showed, for example, how the choice of postcodes covering less than 100,000m^2 approximated to urban areas based on postcodes in the Newcastle and Sunderland area.
[223] By reference to the 'lead postcodes' and [✂] postcodes that Virgin Media had provided in its planned build data.
[224] We acknowledge that if Virgin has at least a 50% presence in a cluster and a postcode sector has at least a 50% presence in a cluster it does not necessarily mean Virgin has at least a 50% presence in that postcode sector. So, this mapping is imperfect, but we consider it is a reasonable proxy for Virgin Media's forecast presence.
[225] See Annex 3, paragraph 3.29.

Results of our geographic markets analysis

A4.25 Table A4.2 shows results of the geographic market analysis based on Virgin Media and CityFibre presence as of June 2020. Figures in all tables in this annex exclude the 59 Hull Area postcode sectors and their premises.

Table A4.2: Summary of results of geographic market analysis based on existing Virgin Media and/or CityFibre presence as of June 2020

Virgin Media and CityFibre existing presence	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Both	34	0.1 million	0.3%	0.4%
One	4,523	17.2 million	45%	56%
Neither	5,543	13.5 million	55%	44%
Total	10,100	30.9 million	100%	100%

Source: Ofcom. Figures may not sum due to rounding.

A4.26 Table A4.2 shows that one or both of Virgin Media and CityFibre are already present in just over 45% of UK postcode sectors that account for just over 56% of UK premises.

Table A4.3: Summary of results of geographic market analysis based on Virgin Media's and CityFibre's existing and planned network presence

Virgin Media and CityFibre network presence including plans	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Both	1,718	6.9 million	17%	22%
One	4,361	14.8 million	43%	48%
Neither	4,021	9.2 million	40%	30%

Source: Ofcom. Figures may not sum due to rounding.

A4.27 As Table A4.3 shows, we expect Virgin Media and/or CityFibre to be present in 60% of UK postcode sectors that account for 70% of UK premises by 2026.

A4.28 The map below (Figure A4.4) shows Area 2 (in blue), where one or both of Virgin Media and CityFibre are expected to have presence by 2026 based on existing and planned build.

Figure A4.4: Map of Area 2 and Area 3 postcode sectors

Source: Ofcom.

A4.29 Table A4.5 shows the results for Areas 2 and 3.

Table A4.5: Summary of results of geographic market analysis

Geographic Market	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Area 2	6,079	21.7 million	60.2%	70.2%
Area 3	4,021	9.2 million	39.8%	29.8%

Source: Ofcom.

A4.30 Based on our analysis of existing and planned build, Area 2 comprises 60% of postcode sectors and 70% of UK premises.

Methodology for WLA market shares

A4.31 In this section of the annex we set out our methodology for calculating WLA market shares.

Source data

A4.32 We collected data on all active broadband connections to homes and businesses for June 2020. We have used this data to calculate the number of connections by network in each postcode sector.

Methodology

A4.33 Each record in the data represents a single broadband connection. A single building may have multiple connections (e.g. where a building has multiple occupants such as block of flats).

A4.34 The data is supplied by retail service providers and by CityFibre which only provides wholesale services. Some grouping and data processing was required to produce *wholesale* operator level data.

A4.35 Counts of wholesale operator connections are aggregated to postcode sector level, and then used in conjunction with the results of the geographic market analysis.

A4.36 Data records that could not be matched to a postcode sector have been excluded. Of c.25 million connections, c.24 million could be matched to postcode sectors. These unmatched connections are likely to be to locations without a postal address (such as a telephone box, street furniture, MNO base stations, etc). The vast majority of these unmatched connections are provided by BT and thus excluding them will mean that Openreach services shares are understated. We also exclude records for any postcode sectors that are no longer in use.

A4.37 We collect data from the main broadband suppliers together with several smaller operators.[226] This means that smaller operators may be under-represented, but the impact on overall market shares will be immaterial.

Table A4.6: Summary of market shares for WLA markets

	Area 2	Area 3
BT, share of WLA connections[227]	[✂]% 61 - 80%	[✂]% 91 - 100%
Next largest rival (Virgin Media), share of connections	[✂]% 21 - 40%	[✂]% 0 - 10%

Source: Ofcom analysis of provider data.

[226] CN 2020 obtained information from B4RN, BT Groups, Call Flow, CityFibre, Community Fibre, County Broadband, Fibrespeed, Gigaclear, G network, Hampshire Broadband, Hyperoptic, Openreach, Sky, TalkTalk, Truespeed, Virgin Media, Vodafone, Wessex Internet, Wight Fibre and Zzoomm. See Connected Nations 2020, Annex A, Methodology section.
[227] Includes active broadband connections only i.e. exclude standalone landline connections.

A5. Leased lines geographic analysis

A5.1 In this annex we describe the data analysis that we have carried out in relation to the LL Access and IEC markets.

A5.2 We first cover:

- input data – the sources and types of data that we gathered for this work; and
- data cleaning – the steps taken in checking and preparing the datasets for our analysis.

A5.3 We then set out the methodologies we adopted in carrying out the following elements of our analysis:

- **network reach analysis**, used to determine the location of competing networks and their proximity to users of leased line services;
- **connections and MNO inventory analysis**, used to calculate service shares and other measures of competitive market conditions in the provision of leased lines;
- **IEC proximity analysis,** used to identify the proximity of BT exchanges to competing networks; and
- **fibre connected buildings analysis**, used to determine the extent to which Openreach and competing networks have active connections to buildings.

A5.4 At the end of each methodology subsection, we set out the results that we draw on in reaching our conclusions in our market analysis, as set out in Volume 2, Sections 6, 7 and 8.

Input data

A5.5 In this subsection we describe the data inputs we used. All data provided by network operators was obtained using our formal information gathering powers.

Postcode data

A5.6 We used Ordnance Survey May 2020 postcode dataset together with CodePoint.[228] This postcode data is used to determine the locations of 'demand sites' (see below), BT exchanges, and a small number of circuit ends in our leased lines data.

Physical network infrastructure data

A5.7 We asked a number of network operators[229] to supply details of their physical networks as set out in the following paragraphs.

Duct maps

A5.8 We asked network operators other than Openreach to supply digital maps of their duct networks (including, where possible, their future build plans). We extracted coordinates for

[228] CodePoint is a database of polygons used for mapping provided by AddressBase Premium, an Ordnance Survey product.
[229] CenturyLink, CityFibre, Colt, Eircom, EU Networks, Fibrespeed, GTT, KCOM, MS3, Openreach, SSE, Verizon, Virgin Media, Vodafone, WPD, and Zayo.

each of these duct networks and used these coordinates to map the network infrastructure of each network operator.[230]

Flexibility points

A5.9 We asked network operators to provide the location of all their flexibility points.[231] These are points where existing network can be accessed to connect an end-user premises, and from which the network operator would consider extending their network to provide services to additional end-user premises. Examples of flexibility points include buildings where fibre terminates on an optical distribution frame, and underground chambers where fibre can be accessed, such as where ducts meet at a junction.

A5.10 With the exception of [✂], [✂] and [✂] who did not provide data on their flexibility points, we used both the flexibility points provided by the networks and the coordinates generated from network operators' duct maps, in our network reach analysis (see below).

A5.11 We also asked network operators for details of their plans for network expansion. Most stated that they had no specific network expansion plans (beyond customer-specific requests). [✂] was not able to provide digital maps or flexibility points for its planned network build. [✂] provided detailed flexibility point data [✂]. [✂] provided postcodes concentrated in [✂] where they planned to build new network. [✂] and [✂] identified cities where they planned to expand their network.

Network sites

A5.12 Network sites are buildings housing telecoms equipment for the transmission, switching, routing and/or aggregation of traffic.[232] We asked network operators for a list of network sites where they had installed transmission equipment used for the supply of leased lines and which are capable of serving more than one business customer.

A5.13 For each network site, we asked for the address (or geographic coordinates where no postal address was available), a brief description of the nature of the site, and whether it coincides with a customer site.

A5.14 Using these details, we filtered out network sites that were out of scope, such as those labelled as test sites, those associated with out of scope products, those that are inactive, and those coinciding with customer sites.

[230] From the duct maps provided by network operators, we use a 'Coordinate Extractor' function in software called 'MapInfo' to generate flexibility point coordinates in 'British National Grid [EPSG: 27700]' projection.
[231] In many cases flexibility point data was provided as eastings and northings. Eastings and northings provide the coordinates of any given location in the UK in metres east and north of an origin just to the south-west of the Isles of Scilly. Where data was provided as latitude and longitude, we converted this to eastings and northings using software called MapInfo.
[232] For example, a telecoms provider's own network equipment rooms, the common equipment room in a multi-tenant building, or an end-customer equipment room from which you serve other customers.

Demand sites

Data centres

A5.15 We asked network operators for a list of data centres[233] to which they provide a leased line, whether they own that data centre or not.

A5.16 For each data centre[234], we asked for the name and postcode location, and to identify whether it is being used for aggregation and/or onward routing purposes[235] or is more akin to an end customer connection (i.e. there is no aggregation or onward routing).

A5.17 Using this information, we constructed two lists:

- data centres being used for aggregation and/or onward routing purposes (network site data centres), which we used to help identify ends of circuits which are not in the leased lines access market; and
- data centres that are more akin to an end customer connection (customer site data centres), which we used in creating a list of demand sites.

Large business sites

A5.18 We used Market Location[236] data to identify the locations of businesses with 250 or more employees nationally (we also used this approach in 2019 BCMR).

A5.19 We have previously considered using actual customer sites (i.e. circuit inventory) data but, as detailed in Annex 12 of the 2019 BCMR[237], we had quality concerns about the inventory data. There are insufficient volumes in the connections data (see below) collected in its place to use as an effective weight in our network reach analysis due to the geographic granularity required.[238]

A5.20 We also considered using Ordnance Survey data on the coordinates of business sites, but this dataset does not provide information on the number of employees required to identify large businesses that would demand leased lines.

Mobile cell sites

A5.21 MNOs use leased lines to connect mobile cell sites to the core network (mobile backhaul). Using the MNO inventory dataset (see below), we identify the locations of MNO cell sites by their postcode.

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[233] Premises whose main purpose is to house computing, data and application hosting, and communications equipment. They tend to have multiple tenants and may be owned and operated by carriers and/or run by third party providers that are carrier neutral. A carrier neutral data centre is owned and operated entirely independently of network providers and allows interconnection to and between multiple telecoms providers.
[234] For those data centres not owned by the network operator, we asked for the operator of the data centre.
[235] This can include, for example, core and backhaul aggregation and traffic routing functionality as well as being used for interconnection to other networks.
[236] Market Location is a list of UK businesses which includes information on the number of employees.
[237] BCMR 2019, paragraphs A12.70 to A12.74.
[238] This contrasts with our connections analysis, which is calculated over larger geographic areas, so the smaller volumes in the connections data are sufficient.

Combined demand sites data

A5.22 We combined data on the location of customer site data centres, large business sites and MNO sites, to create a list of 'demand sites'.

Table A5.1: Breakdown of demand sites

Type of demand site	Number	Percentage
Customer site data centres	943	0.6%
Large businesses	133,735	90.4%
MNO sites	13,215	8.9%
Total	147,893	100%

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

Connections and MNO inventory data

A5.23 We asked network operators to provide a list of all 'live' leased lines (i.e. circuits that were active at the end of 2019) that they connected to customers in 2018 and 2019[239], and combined this with the 2017 information gathered for the 2019 BCMR.[240]

A5.24 We refer to this list of leased lines as 'connections' and the information provided in relation to these connections includes:

a) circuits supplied to business customers or mobile cell sites or to other telecommunications providers;

b) newly connected circuits, and upgrades or regrades to existing circuits;

c) on-net and off-net circuits; and

d) services supplied using any of the following interfaces:

i) Ethernet (other than EFM);

ii) SDH/PDH;

iii) EFM;

iv) SDSL;

v) analogue; and

vi) any other interfaces that support dedicated capacity presented to the customer (e.g. WDM, Fibre Channel, ATM, Frame Relay, broadcast-specific interfaces such as SDI).

A5.25 We used this list to generate the connections dataset, containing all leased lines and dark fibre products connected by network operators in 2017, 2018 and 2019.[241]

[239] Stakeholder responses to questions A1 and A2 of the WFTMR s.135 notices.
[240] The cleaning and processing of the 2017 connections data has not changed since the 2019 BMCR. Refer to paragraphs A12.20 to A12.75, BCMR 2019, for details on this dataset.
[241] We did not ask for a full inventory of leased lines circuits given previous concerns in relation to the quality of the data held by network operators (see paragraphs A12.70 to A12.74, BCMR 2019 Annex 12).

A5.26 We also asked MNOs[242] to provide a list of all live leased lines they purchase and self-supply for mobile backhaul, including those purchased or self-supplied prior to 2017.

A5.27 We used this list to generate the MNO inventory dataset, containing all live leased lines and dark fibre products used by MNOs.

A5.28 After taking the steps set out below, to identify the access portion of the networks, we converted each operator's data from circuits to circuit ends (a single circuit has two circuit ends). The connections dataset contains 208,361 circuit ends, and the MNO inventory dataset contains 18,532 circuit ends.

Data cleaning

A5.29 In this sub-section, we describe the steps involved in using our input data to create the connections and MNO inventory datasets we need for our analysis. The key steps are:

- identifying and excluding all circuits that are not in the LL Access product market;
- removing duplicate dark fibre circuits;
- ensuring all circuits are classified as either being supplied by the network operator (on-net) or being purchased from a third party (off-net);
- identifying the location (i.e. postcode) of each circuit end;
- excluding circuit ends that do not connect to customer sites;
- identifying the bandwidth sold to the customer;
- identifying how the circuit was connected (e.g. whether digging was required); and
- adjustments made to network operators' connections data.

A5.30 We discuss these in turn below before describing our output datasets.

Identifying and excluding circuits not in the LL Access product market

A5.31 We looked for key words of products, interfaces, and physical links that we wanted to exclude from both datasets. We assumed that any circuits not flagged in this way for exclusion were in the LL Access product market.[243]

A5.32 We excluded:

- circuits classed as analogue, PDH/SDH[244], time division multiplex (TDM), radio base station (RBS), and legacy analogue traditional interface (TI) products;[245]
- Cablelink circuits, as these are only used for access to network equipment within a BT exchange or to connect to infrastructure close to a BT exchange, which means that they are not end-to-end access or inter-exchange circuits;
- leased lines used for specialist applications such as Broadcast and Street Access;

[242] EE, H3G, MBNL, Telefonica, and Vodafone.
[243] In this process, we had to make some assumptions. For example, we assume that circuits labelled "Private line" are TDM circuits, which fall outside the scope of this review.
[244] Plesiochronous / synchronous digital hierarchy.
[245] In the connections dataset, we excluded KiloStream and MegaStream which are types of TI circuit. In the MNO inventory dataset, we excluded managed connectivity products based on TI (MEAS E1X15, MEAS E1X2, MEAS E1X25 and MEAS E1X7).

- business-grade connectivity services provided over Ethernet in the first mile (EFM) and asymmetric broadband (DSL);[246]
- wavelength division multiplex (WDM) bearers, as the presence of wavelengths would lead to double counting of circuits; and
- circuits transmitted via radio, as these are not included in any of the relevant markets for this statement.

A5.33 Many of these excluded circuit types had low volumes. Table A5.2 shows that this step resulted in 10% of circuit ends in the raw dataset being excluded from the connections dataset, and 69% from the MNO inventory dataset.

Table A5.2: Leased line products identification

Circuit end observations*	Connections	MNO inventory
All products	410,073	94,172
Non-Leased line products	39,518 (10%)	64,548 (69%)
Leased Line products	370,555 (90%)	29,624 (31%)

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

**At this stage of data processing, a circuit end may be captured by more than one observation where it is supplied by one telecoms provider to another. In this case, the circuit end will be classified as "on-net" for the telecoms provider who supplies it using their own network and as "off-net" for the purchasing telecoms provider.*

Removing duplicate dark fibre circuits

A5.34 Dark fibre circuits sold to other network operators appear in the raw connections dataset twice: once as a passive circuit for the network operator who leased the circuit, and again as an active circuit for the network operator who purchased it. We used information provided by the networks supplying and purchasing dark fibre circuits to exclude all circuits sold to other network operators.

A5.35 Table A5.3 shows that this step resulted in 1,161 dark fibre circuits being removed from the raw connections dataset.

[246] See Volume 2, Section 7.

Table A5.3: Dark fibre identification

Circuit end observations*	Connections
All products	370,555
Dark fibre supplied to other network operators	1,161 (0.3%)
All products excluding dark fibre supplied to other network operators	369,394 (99.7%)

Source: Ofcom's analysis of stakeholder responses to the WFTMR s.135 notices.

**At this stage of data processing, a circuit end may be captured by more than one observation where it is supplied by one telecoms provider to another. In this case, the circuit end will be classified as "on-net" for the telecoms provider who supplies it using their own network and as "off-net" for the purchasing telecoms provider.*

Classifying all circuits as on-net or off-net

A5.36 Where circuit ends were not identified as being supplied either on-net or off-net, we included them as on-net in our service share analysis (to the extent we were able to identify their geographic location – see below). Table A5.4 shows that only 9% of connections in the raw dataset were classified in this way.

Table A5.4: On-net and off-net circuit ends in connections dataset

Circuit end observations	Number	%
LL excluding dark fibre supplied to other network operators	369,394	100%
On-net	296,450	80%
Off-net	38,178	10%
Unclassified	34,766	9%
LL wholesale (on-net and unclassified)	331,216	90%

Source: Ofcom's analysis of stakeholder responses to the WFTMR s.135 notices.

A5.37 About 73% of the unclassified circuit ends in the raw connections dataset are Virgin Media's circuits; this represents about 7% of circuit ends in the raw connections dataset. By classifying these as 'on-net' there is a risk that Virgin Media's volumes and services shares could be overstated. However, most of these circuit ends are removed from our dataset in later processing steps. Overall, Virgin Media's circuit ends with missing on-net classification decreases to [✂] of the connections dataset.

Identifying the postcode of each circuit end

A5.38 This step involved ensuring that all postcode information on the location of circuit ends was correctly formatted, validating the list of postcodes in the raw dataset by matching them to our list of Ordnance Survey postcodes and identifying missing postcodes.

A5.39 A significant proportion (91%) of circuit ends with a missing postcode were not in the LL Access product market.[247]

A5.40 The results of postcode validation exercise are presented in Table A5.5.

Table A5.5: Missing and invalid postcodes and postcode sectors

	Connections	MNO inventory
LL circuit ends (on-net and unclassified), of which:	331,216	29,624
Missing postcode[248]	27,474	3,934
Invalid postcode[249]	9,292	188
Valid postcode[250]	294,450	25,502
Missing postcode sector	27,320	3,127
Invalid postcode sector	500	838
Valid postcode sector	303,396	25,659

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

A5.41 We found that about 91% of the missing postcode sectors in the connections dataset are due to Virgin Media's data; this represents about 34% of Virgin Media's circuit ends. With postcode sectors that are missing or invalid, we cannot allocate the circuit ends to geographic markets. Given that Virgin Media is the largest competitor to Openreach, there is a risk of materially understating Openreach's service shares in those markets. We sought to address this issue by assuming that Virgin Media's customer ends with missing and invalid postcode sectors follow the same distribution as Virgin Media's customer ends with valid postcode sectors, using this to apply an uplift to those Virgin Media customer ends with valid postcode sectors (see the section "Blank postcode sector uplift" below).

Excluding circuit ends that do not connect to customer sites

A5.42 This step involves excluding circuit ends that are not within the access layer - i.e. those ends of circuits that do not connect to end-customers. Specifically, circuit ends that correspond to BT exchanges, KCOM exchanges, network site data centres and other network sites.[251]

A5.43 We asked network operators to identify whether each circuit end terminates in an end-customer site or a network site.[252] Where network operators did not provide this information,

[247] E.g. Internet Protocol Virtual Private Network.
[248] Includes completely blank entries and circuit ends for which information was provided but did not match the UK postcode format.
[249] Includes postcodes that matched the UK postcode format but were not matched to the Ordnance Survey postcode list.
[250] Includes postcodes with both the required format and were matched to the Ordnance Survey list.
[251] MNO base stations are treated as customer sites.
[252] We identified network sites by searching for key words such as "exchange", "pop", or "data centre".

we used information on the postcodes of network operators' network sites to identify circuit ends connected to one (or more) of the types of network sites listed above.[253]

A5.44 All circuit ends flagged by network operators as a customer site are treated as such regardless of whether its postcode also matches a network site.

A5.45 Table A5.6 shows that this step resulted in the exclusion of around 48% of circuit ends in the raw connections dataset, and around 37% of circuit ends in the MNO inventory.[254]

Table A5.6: Network sites and customer sites by dataset

	Connections	MNO inventory
LL circuit ends (on-net and unclassified), of which:	331,216	29,624
Network sites	160,193 (48%)	11,092 (37%)
Customer sites	163,975 (49%)	18,532 (63%)
Unknown*	7,048 (2%)	0 (0%)

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

**Circuit ends with missing postcodes where the data provider has not identified the circuit end type.*

A5.46 For about 2% of the circuit ends in the raw connections dataset, we could not apply either of the above methods of classifying them as network sites or customer sites, as both the network operators' classification and postcode are missing. For the purposes of calculating service shares, we assume that the distribution of network sites and customer sites is the same as for each network operator's circuit ends with known postcodes (see discussion on the "Blank postcode sector uplift" below).

Bandwidth sold to the customer

A5.47 This step involved standardising the format of the information provided on the sold bandwidth used to define the bandwidth categories in the service share analysis. The process involved using regular expressions to identify the number provided in the bandwidth field. We assumed the number provided to be Mbit/s unless otherwise stated (in which case we converted to Mbit/s).

[253] We matched our dataset with three lists of postcodes: one containing all postcodes belonging to network site data centres, one containing all BT exchange postcodes, and finally one containing all other network sites postcodes as identified by all the telecoms providers in our dataset.

[254] A network site can be either a BT exchange, a data centre, the telecoms provider's own network site, or another telecoms provider's network site. Depending on the telecoms provider's definition of network site, the same postcode can be classified as more than one type of network site (e.g. a data centre and an own network site) but is only counted once in excluding network sites.

A5.48 For 8% of circuit ends in the raw connections dataset and less than 1% of circuit ends in the MNO inventory dataset (excluding off-net ends), the bandwidth information was missing.

How the circuit was connected

A5.49 For each on-net circuit in the raw connections dataset, we asked network operators whether they used existing fibre, existing fibre tubing, existing duct, or if digging was required to connect the circuit. In addition, for the connections that involved the installation of these infrastructure, we asked for information on the actual distance dug, the length of fibre tubing installed, and the length of blown fibre.

A5.50 We generated a list of new variables (dig1, distance1, tubedistance1, flexdistance1)[255] and allocated all the dig statistics to the access end of the circuit. For the small proportion circuits that begin and terminate at an access site (i.e. customer-to-customer circuits)[256] we allocate the dig statistics based on the order of circuits in the raw data (with a chance that the dig is allocated to the wrong end).

A5.51 For our analysis of digging behaviour we filtered out all circuit ends with missing on-net classifications and recoded the dig variable so that all off-net circuits with a positive dig variable are treated as connections that did not involve digging.

Adjustments to network operators' connections data

A5.52 [✂] could not provide accurate or complete 2018 and 2019 connections data. Although [✂]'s share of 2017 connections was small (at less than [✂]% of total connections in the UK), rather than exclude them from our analysis, we decided to replicate their 2017 connections data, previously submitted and processed as part of the 2019 BCMR, for each of 2018 and 2019.

A5.53 The connections data [✂] provided included circuits labelled as [✂] circuits, which [✂] explained were [✂] circuits with a single end. We excluded the "b" ends of these [✂] circuits from the connections dataset as these are not LL Access products.

Output datasets

A5.54 Following these steps we created two datasets including only circuit ends in the LL Access product market. The connections dataset (including all connections in 2017, 2018 and 2019[257]) has 208,361 circuit ends, and the MNO inventory dataset has 18,532 circuit ends.

A5.55 Table A5.7 below shows that the connections dataset contains a small proportion of circuits where we are missing information on key variables. For example, for 2.3% of connections we do not know if these were on-net or off-net.

[255] These variables describe, respectively: whether digging was required, the actual distance dug for connections involving digging, the length of fibre tubing installed, and the length of blown fibre.
[256] We estimate that the number of customer-to-customer circuits with digs to be less than 5% of all digs in the connections dataset.
[257] Once 2017 connections are added.

Table A5.7: Proportion of circuits missing key values

	Connections*	
LL Access, of which:	**All**	**[✄]**
Unknown if on-net or off-net	2.3%	38%
Missing postcode	4.2%	48%
Missing postcode sector	3.2%	60%
Missing bandwidth	0.9%	74%

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 notices.

** After excluding [✄]'s circuit ends with missing postcodes in the connections data set that have not been identified as relevant customer ends based on the classification rules provided by [✄].*

Further adjustments

A5.56 We set out below two adjustments to the connections data: the dark fibre adjustment and the blank postcode sector uplift.

Dark fibre adjustment

A5.57 In BCMR 2019 we said that CityFibre's dark fibre connections were primarily used in providing circuits at 1 Gbit/s and below,[258] and we assigned 95% of CityFibre's dark fibre circuits to bandwidths 1 Gbit/s and below,[259] and the remaining 5% are assigned to the 10 Gbit/s bandwidth. We have continued with this approach.

A5.58 For other network operators their dark fibre circuits are completely assigned to the 10 Gbit/s bandwidth.

Blank postcode sector uplift

A5.59 As discussed above, the purpose of this uplift was to address the missing postcode sectors in the circuits datasets.

A5.60 Table A5.8 shows that a material proportion of customer ends in the connections dataset do not have an associated postcode or postcode sector. Unadjusted, this could result in too much weight being given to sales by some networks and too little to others.

[258] See Annex 14 of the 2019 BCMR.
[259] Split evenly between the 10 Mbit/s, 100 Mbit/s, and 1 Gbit/s bandwidths.

Table A5.8: The volume of circuit ends in the connections dataset with blank postcode sectors

Provider	Circuit ends	Blank postcode sector circuit ends
CenturyLink	[✂]	[✂] [✂]% [51-60]%
CityFibre	[✂]	[✂] [✂]% [0-10]%
Colt	[✂]	[✂] [✂]% [0-10]%
Eircom	[✂]	[✂] [✂]% [21-30]%
EU	[✂]	[✂] [✂]% [21-30]%
Fibrespeed	[✂]	[✂] [✂]% [0-10]%
GTT	[✂]	[✂] [✂]% [11-20]%
KCOM	[✂]	[✂] [✂]% [0-10]%
MS3	[✂]	[✂] [✂]% [0-10]%
Openreach	[✂]	[✂] [✂]% [0-10]%
SSE	[✂]	[✂] [✂]% [0-10]%
Verizon	[✂]	[✂] [✂]% [11-20]%
Virgin	[✂]	[✂] [✂]% [0-10]%
Vodafone	[✂]	[✂] [✂]% [0-10]%
WPD	[✂]	[✂] [✂]% [0-10]%
Zayo	[✂]	[✂] [✂]% [71-80]%
Total	**208,361**	**6,661 (3%)**

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 notices.

A5.61 For each network operator, this uplifting process works as follows:

- we use the ratio of customer ends to network ends for circuit ends with known locations to estimate the volume of circuit ends that are customer ends among those circuit ends with unknown locations; and
- we then distribute these identified customer ends with unknown locations among those customer ends with known locations based on the latter's existing geographic distribution.

Network reach analysis

A5.62 Using the demand sites and flexibility points datasets, we conduct our network reach analysis to determine the scale and location of competing network deployment.

A5.63 In this analysis, for each postcode sector, we determined whether 65% of demand sites were within 50m of zero, one, or two or more competing networks. As we do not know the precise location within a postcode of the demand sites, we assume all sites are located at their postcode centroid.

A5.64 Some postcode sectors do not have any demand sites located within their boundaries (see Table A5.14 below). For these postcode sectors we nominally assign each postcode within the postcode sector a demand site for the purposes of our geographic market classification. This ensures that competing network 'presence' is identified in these postcode sectors.

A5.65 A postcode sector with, for example, 50% of its demand sites within 50m of two or more competing telecoms infrastructure providers, 75% within 50m of one or more competing telecoms infrastructure providers, and 100% within 50m of zero or more competing telecoms infrastructure providers, will be classified as BT+1 competing telecoms infrastructure providers since at least 65%[260] of its demand sites are within one or more competing telecoms infrastructure providers.

A5.66 Our analysis uses flexibility points and coordinates generated from network operators' duct maps in relation to the location of existing networks (see above).

A5.67 The results of this analysis are set out in Volume 2, Section 7. Below we provide results on the following:

- CLA boundary;
- the average number of competing networks and the proportion of demand sites within 50m of X competing networks, by geographic market; and
- the number of postcode sectors with no demand sites, by geographic market.

CLA boundary

A5.68 We revisited the analysis carried out in BCMR 2019 to determine whether there had been any material changes that might lead to us changing the CLA boundary.

A5.69 We identified 3 postcode sectors geographically within the CLA boundary with a high level of competing network 'presence' that were not included within the CLA market we defined in 2019 BCMR (see Table A5.9). All 3 postcode sectors have no demand sites. Two of these sectors (EC3M 2 and W1A 3) were not categorised within the CLA in 2019 BCMR instead falling within the HNR Area, while the other (W1A 9) was not previously present in our postcodes data. These 3 sectors have now been included in the CLA.

Table A5.9: Number of competing networks present for contiguous postcode sectors to be included within the CLA

Postcode Sector	Number of competing networks with at least 65% of demand sites within 50m
EC3M 2	5
W1A 3	6
W1A 9	9

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

A5.70 In BCMR 2019, we considered if the CLA should be expanded to include HNR postcode sectors that were outside, but contiguous to, the CLA boundary. We looked at network reach metrics

[260] The threshold we apply in geographically classifying postcode sectors.

for these postcode sectors and reached the view that competitive conditions were sufficiently distinct from the CLA, and more similar to other HNR areas in the UK, to include them in the latter group.[261] We have again considered whether the CLA should be expanded to include postcode sectors contiguous to the CLA boundary with high network reach. We considered whether conditions of competition in these contiguous postcode sectors were sufficiently similar to the CLA to include them in the same market. However, we reached the view that they were not. In particular we did not find any contiguous postcode sectors with levels of competing network presence comparable to that found in the CLA.

A5.71 Table A5.10 shows the number of CLA postcode sectors in each competitive level classification. We found 12 postcode sectors that were classified as BT+1 within the CLA, with the remainder being HNR.

Table A5.10: No. of CLA postcode sectors in each competitive classification

Competitive classification	No. of postcode sectors
BT only	0
BT+1	12
BT+2	30
BT+3	46
BT+4	50
BT+5	46
BT+6	34
BT+7	31
BT+8	19
BT+9	10
Total	278

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

A5.72 Table A5.11 below sets out the competitive metrics for the 12 BT+1 postcode sectors within the CLA.

[261] BCMR 2019 Statement, Volume 2, paragraphs 5.106-5.115.

Table A5.11: Competitive indicators for BT+1 sectors within the CLA

Postcode Sector	No. of demand sites	Average distance (m) from customer sites to closest competing networks:			
		1st closest	2nd closest	3rd closest	4th closest
E1 2	16	13	37	67	81
E1 3	2	23	49	76	106
E1W 3	11	65	90	106	130
EC1R 4	11	10	24	37	53
EC1V 3	5	9	16	30	56
EC2Y 8	11	15	37	47	55
EC4Y 7	0	14	43	64	85
SW1X 8	4	17	46	59	74
W1A 1	8	20	48	57	61
WC1E 6	6	15	20	30	43
WC1X 9	5	14	38	50	79
WC2N 6	11	23	39	59	82
12 sectors combined	90	42	51	62	80

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 notices.

Average number of network operators

A5.73 Table A5.12 shows, for each geographic market, the average number of competing network operators within 50m of demand sites (i.e. for each demand site we identify the number of competing networks within 50m and then calculate an average for all demand sites in each geographic market).[262]

[262] In Volume 2 we sometimes refer to this as "average network presence" for shorthand

Table A5.12: The average number of network operators within 50m of demand sites for each geographic market (excluding the Hull Area)

Geographic Market	Average number of competing networks within 50m
CLA	5.1
HNR Area	2.4
Area 2	0.9
Area 3	0.2
UK exc. the Hull Area	0.9

Source: Ofcom's analysis of stakeholder responses to the WFTMR s.135 notices.

Proportion of demand sites within 50m of X competing networks

A5.74 Table A5.13 shows, for each geographic market, the proportion of demand sites within 50m of a certain number of competing networks. Areas of higher competition will see a higher proportion of demand sites within 50m of a higher number of competing networks – e.g. the CLA has 94% of demand sites within 50m of two or more competing networks.

Table A5.13: The proportion of demand sites within 50m of a certain number of competing networks, for each geographic market (excluding the Hull Area)

Geographic Market	Number of competing networks within 50m distance (X)										
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
CLA	100%	99%	94%	84%	71%	60%	45%	31%	18%	8%	1%
HNR Area	100%	97%	79%	40%	14%	6%	2%	1%	0%	0%	-
Area 2	100%	76%	13%	2%	1%	0%	0%	0%	0%	0%	-
Area 3	100%	17%	2%	0%	0%	0%	0%	0%	-	-	-

Source: Ofcom's analysis of stakeholder responses to the WFTMR s.135 notices.

Postcode sectors with no demand sites

A5.75 Table A5.14 shows, for each geographic market, the percentage of postcode sectors in each geographic market with no demand sites. Overall, 9% of postcode sectors do not have a demand site within their boundaries.

Table A5.14: The number of postcode sectors with no demand sites in the UK (excluding the Hull Area)

Geographic market	Number of postcode sectors with no demand sites	Percentage of postcode sectors in the relevant geographic market
CLA	11	4%
Area 2	171	3%
Area 3	623	16%
HNR Area	144	27%
UK	949	9%

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notice.

Connections and MNO inventory analysis

A5.76 In this section we describe and set out various results from the analysis of the 2017, 2018 and 2019 connections data and MNO inventory data.

Wholesale service shares

A5.77 Tables A5.15, A5.16, A5.17 and A5.18 show the wholesale service shares for individual years 2017, 2018, and 2019, and all three years combined, respectively, by geographic market and bandwidth.

Table A5.15: Number of connections in 2017 and Openreach's wholesale market service shares (%), by geographic market and bandwidth

Geographic Market	Number of connections in 2017			Openreach Wholesale Service Share (%)		
	All bandwidths	1Gbit/s and below	VHB inc. DF	All bandwidths	1Gbit/s and below	VHB inc. DF
CLA	7,989	7,476	471	[✂]% [51 - 60]%	[✂]% [61 - 70]%	[✂]% [21 - 30]%
HNR Area	6,347	6,095	216	[✂]% [61 - 70]%	[✂]% [61 - 70]%	[✂]% [41 - 50]%
Area 2	36,321	35,175	988	[✂]% [71 - 80]%	[✂]% [71 - 80]%	[✂]% [51 - 60]%
Area 3	13,173	12,903	246	[✂]% [91 - 100]%	[✂]% [91 - 100]%	[✂]% [61 - 70]%
UK exc. Hull Area	63,829	61,648	1,920	[✂]% [71 - 80]%	[✂]% [71 - 80]%	[✂]% [41 – 50]%

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

Table A5.16: Number of connections in 2018 and Openreach's wholesale market service shares (%), by geographic market and bandwidth

Geographic Market	Number of connections in 2018			Openreach Wholesale Service Share (%)		
	All bandwidths	1Gbit/s and below	VHB inc. DF	All bandwidths	1Gbit/s and below	VHB inc. DF
CLA	6,859	6,415	371	[✂]% [61 - 70]%	[✂]% [61 - 70]%	[✂]% [31 - 40]%
HNR Area	6,857	6,559	223	[✂]% [51 - 60]%	[✂]% [51 - 60]%	[✂]% [51 - 60]%
Area 2	39,176	37,548	1,245	[✂]% [61 - 70]%	[✂]% [61 - 70]%	[✂]% [51 - 60]%
Area 3	12,578	12,247	292	[✂]% [81 - 90]%	[✂]% [91 - 100]%	[✂]% [61 - 70]%
UK exc. Hull Area	65,470	62,769	2,132	[✂]% [61 - 70]%	[✂]% [61 - 70]%	[✂]% [51 - 60]%

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

Table A5.17: Number of connections in 2019 and Openreach's wholesale market service shares (%), by geographic market and bandwidth

Geographic Market	Number of connections in 2019			Openreach Wholesale Service Share (%)		
	All bandwidths	1Gbit/s and below	VHB inc. DF	All bandwidths	1Gbit/s and below	VHB inc. DF
CLA	7,273	6,625	603	[✂]% [51 - 60]%	[✂]% [61 - 70]%	[✂]% [31 - 40]%
HNR Area	7,646	7,148	456	[✂]% [51 – 60]%	[✂]% [51 – 60]%	[✂]% [51 - 60]%
Area 2	46,200	42,959	3,030	[✂]% [61 - 70]%	[✂]% [61 - 70]%	[✂]% [71 - 80]%
Area 3	13,211	12,805	388	[✂]% [81 - 90]%	[✂]% [81 - 90]%	[✂]% [71 - 80]%
UK exc. the Hull Area	74,330	69,537	4,478	[✂]% [61 - 70]%	[✂]% [61 - 70%]	[✂]% [61 - 70]%

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

Table A5.18: Number of connections in 2017, 2018 and 2019 and Openreach's wholesale market service shares (%), by geographic market and bandwidth

Geographic Market	Number of connections in 2017, 2018 and 2019			Openreach Wholesale Service Share (%)		
	All bandwidths	1Gbit/s and below	VHB inc. DF	All bandwidths	1Gbit/s and below	VHB inc. DF
CLA	22,145	20,511	1,470	[✂]% [51 – 60]%	[✂]% [61 - 70]%	[✂]% [31 - 40]%
HNR Area	20,848	19,791	899	[✂]% [51 - 60]%	[✂]% [61 - 70]%	[✂]% [51 - 60]%
Area 2	121,858	115,781	5,306	[✂]% [61 - 70]%	[✂]% [61 - 70]%	[✂]% [61 - 70]%
Area 3	38,909	37,949	878	[✂]% [91 - 100]%	[✂]% [91 - 100]%	[✂]% [71 – 80]%
UK exc. the Hull Area	203,761	194,033	8,553	[✂]% [71 – 80]%	[✂]% [71 - 80]%	[✂]% [51 - 60]%

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

Mobile backhaul service shares

A5.78 Table A5.19 shows, for each geographic market, shares in the supply of mobile backhaul services to MNO.

Table A5.19: BT and competing network share of supply to MNOs (%), by geographic market

Geographic market	BT[263]	Virgin Media	Vodafone	Other
CLA	[✂]%	[✂]%	[✂]%	[✂]%
HNR Area	[✂]%	[✂]%	[✂]%	[✂]%
Area 2	[✂]%	[✂]%	[✂]%	[✂]%
Area 3	[✂]%	[✂]%	[✂]%	[✂]%
UK exc. the Hull Area	[✂]%	[✂]%	[✂]%	[✂]%

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 Notices.

A5.79 Table A5.20 shows that all MNOs purchase backhaul access services from both BT and Virgin Media, MNOs also purchase services from other networks.

[263] Openreach and BT Wholesale combined service share.

Table A5.20: Telecoms providers’ share of supply to mobile network operators

	MBNL, EE, Three	Telefónica	Vodafone	Total
BT[264]	[✂]%	[✂]%	[✂]%	[✂]%
Virgin Media	[✂]%	[✂]%	[✂]%	[✂]%
Other	[✂]%	[✂]%	[✂]%	[✂]%

Source: Ofcom’s analysis of the stakeholder responses to the WFTMR s.135 Notices.

A5.80 Table A5.21 shows, for each geographic market, BT’s share in the supply of mobile backhaul services to MNOs.

Table A5.21: BT’s share of supply by geographic market

Geographic Market	BT share of supply to MNOs only
CLA	[✂]%
HNR Area	[✂]%
Area 2	[✂]%
Area 3	[✂]%
UK exc. the Hull Area	[✂]%

Source: Ofcom’s analysis of the stakeholder responses to the WFTMR s.135 Notices.

Distance to competing network operators’ infrastructure

A5.81 We looked at the proximity of competing telecoms infrastructure providers’ networks to customer circuit ends connected in 2017, 2018 and 2019 as a measure of the distances competing networks would potentially have to dig to provide leased lines to customers.

A5.82 Each competitor’s distance to a 2017, 2018 and 2019 connected customer circuit end is ranked by their closeness, with averages for these different rankings then calculated. The average distances to the four closest competing network operators by geographic market are shown in Table A5.22 below.

[264] Openreach and BT Wholesale combined service share.

Table A5.22: The average distance from customer's circuit ends connected in 2017, 2018 and 2019 to competing network operators by geographic market

Geographic Market	Average distance (m) from customer sites to closest competing networks:			
	1st closest	2nd closest	3rd closest	4th closest
CLA	14	23	31	42
HNR Area[265]	20	41	104	243
Area 2	79	389	851	1,924
Area 3	1,857	4,001	7,530	11,236
UK exc. the Hull Area	413	1,020	1,993	3,375

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

Installation of new infrastructure

A5.83 Tables A5.23 show results of analysis on the extent of digging by Openreach, competing networks and geography. We calculate the following statistics:

- proportion of 2017, 2018 and 2019 connections already duct connected ('on-net duct connected')[266], connections where digging was required ('on-net dig'), and connections purchased from a third party (i.e. 'off-net');
- the "build vs. buy" metric which shows the proportion of connections where digging was required compared to those that were purchased from a third party; and
- the median distance dug.

Table A5.23: An analysis of digging behaviour by geographic market and competing networks

Infrastructure indicator		CLA	HNR Area	Area 2	Area 3
Openreach's proportion of new 2017, 2018 and 2019 connections already duct connected		[✂]% [91 - 100]%	[✂]% [91 - 100]%	[✂]% [81 - 90]%	[✂]% [81 - 90]%
Competitors' breakdown of new 2017, 2018 and 2019 connections[267]	Customer ends	9,376	10,317	60,303	15,260

[265] There are seven postcodes in Belfast that we have excluded from this calculation due to erroneous postcode centroid coordinates.
[266] To connect these circuits, network operators may have had to install fibre tubing, blow fibre or use an existing fibre connection to the end customer.
[267] 'On-net duct connected' is where a telecoms provider has existing duct in place to the customer site, but fibre may need to be installed. 'On-net dig' is where a telecoms provider extends their network by building new duct. 'Off-net' is where an active wholesale leased line product is purchased from another provider to reach the customer.

	On-net duct connected	70%	57%	48%	17%
	On-net dig	4%	13%	9%	2%
	Off-net	26%	29%	42%	81%
Competitors' build vs. buy[268]		13%	32%	18%	3%
Median radial distance dug in 2017, 2018 and 2019 (m)	Openreach	[✂] [0 - 25]	[✂] [0 - 25]	[✂] [0 - 25]	[✂] [0 - 25]
	Competing networks	7.14	10.71	15.71	17.86

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

A5.84 We also looked at how digging by competing networks in the provision of VHB services (>1 Gbit/s) compared with that for services offering speeds of 1 Gbit/s and below. We found that over the period 2017 to 2019:

- 8% of new connections involved some digging;
- 30% of new VHB connections involved some digging compared with 7% for slower speeds; and
- the median dig distance for new VHB connections was 20m compared with 14m for slower speeds.

A5.85 Table A5.24 shows the proportion of [✂] connections that required new duct, new cabling, and new blown fibre.

Table A5.24: Analysis of [✂] connections

New infrastructure or other aspects required	Openreach connections (circuits, not circuit ends)	
	2017	2018 and 2019
New duct	[✂]%	[✂]%
New fibre	[✂]%	[✂]%
New tubing	N/A	[✂]%

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 notices.

**These figures are rounded to the nearest integer so do not add up to 8%.*

Circuit density

A5.86 Table A5.25 shows the average number of customer ends connected in 2017, 2018 and 2019 per square kilometre by geographic markets.

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[268] We determine rivals 'build' (on-net dig) as a percentage of rivals 'build' (on-net dig) plus rivals 'buy' (off-net) in relation to the supply of a leased line to a customer's site outside their existing network reach.

Table A5.25: The average number of 2017, 2018 and 2019 connections per square kilometre for each geographic market (excluding the Hull Area)

Geographic Market	Number of circuits (per sq km)
CLA	657.1
HNR Area	47.1
Area 2	3.6
Area 3	0.2

Source: Ofcom's analysis of the stakeholder responses to the 1st BCMR s.135 notice and WFTMR s.135 Notices.

IEC proximity analysis

Distance to competing network operators' infrastructure

A5.87 In Volume 3, Section 6 we set out our decision that Openreach is required to make dark fibre available for the supply of inter-exchange connectivity at BT Only exchanges with no competing networks within 100m. To identify these exchanges, which we list in Schedule 4 of our legal instrument, we looked at the average and median distances from BT exchanges to competing network infrastructure.[269]

A5.88 Each PCO's distance to a BT exchange[270] is ranked by their closeness, with averages and medians for these different rankings then calculated. These are shown in Table A5.26 below for each presence classification at a BT exchange.[271]

Table A5.26: The average and median distance from BT exchanges to PCOs for each BT exchange presence

Presence at BT exchange	Average distance (m) to:		Median distance (m) to:	
	1st closest	2nd closest	1st closest	2nd closest
BT Only	5,565	11,585	2,588	5,712
BT+1	39	875	23	250
BT+2 or more	23	57	21	37

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 notices.

[269] When conducting analysis in areas 2 and 3, we found 3 out of 5,569 exchanges have inconsistencies with eastings and northings coordinates to their postcode. Any analysis done when comparing exchanges to these area classifications will therefore be compared to 5,566 exchanges.

[270] BT exchanges are assumed to be located at their postcode centroid.

[271] In BT+1 exchanges, the first closest rival is connected to the exchange either directly, within the exchange, or via an external cablelink if it within 100m of the exchange. Together with the use of postcode centroid as a measurement, this means that the distance to an already connected telecom providers is not zero.

Fibre connected buildings analysis

A5.89 We asked network operators to provide a list of customer sites[272] for which they have a leased line fibre connection, whether the fibre connection was currently in use (i.e. active) or available for use but not in use currently (i.e. inactive).[273]

A5.90 However, most could not provide the information requested in relation to inactive connections.[274] [✂] provided a [✂] which is a snapshot of their fibre infrastructure covering most metro areas in the UK.[275] [✂] could not provide a list of active or inactive sites.

Data cleaning and processing for fibre connected buildings

A5.91 We excluded some connections in the data provided by network operators identified as off-net, and created a list of on-net active fibre connections for each network operator in each postcode. We added to this list a number of circuits identified in the connections dataset but missing from the list of active connections (on the assumption that recent connections would still be active).[276] For [✂] and [✂] this was our only source of data on active connections and, as such, the list of active connection is likely to understate the true number of fibre connected buildings for these network operators.

Analysis and results for fibre connected buildings

A5.92 We investigated each network operator's 'presence' in each postcode, where 'presence' is given by a network operator having an active fibre connection in that postcode. We then classify a postcode based on this 'presence' into the following categories:

- Only competing network operators to Openreach have 'presence' ('rivals only');
- Only Openreach have 'presence' ('BT only'); and
- Openreach and a number of its competing networks have 'presence' ('BT+1', 'BT+2' and 'BT+3 or more').

A5.93 As most network operators could not provide information on inactive connections and [✂] could not provide information outside the CLA and most metro areas, this analysis is limited to active connections in the CLA.

A5.94 In Table A5.27 we present the proportion of circuits (or volumes) in each of the 'presence' categorisations. By presenting the proportion of volumes, this reflects the scale of demand in each of these categorisations (i.e. postcodes with more circuits will have a higher contribution to the proportion). An alternative to volumes would have been to look at the proportion of postcodes in each category, where the same weight is given to each postcode regardless of the scale of demand.

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[272] A customer site is any customer location to be served by a telecoms provider, for example, a residential property, business premises or mobile base station.
[273] Stakeholder responses to our WFTMR s.135 notices.
[274] Due to either not having the information on their systems or they did not have any inactive fibre connections.
[275] [✂]'s response to question 5 of the WFTMR s.135 notices.
[276] An additional 2.13% of active connections were found on top of our fibre connected buildings data set.

Table A5.27: Existing connections at postcodes by share of circuit volume for the CLA

Operators at postcode	% of volumes[277]
(proxy for building in CLA)	(only operators with active circuits) CLA
Rivals only	[✂]% [10 - 20]%
Openreach +3 or more	[✂]% [0 - 10]%
Openreach + 2	[✂]% [10 - 20]%
Openreach + 1	[✂]% [30 - 40]%
Openreach only	[✂]% [30 - 40]%

Source: Ofcom's analysis of the stakeholder responses to the WFTMR s.135 Notices.

A5.95 Table A5.27 shows that competing network operators are providing active fibre connections in postcodes accounting for [✂]% of volumes in the CLA. This includes [✂]% of volumes in postcodes with Openreach and at least three competitors with 'presence' and [✂]% of volumes in postcodes where only competitors have 'presence'. Openreach was the only operator with 'presence' in postcodes accounting for [✂]% of volumes in the CLA.

[277] Figures do not add to 100% due to rounding.

A6. Inter-exchange connectivity

A6.1 As explained in Volume 2, Section 8, in order to assess significant market power (SMP) in inter-exchange connectivity, we have looked at Principal Core Operator (PCO) presence at BT exchanges.

A6.2 To identify the number of PCOs present at BT exchanges we have looked at sales of external Cablelink products at BT exchanges.[278]

A6.3 In this annex, we explain how we have undertaken our presence analysis. We also detail the results of our analysis, explaining how and why they have changed since the 2019 BCMR Statement. Finally, we provide a high-level description of the modelling process we have used to complete our analysis.

Information request to Openreach

A6.4 On 15 October 2020, we sent a statutory information request to Openreach which requested data on sales of external Cablelink products.[279, 280] We requested confirmation of which customer was purchasing which product, including the numbers of each product, and at which exchange.

A6.5 On 22 October 2020, Openreach responded to our request. It provided a list of customers that had purchased an external Cablelink product. There were three variants included: 'BT Cablelink-External', 'Cablelink External', and 'LLU Egress – External'. It also provided a list of sales of internal Cablelink products (1-3)[281], other legacy internal products[282] and a Cablelink Cell Sites product.

Information request to BT

A6.6 In the 2019 BCMR, we identified that BT's downstream divisions were reselling external Cablelink products to other telecoms providers.

A6.7 On 19 November 2020, we sent a statutory information request to BT in order to confirm which telecoms providers it was supplying external Cablelink products to. BT provided a response on

[278] In order for a non-BT network to connect to a BT exchange, it needs to purchase an external cablelink product. These products can be purchased both by the PCO (e.g. Virgin Media) or by a non-PCO telecoms provider that wants an inter-exchange connectivity service from the exchange (e.g. TalkTalk). In both instances, we request confirmation as to the underlying network providing the service. This is why purchases of external cablelink products are a good indicator of PCO presence at BT exchanges.

[279] There are a number of different cablelink products. For this assessment we are primarily interested in external cablelink product. These are products that allow telecoms providers to connect network equipment within an exchange to non-BT fibre outside the exchange.

[280] We note, that prior to issuing this statutory request, we established from Openreach that BT Cablelink (a legacy cablelink service) has both internal and external variants. In the request sent on 15 October 2020, we asked Openreach to separate and provide information to us on its sales of external variants of BT Cablelink.

[281] We decided not to look at these links as they helped to identify reseller relationships but did not further help to identify fibre providers present at the BT exchange. We considered it would be disproportionate to look at these, given that it would not enhance our analysis of presence at BT exchanges.

[282] These are inclusive of BT Cablelink – Internal and LLU Egress – Internal. We note [✂].

17 December 2020. The information we received showed that BT was supplying [✁] with external Cablelink products. Therefore, we sent further statutory requests to these telecoms providers to understand what they were using these products for.

Information requested from other telecoms providers

A6.8 In November 2020 and December 2020, we sent further statutory information requests to 33 of the largest providers and buyers of inter-exchange connectivity (IEC) services.

A6.9 We asked these providers to verify their purchases of external Cablelink products from Openreach and confirm what they were using them for. We also asked these telecoms providers questions about their plans at BT exchanges, and whether there had been any changes or new entry in the provision of IEC services since the 2019 BCMR Statement.

Data check

A6.10 Having received the data from telecoms providers we undertook data quality checks and reviewed the consistency of results with those from the 2019 BCMR.

A6.11 We did find a difference in the results, primarily driven by an apparent reduction [✁]. The difference in results could have been caused by a real change in competitive network presence or a reporting error (either in response to the 2019 BCMR information requests, or in response to the information requests for this review).

A6.12 Therefore, we issued [✁] to confirm their status at exchanges where the data showed a change, detail the reasons for any discrepancy and more generally check responses to our information requests.

A6.13 We received [✁] explained that [✁]. This showed that an error in the data provided in response to 2019 BCMR was a main driver behind the change in results between 2019 BCMR and this review. This had overstated competitive network presence. This error has now been corrected.

A6.14 We note that in most other instances, compared to the results in 2019 BCMR, there were only small or no change in PCO presence. For example, [✁]. There was a more material increase [✁], and a reduction in [✁][283].

A6.15 Separately, we identified a small discrepancy in our lists of BT exchanges. Following internal checks, we requested a clarification from Openreach[284], as to whether these sites were exchanges. Openreach confirmed that four sites had been mistakenly listed as exchanges, and were in fact a mixture of cabinets and non-MDF sites.[285] As such, we have removed them from our list of exchanges.

[283] We note that the [✁].
[284] Clarification to s.135 WFTMR-20 sent to [✁].
[285] The sites that were incorrectly listed as exchanges are: EALLN (Lucy Lane), MRMHE (Martin Heath UAX), EANCE (Norwich Russell House), LNILC/LNROD (Millhouse). We discuss the impact that changes to the classification of BT exchanges have on our remedies in Volume 3 Section 5 and 6.

The results of our analysis

A6.16 As in the 2019 BCMR, we have only counted PCO presence at BT exchanges.

A6.17 In summary, we have identified 4275 exchanges as BT Only, 745 as BT+1 and 549 as BT+2 or more.

A6.18 We have provided a detailed list of exchanges that we have decided to regulate and not regulate in Schedule 4 to the legal conditions in Volume 7. This includes information on whether BT is required to provide access to dark fibre at a given BT Only exchange. It also provides further detail on the regulation that applies for multiple MDF IDs that are co-located within one exchange building.

Changes in presence since the 2019 BCMR Statement

A6.19 We note that the results of our assessment are similar to those in our 2019 BCMR Statement.

A6.20 Nevertheless, there have been some changes in our results. There has been a decrease in the number of exchanges that are BT+2 or more (-22 exchanges), and an increase in BT+1 (+13 exchanges) and BT Only (+9 exchanges). There has however been larger changes at the exchange level.

A6.21 The two tables below summarise the changes to our findings.[286]

Table A6.1: Change in presence at BT exchanges

Type	BCMR 2019	WFTMR 2021	Change
BT Only	4266	4275	+9
BT+1	732	745	+13
BT+2 or more	571	549	-22
Total	5569	5569	

Table A6.1: Change in presence at the exchange level[287] [288]

Type of change	Count of change
BT Only to BT+1	14
BT Only to BT+2 or more	2
BT+1 to BT Only	25

[286] The 2019 BCMR numbers have been updated to reflect the removal of the four non-exchange sites mentioned above. This is to help aid the comparability of the results. So, in the 2019 BCMR 4269 exchanges were classified as BT Only, 733 BT+ 1 and 571 as BT+2 or more (LNILC was classified as BT+1 and the other three BT Only).
[287] As noted above, a significant driver for changes to the results was the error in the input data provided [✂] in response to statutory requests in the 2019 BCMR. As such, we consider the data we have received through statutory powers, as part of this review, to be a better reflection of PCO presence outside BT exchanges.
[288] Due to the changes in exchange classification a number of exchanges have been de-regulated (i.e. 22 exchanges) and others have been re-regulated. Please see Section 8 and the relevant remedies Sections (5 and 6) in Volume 3.

BT+1 to BT+2 or more	20
BT+2 or more to BT+1	44
BT+2 or more to BT Only	0
No change	5464
Total	5569

High-level description of our modelling approach

A6.22 The purpose of our IEC model is to find PCO presence at BT exchanges. The model allows us to identify and choose which telecoms providers are PCOs and which are not.

A6.23 There are two input sources used in the model:

a) BT has provided a list of their exchanges; and

b) Each telecoms provider has responded to our statutory information requests with information about their use of external Cablelink products from Openreach and/or BT, and which non-BT networks they are using for the purpose of receiving backhaul/core services.

A6.24 An automated VBA script collates the responses from the data provided in response to our statutory information requests to a single input summary table and uses this information to calculate the number of PCOs that are present at each BT exchange.

A6.25 A summary table is produced, which details the BT exchanges where no PCOs are present, one PCO is present and the exchanges where two or more PCOs are present.

A7. Potential adverse effects of the physical infrastructure access remedy

A7.1 In Volume 3, Section 4 we set out that we consider, in this review period, that any adverse effects arising from the imposition of our physical infrastructure access (PIA) remedy are not disproportionate to our overall aim since the benefits that accrue outweigh any such effects.

A7.2 In this annex we present our detailed assessment of the potential adverse effects of the PIA remedy, to inform our assessment of the proportionality of this remedy.

A7.3 We have considered the following potential adverse effects:

- Impact on dynamic efficiency: We consider the potential for the PIA remedy to adversely affect the investment incentives of BT and other telecoms operators.
- Impact on Openreach's pricing structures: We consider the potential for the PIA remedy to flatten the bandwidth price gradient which could lead to inefficient common cost recovery.
- Cost of competition: We recognise that competition could lead to some duplication of costs which could put upward pressure on industry average costs.
- Impact on competitive markets: We consider the effect of a PIA remedy on some markets which we already deem competitive.
- Externalities caused by our approach to network adjustment costs: We consider whether our approach to the recovery of network adjustment costs might give rise to adverse effects.

Impact on dynamic efficiency

A7.4 In developing our PIA remedy, we have sought to enhance the investment incentives both of BT and of other telecoms providers. We have considered incentives to invest in both residential broadband markets and business connectivity markets.

Impact on end-to-end telecoms providers other than BT

A7.5 An effective PIA remedy will reduce the absolute costs and time required to build fibre networks, and we expect that this will encourage competitors to invest in their own networks. We have considered what effect this will have on existing end-to-end competition (i.e. where competitors build their networks from scratch, including building their own physical infrastructure), for both broadband and business markets.

A7.6 We recognise that existing end-to-end competitors which have already deployed networks by building their own physical infrastructure may face a more competitive environment in certain areas, which could affect their ability to retain some of their customers without adjusting prices. However, at the same time, an effective PIA remedy provides these telecoms providers with opportunities to expand their networks at lower cost and more quickly, allowing them to compete in other areas where it would not be viable to deploy their own physical infrastructure. Given the higher costs and time required to build a new network from scratch, the scope for end-to-end network competition is likely to be more limited than the scope for network competition based on PIA. Therefore, to the extent our remedy displaces some end-to-end competition, this is likely to be small, and far outweighed by the significant benefits of realising network competition based on PIA in potentially many more geographic areas. We also note that existing end-to-end competitors are generally supportive of the PIA remedy.

Impact on BT's incentives to invest

A7.7 We consider that BT's SMP in physical infrastructure has been a factor in limiting network investment. As noted above, we expect that the PIA remedy will encourage competitors to invest in their own networks. We observe that it has been competition which has previously incentivised BT to invest in upgrading its services and we expect competition, or the threat of competition, to continue to incentivise BT to invest.[289]

A7.8 While we have seen some benefits from the network competition that already exists between BT and Virgin Media, we consider that a greater degree of network competition – in terms of the number and geographic coverage of competing networks – will drive a material change in outcomes. Greater network competition, enabled by our PIA remedy, will open up more of the value chain to more effective competition than is the case under current wholesale access remedies.

Impact on BT's cost recovery

A7.9 By allowing telecoms providers to use PIA for business connectivity services, this should have the effect of increasing the competitive pressure on Openreach's business connectivity wholesale active products, especially in geographies where these are currently subject to limited or weak competition. Similarly, in broadband markets we expect competition, or the threat of competition, to incentivise BT to invest in upgrading its services.

A7.10 As a result of competition, Openreach might see a reduction in its local access and leased lines volumes which could affect BT's ability to recover its costs from regulated products.[290] If BT does not have a fair opportunity to recover the costs of its previous investments, it could undermine its incentives to make future investments.

A7.11 Over the market review period, we recognise that Openreach may experience a reduction in its leased lines volumes as a result of our PIA remedy. While we expect PIA to be effective in increasing competition in this market, we consider that Openreach will be able to adjust to the new competitive conditions such that it can recover the cost of existing assets. Accordingly, we believe that even with a declining share of the sales of active leased lines, Openreach will still be able to recover the costs of these undepreciated assets from future charges for its leased line sales. Moreover, in the charge control we are imposing, we believe we have allowed sufficient flexibility for Openreach to recover some revenues to compensate for any reduced leased lines sales.

A7.12 Similarly, we would expect Openreach to experience a loss in WLA volumes as a result of the PIA remedy. Insofar as this is a loss of volumes served by its copper network we consider that

[289] Ofcom, 2019 PIMR Statement, paragraph A1.9.
[290] Alternatively, it may reduce prices to maintain market share but with the same effect.

our charge controls should ensure that Openreach will be in a position to recover its efficiently incurred costs over this review period. We would expect Openreach to take account of the challenge imposed by PIA in its investment in FTTP networks.

Impact on Openreach's pricing structures

A7.13 We have considered the impact that widespread use of the PIA remedy we are imposing (including for leased lines) could result in Openreach having to change its existing pricing structure. Openreach has a large amount of fixed and common costs and needs to make sufficient revenue to allow for their recovery.[291] We have historically provided Openreach with flexibility to set prices for individual products, which has resulted in it pricing according to a bandwidth gradient. We acknowledge that in theory a bandwidth pricing gradient can allow a more efficient recovery of common costs relative to a flat pricing structure.

A7.14 In general, when imposing wholesale access remedies in market reviews, Ofcom has given BT flexibility in setting prices in the hope that this would lead BT to recover its common costs relatively efficiently. However, taking regulatory measures in order to encourage relatively efficient pricing in circumstances where competition is absent does not imply that it is desirable to restrict (or avoid promoting) competition simply in order to preserve BT's ability to set prices flexibly. The purpose of the PIA remedy is to subject BT and the decisions it makes to substantially greater competition and contestability. We accept that the presence of effective competition will mean Openreach will have less control over pricing; that is a natural and desirable constituent of a more competitive market.

Cost of competition

A7.15 Our strategy for competing networks will entail some duplication of costs, which could put upward pressure on average costs. Duplication of fixed costs occurs in many markets across the economy and is a normal element of the process of competition. In fixed telecoms the presence of the Virgin Media network entails substantial fixed cost duplication, but it has been an important source of competitive pressure on BT and has delivered substantial benefits for consumers over many years. Accordingly, the presence of duplication of fixed costs is an accepted constituent part of our pro-competition strategy.

A7.16 The PIA remedy helps reduce the scale of fixed cost duplication by allowing new networks to use BT's ducts and poles, significantly lowering the extent of replication of fixed costs.

Impact in competitive markets

A7.17 In Volume 2 Section 8, we conclude that BT does not have SMP in the provision of LL Access services in the CLA. One of the factors in our finding is the increased competitive constraint BT will face from competitors in the CLA as a result of competitors using PIA.

[291] Common costs are those costs that do not vary with output and are common to two or more products or services, which cannot be avoided except by closure of all the activities to which they are common.

A7.18 While we accept that the prospect of greater competition in the CLA will put pressure on existing operators in that area, we consider that the PIA remedy will sustain and support greater competition in competitive markets such as the CLA as existing network operators infill network extensions using the PIA remedy and new entrants are provided a lower cost route to entry.

A7.19 We have also considered the potential impact of the PIA remedy on some inter-exchange and backhaul markets, that we already consider competitive. We do not consider that the remedy will have a material impact on existing competition as the distances between the exchanges and the existence of competing wholesale providers of backhaul means that investment in further capacity is unlikely to be commercially attractive, so to the extent there is any impact it is likely to be minimal.

Externalities caused by our approach to network adjustment costs

A7.20 Under the remedy, Openreach recovers network adjustment costs over all users of the infrastructure subject to a financial limit. We think this is necessary to promote competition by reducing barriers to investment in competing networks, including ensuring a level playing field with respect to the recovery of these costs. We consider below whether our approach to the recovery of network adjustment costs might give rise to adverse effects which are disproportionate compared to our objectives. We have considered the following potential adverse effects:

a) The risk of promoting inefficient entry;

b) The risk of encouraging inefficient network adjustments;

c) The risk of distorting competition;

d) The financial impact on Openreach; and

e) The impact on consumers.

A7.21 In general, the scale of the impact of our approach to network adjustments is contingent on the scale of network deployment, and so is directly linked to the scale of the benefits that result from imposing the PIA remedy. As a result, we consider that any adverse impacts are more likely to be justified by significant benefits to consumers in the longer term from greater network competition.

Risk of promoting inefficient entry

A7.22 We recognise that our approach to cost recovery may result in competing network build occurring in circumstances where the build would not be profitable if access seekers had been charged for the network adjustments and such build may not be productively efficient.

A7.23 However, we are proposing to require BT to provide access to its physical infrastructure with the aim of promoting competition and investment in rival networks, in the context of BT’s substantial incumbency advantages. Our approach to the recovery of network adjustment costs is necessary to support this objective. We anticipate significant dynamic benefits to consumers where actual network competition emerges, which are not taken into account in the profit evaluations of potential entrants. This means that even if our approach does entail some degree of productive inefficiency, that does not mean our approach is inappropriate.

A7.24 While the dynamic benefits we expect to arise as a result of promoting greater network competition cannot be readily or reliably quantified, we consider it likely that they will far exceed the likely costs of network adjustments. We have also introduced a financial limit to provide a greater degree of certainty around the costs of network adjustments.

Risk of encouraging inefficient network adjustments

A7.25 We recognise that there is a risk that telecoms providers may have a weaker incentive to minimise requests for network adjustments than under any approach where they faced some cost of network adjustments. However, we do not consider this to be a significant risk, as the ability for telecoms providers to obtain inefficient adjustments is limited by the network access obligation: Openreach is only required to make adjustments that are necessary, feasible, and where making the adjustment is more efficient than it would be for the telecoms provider to build its own network. Openreach can also suggest alternative, more efficient solutions to meet its obligation.

A7.26 We recognise that by imposing a financial limit on the network adjustment costs to recover across all users of the infrastructure, Openreach could have a reduced incentive to keep costs under the financial limit, to dissuade telecoms providers from requesting network adjustments. However, by setting the financial limit at a level which should include the cost of all adjustments other than those that are exceptionally high cost, and because there are some limitations on Openreach's ability to inflate costs, we are of the view that this will not be an issue in the majority of circumstances.

Risk of distorting competition

A7.27 We have considered if our approach to network adjustments costs would distort Openreach's competitive position, compared to other network providers which did not face the same obligation.

A7.28 We have previously estimated that the costs for network adjustments to leased lines will be immaterial.[292] Whilst we expect network adjustment costs to increase further over this review period, we still believe the effect on Openreach's prices will be immaterial, given Openreach's large customer base.

A7.29 These small increases in prices are unlikely to affect Openreach's ability to compete, particularly given its SMP. However, the impact of the measures we are imposing, and objective of the PIA remedy, is that other telecoms providers will be able to compete more effectively with Openreach.

[292] WLA 2018, Volume 3, paragraph 4.89; PIMR 2019, Section 7, Volume 1.

Financial impact on Openreach

A7.30 We recognise that our approach requires Openreach to recover additional costs of network adjustments over all products that use the physical infrastructure. However, we do not consider that this approach transfers significant risk to Openreach.

A7.31 When regulating prices, we seek to ensure that Openreach has an opportunity to recover its efficiently incurred costs, including a return which reflects the risks of the investment. Physical infrastructure is a shared asset supporting a range of products, which lowers the risk associated with investment required to undertake network adjustments. We expect Openreach to have a customer base over which to recover these costs for the foreseeable future. Even if Openreach loses significant volumes of downstream customers to competing networks built using PIA, Openreach will still be able to recover these costs from charges for PIA users.

Impact on consumers

A7.32 We recognise that an increase in the costs Openreach recovers over products which use its physical infrastructure will increase the costs to be recovered by users other than of the competing telecoms provider. However, this needs to be weighed against the significant benefits to consumers in the longer term from innovation (including innovation to increase efficiency and lower costs), choice, stronger incentives to price keenly to attract customers and higher quality of service, which will benefit a wide group of consumers.

A7.33 Where costs are incurred, we consider there to be little risk of the costs being incurred without these benefits to consumers arising. This is because the chances of the services deployed using PIA of being withdrawn after deployment are small.

A8. Guidance on PIA network adjustments and no undue discrimination compliance

A8.1 In Section 4, we outlined our specific access remedies for access to BT's physical infrastructure. Our specific access remedies include a requirement on BT to make adjustments to its physical infrastructure network in certain circumstances. In Section 3, we also propose to impose a no undue discrimination requirement on BT in the physical infrastructure market.

A8.2 In this annex, we outline our guidance on what we consider a network adjustment constitutes, and how we propose to monitor Openreach's compliance with our no undue discrimination remedy in the physical infrastructure market.

Network adjustments

The requirement to make network adjustments is limited

A8.3 While our approach allows Openreach some degree of flexibility, we are concerned to ensure that Openreach does not act unreasonably. Therefore, where Openreach refuses a request for network access, it should provide reasons for doing so. Furthermore, if it becomes apparent that this approach is not working, we will reconsider whether it is appropriate to adopt a more prescriptive approach.

A8.4 When designing our guidance on the extent of the network adjustments requirement we have taken into account the factors set out in section 87(4) of the Act, in particular:

a) the technical and economic viability (including the viability of other network access products, whether provided by the dominant provider or another person), having regard to the state of market development, of installing and using facilities that would make the proposed network access unnecessary;

b) the feasibility of the provision of the proposed network access;

c) technological developments that are likely to affect the design of the network;

d) the need to ensure that the provision of network access does not have the effect of favouring one form of technology over another in relation to the design and management of the network;

e) the investment made by the person initially providing or making available the network or other facility in respect of which an entitlement to network access is proposed (taking account of any public investment made);

f) the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long-term and to support innovative business models that support sustainable competition.

A8.5 In our guidance, we have set out the criteria we expect to apply. In selecting these criteria, we have taken particular account of the first, second and sixth of the 87(4) factors set out above. We consider these factors follow on from our reasons for imposing a PIA obligation. Without access to BT's physical infrastructure network, large-scale network deployment in significant parts of the country is likely to be unviable. As explained above, without an obligation to make network adjustments, the scope for competitive network investment will be reduced. Moreover, our objective in imposing PIA is to unlock the efficiencies arising from sharing existing infrastructure to the greatest extent possible to help facilitate competitive network investment at scale, and therefore promote effective competition in the long-term. However, in imposing PIA we are concerned that the obligation is appropriately limited and that we do not create incentives to use PIA where this is not necessary.

A8.6 Specifically, our view is that the following three criteria should be applied to determine whether a particular network adjustment falls within the scope of the PIA obligation.

- **Is the requested adjustment necessary?** This criterion considers the narrow question of whether an alternative option exists which would render the requested adjustment unnecessary, taking account of the first factor set out in section 87(4) of the Act.
- **Is the requested adjustment feasible?** This criterion considers whether there are barriers that prevent Openreach from being able to make the required adjustment, taking account of the second factor set out in section 87(4) of the Act.
- **Does the requested adjustment improve efficiency?** This criterion considers whether the requested adjustment promotes efficiency and is therefore consistent with our rationale for requiring BT to provide network access in the form of PIA (i.e. to unlock the efficiencies from sharing existing infrastructure). This takes account of the sixth factor set out in section 87(4) of the Act.

A8.7 With respect to the third and fourth factors set out in section 87(4) of the Act, our criteria are technologically and network design neutral and therefore take account of these factors.

A8.8 With respect to the fifth factor set out in section 87(4) of the Act, we take account of this through our approach to cost recovery, set out in Volume 4. Specifically, we ensure that Openreach has a fair opportunity to recover the costs of any network adjustments.

Defining a network adjustment

A8.9 Before discussing the three criteria we intend to apply to determine the extent of the PIA obligation on Openreach, we clarify what we mean by a network adjustment:

Facilitating access to existing infrastructure

A8.10 Network adjustments forming part of PIA involve facilitating access to existing infrastructure, rather than the construction of new infrastructure. Since the specific network access obligation proposed in this review requires Openreach to provide access to existing physical infrastructure, it does not ordinarily require Openreach to construct physical infrastructure on behalf of other telecoms providers. This does not mean that Openreach is never required to construct new physical infrastructure assets (e.g. new ducts, chambers or poles), but where it is required to do so, this will be for the purposes of facilitating access to existing physical infrastructure.

A8.11 Therefore, Openreach should not be required to construct new physical infrastructure for rival telecoms providers in geographic locations where it does not already have infrastructure (i.e.

outside its network footprint). This amounts to an extension of the infrastructure network rather than making use of existing infrastructure assets and will therefore always fall outside the scope of our network access obligation.

A8.12 Similarly, where additional capacity is required within the existing network footprint, as the amount of additional capacity sought increases relative to the total capacity in that section of the existing infrastructure, the work required to provide that capacity is increasingly likely to resemble the construction of new parallel physical infrastructure, rather than the augmentation of the existing infrastructure.

Permanent changes

A8.13 Network adjustments involve making changes which are permanent. It is sometimes necessary to remove obstructions preventing use of existing infrastructure that is otherwise in good working order.[293] Our view is that it is more appropriate to regard the removal of obstructions as ancillary activities associated with the deployment and maintenance of access networks, rather than network adjustments. This is because activities associated with removing obstructions often need to be undertaken every time cables are to be installed or where a telecoms provider or Openreach needs to access its fibre network as part of on-going maintenance or repair of that fibre. The ability of telecoms providers to remove such obstructions is provided for by virtue of the requirement on BT to provide certain ancillary services, but we do not regard them as network adjustments.[294]

A8.14 In contrast, we regard network adjustments as involving permanent changes which are required to facilitate access to the physical infrastructure. Generally, this will involve making a permanent change to the physical infrastructure itself, although as we explain below, it may involve the permanent removal of redundant cables or equipment left in the physical infrastructure.[295]

The three criteria for determining whether the obligation to make a network adjustment applies

A8.15 Below, we explain how we propose to apply the three criteria identified above, to determine whether a particular network adjustment falls within the scope of the PIA obligation. We consider that these criteria are cumulative, i.e. Openreach should only be required to make adjustments where all three criteria are met.

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[293] For example, removing silt from ducts, or pumping water out of chambers before being able to deploy and maintain access networks through Openreach's underground physical infrastructure. Similarly, it is sometimes necessary to cut back trees to access the top of poles and install or maintain dropwires or pole-top equipment.

[294] The practical effect of this is that these ancillary activities are not subject to our proposals regarding the recovery of network adjustment costs.

[295] The removal of redundant cables or equipment left in the physical infrastructure by telecoms providers using the infrastructure (including BT), is distinct from changes to BT's active network. The latter is not part of the PIA remedy (although under our regulation BT can choose to meet its obligations to make network adjustments by making changes to its active network in lieu of making a network adjustment).

Is the requested adjustment necessary?

A8.16 In some of the cases where a telecoms provider encounters an unusable section of physical infrastructure, an alternative option of still using BT's physical infrastructure may exist, which would enable the telecoms provider to deploy its access network without an adjustment to the physical infrastructure being made. Provided these alternatives allow for a reasonably equivalent outcome for the telecoms provider compared to making an adjustment, Openreach is unlikely to be under an obligation to remedy the unusable section of the physical infrastructure.[296]

Is the requested adjustment feasible?

A8.17 Adjustments which are infeasible are not required under the network access obligation. In some cases, there may be technical, operational or legal barriers that prevent Openreach from being able to make the required adjustment, for example, wayleave access for the work is not granted, or planning restrictions are in place.

A8.18 In some cases, such barriers may not be insurmountable, but the cost involved in overcoming any barriers would be significant. We consider that this is addressed by the third factor discussed below (i.e. whether the adjustment is efficient).

Does the requested adjustment improve efficiency?

A8.19 We consider that Openreach should only be required to make adjustments where this improves efficiency (i.e. it is quicker, easier and/or cheaper for Openreach to adjust the existing physical infrastructure than for a telecoms provider to install its own infrastructure alongside BT's). This is consistent with our rationale for requiring BT to provide network access in the form of PIA. We want to encourage infrastructure sharing when it is more efficient than the other options available to a telecoms provider, such as building its own physical infrastructure, as these efficiencies will facilitate investment which would not otherwise be viable.

A8.20 If telecoms providers paid the full upfront cost of any network adjustments they requested, we would expect them to have incentives to request network adjustments only where this was the most efficient way to overcome unusable sections of physical infrastructure. However, for the reasons set out in Volume 4 we have decided that Openreach should recover the costs of network adjustments over all users of the physical infrastructure up to a financial limit. We recognise that as a result, telecoms providers may not have the incentive to choose the most efficient solution to overcome unusable sections of physical infrastructure (for example, when choosing between requesting a network adjustment or building their own parallel infrastructure).

[296] For further discussion please see paragraph 2.52 of Section 2, Volume 3, 2018 WLA Statement.

A8.21 Given the risk that telecoms providers request network adjustments which would be inefficient, we consider that Openreach should only be required to make adjustments to its physical infrastructure where this improves efficiency.[297]

A8.22 We would consider whether this is the case by comparing two scenarios:

a) Openreach adjusts its physical infrastructure to remedy the unusable section of Openreach's infrastructure (the 'factual' scenario); and

b) the telecoms provider builds its own network asset to circumvent the unusable section of Openreach's infrastructure (the 'counterfactual' scenario).

A8.23 Openreach should only be required to make adjustments where the factual scenario is more efficient than the counterfactual scenario, for example, it is quicker, easier and/or cheaper.[298]

A8.24 In this comparison, the cost in the factual scenario should be the incremental cost to Openreach of making the adjustment at the telecoms provider's request. For example, if Openreach would have carried out the work anyway, even if the telecoms provider had not requested the adjustment, the incremental cost will be lower than the cost of the civil works (and in some cases could be zero).

A8.25 Moreover, the factual and counterfactual scenarios should be based on Openreach's own engineering practices applicable at the time. This ensures that Openreach cannot refuse requests for network adjustments by requiring competing telecoms providers to choose a lower cost engineering solution that it would not choose for itself. This approach will also provide greater certainty to Openreach and competing telecoms providers in cases where a range of engineering solutions might exist.

A8.26 We recognise that it might be argued that even in cases where it is more efficient for Openreach to make an adjustment than for the telecoms provider to build its own network asset, the costs involved in making the adjustment outweigh the benefits of making of the adjustment (i.e. so the adjustment could still be considered inefficient). At the level of individual network adjustments, we think a comparison of the costs and benefits is unlikely to be a meaningful exercise. This is because the benefits of making network adjustments – i.e. more fully realising the efficiency benefits of sharing the existing infrastructure, thereby increasing the scope for competitive network investment – arise from the cumulative impact of multiple adjustments, rather than an individual network adjustment. We consider that the risks of the costs outweighing the benefits should be assessed at the overall level of whether

[297] This reflects our aim in requiring Openreach to make network adjustments, namely, to avoid unnecessary duplication of the physical infrastructure in situations where it is quicker, easier and/or cheaper for Openreach to adjust the infrastructure than for a telecoms provider to install their own infrastructure. We recognise that it might be argued that Openreach should also be required to make network adjustments in situations where the adjustment is as efficient as the telecoms provider installing its own infrastructure, on the basis that this would promote greater network competition (as the costs of these additional adjustments would be recovered across all users of the infrastructure under our approach to cost recovery) and would still ensure telecoms providers cannot request network adjustments which would be inefficient. However, at this stage, we are not persuaded that such an obligation is necessary to ensure effective competition in the long term, or proportionate given our current understanding of the benefits and risks. For the avoidance of doubt, our approach does not prevent Openreach from choosing to undertake a broader set of network adjustments than required under the network access obligation, provided it treats all telecoms providers including BT in the same way (unless differences can be justified).

[298] We note that time and difficulty (or operational complexity) can be thought of as drivers of additional costs.

the entry of a competing network provider is efficient, and address this in Section 4 of Volume 3.

Openreach should choose how to undertake network adjustments

A8.27 We believe that, where an adjustment is necessary for Openreach's physical infrastructure network to be available to telecoms providers for the purpose of deploying their own networks, Openreach should be able to choose the form of adjustment it makes to meet its obligation. This provides Openreach with the flexibility to choose the most efficient solution possible, and allows it to take account of its own future requirements.

A8.28 We note that a possible concern of other telecoms providers might be in relation to Openreach's ability to choose how to undertake network adjustments. Notwithstanding the benefits of giving Openreach flexibility, it is important that Openreach is not able to exploit this flexibility to undermine the effectiveness of the remedy. We consider that our broader regulation prevents Openreach from doing this in the following ways (see Section 3 of Volume 3):

a) The non-discrimination requirements we are imposing on BT prevent Openreach from applying a different approach for external PIA users to the approach taken for its own network deployments unless such a difference can be justified;

b) The requirement to produce a Reference Offer includes a requirement to set out the terms and conditions on which other providers may purchase PIA and access BT's infrastructure (also see below); and

c) Our decision on how BT should recover the costs of making any adjustments provide Openreach with the incentive to select the most efficient approach and limit the incentive to select high cost solutions to increase a competing telecoms provider's costs of deployment.

A8.29 Some network adjustments may be just as easily carried out by the telecoms provider. For the avoidance of doubt, our guidance sets out where a network adjustment is likely to be required. If an adjustment falls within the scope of the access obligation, although the responsibility for the adjustment rests with Openreach, it may meet this requirement by agreeing with industry arrangements for the telecoms provider to undertake the works itself (effectively on behalf of Openreach).[299]

Breaking in and out of BT's network infrastructure

A8.30 Telecoms providers are likely to deploy hybrid networks, using a mixture of Openreach's infrastructure and their own infrastructure.[300] Therefore, to make effective use of Openreach's physical infrastructure, telecoms providers need to be able to break in and out of the

[299] As network adjustments are made to Openreach's physical infrastructure, Openreach will retain ownership of the relevant assets.
[300] We expect most deployments to be hybrid designs.

infrastructure to interconnect with their own infrastructure.[301] In addition, the ability of telecoms providers to overcome unusable sections of Openreach's physical infrastructure as efficiently as Openreach depends on the ability to break in and out of Openreach's physical infrastructure at particular points.[302]

A8.31 For the avoidance of doubt, the ability of telecoms providers to break in and out of the infrastructure is provided for by virtue of the requirement on BT to provide certain ancillary services, but we do not regard breaking in and out of the network as network adjustments on the basis that these are for the purpose of enabling hybrid networks rather than making BT's network ready for use.

Compliance with the no undue discrimination obligation in the physical infrastructure market

A8.32 In Volume 3, Section 3 we impose a no undue discrimination on BT in the physical infrastructure market. We said we would interpret that obligation as requiring strict equivalence in respect of all processes and sub-products that contribute to the supply and consumption of network access, with discrimination permitted only in cases where Openreach demonstrates that a difference in respect of a specific process step or sub-product is justified. Where Openreach can justify any processes or systems used by network users as being different from those used by Openreach, the condition requires these to be broadly equivalent. This means that any difference must not put network users at a disadvantage, particularly in terms of extra cost, time or uncertainty, compared to the processes Openreach follows internally.

A8.33 We are not imposing an upfront obligation on Openreach to justify all instances of non-equivalence, however, we are retaining the requirement on Openreach to produce an Internal Reference Offer that requires it to set out its internal processes to some degree. This will allow Ofcom and stakeholders to identify any differences in the processes for internal use of network access compared to such use by third parties and to assist transparency for the monitoring of potential anti-competitive behaviour. This helps to ensure that PIA users can have confidence that they are not at a disadvantage, particularly in terms of extra cost, time or uncertainty, compared to the processes Openreach follows internally.

A8.34 The Internal Reference Offer should set out the services used by Openreach in a different manner, giving visibility to any justification for non-equivalence, as well as highlighting where processes, rules or systems (or similar) are the same. For example, where engineering rules are equivalent this should be made transparent and steps taken by Openreach to ensure consistency across all activities for physical infrastructure access whether undertaken under PIA, or otherwise.

A8.35 We have also extended the ongoing monitoring programme we established following the WLA review to ensure Openreach complies with the non-discrimination obligation. This programme

[301] For examples of when telecoms providers may need to break in and out of BT's infrastructure see paragraph 2.92 and footnote 71, Section 3, Volume 3, 2018 WLA Statement.
[302] For example, the ability to install duct directly between Openreach's chambers requires that they can break out of the end walls of Openreach's chambers (i.e. in the direction of the duct run).

involves working with the OTA2 and access seekers, in order to evaluate their experience of the network access products. We will also continue to make use of our information gathering powers where appropriate in order to evaluate any network access processes that we identify are at risk of failing to be equivalent. Furthermore, we will carefully consider, and where appropriate investigate, any evidence of non-compliance. This evidence could come from a range of sources, such as information submitted by our stakeholders, our regular review of BT's Regulatory Financial Statements, information gathered as part of our market reviews, the set of no undue discrimination (NUD) KPIs and through use of our investigatory powers.

PIA pricing under the NUD obligation

A8.36 Under the NUD condition, downstream divisions of BT (e.g. BT Enterprise) are required to consume the PIA services and must therefore pay PIA charges.

A8.37 Openreach is not required to, nor does it, consume exactly the same services and so does not pay the PIA charges that other telecoms providers pay. It is important that this does not result in competing telecoms providers being at a disadvantage to Openreach.

A8.38 As explained below, we consider that our regulation of PIA pricing (i.e. the price caps we are imposing and our decision that Openreach should recover the costs of making the existing infrastructure ready for use across all users of the infrastructure) sufficiently addresses most of our concerns over discrimination with respect to PIA pricing. Where this is not the case, the no undue discrimination obligation for the physical infrastructure market should ensure equivalence except where differences can be justified.

Rental charges

A8.39 Any concerns about discrimination between the level of rental charges paid by external customers and what Openreach pays for its use of the physical infrastructure assets are sufficiently addressed by our regulation of rental charges. As explained in Volume 4, we set PIA rental charges that telecoms providers other than Openreach will pay, and in setting these charges, one of our objectives is to ensure a level playing field exists between Openreach and other telecoms providers that make use of PIA to provide downstream products. The way these charges are set means they are not intended to be paid by Openreach. Rather, Openreach must recover the balance of costs not recovered from other users of the physical infrastructure from its own downstream services.[303]

Ancillary charges – network adjustments

A8.40 With respect to ancillary charges, the most significant of these relate to network adjustments i.e. charges for making the existing physical infrastructure ready for use.

[303] The PI cost to be attributed to downstream Openreach services represents total PI rental costs (including a return on capital employed) net of any external purchases of PI (e.g. from sales to external customers and other parts of BT like Global Services). BT should attribute these costs to downstream Openreach markets in an objective and causal way, consistent with the Regulatory Reporting Principles set out in Volume 6. To ensure BT's allocation approach is transparent to us and stakeholders, in Volume 6 we explain that BT is required to explain its approach in its accounting methodology documents (AMD) and publish a diagram illustrating how duct and pole costs are allocated from the PIA market to downstream SMP markets. Any changes to BT's approach must be set out in its annual Change Control Notification, along with the impact of the changes.

A8.41 As explained in Volume 4, we have decided that Openreach should recover the costs of network adjustments over all users of the physical infrastructure, in the same way as it does for BT. Where telecoms providers are not charged for network adjustments, no concerns over discrimination with respect to pricing of network adjustments arise.

A8.42 However, we have also decided that a financial limit should apply to the costs of network adjustments, with any costs incurred above the financial limit recovered directly from the telecoms provider requesting the network adjustment, through ancillary charges. Although the financial limit is intended to cover adjustments that are typically in scope of the PIA remedy, there is still uncertainty around the likely incidence of network adjustments.[304] Therefore, there is a risk that telecoms providers face charges for network adjustments above the financial limit more often than we expect.[305]

A8.43 If this were to happen, competing telecoms providers could be at a disadvantage to Openreach as they do not benefit from the same ability to recover costs from services in which they have SMP when recovering costs of the network adjustments they require, and therefore face greater risk relative to BT.[306]

A8.44 To ensure that other telecoms providers are not at a disadvantage to Openreach with respect to network adjustment charges above the financial limit, we will interpret the no undue discrimination obligation to mean that Openreach should charge itself internal transfer charges for network adjustments which are consistent with the charges faced by competing telecoms providers using PIA (to the extent that a different approach cannot be justified). This means that where Openreach undertakes network adjustments to support its own network deployments, the costs of network adjustments above the financial limit should be attributed entirely to the relevant Openreach downstream products in the regulatory accounts, and not spread across all users of the physical infrastructure. The regulatory accounts will support any assessment of compliance with the no undue discrimination obligation.

A8.45 For the avoidance of doubt, Openreach is not required to charge the internal transfer charges at the point of undertaking the ancillary activity. It can calculate these charges (which should be the same as those incurred by other telecoms providers) retrospectively as part of its regulatory financial reporting. Openreach is also not required to maintain a separate inventory for any assets created or improved by network adjustments which exceed the limit. These assets remain part of the Openreach asset base and are accessible by all users of the infrastructure.

Ancillary charges – other ancillary services

A8.46 With respect to ancillary services other than network adjustments, these are not expected to be as material as network adjustment charges. However, in principle, we would interpret the no undue discrimination obligation in the same way. That is, Openreach should charge itself internal transfer charges which are consistent with the charges faced by competing telecoms

[304] In Volume 4, we explain that this uncertainty is lower now than when we first set the financial limit in 2018.
[305] For example, the incidence of network adjustment could be higher than we expect. The risk that Openreach sets higher unit charges for network adjustments so that telecoms providers exceed the financial limit is addressed by the basis of charges obligation we are imposing.
[306] Volume 4, Section 4.

providers using PIA (to the extent that a different approach cannot be justified). This means that where Openreach provides other ancillary services to support its own network deployments which are the same or similar to those provided to other telecoms providers, the costs of those services should be the same as those incurred by other telecoms providers and be attributed entirely to the relevant Openreach downstream products, and not spread across all users of the physical infrastructure.

A9. Benefits and risks of dark fibre

A9.1 Our general regulatory approach is to apply remedies as far upstream as possible to ensure that as much of the value chain as possible is open to competition. We want to encourage BT's competitors to build their own networks, rather than relying on network access from Openreach. However, we recognise that network competition will not develop uniformly across the UK, and in these situations, access to dark fibre is the next best option.

A9.2 In this annex, we present our assessment of the benefits and risks of the dark fibre remedies – for leased lines access in Area 3 (DFA) and for inter-exchange connectivity at certain BT Only exchanges (DFX). As the types of benefits and risks of each remedy are similar, we discuss them together and highlight where there are points which are specific to one of the remedies. We then discuss take-up of each remedy separately.

Benefits of dark fibre

A9.3 We set out below our assessment of the potential benefits that could arise as a result of the introduction of dark fibre. We consider how the dark fibre remedies allow users to:

- choose their own electronic equipment, enabling them to deliver services that better suit their needs and the needs of their customers;
- make decisions on bandwidth upgrades based on the underlying costs of upgrades;
- eliminate inefficient active equipment duplication;
- attain additional benefits over those that they currently get through purchasing OSA products; and
- benefit from the wider benefits of dark fibre inter-exchange which incentivise investment in alternative access networks.

Dark fibre provides choice over active equipment

A9.4 Under the active remedies imposed in leased lines markets, Openreach chooses the electronic equipment – together with the functionality and features of this equipment – that is made available to deliver the active part of a leased line service. Dark fibre allows telecoms providers to select the equipment that best meets their needs and the needs of their customers.

A9.5 This might allow telecoms providers to better differentiate their services[307] and provides scope for innovation in the functionality of the electronics used to deliver services, even if innovation in the electronic equipment itself is unlikely given it is standardised globally.[308]

A9.6 Changes to service features could also be implemented more quickly and cheaply with dark fibre. With active services, any new service feature developed by Openreach (even if it is

[307] Although telecoms providers will replicate the functions of Openreach's electronics, they are not limited to implementing these functions in the same way as Openreach does for active services nor to implementing additional features. For example, this could include differentiation based on speed, packages, latency, features, pricing structures and quality.
[308] By way of illustration, when mobile operators started using Ethernet circuits for mobile backhaul, they needed the Ethernet circuits to support timing signals. BT's Ethernet services did not support this initially and complex and expensive workarounds were used for an extended period until synchronous Ethernet (SyncE) product was introduced. Dark fibre would have allowed mobile operators to create circuits with the required transference of timing signals much sooner and with far less disruption.

developed at the specific request of a sole provider) must be offered to all customers at the same time and on the same terms under our non-discrimination obligations (see Volume 3 Section3).

A9.7 However, the process of debating and negotiating development requirements with Openreach and with other telecoms providers may introduce additional development time, costs or uncertainties. This may mean that certain service features are not economic to develop across the industry but could be economic for a single provider to deploy. Dark fibre allows users to independently select and deploy service feature changes based on their needs. It also provides stronger incentives for telecoms providers to make such changes, as they can gain first mover advantages.

Cost of upgrading would reflect the underlying cost

A9.8 As demand for bandwidth grows, telecoms providers will need to upgrade the bandwidth of their existing circuits to improve their access and backhaul networks and maintain a good service to end users. Dark fibre allows telecoms providers to make upgrade decisions based on cost.

A9.9 When using Openreach's active leased lines products, to upgrade bandwidth, users must migrate to a higher bandwidth product or purchase an additional circuit. Openreach's charges have historically followed a bandwidth gradient that has been greater than equipment cost differentials alone. This has meant that the incremental price tends to be greater than the incremental cost of upgrading bandwidth. While the bandwidth gradient for circuits of 10Mbit/s, 100Mbit/s and 1Gbit/s has flattened over time, there is still a bandwidth gradient between 1Gbit/s and 10Gbit/s circuits. For example, the unit FAC differential between an EAD 10Gbit/s and 1Gbit/s service is £1,432, but the unit price differential is £4,324.[309]

A9.10 The pricing that we are imposing for dark fibre is independent of bandwidth. Telecoms providers will have access to the full capacity of their equipment connected to the fibre and could also use dark fibre to aggregate multiple active circuits. As a result, the incremental cost incurred by telecoms providers when upgrading bandwidth, will represent the incremental cost of providing the equipment required, which in some cases may be zero (or close to zero). This lowers the cost of upgrading bandwidth and ensures upgrade decisions based on true incremental costs.[310]

A9.11 As a result, telecoms providers using dark fibre, whether for access or inter-exchange connectivity, may be more likely to upgrade capacity earlier than when faced with a price premium, potentially relieving constraints or allowing them to offer faster services to downstream customers. For example, the dark fibre remedies will allow MNOs to increase their

[309] Ofcom analysis based on BT's 2019/20 RFS with Ofcom base-case adjusted costs and Openreach prices as at February 2020. Costs and prices are stated on a Total Cost of Ownership (TCO) basis and includes rental, connection and main link charges. Connection costs are spread over a three-year period and discounted using a 7.8% WACC. For main link costs we have assumed a 5km link distance. To carry out this analysis we have considered the following services: 'EAD 10Gbps Rentals - Internal - Access - BT Only', 'EAD 10Gbps Connections - Internal - Access - BT Only', 'EAD 1Gbps Rentals - Internal - Access – BT only' and 'EAD 1Gbps Connections - Internal - Access – BT only.

[310] As a general principle, prices in line with costs expand output and therefore static efficiency.

capacity and roll out 5G more quickly, compared to using Openreach's active leased line products, generating direct benefits for consumers.

A9.12 While the benefits described above could also be achieved through regulating the structure of pricing of active services, in our view it is better to allow market dynamics to operate. The purpose of the dark fibre remedy is to subject Openreach and the decisions it makes to substantially greater competition and contestability, which would not be achieved through regulating the structure of pricing of active services .

Reducing equipment duplication increases efficiency

A9.13 Dark fibre also gives rise to lower overall costs as it reduces the overall amount of equipment employed compared to the current use of active products. This is true whether dark fibre is used for access or inter-exchange connectivity.

A9.14 When using Openreach active leased lines products, telecoms providers generally deploy their own electronic equipment at the ends of a circuit alongside Openreach equipment. They do this to provide additional control over the service.[311]

A9.15 In many cases, the equipment used by telecoms providers can be configured to replicate and replace the functions of Openreach's electronic equipment. Where this is the case, dark fibre will mean that equipment can be consolidated allowing for savings – both in terms of the cost of the equipment and the associated need for space and power to operate it. We consider that dark fibre will provide the potential for reduced equipment duplication in many cases, and therefore there will be efficiency benefits.

A9.16 The scale of these benefits will depend on the proportion of electronics costs in Openreach active services, how easily telecoms providers can replicate the functionality of Openreach equipment (and associated costs) in different scenarios, and whether the absence of Openreach equipment introduces any countervailing costs. However, our analysis indicates that a material proportion of the costs of an active service could be avoided where dark fibre is provided.[312]

A9.17 We acknowledge that telecoms providers may need to invest in additional equipment to replicate the functionality and/or systems and processes offered by Openreach to manage services over dark fibre. This might also include recruitment of a field force to install and maintain equipment. However, we consider that the prospective users of both dark fibre

[311] For example, better monitoring capabilities, traffic and circuit aggregation functionality, downstream service features, and/or onward routing of the connection.

[312] The available savings from reduced equipment duplication will vary dependent on the specific scenario including the existing active service equipment configurations, the bandwidth of the circuit in question and whether the circuit is new or existing. In general, Openreach electronic components make up a large proportion of active service costs and dark fibre will allow telecoms providers to take advantage of these savings where they arise. By way of illustration, we note that electronics comprise approximately £468 of the costs allocated to an Openreach EAD 1Gbit/s circuit (20%) and £467 of the costs allocated to an EAD LA 1Gbit/s circuit (24%) (Ofcom analysis of BT's 2019/20 RFS with Ofcom base-case adjusted costs). To carry out this analysis we have considered the following services: 'EAD 10Gbps Rentals - Internal - Access - BT Only', 'EAD 10Gbps Connections - Internal - Access - BT Only', 'EAD 1Gbps Rentals - Internal - Access – BT only' and 'EAD 1Gbps Connections - Internal - Access – BT only. We acknowledge that these costs include an allocation of common costs, however a significant proportion of this cost is installed equipment (and therefore an incremental cost).

remedies are likely to have existing equipment in place, in which case they would already have this capability and require minimal additional investment.

OSA Filter Connect does not offer all the benefits of dark fibre

A9.18 Openreach launched OSA Filter Connect in 2018. This WDM product provides flexibility for telecoms providers to connect wavelength channels directly to their own equipment and provides lower-cost bandwidth upgrades through the addition of additional channels. Openreach has previously argued that the OSA Filter Connect product it offers delivers the same benefits as dark fibre, rendering the dark fibre remedies unnecessary.[313] However, we consider that it is less flexible and more expensive than dark fibre.

A9.19 We recognise that OSA Filter Connect provides additional flexibility over other active services, such as Ethernet, and therefore may deliver some of the benefits of dark fibre described above. In addition, as it is a managed service, telecoms providers may not have to invest in the same systems and processes as they would for dark fibre.

A9.20 However, OSA Filter Connect does not replicate all the benefits of dark fibre:

- The base product includes a 10Gbit/s Ethernet circuit which supports fault management by Openreach using one of the WDM wavelengths, thus limiting the features and interfaces that can be deployed, and may therefore not be required by the customer. There may also be equipment duplication for some customers.
- The product is significantly more expensive than an equivalent Ethernet or dark fibre product for bandwidths of 10Gbit/s and below (described earlier), and so would only be suitable for requirements which are higher than 10 Gbit/s.

A9.21 Moreover, by requiring BT to offer dark fibre for access and inter-exchange, users will be able to choose the most appropriate solution for their needs, taking into account the additional flexibility that dark fibre offers versus the greater management of Openreach optical services, such as OSA Filter Connect. Alternative telecoms providers could also use dark fibre to offer competing WDM services, putting downward pressure on the price of Openreach's product and/or encouraging Openreach to make improvements to its product in terms of quality or product offering.

Wider benefits of dark fibre for inter-exchange connectivity

A9.22 As inter-exchange connectivity is an important component of downstream broadband, mobile and access leased line services, requiring BT to offer DFX, will directly benefit consumers through improvements in the quality of their service and the potential for lower costs to be passed on.

A9.23 Furthermore, DFX may encourage investment in access areas by reducing the cost of inter-exchange connectivity. In particular, there may be some areas where deploying an access network could be economic, but there is currently no competitive supply of backhaul and

[313] Openreach response to the 2018 BCMR Consultation, page 16, paragraph 60-61; and BT Group response to the 2018 PIMR and 2018 BCMR Consultations, paragraphs 5.26-5.29.

prospects for this to emerge in future are limited. DFX could relieve this bottleneck and enable greater investment in access networks, and so deliver benefits to end consumers.

Risks of dark fibre

A9.24 In this sub-section we set out our assessment of the potential adverse consequences that could arise as a result of the introduction of dark fibre. We consider whether the dark fibre remedy has the potential to:

- weaken incentives of rival providers to invest in inter-exchange connectivity (i.e. backhaul or core network services) or access networks;
- have an adverse impact on economic efficiency as a result of erosion of the bandwidth gradients;
- undermine Openreach's opportunity to recover its costs;
- undermine Openreach's FTTP roll out and its ability to meet QoS standards for leased lines nationally; and
- result in an increase in faults or make it harder to detect and repair faults.

Impact on incentives to invest

A9.25 We have considered whether the dark fibre remedies have the potential to weaken incentives of rival providers to invest in inter-exchange connectivity (i.e. backhaul or core network services) or access networks.

A9.26 We do not expect the dark fibre remedies we are imposing to materially weaken incentives to invest in rival networks. As discussed in Volume 3 Section 6, this is because, in setting the scope of the remedies, we have sought to avoid imposing the remedies where we think rival network investment is likely to be viable:

- For DFA, we limit the scope of the remedy to Area 3 only, i.e. areas where there is not, and there is unlikely to be potential for, material and sustainable competition to BT in the commercial deployment of competing networks.[314]
- For DFX, we limit the scope of the remedy to routes from BT Only exchanges where the nearest rival PCO network is more than 100m away.

A9.27 We also believe that the design of the DFX remedy addresses the risk that dark fibre could undermine competitive routes by allowing telecoms providers to bypass these using dark fibre via non-competitive exchanges. Together, the route distance limit of 86km that is applied to DFX, allowing Openreach to take steps to address such concerns provided they do not unduly restrict circuit configurations and the limited scope of the remedy all deal with this issue. This reduces the risk that existing investments or future incentives to invest in competitive routes would be materially undermined.

[314] We also note that even within Area 3, Openreach is not required to provide dark fibre access circuits where they would be used to aggregate FTTP to multiple premises for the purposes of deploying a fibre access network. This is consistent with our overall strategy to promote network competition where it is viable.

Impact on economic efficiency

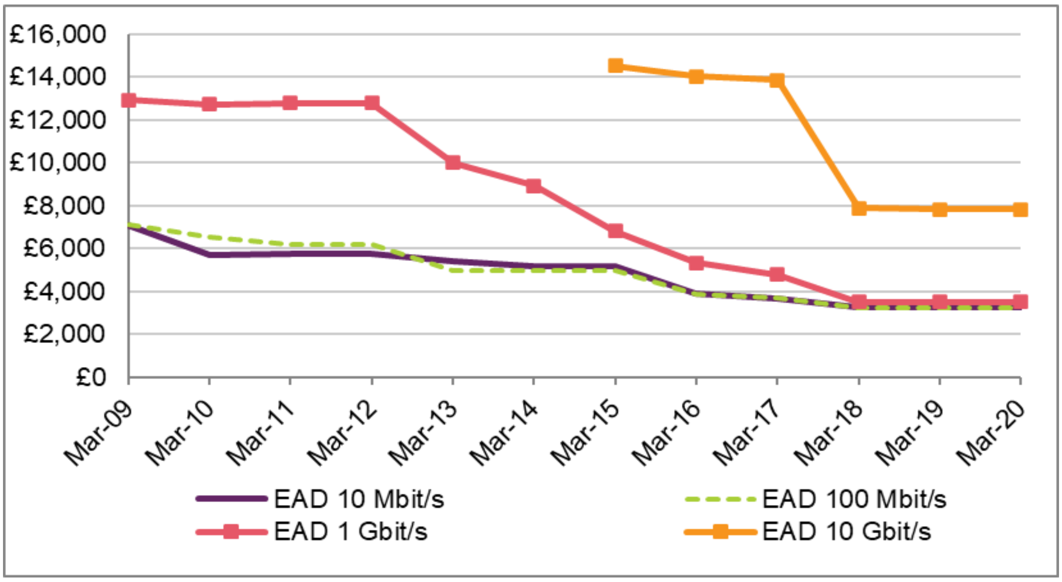
A9.28 Openreach has a large amount of fixed and common costs and needs to make sufficient revenue to allow for their recovery. We have historically provided Openreach with flexibility to set prices for individual products, which has resulted in it pricing according to a bandwidth gradient.

A9.29 The introduction of regulated DFA and DFX products priced at cost is likely to erode the existing bandwidth gradients that exist for both access and inter-exchange circuits. Alternatively, if Openreach does not adjust its prices, then it could see increased switching from its active services (i.e. WDM or Ethernet) to dark fibre.

A9.30 We acknowledge that in theory a bandwidth gradient can allow a more efficient recovery of common costs relative to a flat pricing structure. This could be the case if a greater share of fixed or common costs were recovered from products with more inelastic demand. To the extent low bandwidth consumers are more price sensitive, total output could be expanded if higher prices for high bandwidth circuits allowed lower prices for low bandwidths.

A9.31 However, there is evidence to suggest that both the EAD bandwidth gradient and the EAD LA bandwidth gradient have been flattening over time anyway. Figures A9.1 and A9.2 show that over time Openreach's prices are declining and the price gap across bandwidths is narrowing. Currently, the bandwidth gradient between Ethernet products of 10Mbit/s, 100Mbit/s and 1Gbit/s is almost non-existent. Openreach still maintains a bandwidth gradient between 1Gbit/s and 10Gbit/s, however it has flattened significantly since March 2018.[315]

Figure A9.1: EAD Bandwidth gradient[316]

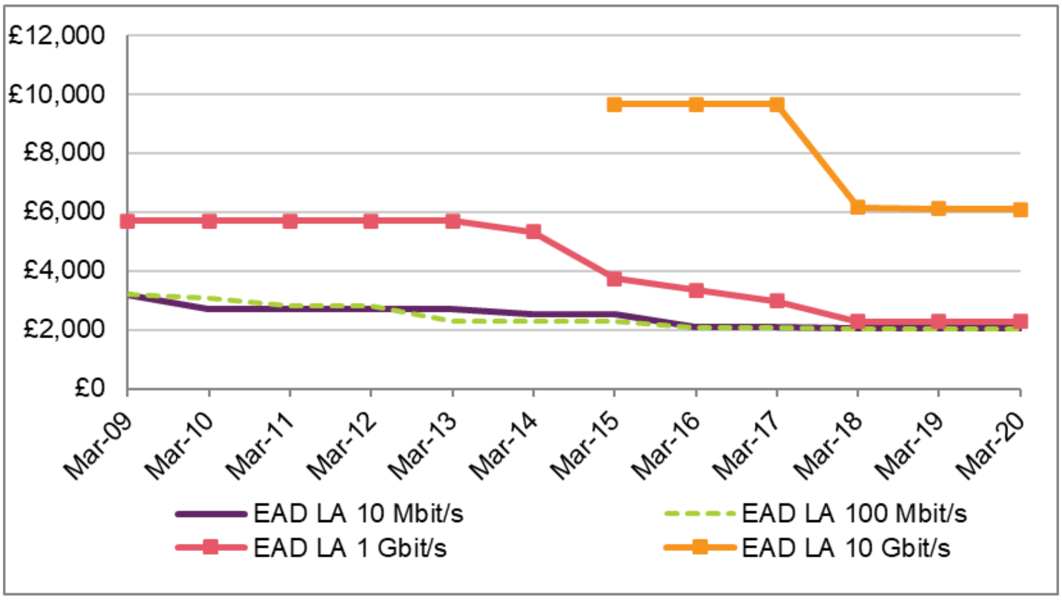


Source: Ofcom based on Openreach price list as at February 2021.

[315] We also note that, in addition to Figure A9.1, in the 2019 BCMR we set out documentary evidence which suggested that the inter-exchange bandwidth gradient was already flattening (2019 BCMR Statement, Volume 2, paragraph 12.82).

[316] The TCOs for EAD circuits calculated in this chart include rental, connection, and main link charges. Connection charges are spread over a three year contract term and discounted based on a 7.9% WACC. For main link charges we assume a 5km link distance. The same methodology is used to calculate the TCOs for EAD LA circuits in Figure A9.2, however a main link charge is not included.

Figure A9.2: EAD LA Bandwidth gradient



Source: Ofcom based on Openreach price list as at February 2021.

A9.32 Although a bandwidth gradient between 10Gbit/s and lower bandwidth services still exists, Openreach has been able to recover its costs without the need for enhanced contributions from VHB services. Prior to the 2019 BCMR Statement, Openreach's prices for access and inter-exchange Ethernet circuits of 1Gbit/s and below were subject to a charge control under the BCMR Temporary Conditions.[317] That control was set with reference to projections of Openreach's costs, the base year for which included an attribution of fixed and common costs that had only a weak link to bandwidth costs.[318] Our analysis shows that Openreach has generally priced close to the cap allowed within leased lines charge controls.[319]

A9.33 Therefore, VHB's high prices and margins are not facilitating materially lower prices or common cost recovery for lower bandwidth services, and Openreach's bandwidth gradient is not necessarily materially expanding the availability of these services. Indeed, if dark fibre led to a reduction in VHB prices (or sales), we expect that Openreach would still be able to recover its costs without an increase in prices for lower bandwidth services. As such, we do not consider

[317] https://www.ofcom.org.uk/__data/assets/pdf_file/0019/108019/BCMR-Temporary-Conditions.pdf

[318] The attributions of some costs do not vary by bandwidth (the costs of passive components such as duct and fibre and some common costs such as systems development, Ethernet Monitoring Platform and accommodation costs). Other costs (Ofcom Admin Fee, Openreach Sales Product Management and Revenue Receivables) are allocated based on revenue and so could vary by bandwidth, given VHB prices are higher than low bandwidth prices. However, these costs only accounted for a small proportion of total costs (less than 2% of the total costs allocated to an EAD 1Gbit/s circuit, for example). Ethernet Electronics (which include overheads) are allocated based on the relative price of the electronics used to provide the service, so higher bandwidth circuits with more expensive electronics will be allocated a higher share of these overheads. See BT's 2019 Regulatory Financial Statements [accessed 12 December 2019] and BT's 2019 Accounting Methodology Document [accessed 12 December 2019].

[319] In 2016/17, Openreach priced to the cap for the CISBO basket. In the period December 2017-March 2018 (the first period of reporting under the BCMR Temporary Conditions), Openreach reduced prices by 1% more than required by the charge control. However, BT's 2017/18 (restated) return on capital was 9.3%, broadly in line with the cost of capital set at the time of the last charge control (BT 2018/19 Regulatory Financial Statements). We note that Openreach has previously applied special offers which have reduced the connection charge of 100Mbit/s circuits below cost. However, these offers are no longer operative. See also Volume 2, Section 8 for more details about Openreach pricing after 2018.

that either of the dark fibre remedies is likely to result in an adverse impact on allocative efficiency through a reduction in total sales due to higher prices for lower bandwidth products.

A9.34 Even if prices of high bandwidth circuits were facilitating lower prices for lower bandwidth circuits, this would not imply that it is desirable to preserve Openreach's ability to set prices in this way. The purpose of the dark fibre remedies is to provide users with a more flexible input to downstream services, which will in turn allow telecoms providers to better compete on price, service quality, and product offering in downstream markets. More generally, it exposes more of the value chain to competition. We accept that this will mean Openreach will have less control over pricing; that is a natural and desirable constituent of a more competitive market.

A9.35 In summary, we do not consider that the DFA and DFX remedies will have adverse impacts on economic efficiency or Openreach's ability to recover appropriately incurred costs. It is more likely that they will improve economic (allocative) efficiency by bringing prices closer to costs (and therefore expanding overall output), particularly for VHB services.

Impact on Openreach's cost recovery

A9.36 There is a risk that the availability of regulated dark fibre products in the access and inter-exchange markets will mean that BT's investment in infrastructure may become obsolete or cannot be used. If such stranded assets are not appropriately taken into account in setting the price for Openreach's other services, Openreach may not have the opportunity to recover its efficiently incurred costs. This could lead to perceived regulatory instability or uncertainty which could reduce BT's incentives to invest in infrastructure in the future.

A9.37 The risk of stranded assets arises from both DFA and DFX and comes from two sources:

a) the active layer or electronics: as these will no longer be included in dark fibre services that replace active services; and

b) fibre: here the risk of stranding may be due to:

   i) Aggregation: once dark fibre is made available, telecoms providers may have a greater incentive to aggregate circuits, leading to reduced fibre utilisation on a given route.

   ii) Migration: to facilitate migration to dark fibre, telecoms providers may ask Openreach to install additional fibre, which may result in the existing fibre becoming redundant.

A9.38 In general, we consider that the risk of stranded assets is low. The main passive infrastructure, such as existing ducts, would continue to be used in the provision of both the DFA and DFX remedies.

A9.39 Moreover, our CPI-0% charge control on active leased lines allows sufficient flexibility for Openreach to recover some revenues to compensate for any stranded assets. Our modelling shows that migration does not result in risks to cost recovery in this review period.[320]

A9.40 In the following paragraphs we consider each of the above risks and address stakeholder responses where relevant.

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[320] Beyond this review period, to the extent that dark fibre leads to a material change in fibre utilisation, this could be reflected in future dark fibre charge controls.

Stranded active layer of electronics

A9.41 In its response to the consultation, BT Group submitted that a large impact of the proposed dark fibre remedy will be the early redundancy of electronics equipment which will not have been fully depreciated when active circuits are replaced by the new passive regulated services.[321]

A9.42 We expect Openreach to recover some of these costs across the contract period. As explained in Annex 16, given the expected gradual take-up of dark fibre over this review period, we consider it likely that the charge control on active leased lines in Area 3 allows for the recovery of any residual costs.[322]

A9.43 In light of the above, we consider the risk of stranded electronics to be very low.

Stranded fibre due to aggregation

A9.44 In response to our March 2019 Consultation, Openreach commissioned a report by Alix Partners to consider the impact of a DFA remedy in non-competitive areas. In this report, Alix Partners argued that the ability and incentives for telecoms providers to aggregate[323] under the dark fibre remedies proposed in the March 2019 Consultation, are likely to be material and greater than those for the 2019 BCMR dark fibre inter-exchange remedy.[324]

A9.45 As set out above, aggregation is a benefit where it allows for more flexible upgrading of bandwidth at lower incremental costs. Accordingly, while potential stranding is naturally one factor to consider when evaluating the impact of aggregation, we do not view aggregation as an intrinsic reason not to impose the dark fibre remedies.

A9.46 We recognise that both dark fibre remedies may result in additional aggregation opportunities over and above those that are possible with active circuits alone. This could cause some fibre to become stranded if it cannot be reused to provide an additional dark fibre circuit or active service. However, for the reasons set out below, we believe that the risk of stranding due to aggregation is limited.

A9.47 Aggregation is already an option when purchasing active circuits. For example, rather than buying multiple 1Gbit/s circuits, a customer can buy a 10Gbit/s circuit instead. There are already incentives to aggregate Openreach's active products, and in many cases where aggregation is desirable for customers, it will already have occurred. This limits the extent to which the dark fibre remedies might result in significant incremental stranded fibre.[325]

[321] BT Group response to the January 2020 WFTMR Consultation, paragraph 5.37.
[322] As set out in Annex 16, we consider it appropriate that any potential impact from stranding of active costs should be recovered through active services.
[323] Aggregation occurs where several active circuits, each of which would generate revenue for Openreach, are replaced with a smaller number of dark fibre circuits (e.g. by replacing two low bandwidth active circuits with one dark fibre circuit that can be used to deliver a high bandwidth).
[324] AlixPartners report, paragraph 70. AlixPartners considered that DFA risks multiple forms of arbitrage in the form of single-circuit substitution, multiple-circuit substitution and multiple-service substitution. Paragraphs 27 and 31.
[325] For example, a telecoms provider requiring more than 10Gbit/s already may already have an incentive to upgrade to OSA Filter Connect rather than purchase a second active circuit. We also note that given the pricing structure of Ethernet circuits (as indicated in Figures A9.1 and A9.2), telecoms providers already have an incentive to aggregate circuits up to 1Gbit/s and so aggregation opportunities for these circuits are likely to already be exhausted.

A9.48 The way in which the dark fibre access remedy is specified, and the nature of demand within Area 3, are further reasons to expect that the extent of aggregation within the access market will be modest. Specifically, the DFA remedy does not require BT to provide dark fibre to intermediate points which would allow for aggregation of leased lines connecting multiple premises. Aggregation of leased lines connecting to the same premises would be possible, but these account for a small proportion of circuits within Area 3.[326]

A9.49 In relation to DFX, we note that the scope for any aggregation is limited by the fact that this remedy cannot be used for connections between core and/or backhaul aggregation nodes. Notwithstanding this, any negative effect may be offset, at least partially, by demand for new DFX circuits which do not substitute for existing circuits.[327] In the 2019 BCMR we considered whether there are incentives for customers to use dark fibre for relatively shorter connections and Openreach's EBD product for longer ones.[328] We did not consider that this is a material risk and remain of this view. In summary:

a) Our analysis suggests that the dark fibre remedy would almost always be more cost effective than an EBD 10Gbit/s[329] service, so there is no incentive to arbitrage at current EBD 10Gbit/s prices. Instead, telecoms providers will purchase dark fibre for all distances where it is available.

b) EBD circuits currently account for a minority of inter-exchange circuits from BT Only exchanges.[330] If Openreach were to offer a more attractive pricing structure for EBD, the impact is likely to be very limited and may actually result in a price structure more closely aligned to economic costs.

c) EBD is based on legacy high-cost technology. In our view, this means that overall it is likely to be more efficient for telecoms providers to replace EBD with dark fibre and modern electronics.

Stranded fibre due to migration

A9.50 The migration from existing active connections to dark fibre connections could cause some fibre to become stranded. This risk arises where telecoms providers request a dark fibre

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[326] We estimate that it is only a minority ([✄]%) of total access circuit segments that are prone to aggregation in Area 3 as defined in the January 2020 consultation (i.e. circuits which are provided by the same telecoms provider and terminate at the same postcode). Source: Openreach Circuit Inventory as of December 2017, provided in response to 1st s135 of the 2019 BCMR. This figure is unlikely to change materially applying the new boundaries for Area 3. This figure is also likely to be an upper bound as there are multiple premises per postcode (such that some circuits which share a postcode but not a premise will be included in the above figure but will not actually be eligible for aggregation). Furthermore, we note that this analysis considers circuit segments rather than end-to-end circuits. As such, the above figure includes instances where premises which share a postcode are purchasing different circuit types which are unlikely to be aggregated (for example an end-to-end EAD circuit which has both ends terminating at a premise and an EAD LA circuit). Finally, non-price factors in relation to aggregation (e.g. resilience) may limit the incentives faced by telecoms providers.

[327] We discuss this in more detail in paragraphs A20.24-A20.28 of the 2019 BCMR.

[328] EBD circuits are Ethernet connections available mainly at 1Gbit/s and 10Gbit/s from BT's larger exchanges. The DFX remedy will be priced on a per kilometre basis, whereas Openreach's active EBD product per circuit. If the costs of providing circuits are higher over longer distances but the price does not vary, and the typical EBD circuit increases in length as a result of dark fibre, there is a risk that BT would not be able to recover its costs if EBD circuits are priced assuming that the distribution of circuit lengths is unchanged.

[329] For B and A, B and B and B and C circuits.

[330] BCMR 2019 Statement, paragraph 12.107.

connection before ceasing their active circuits (so called “new provide and cease”), and Openreach needs to install additional fibre to meet this request. The fibre that is used to provide the active circuit could then become stranded if it cannot be reused to provide an additional dark fibre circuit or active service.

A9.51 Where migrations to dark fibre are carried out using the existing fibre connection, there is no need for additional fibre, and so no risk of stranding. However, Openreach submitted that nearly 100% of migrations to dark fibre will use the “new provide and cease” process to avoid operational downtime.[331]

A9.52 Vodafone differed from Openreach’s submission, suggesting that using the existing circuit could be attractive to some telecoms providers.[332]

A9.53 Even if a high proportion of migrations did use the “new provide and cease” process, where there is spare fibre available there will be no need for additional fibre, and so no risk of stranding. On this:

a) Openreach has previously indicated that in the inter-exchange market there are currently just 130 routes with no spare fibre, out of all routes between 5,575 exchanges.[333]

b) Openreach estimates that the vast majority of new provides (90%) would have existing spare fibre.[334]

A9.54 This suggests that additional fibre would only be required on a minority of routes. Therefore, we do not consider the risk of stranding due to migration to be significant.

A9.55 In its response to our November 2020 WFTMR Consultation, Openreach also pointed to the risk of stranded fibre due to migration from leased lines connections to FTTP.[335] We recognise that migration from leased lines to FTTP could cause some fibre to become stranded, including additional fibre installed to meet requests for dark fibre. However, this stranding is primarily caused by the roll out of FTTP, rather than the introduction of the DFA remedy.

Conclusion on impact on Openreach’s cost recovery

A9.56 In summary, we believe that the risk of stranded costs caused by the introduction of DFA and DFX is low. In any event, our proposed charge control allows sufficient flexibility for Openreach to recover some revenues to compensate for any stranded assets. Therefore, we do not believe there is any material risk to Openreach’s ability to recover costs.

Impact on FTTP rollout and QoS

A9.57 In response to our January 2020 WFTMR Consultation BT Group and Openreach submitted that Ofcom’s proposed prices for dark fibre were too low. They argued that, in addition to new

[331] Openreach response to the January 2020 WFTMR Consultation, paragraph 7.113.
[332] See, for example, Vodafone response to November 2020 consultation, Clarifications, page 3.
[333] 2019 BCMR Statement, Volume 2, paragraph 12.103.
[334] Openreach response to the January 2020 WFTMR Consultation, paragraph 7.118. In response to question 2 of the s.135 notice dated 5 March 2021, Openreach submitted that it has not undertaken any additional analysis that would improve upon this estimate of the percentage of DFA circuits that would have existing spare fibre in Area 3 in the period 2022/23 to 2025/25 inclusive.
[335] Openreach response to Ofcom November consultation, para. 3.38.

supply of circuits moving to DFA, this would lead to overly rapid mass migration from active to passive services in Area 3, which would carry significant additional costs, undermining Openreach's operational ability to deliver scale FTTP build in Area 3 and Openreach's ability to meet QoS standards for leased lines nationally.

A9.58 Openreach submitted that at a price point of £850 (i.e. broadly in line with the price we have set), around [✂] Ethernet circuits would be migrated to DFA from 2022/23 to the end of 2025/26, which would drive around a [✂]% increase in leased line orders in Area 3 during this period. Openreach said this would require an additional [✂] staff, with an associated cost of at least £[✂].

A9.59 We explain below that the scale and speed of migration is likely to be lower than that assumed by Openreach. However, even taking Openreach's estimates of migration at face value, we consider that the potential impact on Openreach's FTTP rollout or QoS standards would be small for a number of reasons:

a) The scale of the work needed to accommodate migration to dark fibre is small compared to the scale of the work needed to deliver Openreach's FTTP rollout plan;[336]

b) Substitutability of engineering resources between dark fibre migration and FTTP rollout is likely to be limited as the skillsets required are quite different;[337] and

c) we have also revised the implementation period from 1 month for a full launch to 4.5 months for a soft launch (provisioning and repair) and 14 months for full launch (automation of all other functionality). We also acknowledge Openreach's comments regarding the temporary limitations on the DFA product until the full launch. Hence, Openreach will have more time to hire new engineers or train existing ones if needed.[338]

A9.60 In summary, we believe that even a high level of migration will not materially undermine FTTP rollout in Area 3 or Openreach's ability to meet QoS standards for leased lines nationally.

Fault frequency, detection and repair

A9.61 We have considered whether the dark fibre remedies have the potential to result in an increase in faults or make it harder to detect and repair faults.

A9.62 In general, the overall causes of fibre faults in access or inter-exchange connectivity circuits will be similar whether they use active or dark fibre products as an input. However, where dark fibre allows a reduction in the total equipment used to deliver the service, there will be fewer points of failure and hence this should entail a lower frequency of faults. Dark fibre will therefore provide more reliable services and potentially reduce costs, through associated reductions in required repairs.

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[336] Openreach estimates that c. [✂] Ethernet circuits would need to be migrated to DFA from 2022/23 to the end 2025/26. This implies that Openreach would have to migrate around [✂] circuits per year. On the other hand, Openreach expects to deploy FTTP at an average rate of 2.2m premises per year (see BT, 2021. *Q3 2020/21 trading update* [accessed 4 February 2021].)
[337] As discussed in Annex 3: The workforce of an operator running a leased line-only network is likely to be more highly skilled and capable of supporting demanding service levels. A broadband workforce may be geared toward more civil work (laying access lines from the street into homes) and provisioning of a standard configured network termination point and router.
[338] Openreach website indicates that they hired 3,350 engineers in 2019/20 and they are planning to hire more than 1,500 new engineers in 2020/21. See Facts and figures (openreach.com).

A9.63 The fault detection and repair processes for DFA and DFX would differ from those for active services because telecoms providers other than Openreach would be operating the network equipment that facilitates monitoring and fault diagnosis. However, we see no reason why telecoms providers should not be able to develop repair processes that perform at least as well with dark fibre as with Openreach wholesale active circuits. Repairs (except repairs to Openreach's fibre) would also be within the purchasing provider's control.

A9.64 The concentration of remote monitoring and remote diagnoses with the purchasing provider could also reduce costs, by reducing the need for the provider to co-ordinate with Openreach if a fault does not relate to Openreach fibre.

A9.65 In general, purchasers of both dark fibre products should have strong commercial incentives to manage faults effectively and coordinate with Openreach. We also note that Openreach can incentivise providers to make efficient decisions on repair through the Right When Tested (RWT) charge.

A9.66 In summary, we do not expect dark fibre remedies to result in an increase in faults or make it harder to detect and repair faults. Rather, both dark fibre remedies could result in lower overall fault rates and potentially reduced costs associated with fault reduction and repair. If potential dark fibre users have concerns about differences in fault detection or repair they are able to choose an active service in this review period as an alternative if this better suits their needs.

Take-up of dark fibre

A9.67 We expect telecoms providers will use DFA and DFX where they are able to realise the benefits discussed above – cost savings and/or increased flexibility and control. DFX is an existing remedy and we considered potential take-up in BCMR 2019[339]. We consider the take-up of DFA below.

Take-up of dark fibre access

A9.68 To understand the potential take-up of the dark fibre access remedy we have considered the current volumes of EAD and EAD LA circuits (see Table A13.3). These circuits account for the vast majority [✂]% of Openreach's access circuits.[340]

A9.69 We consider Ethernet circuits are very similar to dark fibre and in general we believe that they are likely to be straightforward to replace with dark fibre. Below, we set out information relating to the total number and distribution of EAD and EAD LA circuits from exchanges in Area 3.[341]

[339] 2019 BCMR Statement, Volume 2, paragraph 12.117.

[340] Ofcom analysis of Openreach data.

[341] We note that this analysis uses data which classifies the location of circuits using the postcode sector of the exchange end of the circuit, rather than the postcode sector of the premise end of the circuit. However, we expect that the vast majority of access circuits terminating at an exchange in Area 3, will also terminate at a premise in Area 3, such that they are eligible to be replaced with dark fibre access.

Table A9.3: Breakdown of Ethernet products at exchanges in Area 3[342]

Product	Openreach circuits at exchanges in Area 3	
	Circuits	%
EAD LA 10Mbit/s	[✂]	[✂]
EAD LA 100Mbit/s	[✂]	[✂]
EAD LA 1Gbit/s	[✂]	[✂]
EAD LA 10Gbit/s	[✂]	[✂]
EAD 10Mbit/s	[✂]	[✂]
EAD 100Mbit/s	[✂]	[✂]
EAD 1Gbit/s	[✂]	[✂]
EAD 10Gbit/s	[✂]	[✂]

Source: Ofcom analysis of Openreach data.

A9.70 The cost saving that can be achieved when replacing a dark fibre circuit with an active circuit is likely to be a key driver of the take up of dark fibre.[343] At current prices, dark fibre provides savings over EAD LA 10Mbit/s, 100Mbit/s and 1Gbit/s circuits and more significant savings over EAD LA 10Gbit/s circuits. It also provides savings for the vast majority of EAD 10Mbit/s, 100Mbit/s and 1Gbit/s circuits and more significant savings for the vast majority of EAD 10Gbit/s circuits.[344] Given this, we would expect a significant proportion of new circuits that would have used these services to use dark fibre instead.

A9.71 Dark fibre will also provide a price incentive for users with existing circuits. However, we note that migration of existing circuits is often a customer led event, such as a contract renewal.[345] This may limit the speed of migration to the pace of customer led renewals or migration, notwithstanding the saving offered by the remedy.

A9.72 Based on Openreach's current Ethernet product prices there is a clear incentive for telecoms providers to use dark fibre instead of active products. We recognise that initial take up may take time to ramp up, and therefore the speed of take-up is uncertain. Nevertheless, we expect a material volume of dark fibre circuits to be purchased in Area 3 over the five-year review period.

[342] Openreach offers an EAD product that can be used for both access and inter-exchange connections. The EAD figures in this table relate only to Openreach's EAD volumes that are used for access circuits.
[343] We also note that the flexibility advantages offered by dark fibre may encourage take up of the remedy, even where potential cost savings are minimal.
[344] Savings over both EAD and EAD LA circuits are likely to persist even where telecoms providers incur additional costs due to non-domestic rates.
[345] We consider contract renewals as a key customer led event which would lead to telecoms providers obtaining a different wholesale product (e.g. dark fibre).

A9.73 We also requested stakeholders' forecasts and comments on expected usage of dark fibre access. The forecasts[346] and comments[347] received indicate that stakeholders do not have firm projections for their usage yet. We consider that these responses are consistent with our expectations set out above.

[346] Some stakeholders did not submit any evidence to suggest significant take-up of dark fibre access in the future, while others forecasted high take-up levels of dark fibre access.
[347] In particular, Three submitted that it is not yet in a position to formalise plans for usage of regulated dark fibre as it develops solutions in Area 3. However, it expects regulated DFA to be critical to its plans to expand mobile capacity and coverage within Area 3. (Three's response dated 20 August 2020 to the s.135 notice dated 30 July 2020).

A10. Quality of Service KPI reporting tables

A10.1 In this section, we have outlined transparency remedies aimed at monitoring performance, potential discrimination, and instances of extended delays, and which we consider are appropriate, proportionate, and necessary to complement our quality of service standards.

A10.2 We require Openreach to report KPIs for all markets where we have found SMP and separately for the markets where we are imposing QoS standards. The following tables set out the KPIs on which we require Openreach to report or publish.

Wholesale Local Access

Table A10.1: KPIs relating to QoS standards for MPF, GEA-FTTC and GEA-FTTP.

KPI		SML	MPF	GEA-FTTC	GEA-FTTP
(i)	Appointment availability • D • D+1 • D+2 • D+5 • D+10 • D+20		Y P GM	Y P GM	Y
(ii)	Installation completion – all orders • D • D+1 • D+2 • D+5 • D+10 • D+20		Y P GM	Y P GM	Y
(iii)	Repair completion • D • D+1 • D+2 • D+5 • D+10 • D+20	1	Y P GM	Y	x
		2	Y P GM	Y P GM	Y GM
		Business 2 Plus	x	x	x
		3	Y GM	Y GM	Y GM
		4	Y GM	Y GM	Y GM
(iv)	Average first available appointment date		Y P	Y P	Y
(v)	Percentage of installation orders rejected		Y	Y	Y

KPI		SML	MPF	GEA-FTTC	GEA-FTTP
(vi)	Installation completion - appointed orders • D • D+1 • D+2 • D+5 • D+10 • D+20		Y	Y	Y
(vii)	Average installation time – appointed orders		Y P	Y P	Y
(viii)	Average installation time – non-appointed orders		Y P	Y P	Y
(ix)	Percentage of installations affected by MBORC declarations that missed the Committed Date		Y	Y	Y
(x)	Percentage of installations reported as faulty within 8 days		Y	Y	Y
(xi)	Percentage of installation reported as faulty within 30 days		Y	Y	Y
(xii)	Average time to restore service	1	Y P	x	x
		2	Y P	Y P	Y
		Business 2 Plus	x	x	x
		3	Y	Y	Y
		4	Y	Y	Y
(xiii)	Percentage of repairs affected by MBORC declarations that missed the SLA		Y	Y	Y
(xiv)	Average time to restore service for repairs that have exceeded the SLA by 20 or more working days	1	Y	x	x
		2	Y	Y	Y
		Business 2 Plus	x	x	x
		3	Y	Y	Y
		4	Y	Y	Y
(xv)	Percentage of repeat faults		Y	Y	Y

KPI		SML	MPF	GEA-FTTC	GEA-FTTP
(xvi)	Percentage of installed based reported as faulty		Y	Y	Y
(xvii)	Percentage of missed repair appointments		Y P	Y P	Y
(xviii)	Percentage of missed installation appointments at customer premises		Y P	Y P	Y
(xix)	Percentage of missed installation appointments at street cabinet		x	Y P	x
(xx)	Number of delayed Orders completed		Y P GM	Y P GM	Y GM
(xxi)	Number of delayed Repairs completed		Y P GM	Y P GM	Y GM
(xxii)	Number of delayed Orders not completed		Y P GM	Y P GM	Y GM
(xxiii)	Number of delayed Repairs not completed		Y P GM	Y P GM	Y GM

A10.3 ‘Y’ means that BT is required to provide information under the KPI to Ofcom and industry (the precise information that must be provided to each differs in some KPIs).

A10.4 ‘P’ means that BT is required to publish this information on its website every three months.

A10.5 ‘GM’ means that the data must be disaggregated between each GM region. Where the ‘GM’ marking is not used, BT is only required to publish KPIs for the UK as a whole.

A10.6 ‘x’ means the KPI does not apply to the service indicated.

A10.7 ‘D’ or ‘D+x’ means regulated minimum appointment date, the committed date or the repair timescale date as applicable (or days in excess of that).

Leased Lines and Inter-exchange Connectivity

Table A10.2: KPIs for UK SMP areas and their reporting criteria

Area:	UK SMP areas				
KPI requirement:	Total	Split by region	Split by product	Split by HNR areas [348]	Num. & den.
a) Mean time to provide	Y P	Y P	Y	Y	Y*
b) Fault repair performance	Y P	Y P	Y	Y	Y
c) Delivery date certainty	Y P	Y P	Y	Y	Y
d) Time to provide (lower percentile)	Y	Y			Y
e) Time to provide (upper percentile)	Y P				Y
f) Certainty Cross-Link (mean initial contractual delivery period)	Y	Y	Y	Y	Y*
g) Monitoring the tail (closed work stack)	Y				Y
h) Monitoring the tail (open work stack)	Y	Y P	Y	Y	Y
i) Time to provide of the tail extremities	Y				Y*
j) Order validation	Y				Y
k) Mean time to issue the initial contractual delivery dates	Y	Y	Y	Y	Y
l) Performance in issuing initial contractual delivery dates	Y				Y
m) Changes to CDDs	Y				Y
n) Mean delay due to contractual delivery date changes	Y				Y*
o) Mean customer caused delay	Y				Y*
p) Monitoring traffic management Delay Code applications	Y				Y
q) Monitoring wayleave Delay Code applications	Y				Y
r) Size of the installed base	Y				
s) Performance against final CDD	Y				Y

[348] By HNR areas, we are referring to High Network Reach areas, as defined by our market definition.

Table A10.3: KPIs for QoS standards products in QoS standards areas and their reporting criteria

Area:	QoS standards products in QoS standards areas			
KPI requirement:	**Total**	**Split by PC**	**Split by BT /non-BT**	**Num. & den.**
a) Mean time to provide	Y	Y	Y	Y*
b) Fault repair performance	Y		Y	Y
c) Delivery date certainty	Y	Y	Y	Y
d) Time to provide (lower percentile)	Y		Y	Y
e) Time to provide (upper percentile)	Y		Y	Y
f) Certainty Cross-Link (mean initial contractual delivery period)	Y	*Y	Y	Y*
g) Monitoring the tail (closed work stack)	Y		Y	Y
h) Monitoring the tail (open work stack)	Y	Y	Y	Y
i) Time to provide of the tail extremities	Y		Y	Y*
j) Order validation	Y		Y	Y
k) Mean time to issue initial contractual delivery dates	Y	Y	Y	Y
l) Performance in issuing initial contractual delivery dates	Y		Y	Y
m) Changes to CDDs	Y		Y	Y
n) Mean delay due to contractual delivery date changes	Y		Y	Y*
o) Mean customer caused delay	Y		Y	Y*
p) Monitoring traffic management Delay Code applications	Y		Y	Y
q) Monitoring wayleave Delay Code applications	Y		Y	Y
r) Size of the installed base	Y		Y	
s) Performance against final CDD	Y		Y	Y

A10.8 "Y" in a column means yes, the KPI is required and must be provided as indicated by the column headings in the following ways:

a) "UK SMP areas" means for the following reporting criteria, the KPI should be provided for the following column headings for Ethernet, WDM and dark fibre products, for all areas of the UK where we have found BT to have SMP (i.e. excluding the CLA and Hull Area);

b) "Total" means the KPI must be provided (as one figure) for the whole of the areas of the UK where we find BT to have SMP (i.e. excluding the CLA and Hull Area); and

c) "Split by region" means the KPI must be provided for each of the following nations/regions: Scotland; Wales; Northern Ireland; England – North; England – West and England – East;

d) "Split by product" means the KPI must be provided for each of the following products:

   i) EAD (including EAD LA);

   ii) EBD;

   iii) Cablelink;

   iv) WDM; and

   v) Dark fibre Access

   vi) Dark fibre inter-exchange.

e) "Split by HNR areas" means the KPI must be provided for the areas which we have determined as High Network Reach and for non-HNR SMP areas. This split should provide data for QoS standards products only (i.e. excluding WDM).

A10.9 "QoS standards products in QoS Standards areas" means for the following reporting criteria, the KPI should be provided for the following column headings for Ethernet and dark fibre products, for all areas of the UK where we have determined QoS standards apply:

a) "Total" means the KPI must be provided (as one figure) for the areas of the UK where we determine QoS Standards apply;

b) "Split by PC" means the KPI must be provided for each of the applicable provision categories;

c) "Split by BT / non-BT" means the KPI must be provided separately for an aggregate of BT businesses that are downstream customers of Openreach and for an aggregate of all other telecoms providers that are downstream customers of Openreach

A10.10 "(P)" adjacent to a Y means the KPI must be made publicly available, split according to the column heading, by means of publication on an Openreach website on a quarterly basis.

A10.11 "Num. & den." mean numerator and denominator respectively. For the average values (marked as *), we require for each month the numerator representing the sum of the product of the time values (or number of changes) and the quantities of product exhibiting that time values (or number of changes). For the denominator we require the volume of products over which the average is taken.

A11. Processes for granting consent for geographic discounts and considering whether to intervene in relation to other commercial terms

A11.1 In Volume 3, Section 7 we set out our decisions on addressing concerns around Openreach's use of geographic discounts and other commercial terms to potentially deter new network build. We are prohibiting geographic discounts on rental charges as follows:

- All VULA – in each of Area 2 and Area 3.
- Ethernet and WDM services – in LL Access Area 2.

A11.2 Under the terms of the SMP conditions we are imposing, Openreach can apply to us for consent to use different geographic prices where this would otherwise be prohibited by our regulation.

A11.3 We have also decided to require Openreach to notify commercial terms where the price or other contractual conditions are conditional on the volume and/or range of services purchased. We will analyse such commercial terms to assess whether they may deter new network build and where necessary we will intervene to prevent such terms through our direction-making powers under SMP conditions.[349] To facilitate us considering terms that may be problematic, Openreach is required under SMP Condition 8.6 to give 90 days' notice of such changes.[350]

A11.4 In this Annex we set out the processes that sit alongside this regulation, namely:

- The process for Openreach to request consent for an exemption to the prohibition on geographic discounts; and
- The process we will follow to consider whether we should use our direction making powers in relation to commercial terms where the price or other contractual conditions are conditional on the volume and/or range of services purchased.

A11.5 We have included this additional detail in response to stakeholder comments requesting greater clarity around the above processes. We have not set indicative timings for each element of the process. This is because the time required will depend on the specific circumstances of the case (e.g. the issues raised, extent of information gathering, consultation period and nature/extent of responses). We will aim to reach a decision as soon as possible.

Consent process for geographic pricing

A11.6 The steps we plan to follow are outlined below:

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[349] SMP Condition 1.

[350] See Volume 3, Section 3.

a) Openreach can discuss the proposed consent request with us on an informal basis. This is not a requirement but may be helpful i.e. so we can share any initial concerns with Openreach, and it could allow us to conduct initial analysis ahead of formal notification which could aid overall expediency of the process.

b) Openreach formally notify us in writing that it is requesting consent for specific geographic pricing. We would expect the notification to include:

   i) the services and areas the geographic pricing would apply to; and

   ii) the prices, terms and conditions that would apply.

c) We would expect Openreach to explain the purpose of the scheme and why it will not deter new alternative network rollout.

d) We would expect to communicate to stakeholders that Openreach has formally applied for a consent and the geographic pricing requested.

e) We may gather further information from Openreach and other stakeholders (as appropriate). We anticipate gathering information using our statutory powers. We will decide what information to gather on a case-by-case basis depending on the details of the proposed pricing and likely impact on the market.

f) We will assess the information and evidence to reach a provisional view, considering our assessment criteria and guidance set out at Volume 3, Section 7. Having done so, we will consider the appropriate next steps in each case.

g) We would expect to consult for one month.[351] Our consultation would set out our assessment and provisional view on whether consent should be granted or not.

h) At the end of the consultation period we would consider stakeholder responses and aim to issue a final decision as soon as possible (clearly this would depend on the nature and extent of responses).

A11.7 If we have decided to consent to the geographic pricing, we would then expect Openreach to issue an Access Change Notice (see Volume 3, Section 3).

Process in relation to commercial terms where the price or other contractual conditions are conditional on the volume and/or range of services purchased

A11.8 The steps we plan to follow are outlined below:

a) Openreach can discuss the proposed commercial terms with us on an informal basis. This is not a requirement but it may enable us to share any initial concerns with Openreach, and it could allow us to conduct initial analysis ahead of formal notification which could aid overall expediency of the process.

[351] We would consider our statutory obligation to consult under s.49A CA03.

b) Openreach formally notify the proposed commercial terms to us. The notification must include:

   i) the services included in the offer; and

   ii) the prices, terms and conditions that would apply.

c) At the same time Openreach may notify industry through an Access Change Notice.

d) We will form a preliminary view on whether the proposed commercial terms raise competition concerns. Stakeholders are welcome to raise any initial concerns with us.

e) If we decide the proposed commercial terms may raise competition concerns, we will publicly announce a review and start initial evidence gathering. The exact form of the process will depend on the proposed terms and the nature of any potential concerns. In some cases, it may be appropriate for us to issue a general call for inputs/evidence from interested stakeholders. In other cases, we may only require specific input or evidence from Openreach and specific stakeholders. We anticipate using our statutory information gathering powers.

f) We will assess the information and evidence to reach a provisional view. We discuss the analytical framework and provide guidance on specific types of terms at Volume 3, Section 7. The next steps depend on whether we plan to use *ex ante* intervention:

   i) If we consider that there are competition concerns that would be addressed by a direction under our powers under SMP conditions, we would generally expect to consult for one month.[352] At the end of the consultation period we would consider stakeholder responses and aim to issue a final decision (and where appropriate direction) shortly after the consultation period (clearly this would depend on the nature and extent of responses).

   ii) If our analysis suggested that there were no substantive concerns requiring ex ante intervention, we would expect to announce that we were closing our review to give certainty to the market.

[352] We would consider our statutory obligation to consult under s.49A CA03.

A12. Stakeholder comments on price regulation in Area 2

A12.1 In Volume 4 Section 1, we set out our decisions relating to price regulation in Area 2 for both WLA services and Leased Line Access services. We also set out our decision in relation to price regulation in the LL Access market in the High Network Reach area (HNR Area).

A12.2 In this annex, we set out the main arguments put forward by stakeholders in response to our January 2020 Consultation and our response, referring to Volume 4 Section 1 where appropriate. Unless otherwise indicated, paragraph references in this annex refer to Volume 4 Section 1.

Wholesale Local Access in Area 2

Pricing continuity

A12.3 CityFibre, Virgin Media, Gigaclear, BUUK, County Broadband and [✂] agreed with our pricing continuity approach for WLA in Area 2.[353] Axione and Connect Fibre also agreed that cost-based prices would deter investment but considered that prices should be even higher to better reflect the true costs of an altnet.[354]

A12.4 CityFibre and Gigaclear considered that our approach will support competition and investment in fibre networks.[355] They also agreed with our pricing continuity approach instead of alternative options such as cost-based controls, adaptive regulation or a copper wedge.[356]

A12.5 CityFibre considered that the introduction of a cost-based price cap on FTTC 40/10 in 2018 did not support investment in fibre networks, and left very little margin on these products.[357] It argued that pricing flexibility on higher speeds now is therefore of particular importance.[358] It also considered that an anchor on a higher speed service e.g. 80/20 would have a detrimental impact on fibre investment incentives across the industry.[359]

A12.6 CityFibre warned that any further falls in broadband prices risk undermining investment incentives,[360] and says that if its own prices are continually driven down according to the costs of BT's large-scale business, then its ability to build a competitive network is severely limited.[361]

[353] CityFibre, paragraph 6.21; Virgin Media, paragraphs 1, 10, 11; Gigaclear, paragraph 117; BUUK, page 8; County Broadband, paragraph 4; [✂].
[354] Axione response to January 2020 Consultation, paragraphs 5.2 – 5.5; Connect Fibre response to January 2020 Consultation, pages 1 – 2.
[355] CityFibre response to January 2020 Consultation, paragraph 6.21; Gigaclear response to January 2020 Consultation, paragraph 117.
[356] CityFibre response to January 2020 Consultation, paragraph 6.21; Gigaclear response to January 2020 Consultation, paragraph 117.
[357] CityFibre response to January 2020 Consultation, paragraphs 6.33, 6.34.
[358] CityFibre response to January 2020 Consultation, paragraphs 6.56.
[359] CityFibre response to January 2020 Consultation, paragraphs 6.57.
[360] CityFibre response to January 2020 Consultation, paragraphs 6.67 - 6.69.
[361] CityFibre response to January 2020 Consultation, paragraph 6.61.

In addition, altnets require predictability over the prices that they will be able to charge so they can be confident that build will be viable.[362]

A12.7 Openreach considered that CPI indexation provides an appropriate baseline for potential network builders to assess investment opportunities. It also said that any further anchor price reductions, noting the FTTC price reductions imposed in the 2018 WLA, would make investment cases even more challenging.[363] Regarding higher speed services, Openreach stated that there must be no charge controls on services above 40 Mbit/s to allow competition to play out in a way that reflects changing market dynamics.[364]

A12.8 TalkTalk,[365] Sky and Vodafone[366] disagreed with our pricing continuity approach. We set out these arguments and our responses below, grouped in the following broad themes:

- Impact of higher wholesale prices on competitive network investment
- Impact of higher wholesale prices on Openreach's investment
- Impact of pricing flexibility on higher bandwidth services on consumers
- Distributional effects
- Impact of higher wholesale prices on downstream competition
- Proportionality of pricing continuity

Impact of higher wholesale prices on competitive network investment

The relationship between wholesale prices and network investment

A12.9 TalkTalk and Vodafone both stated that we had not provided any reasoning or evidence to support the claim of a "significant relationship" between higher wholesale prices and network build, stating that we should quantify this linkage.[367]

A12.10 TalkTalk submitted an indicative model which it argued showed:

a) the positive effect of higher wholesale prices on altnet returns is unlikely to be significant; and

b) higher wholesale prices will undermine non-BT ISPs through market share erosion, which would outweigh (a).

A12.11 TalkTalk estimated that pricing continuity would increase consumer prices by £934m,[368] of which only £9m would feed through to altnet FTTP returns. TalkTalk estimated that the increased returns would equate to a 0.03 percentage point increase in the IRR. It said that the

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[362] CityFibre response to January 2020 Consultation, Annex 1, paragraphs A1.4, A1.5.
[363] Openreach response to January 2020 Consultation, paragraph 3.18.
[364] Openreach response to January 2020 Consultation, paragraphs 3.26, 3.27.
[365] As part of TalkTalk's response to our January 2020 Consultation, Frontier Economics submitted a report which compares TalkTalk's proposed adaptive regulation approach with pricing continuity. We refer to this where Frontier made additional arguments to those in TalkTalk's response.
[366] As part of Vodafone's response to our July 2020 Consultation, Frontier Economics submitted a report to assess whether Ofcom's UK wide set of proposals best meet our overall objectives. We refer to this where Frontier made additional arguments to those in Vodafone's response.
[367] TalkTalk response to January 2020 Consultation, paragraphs 5.20 – 5.21; Vodafone response to January 2020 Consultation, Part 3, paragraphs 6.1-6.3.
[368] TalkTalk used Ofcom's recovery estimates in the consultation over MPF, FTTC 40/10 and higher bandwidth FTTC services to be £655m, and assumed a further uplift for FTTP prices. TalkTalk noted that this was an underestimate.

small increase in altnet returns would make projects with a projected return of between 7.86% and 7.89% viable for investment, while all other projects would be unaffected.[369]

A12.12 TalkTalk argued that the impact of non-BT ISP market share erosion (due to the higher wholesale FTTC price) would be likely to materially outweigh the potential increase in returns. It argued that this market share erosion would be significant given that non-BT ISPs would face higher FTTC prices but would not have access to altnet FTTP products in about 80% of Area 2.[370] TalkTalk's indicative model assumed a reduction in non-BT ISPs' market shares by 0.1% per year as a result of higher wholesale FTTC prices, which it argued was conservative. This caused a reduction in the IRR by 0.04 percentage points in its indicative model, which outweighed the 0.03 percentage point increase in the IRR discussed above.[371]

A12.13 Vodafone argued that the relationship between regulated copper prices in the short period before copper switch off and pricing of ultrafast fibre services in the long term is weak, and as such increasing copper prices has little impact on the business case for fibre roll out.[372] It called for us to analyse "when operators announced investment and plans for FTTP roll-out and whether these changed after Ofcom's last business connectivity market review (which was the first review to move away from cost based regulation)."[373] Meanwhile, Frontier argued that operator announcements provide little or no evidence to suggest our approach is necessary to support altnet investment, relative to other policy options.[374]

A12.14 Vodafone argued that Ofcom's own modelling showed that a tighter charge control would still be consistent with a fibre price level which would allow a new entrant sufficient returns to justify roll out. It argued that setting copper charges above this would result in consumers paying more for no corresponding benefit.[375] Frontier argued that the results of our price cost test checked whether our price continuity approach is sufficient, but not necessary.[376] Frontier estimated that both a CPI-CPI or cost-based approach, which are less costly for consumers, would yield expected fibre wholesale revenues above Ofcom's estimated altnet fibre network unit build costs.[377]

A12.15 Vodafone also argued there is no evidence to suggest that an anchor set at 80/20 would discourage fibre investment, particularly given the significant speed differential and the consistent and uniform performance offered by fibre.[378]

Our assessment

A12.16 The relationship between prices and network investment is complex, and it is not possible to accurately quantify it. However, for the reasons set out in Volume 4 Section 1, we remain of

[369] TalkTalk response to January 2020 Consultation, paragraphs 5.37.
[370] Talktalk estimated that "*Area 2 is 21m premises. If 10m are built with a higher build rate towards the end of the period on average across the period about 4m homes will have altnet FTTP and 17m (or 81% of Area 2) will not have altnet FTTP.*"
[371] TalkTalk response to January 2020 Consultation, paragraphs 5.33, and 5.81 – 5.82.
[372] Vodafone response to July 2020 Consultation, paragraph 16.
[373] Vodafone response to January 2020 Consultation Part 3, paragraphs 5.1 – 5.3.
[374] Frontier Economics, September 2020. *Pricing Wholesale Local Access Services: A report for Vodafone* (2020 Frontier Report for Vodafone) in Vodafone response to our July 2020 Consultation, Annex 1, section 4.3.
[375] Vodafone response to July 2020 Consultation, paragraph 16.
[376] 2020 Frontier Report for Vodafone, section 4.4.2.
[377] 2020 Frontier Report for Vodafone, section 4.4.2.
[378] Vodafone response to July 2020 Consultation, paragraph 18.

the view that there is a significant and positive relationship between higher wholesale prices and network build.

A12.17 We disagree with TalkTalk's argument that higher wholesale prices will not have a significant effect on competitive network investment. TalkTalk's model of pass-through ignores some important determinants of profitability and seems to have underestimated the impact of others, for example:

a) It focuses on the impact that pricing continuity will have on expected revenues on each premises served. It ignores the impact pricing continuity will have on the take-up altnets can expect to achieve, by making it more attractive for ISPs to buy from competing network operators than from Openreach, which we explain at paragraphs 1.28 to 1.32.

b) It does not take into account that pricing continuity signals our approach to regulation in future review periods, which will also impact expected profitability. See, for example, paragraph 1.26.

c) The earliest build start in TalkTalk's model scenarios is the beginning of FY22, however build has already started.

d) It assumes weak substitutability between FTTC and FTTP products, that grows weaker over time, which means higher FTTC prices would only have a partial impact on altnet FTTP returns.[379] However, the evidence set out in Volume 2 Section 2 indicates that most consumers are not willing to pay significantly more for higher speeds. This suggests FTTC prices will have a large impact on FTTP prices charged by altnets and will continue to do so over this review period.

A12.18 We address TalkTalk's detailed arguments on market share erosion as a result of our approach below. As we state at paragraphs 1.31 and 1.32, we do not expect that keeping price caps the same in real terms would result in significant damage to ISPs' competitive positions in this review period, such that they would no longer be able to offer a large customer base to new network builders.

A12.19 It is also of significance that altnets who are deploying fibre networks disagree with TalkTalk. As set out above, these altnets believe that pricing continuity will support competition and investment in fibre networks.

A12.20 We disagree with Vodafone's view that we should analyse how rollout plans changed following the last BCMR publication. This is not when we changed our approach to price regulation. This approach to pricing was trailed in the DCR (2016), with implementation taking shape in both our WLA (2018) and BCMR (2019) decisions. We consider that increasing FTTP build plans over recent years has been supported by the increasingly pro-investment regulatory environment.

A12.21 We also disagree that our cost-modelling suggests that a reduction in price caps would promote competitive network investment. We explain why a reduction in price caps would not promote competition at paragraph 1.65. In addition, our estimate of the average wholesale revenue per full fibre customer that a competing network operator might be expected to earn

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[379] It assumed pass-through from retail FTTC to retail FTTP prices would be 50% in FY22, falling to 30% by FY26.

is only slightly above our upper estimate of the costs of a competing network operator (see paragraphs 1.36 to 1.38.

Risk that Openreach prices below the cap

A12.22 Frontier argued that altnet business cases will consider the overall regulatory framework, including the possibility that Openreach will set access prices below the cap to protect its market share, rather than relying on it maintaining inflation-adjusted prices.[380] It argued that long run broadband pricing will reflect competitive conditions or fibre network costs, rather than regulated copper prices, particularly given that regulation of copper-based services is likely to be withdrawn across most of Area 2 in the next decade. For example, Openreach may be incentivised to set 40/10 prices below the level of the cap, which it is currently doing through its GEA discount contract.[381]

Our assessment

A12.23 We note at paragraph 1.35 that we expect that post-entry prices will be informed by competition rather than regulation in the long term. However, given Openreach's market power and the time it will take for competition to become established, we expect price caps to be a strong determinant of Openreach's wholesale prices over the review period and potentially beyond that.

a) Given the level of competitive network investment underway, we do not think the risk that Openreach prices below the cap will undermine competitive network investment.

Continuity of our approach

A12.24 TalkTalk stated that our term "pricing continuity" is misleading and considers that our approach departs from our past cost-based price caps. For example, it argued that "MPF prices have been cost-based for more than 15 years and FTTC 40/10 prices have been on a glidepath to costs since June 2018." It considered that this creates uncertainty.[382]

Our assessment

A12.25 We refer to our approach as pricing continuity because it involves maintaining existing price caps at their current levels. In the DCR (2016) we signalled that we would set prices to promote network competition, with implementation taking shape in our WLA (2018) and BCMR (2019) decisions.[383] For example, in the WLA 2018, we did not impose cost-based price caps for all FTTC services, refraining from regulating the higher bandwidths.[384]

Expectations of prices in future review periods

A12.26 TalkTalk argued that Ofcom is unable to commit to continued higher wholesale FTTC prices following the review period, which brings about uncertainty. It thinks that this will be

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[380] 2020 Frontier Report for Vodafone, section 4.3.

[381] Frontier Economics, February 2020. *Ofcom Access Review 2021-20216: Assessment of TalkTalk's adaptive regulation proposals* (2020 Frontier Report for TalkTalk) in TalkTalk response to January 2020 Consultation, Annex 3, section 4.2.2.

[382] TalkTalk response to January 2020 Consultation, paragraphs 5.55-5.57.

[383] See Volume 4, Section 1.

[384] Prior to WLA 2018, we allowed pricing flexibility on all wholesale FTTC services.

considered by rational investors, given that the review period represents only a small portion of total revenues across an asset life of 30 years or more.[385]

Our assessment

A12.27 As discussed at paragraph 1.26, we consider that our decision now will affect investors' expectations about future regulation. We also set out our expectations about future regulation in paragraphs 1.106 to 1.123.

Efficiency of competitive network investment

A12.28 Vodafone argued that "Ofcom should not underestimate the consequences of inefficient investment signalling" suggesting that price caps above cost might encourage competing networks that are less efficient than Openreach to enter. It argued that in the long run Openreach might be able to eliminate those competitors, by reducing prices down to cost (or between the regulated price and cost) and "if network operators roll out network on the back of regulated prices that are above cost, it is only a matter of time before they run into financial difficulties".[386]

Our assessment

A12.29 Our view is that network competition will benefit consumers regardless of whether competing networks' costs are as low as Openreach's. For the reasons set out in Volume 4 Section 1, we consider that price regulation will impact altnets' returns in the short run. In the long run, we expect prices will be informed by competition rather than regulation, if altnet build continues. When deciding whether to invest, altnet builders will only invest if they consider that the investment will be profitable on this basis.

Impact of higher wholesale prices on Openreach investment

A12.30 Sky and TalkTalk both argued that allowing Openreach's 40/10 FTTC prices to rise by inflation would disincentivise FTTP rollout by Openreach, by increasing the profitability of its copper and FTTC services.[387] TalkTalk estimated that a £1 increase in wholesale FTTC prices would lead to an increase of about £0.30 in retail FTTP prices, meaning BT's incremental profits are reduced by £0.70 when it moves a customer from FTTC to FTTP. Therefore, it argued, where the threat of altnet entry is limited, higher wholesale FTTC prices will reduce Openreach's FTTP investment incentive. TalkTalk also considered that the majority of Area 2 will not see any altnet FTTP build over this review period, limiting the altnet threat.[388]

A12.31 TalkTalk disagreed with our view that additional profits from higher FTTC prices will help fund FTTP investment, stating that "the mere existence of spare cash will not increase Openreach's incentive to invest in FTTP".[389]

[385] TalkTalk response to January 2020 Consultation, paragraph 5.23.
[386] Vodafone response to January 2020 Consultation, Part 3, section 9.
[387] Sky response to January 2020 Consultation, page 13. TalkTalk response to January 2020 Consultation, paragraphs 5.41 – 5.45.
[388] TalkTalk response to January 2020 Consultation, paragraph 5.45.
[389] TalkTalk response to January 2020 Consultation, paragraphs 5.48 and 5.84.

Our assessment

A12.32 At paragraphs 1.39 to 1.42, we explain why we do not think higher FTTC prices would undermine Openreach's incentive to invest in gigabit-capable networks.

A12.33 Moreover, TalkTalk appears to have acknowledged that where there is a clear threat of altnet entry, any added incentive to sweat its copper assets would be outweighed by its incentive to invest in order to not lose volumes to competitors.[390]

A12.34 We explain why we consider that additional legacy profits will support Openreach's investment at paragraph 1.40.

Impact of pricing flexibility on higher bandwidth services on consumers

A12.35 Sky and Vodafone disagreed with our proposals that there should be no charge control on 80/20, arguing that the price cap on 40/10 would not sufficiently protect consumers. Vodafone argued the anchor should cover 40/10, 80/20 and 160/30.[391] Sky said it sees a real risk that, absent a price cap on 80/20, Openreach will be incentivised to increase wholesale prices over the market review period. Vodafone predicted that ISPs will be pressured to move their customer bases upwards from 80/20 speeds once Openreach's GEA discount scheme ends, rendering the market effectively free of all price regulation.[392] SPC Network submitted reports on behalf of Vodafone and Sky on the effectiveness of 40/10 as an anchor product.[393]

A12.36 We summarise the evidence they provided in support of this view in more detail below.

Volumes on 80/20 and above are increasing

A12.37 Sky said that the 80 Mbit/s service is more widely adopted than 40 Mbit/s.[394] It said that it has rapidly migrated customers to higher speed services, such that [✂]% are on 80 Mbit/s or above, which it expects to [✂]% by 2023. Between June 2019 and 2020, the number of superfast broadband connections increased from around two-thirds to 74% and average download speeds increased from 50 Mbit/s to over 60 Mbit/s.

A12.38 Vodafone said that recent Openreach's offers will accelerate demand for 80/20-based products, such that it will outsell 40/10-based products by almost two-to-one this financial year. [395] It also said that, in addition to Openreach's incentive and special offers to encourage Sky and TalkTalk customers from standard broadband to GEA, several mainstream ISPs do not offer 40/10-based products and their entry-level mainstream broadband product is a higher speed one e.g. Sky and BT Consumer.[396] Vodafone said that 80/20 is now the volume FTTC product, outselling all other speeds by a considerable margin for new provides.[397]

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[390] TalkTalk response to January 2020 Consultation, paragraph 5.42.
[391] Vodafone response to January 2020 Consultation, Part 1, paragraphs 3.41 and 3.50.
[392] Vodafone response January 2020 Consultation, Part 1, paragraph 3.47.
[393] SPC Network, April 2020. *Report for Vodafone: Geographic Market Definitions and Remedies in the Wholesale Fixed Telecoms Market* (SPC Report 1) in Vodafone response to January 2020 Consultation, Annex 3. SPC Network, September 2020. *Is GEA 40/10 an Effective Anchor Product? Report for Vodafone UK and Sky* (SPC Report 2).
[394] Sky response to January 2020 Consultation, pages 13-14.
[395] Vodafone response to January 2020 Consultation, Part 1, paragraph 3.4.
[396] Vodafone response to January 2020 Consultation, Part 1, paragraph 3.4.
[397] Vodafone response to July 2020 Consultation, paragraph 18.

A12.39 SPC showed that the weighted average speed increased from 31 to 66 Mbit/s between 2013 and 2018,[398] and the proportion of consumers on speeds between 10 and 30 Mbit/s fell from 64% in 2013 to 33% in 2018.[399]

Our assessment

A12.40 We acknowledge that volumes on 80/20 and above are increasing. However, we do not consider that this contradicts our view that 80/20 prices will be constrained by the 40/10 price cap for the reasons outlined in paragraphs 1.56 to 1.58.

Increase in data usage

A12.41 Vodafone argued that 80/20 is increasingly regarded at an entry-level broadband service[400] and that consumers are using their broadband connections more intensively year-on-year.[401] It said that Covid-19 is likely to accelerate the weakening constraint of 40/10-based prices on 80/20-based prices,[402] and argued that many consumers find 40/10 insufficient to meet the demands of home working, home schooling or content streaming.[403] In addition to a greater need for quality broadband, it argued that COVID-19 is also hampering consumers' ability to fund this need.[404]

A12.42 [✂][405] SPC attributed increasing speeds to the increased demand for data e.g. due to increased use of video streaming services. In addition, the use of higher quality equipment e.g. 4K TVs (of which sales grew from 17% in 2017 to 35% in 2019) requires higher speed broadband services.[406]

Our assessment

A12.43 We agree that data usage has been increasing, particularly over the past year. However, Vodafone did not submit evidence that this increase in data usage means that a 40/10 product would not be sufficient for the majority of consumers.

A12.44 The evidence set out in Volume 2, Section 2 suggests that satisfaction with broadband speeds was sustained throughout the first Covid-19 lockdown period when usage was increased.[407] We also note that Frontier argued that that current networks have generally coped well with increased traffic due to Covid-19 lockdowns, and that they are sufficient to meet consumers' requirements during these periods.[408]

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[398] To calculate the weighted average, they "have used a bandwidth of 7.5Mbps for the "<10Mbps" band and 150Mbps for the ">100Mbps" band. The mid-point has been used for other bands".
[399] SPC add that such trends are seen across Europe. SPC Report 1, section 5.3.1.
[400] Vodafone response to July 2020 Consultation, paragraph 18.
[401] Vodafone response to January 2020 Consultation, Part 1, paragraph 3.4.
[402] Vodafone response to January 1010 Consultation, Part 1, paragraphs 3.4 – 3.7.
[403] Vodafone response to July 2020 Consultation, paragraph 18.
[404] Vodafone response to January 2020 Consultation, Part 1, paragraph 3.38.
[405] [✂].
[406] SPC Report 1, section 5.3.1.
[407] Bandwidth recommendations are consistent with this. See footnote 23 of Volume 4.
[408] 2020 Frontier Report for Vodafone, section 5.6.1.

SPC higher bandwidth pricing evidence

A12.45 SPC said that the Hull Area has close to 100% full fibre coverage, meaning it can act as a natural experiment to test demand for this product.[409] It showed that KCOM's prices for its 30 Mbit/s, 75 Mbit/s and 200 Mbit/s products follow a shallow price gradient (as the rest of the UK's does), but at a significant premium to UK-wide prices.[410] Using average download speed data, SPC showed a significant decline in 30 Mbit/s consumers and a consequent rise in 75 and 200 Mbit/s consumers. They also calculated the proportion of high bandwidth customers to be three times as high in the Hull area where FTTP is everywhere, despite a higher price and lower median income. SPC considered that this means consumers are willing to pay a premium for higher speed broadband.[411]

A12.46 SPC also attempted to test the effect of a change in the price premium for speeds over 100 Mbit/s compared to speeds between 12 and 30 Mbit/s across 27 EU Member States. It showed that consumers have moved up bandwidths even if the price premium grew.[412] SPC stated that Ofcom has no reason to presume that consumers will spin down to a slower speed in response to price rises, and that consumers' taste for higher speeds will outweigh increases in the 80/20 price premium.[413]

Our assessment

A12.47 We disagree with SPC that a higher proportion of FTTP customers in the Hull area indicates a willingness to pay a premium for higher speed broadband. SPC acknowledged that KCOM's prices follow a shallow price gradient, which is consistent with our view that there is not a significant willingness to pay for higher speed services. We also consider Hull's higher prices to be driven by the current market and regulatory conditions rather than greater willingness to pay e.g. KCOM has retained a near monopoly at both the wholesale and retail level.[414]

A12.48 We disagree with SPC that reliable conclusions can be drawn from plotting the change in subscribers over 100 Mbit/s relative to the change in the price dispersion over 100 Mbit/s. For example, this approach does not control for any other factors driving demand.

SPC demand estimation and price reaction models

A12.49 SPC submitted a separate report (on behalf of Vodafone and Sky), in which they provided results from a price reaction model and demand model and conclude that the 40/10 wholesale product is an ineffective anchor for 80/20 prices.[415]

A12.50 SPC's price reaction model aimed to test how one provider's retail prices react to the minimum competitors' price among four other operators in the preceding time period. It found that the provider's own 40/10- and 80/20-based prices are both affected by 80/20-based competitors'

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[409] SPC notes that Hull has not been subject to "provider-led" upgrades.
[410] I.e. the average price of the three UK-wide retail products based on GEA 80/20 is £26, whereas the price in the Hull Area for the 75 Mbit/s package is £42 – a premium of 61%.
[411] SPC report 1, section 5.3.2.
[412] Specifically, it finds an insignificant weak negative relationship between the change in 100 Mbit/s customers and the change in the price premium.
[413] SPC report 1, section 5.3.3.
[414] Ofcom, 2020. *Hull Area Wholesale Fixed Telecoms Market Review 2021-26*, Volume 1, page 1.
[415] SPC Report 2, Section 4.

prices, but neither are affected by 40/10-based competitors' prices. On this basis SPC concluded that 80/20-based prices do not react to competitors' 40/10-based prices.

A12.51 SPC's demand models[416] estimated the impact of three different lagged price variables on demand.[417] SPC found that demand for 80/20-based services reacts to own price changes but not to the 40/10-based prices or competitors' 80/20-based prices. Therefore, it concluded that 80/20-based demand is independent of 40/10 prices.

Our assessment

A12.52 We observe the following problems with both SPC's price reaction and demand models:

- Both models have a clear indication of multicollinearity, which can cause the affected variables to become statistically and economically insignificant.
- Both models are likely to suffer from simultaneity bias, which can cause unexpected results.
- Both models fail to confirm established competitive relationships:
  - the price reaction model finds that 40/10 prices are unaffected by competitive 40/10 prices, and
  - the demand model finds that 40/10 demand is unaffected by competitive 40/10 prices, and that 80/20 demand is unaffected by competitive 80/20 prices.
- Both models fail to account for the impact of a provider's own 40/10 prices, which we consider to be important in testing the extent to which the price of the 40/10 service anchors the price of the 80/20 service:
  - the price reaction model excludes the impact of a provider's 40/10 prices on its 80/20 prices, and
  - the demand model excludes "within-company" cross-price elasticities.[418]

A12.53 Overall, we find that SPC's result that 80/20 prices are not constrained by 40/10 prices is unreliable and cannot be considered as evidence to determine the strength of the 40/10 anchor.

Evidence on customer downgrades

A12.54 Sky also argued against our view that consumers may downspin to the price-constrained 40 Mbit/s service if 80 Mbit/s prices increase. They say that "while consumers exhibit a low willingness to pay more for higher speeds, they also exhibit fairly high loss aversion" meaning 40 Mbit/s prices may constrain 40 Mbit/s customers from upgrading to 80 Mbit/s, but that it would be ineffective in preventing rising prices for existing 80 Mbit/s customers given they will be disinclined to downspin to lower speed services.[419] UKCTA also argued that 80/20 should be

[416] SPC estimated two separate demand models – one for Sky and one for Vodafone.
[417] The price variables are own price for product A (i.e. either 40/10- or 80/20-based), minimum competitive price for product A, and minimum price for product B (minimum out of own price and competitors' prices).
[418] SPC stated that "within-company" elasticities are difficult to obtain due to providers keeping a relatively constant pricing relationship between their own 80/20 and 40/10 service. We consider that a constant 40/10 – 80/20 price differential contradicts SPC's message that 40/10 prices do not constrain 80/20 prices.
[419] Sky response to January 2020 Consultation, pages 13-14.

the anchor product and that there is “compelling evidence to suggest that consumers rarely decide to regress their broadband speed.”[420]

A12.55 Vodafone said that there is compelling evidence to suggest that consumers rarely decide to downgrade their broadband speed, meaning customers on speeds higher than a 40/10-based service are unlikely to move back to 40/10. It said that Openreach can incentivise higher speed adoption through offers and discounts, after which consumers will not risk dropping to a lower speed to save money.[421]

Our assessment

A12.56 We address this at paragraph 1.58.

Openreach’s prices post-GEA contract

A12.57 Sky argued that after the GEA contract ends in August 2023 altnet build is an insufficient threat to prevent Openreach from increasing prices given that it is likely to be low throughout the market review period.[422] Vodafone argued that our approach would leave broadband consumers vulnerable to wholesale price rises from 2023 onwards. It argued that Openreach would have a clear incentive to set prices above the competitive level as it would be unlikely that infrastructure competition will be mature enough at that point to act as a meaningful constraint.[423]

Our assessment

A12.58 We set out why we consider that prices of higher bandwidths will continue to be constrained by 40/10 over this review period at paragraphs 1.56 to 1.58. In the longer term we also expect competing network build, as a result of our measures to promote competition, to be an increasing constraint on Openreach’s wholesale prices, in addition to the competition already provided by Virgin Media, as set out at paragraph 1.59.

Distributional effects

A12.59 Vodafone considered that the insufficient constraint of the 40/10 anchor risks consumers having to pay prices above competitive levels or being stuck on slower speeds due to affordability concerns. It said that 40/10 is unlikely to be sufficient for “an increasing number of economically constrained consumers.”[424] Similarly, Frontier raised the concern that higher superfast broadband prices may incentivise downgrades or lower quality/price alternatives, particularly among lower income households.[425]

A12.60 Frontier argued that important distributional effects of pricing continuity had not been evaluated. Higher priced copper-based services are more likely to affect less well-off customers, while the benefits of full fibre competition may be concentrated on higher income

[420] UKCTA response to January 2020 Consultation, paragraphs 11-16.
[421] Vodafone response to January 2020 Consultation, Part 1, paragraph 3.46.
[422] Sky response to January 2020 Consultation, page 13.
[423] Vodafone response to July 2020 Consultation, paragraph 22.
[424] Vodafone said an anchor covering 40/10, 80/20 and 160/30 would promote “price certainty at these basic wholesale price points” leaving FTTP investment free to compete for the growing retail appetite for higher speeds (i.e. above 160 Mbit/s). Vodafone response to January 2020 Consultation, Part 1, paragraphs 3.40-3.42.
[425] 2020 Frontier Report for Vodafone, section 5.6.3.

customers. In addition, the costs are borne across all of Area 2, but direct consumer benefits will only arise for those who live in an area with FTTP rollout and consume FTTP. Frontier said there are potential spillover effects of greater competition in other parts of Area 2 due to nationally uniform pricing but say that "this may not be the case in relation to other dimensions of competition". It believed that a net transfer from less urban to more urban consumers is likely.[426]

A12.61 Frontier also said that the Covid crisis highlighted the significant externality benefits of widespread access to decent broadband,[427] and that widespread access to superfast broadband, rather than standard broadband, is fundamental.[428] It argued that superfast broadband take-up may be undermined by allowing access prices to rise significantly above cost, potentially slowing down the migration of standard broadband households to superfast.[429] It suggests there could be "sufficient 'headroom' in the FTTC network to absorb any longer-term/sustained shifts in usage resulting from the crisis".[430]

Our assessment

A12.62 In response to the argument that some customers may need to downgrade from 80/20 to 40/10, we have explained why we consider that 40/10 will be sufficient for the majority of consumers. We also consider that the risk of consumers downgrading will provide an incentive for Openreach to maintain a low price differential between those speeds.

A12.63 We recognise that not all premises will have access to gigabit-capable networks by the end of this review period. Investment in gigabit-capable networks is expected to take place over much of the next decade.[431] Our objective in Area 2 is to promote competition and investment in these networks by Openreach and other operators. We explain in Volume 4 Section 1 why pricing continuity is the only option that would be effective in meeting this objective.

A12.64 We explain why we disagree with Frontier's suggestion that we should seek to minimise short term prices for consumers, rather than promote competition and investment, at paragraph 1.52.

Impact of higher wholesale prices on downstream competition

A12.65 As mentioned above, TalkTalk considered that higher FTTC wholesale prices will erode non-BT ISPs' market shares.[432] TalkTalk argued that BT gained about 1% market share each year "from 2011 [to 2017] when no charge control was imposed on FTTC and prices were set above cost".[433]

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[426] 2020 Frontier Report for Vodafone, section 5.5.
[427] It said, for example, that. survey evidence suggested a greater acceptance of remote working and remote GP appointments.
[428] E.g. Increased video calling has emphasised the importance of upload speeds as well as download speeds, and recent Ofcom data shows that mean upload speeds are an order of magnitude greater for superfast broadband than standard broadband.
[429] As well as the migration of customers from lower to higher bandwidth superfast broadband. Frontier says that around one third of households still use standard broadband. 2020 Frontier Report for Vodafone, section 5.6.2.
[430] 2020 Frontier Report for Vodafone, section 5.6.1.
[431] See Annex 3.
[432] TalkTalk response to January 2020 Consultation, paragraphs 5.81 – 5.82.
[433] TalkTalk response to January 2020 Consultation, paragraphs 5.33.

A12.66 Vodafone argued that a weak anchor damages retail competition, given that a retail ISP that cannot access the latest discount scheme risks being unable to grow and will compete less intensively. It argued that this decline in retail competition will lead to poor consumer outcomes.[434] Vodafone also argue that allowing wholesale prices to rise above costs, when the wholesale provider is also a retail provider (as is the case for Openreach and BT), hands a 'product advantage' to that provider.[435]

A12.67 Vodafone also considered that Openreach's excess profits are likely to be used by BT Group to the detriment of the long-term competitiveness of the market by acting in the interests of its shareholders and either offering targeted discounts or seeking to win greater market share.[436]

Our assessment

A12.68 We disagree that BT's market share increase between 2011/12 and 2016/17 demonstrates that not controlling FTTC prices to cost will lead to significant harm to non-BT ISPs. TalkTalk referred to a report by Frontier Economics for Sky in 2019, but that report acknowledges that a number of reasons may have contributed to the growth in BT's market share (e.g. BT's entry into ownership/provision of premium content).[437]

A12.69 We explain at paragraph 1.61 why we do not consider that pricing continuity would pose a serious threat to the sustainability of retail competitors over the review period.

A12.70 Our view is that this pricing continuity would create a longer-term threat to ISPs' market shares if they chose to remain on Openreach's network, which would create an additional incentive to move to an alternative network, as we explain at paragraph 1.32.

A12.71 We disagree that Openreach's returns on its copper products could harm competition in the retail market. For the reasons set out at paragraph 1.40, our view is that allowing Openreach to set prices above the cost of copper services would also support Openreach's investment in FTTP. In addition, Vodafone did not explain why any additional profits would affect Openreach's incentive and ability to harm competition on the retail market, and it is unclear why this would be the case.

Proportionality of pricing continuity

Costs and benefits of pricing continuity

A12.72 TalkTalk and Vodafone considered that we should have completed a thorough cost benefit analysis of our proposals, by comparing the incremental costs and benefits against a counterfactual (in which cost-based prices are the status quo).[438] Frontier Economics submitted a report (on behalf of Vodafone), which argued that our analysis for Area 2 fell significantly

[434] Vodafone response to January 2020 Consultation, Part 1, para 3.48.
[435] Vodafone response to January 2020 Consultation, Part 3, paragraphs 7.14-7.15.
[436] Vodafone response to January 2020 Consultation, Part 3, paragraphs 7.1-7.3.
[437] Frontier Economics, June 2019. *Ofcom's Proposed Approach to Remedies: Review of Ofcom's proposals* (2019 Frontier Report for Sky) in Sky response to March 2019 Remedies Consultation (initial proposals), Annex, page 23.
[438] TalkTalk stated that Ofcom's assumed 'benefit' of 5m homes passed is incorrect, given that it cannot equal the incremental build (which should be the true benefit) and such an incremental benefit of that size is implausible given the negligible impact of wholesale FTTC prices on altnet returns. TalkTalk response to January 2020 Consultation, paragraph 5.62; Vodafone response to January 2020 Consultation, Part 3, paragraph 1.4.

short of a proper impact assessment. It said that we qualitatively examined the merits of different regulatory approaches, but failed to meet our own impact assessment guidelines.[439]

A12.73 Frontier argued that our 'counterfactual' scenario was inadequately defined, and our cost model made assumptions based on the "expected out-turn" following policy implementation, instead of the "expected out-turn" if alternative proposals were implemented. Frontier said that, if a cost-based approach would lead to less premises passed, then "the degree to which it will be lower should be consistent with Ofcom's assumptions of the benefits of a CPI-0 approach".[440] Frontier argued that our estimation of Openreach's recovery on copper-based access products under our pricing continuity approach, relative to a cost-based one, was therefore understated because they assumed volume losses that would not occur under a cost-based approach. It estimated the true cost of higher retail prices, relative to cost-based pricing (without a contribution to Openreach's FTTP costs), to be £2.7 to £3.6bn across the UK. [441]

A12.74 As set out above, Frontier argued that we had not demonstrated a causal relationship between pricing continuity and increased network competition.[442] It estimated that the costs above would also be the welfare loss to consumers as a result of our approach.

A12.75 Frontier said this could be understated as there are additional costs of our proposals that need to be considered. For example, some households may respond to higher prices by reducing their demand for broadband, by downgrading service or disconnecting.[443] This would result in a deadweight loss due to the loss of economic surplus from those consumers and reduced externalities due to lower overall broadband penetration.[444,]

Our assessment

A12.76 We do not believe that it is necessary to conduct a detailed cost benefit analysis, for the reasons set out at paragraph 1.90.

A12.77 We agree that our estimates of Openreach's recovery presented in the January 2020 Consultation assumed volume losses, and that these would have been higher had we assumed lower volume losses. We explain why it is difficult to estimate costs compared to a counterfactual at paragraph 1.92 and footnote 32. At paragraphs 1.91 to 1.96 we have presented a high-level sense check, which estimates costs compared to a counterfactual where no additional competition enters the market and there is no further investment in gigabit capable networks. This would result in the lowest prices that could apply. Therefore the difference between this lowest price and pricing continuity (£2.4bn) represents a crude

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[439] Frontier Economics, September 2020. *A report for Vodafone:* Frontier Economics: A report for Vodafone, *Pricing wholesale local access* services, dated September 2020, section 2.3.
[440] 2020 Frontier Report for Vodafone, section 5.2.1.
[441] This also includes costs relating to our Area 3 approach. For its calculation of the costs, Frontier set out its assumptions on the path of wholesale prices in its counterfactual scenario in section 5.3. It then estimated the difference in retail prices assuming Ofcom's pass-through range of 65% - 85% under our proposals and under its counterfactual. 2020 Frontier Report for Vodafone, section 5.3, 5.3.1.
[442] 2020 Frontier Report for Vodafone, section 2.3.
[443] Frontier highlighted previous Ofcom evidence showing that 9% of customers had difficulties paying for one or more communications services, and 2% of customers cancelled or did not have fixed broadband due to cost. It says this proportion may increase in light of COVID-19.
[444] Externalities include increased productivity and GDP associated with broadband, in addition to enabling remote working, online classes and online health. 2020 Frontier Report for Vodafone, section 5.4.

assessment of the maximum cost that consumers will pay in the short run. As explained at paragraph 1.97, our view is that this high-level sense check supports our view that pricing continuity will lead to a good outcome for the market and ultimately consumers.

A12.78 We explain in Volume 4 Section 1 and above why we consider that our approach would lead to more competition and investment compared to an approach that set prices at cost of legacy services. The relationship between prices and network investment is complex, and it is not possible to accurately quantify it. If Frontier is arguing that there would be competitive network investment even at cost-based prices, we note that our estimate of costs to consumers compared to this counterfactual would be lower. This is because if we were to assume that in the counterfactual there would be volume losses to competitors or that Openreach would build some FTTP anyway, Openreach's costs per line would be higher, and prices to consumers would be higher, in this counterfactual.

A12.79 We also note that our pricing remedies not only support investment in rival networks, but also reflect existing and emerging competition from Virgin Media and new network operators.

A12.80 In response to Frontier's arguments that our approach leads to additional welfare costs due to the need for customers to downgrade or disconnect, we do not think that pricing continuity will cause widespread affordability issues, and we explain in Volume 4 Section 1 why we consider that 40/10 will be sufficient for the majority of consumers.

Adaptive regulation

A12.81 As explained in Volume 4 Section 1, TalkTalk proposed an adaptive regulation approach as an alternative to pricing continuity. It argued that both approaches have a small positive impact on competitive network investment, but adaptive regulation results in lower consumer prices and does not cause retail market share erosion.[445]

A12.82 Vodafone highlighted adaptive regulation as a preferable approach to pricing continuity, saying that we do not seem to disagree with it, but that we have not considered, understood or analysed the negative impact of our approach on consumers, the market and potential FTTP competition.[446]

A12.83 We assess TalkTalk's[447] arguments below, addressing the following impacts of adaptive regulation in turn:

- ISPs' incentives to sponsor build;
- Altnets'/investors' incentives;
- Openreach's incentives to invest;
- Proportionality of adaptive regulation vs pricing continuity; and
- Legal issues.

[445] TalkTalk response to January 2020 Consultation, paragraph 1.18.
[446] Vodafone response to January 2020 Consultation, Part 3, paragraphs 10.5 – 10.6.
[447] As part of TalkTalk's submission, Frontier Economics submitted a report which assesses TalkTalk's proposed adaptive regulation approach. We refer to this where Frontier made arguments that differ to those in TalkTalk's response.

ISPs' incentives to sponsor build

A12.84 In our January 2020 Consultation, our view was that ISPs would be less incentivised to sponsor build under adaptive regulation because Openreach's wholesale charges would be cost-based before rival rollout had occurred in an area, making buying from Openreach more attractive. We said that this was important as network builders will seek to de-risk their investments by agreeing future volumes on their network with ISPs in advance of the completed build.

A12.85 TalkTalk argued that commitments from ISPs may not make a difference as to whether a competing network decided to build in some cases. It described three potential scenarios:

- the altnet building FTTP regardless of a deal with the ISP;
- the altnet not building regardless of a deal with the ISP; or
- the altnet only building if it secures a deal with the ISP.

A12.86 TalkTalk stated that, in the first two scenarios, altnets' incentives are the same under a pricing continuity approach and adaptive regulation. In the third scenario, TalkTalk agreed that ISPs could theoretically prevent altnet build where continuing to buy from Openreach was cheaper under adaptive regulation. However, TalkTalk and Frontier said that this would be unlikely because under adaptive regulation ISPs would still sponsor altnet build:

- ISPs would sponsor altnet build to gain a competitive advantage over BT, Virgin Media and other ISPs, and to avoid a competitive disadvantage over other ISPs who had committed to the altnet.[448] Frontier said that ISPs that signed up with a competing network later might be given less favourable terms than those that sponsored the build.[449]
- Frontier identified a further risk for ISPs if they were to not sponsor altnet entry under adaptive regulation. If, instead, a competing operator were to invest and not offer wholesale access (choosing instead only to self-retail), ISPs would then be exposed to higher wholesale charges on Openreach's network under adaptive regulation. ISPs would not be able to migrate customers to that new network and it would be unlikely that another altnet would build in the same area.[450]

A12.87 TalkTalk argued that high prices have not been required in practice for ISPs to commit to sponsoring altnet build. It argued that itself and Vodafone have already signed wholesale agreements with CityFibre under the current cost-based regime, which means Sky now faces the prospect of altnet FTTP rollout proceeding regardless of whether it signs a deal. TalkTalk said that this would provide a strong incentive for Sky to sign up with CityFibre under an adaptive regulation approach, given that it would face higher FTTC prices if it bought from Openreach in an area where CityFibre rolled out. TalkTalk added that Sky would be competitively disadvantaged on quality as well as cost compared to other ISPs.[451]

Our assessment

A12.88 We acknowledge that some business models do not rely on volumes from ISPs and instead seek to win volumes at the retail level. However, we believe that in many cases, having volume

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[448] TalkTalk response to January 2020 Consultation, paragraph 5.77.
[449] 2020 Frontier Report for TalkTalk, section 4.2.1.
[450] TalkTalk response to January 2020 Consultation, paragraph 5.78.
[451] TalkTalk response to January 2020 Consultation, paragraph 5.78.

commitments from ISPs would substantially improve the business case. Therefore, increasing the incentives for an ISP to sponsor build could significantly increase the likelihood of entry.

A12.89 Openreach's wholesale prices are not the only factor affecting entry. For example, there may be a first mover advantage in being the first ISP to sponsor altnet build in an area, if that ISP is able to lock in slightly lower access charges. In addition, switching to an FTTP network would lead to a quality advantage over BT while it remains on Openreach's FTTC network. However, we consider that reducing wholesale price caps now would weaken incentives to sponsor altnet build by providing a significant additional incentive for ISPs to remain on the Openreach network. Our view is that we also need to set wholesale price caps in such a way that incentivises ISPs to sponsor altnet entry, in order to promote large scale competitive network entry.

A12.90 We disagree that the deals CityFibre has already made with ISPs show that cost-based prices provide sufficient incentives for ISPs to sponsor altnet build, for two reasons:

- The context for the deals with TalkTalk and Vodafone was not cost-based pricing. It was the approach to pricing trailed in the DCR (2016), with implementation taking shape in subsequent market reviews, including this present review.
- Whilst the existing deals are important, additional volumes for ISPs would improve the business case for competing networks to expand.[452] [✂][453]

Altnets'/investors' incentives

Impact of ISPs' market shares

A12.91 As explained in above, TalkTalk argued that higher FTTC wholesale prices across all of Area 2 would erode non-BT ISPs' market share, which would reduce profitability of competing network investment. It argued that by setting cost-based prices before competing network rollout, adaptive regulation avoids this.[454] Frontier argued that as a result, altnet investment would be comparatively more attractive because there would be a larger contestable wholesale customer base.[455]

Our assessment

A12.92 As we explain at paragraph 1.31 we do not expect keeping price caps the same in real terms would result in significant damage to ISPs' competitive positions in this review period, such that they would no longer be able to offer a large customer base to new network builders. Even if there were less risk of market share erosion under adaptive regulation, ISPs would have weaker incentives to sponsor altnet entry. Therefore, we do not consider that ISPs having a more certain market share would increase the profitability of competitive network investment.

[452] See, for example, CityFibre response to October 2020 Copper Retirement Consultation, paragraphs 1.10 and 1.25iv.
[453] [✂].
[454] TalkTalk response to January 2020 Consultation, paragraph 1.3.
[455] 2020 Frontier Report for TalkTalk, section 4.2.1.

Importance of post-entry prices

A12.93 In relation to the incentives on the altnets, TalkTalk said that adaptive regulation does not weaken incentives to build because altnets (and their investors) would make their investment decision based on the post-entry price.[456]

Our assessment

A12.94 We agree that altnet profitability will depend in part on the wholesale or retail prices they charge after they have built a competing network, and therefore agree that expectations of post-entry prices are relevant. However, as we explain in Volume 4 Section 1, pre-entry prices also affect the profitability of the business case. We consider that relying on post-entry prices would not promote scale competitive network investment and that additional volumes from ISPs under pricing continuity would improve the business case for new networks.

Complexity of adaptive regulation

A12.95 TalkTalk said that Ofcom "explained that in fact their primary concern in relation to 'complexity' was not related to administrative burden but rather that investors would not understand that under adaptive regulation prices will increase once investment occurs".[457]

A12.96 TalkTalk argued that a pricing continuity approach would be more of a departure from existing regulation than adaptive regulation would be, given that the latter only leads to changes in cost-based prices where altnet build occurs.[458] Therefore, it argued that pricing continuity is more of a drastic change that would erode investor certainty over the medium to long term.[459]

A12.97 Frontier acknowledged that adaptive regulation would be more complex than pricing continuity, and that it would create an additional burden on Ofcom and operators due to the requirement to gather and analyse network coverage data every six months, and to adjust prices accordingly. In addition, Frontier said that reliably estimating 'adjusted REO' costs would likely be challenging. However, Frontier argued that we already collect the relevant data at regular intervals for Connected Nations reviews, and we plan to model fibre deployment costs anyway to inform our approach to future regulation. TalkTalk argued that we could reduce the burden by merging the collection of FTTP coverage data for both existing Ofcom projects and adaptive regulation monitoring.[460]

Our assessment

A12.98 Our primary concern with adaptive regulation is not investor comprehensibility. However, we do consider that adaptive regulation would cause a significant degree of complexity and uncertainty for investors.

A12.99 This would be a significant change from our approach of setting wholesale prices to support network investment. It would create more uncertainty and risks around volumes from ISPs, as discussed above. It would rely on Ofcom moving from cost-based regulation to a price floor, rather than letting the benefits of competition play out where altnet roll out had occurred.

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[456] TalkTalk response to January 2020 Consultation, paragraph 5.75.
[457] TalkTalk response to January 2020 Consultation, paragraph 5.79.
[458] TalkTalk response to January 2020 Consultation, paragraph 5.79.
[459] TalkTalk response to January 2020 Consultation, paragraph 5.53-54.
[460] 2020 Frontier Report for TalkTalk, section 4.2.5; TalkTalk response to January 2020 Consultation, paragraph 5.90.

There would be uncertainties around how long the price floor would be in place, as investors would expect the price floor to be removed once Ofcom concluded that an area was competitive. In addition, the requirements around how adaptive regulation would work in practice would be complex. On the other hand, a pricing continuity approach allows investors more certainty as it involves no changes to the level of price regulation. It also does not rely on any future changes to Openreach's pricing to provide incentives for investment.

A12.100 We remain of the view that adaptive regulation would be more complex for Ofcom to implement than a pricing continuity approach despite the potential efficiencies in data collection highlighted by TalkTalk.

Reduced risk of exclusionary behaviour due to a price floor

A12.101 TalkTalk argued that in assessing adaptive regulation, we ignored the benefits of a price floor in better protecting against exclusionary behaviour by Openreach, compared to a price cap (combined with a geographic discount prohibition).[461] Frontier added that the post-trigger price floor would prevent Openreach from pricing aggressively to deter future entry, and that Ofcom could also set conditions on how Openreach priced higher bandwidth services, so that Openreach could not undermine altnets' ability to compete by aggressively pricing its high bandwidth FTTP service.[462] [463]

A12.102 TalkTalk also argued that our concern that the FTTC price floor may be set too high revealed clear bias in our approach. It said that we had not assessed the pricing continuity approach against this same criterion, otherwise we would have found that there is greater risk that pricing continuity sets a price cap that is too high, and that such higher prices would be inflicted upon far more consumers than under adaptive regulation.[464]

Our assessment

A12.103 We acknowledge that a price floor could in principle give greater protection against exclusionary behaviour by Openreach. However, as explained in Volume 3 Section 7, we remain of the view that a prohibition on geographic discounts is a simpler and more proportionate means of addressing our competition concern than a price floor. In addition, as competition is emerging, we do not want to introduce regulation which would deny consumers the benefits of such competition.

A12.104 We disagree that we have been biased in our assessment. We have acknowledged that, in the short term, prices to consumers would be lower under adaptive regulation. However, as we also consider that as adaptive regulation would lead to less competitive network investment, it does not meet our objective of promoting competition and investment.

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[461] TalkTalk response to January 2020 Consultation, paragraph 5.99.

[462] E.g. "setting prices for FTTC 80/20 / G.fast / FTTP services below the 40/10 FTTC floor or setting wholesale and retail prices that would imply a margin squeeze on access seekers".

[463] 2020 Frontier Report for TalkTalk, section 4.2.1, p33.

[464] TalkTalk response to January 2020 Consultation, paragraphs 5.85-5.86.

Openreach's incentives to invest

A12.105 TalkTalk argued that Openreach would have a stronger incentive to invest in FTTP under adaptive regulation, given its view that higher FTTC profits under pricing continuity would discourage FTTP investment (discussed above).[465]

Our assessment

A12.106 We disagree that adaptive regulation would better promote Openreach investment because:

- Adaptive regulation would reduce the likelihood of competitive network investment, and would thereby reduce the incentive for Openreach to invest (see paragraphs 1.71 to 1.72 and above);
- Adaptive regulation would not allow Openreach to set prices above the cost of copper services, and thereby fail to promote Openreach's own investment in FTTP (see paragraph 1.73); and
- We do not consider that higher FTTC prices under pricing continuity would undermine Openreach's incentives to invest (see paragraphs 1.39 to 1.42).

Proportionality of adaptive regulation vs pricing continuity

A12.107 TalkTalk argued that adaptive regulation would be more efficient in promoting investment than pricing continuity because prices would only increase when and where altnets invested, unlike under pricing continuity. TalkTalk estimated that retail prices would only increase by c.£270m under adaptive regulation, compared to c.£930m under a pricing continuity approach.[466] It estimated the same impact on altnet returns under both approaches. Frontier estimated costs to consumers would be £850m higher under our approach compared to adaptive regulation over the review period.[467]

A12.108 TalkTalk argued that we did not account for an additional consumer benefit under adaptive regulation, which is that wholesale FTTC price rises due to the price floor would be dampened to an extent due to ISPs geographic price averaging.[468]

A12.109 TalkTalk also argued that we could overstate the benefits of pricing continuity as our forecasts of FTTP build are likely to be highly inaccurate. It argued that adaptive regulation would not suffer from this weakness since it adapts to market conditions. [469] [470]

A12.110 Frontier argued that adaptive regulation would be fairer, given that prices would rise only for those customers who benefit from altnet build.[471]

[465] TalkTalk response to January 2020 Consultation, paragraphs5.83-5.84.
[466] TalkTalk response to January 2020 Consultation, paragraph 5.72.
[467] 2020 Frontier Report for TalkTalk, figure 1.
[468] TalkTalk response to January 2020 Consultation, paragraphs5.103.
[469] 2020 Frontier Report for TalkTalk, section 4.2.4, p36.
[470] TalkTalk response to January 2020 Consultation, paragraphs5.101.
[471] 2020 Frontier Report for TalkTalk , section 4.2.2, p35.

A12.111 Frontier also argued the risk of error in our approach in defining Areas 2 and 3, such that retail competition may be dampened in Area 2 locations where altnets do not build, whereas adaptive regulation avoids this risk.[472]

Our assessment

A12.112 While we agree that short term costs to consumers would be lower under adaptive regulation, we disagree that adaptive regulation would promote competition and investment. It therefore does not meet our objective.

A12.113 We do not disagree with TalkTalk that ISPs might set geographically average prices under adaptive regulation. However, in the event that the price floor was triggered, wholesale price rises would still occur as a result, and some pass through in retail prices would be expected.

A12.114 We recognise that there is uncertainty in relation to new competitive network build, and the possibility that in practice it may not occur everywhere in Area 2 in this review period. However, competing network build is well underway and there is a strong expectation that we will see a large injection of new competition in this review period. Moreover, Virgin Media is already present in most of Area 2, and it plans to both extend its coverage in Area 2 and upgrade its network to gigabit-capable over the next few years. Therefore, in addition to planned new network build in some parts of Area 2, we already have an existing material and sustainable competitor present in Area 2 in other areas, and we believe that it is right that our remedies reflect this.

A12.115 In the longer run, we expect new networks' build plans to evolve and it is possible that success in building a scale supply business provides a foundation for subsequent expansion into other parts of Area 2. Pricing continuity also promotes Openreach investment in FTTP, which will benefit consumers.

Legal issues

A12.116 TalkTalk argued that we suggested that we are only able to impose a charge control if there is a risk of excessive pricing or a margin squeeze, and it disputed this. It added that if we do not have such powers to address the risk of predatory pricing under adaptive regulation, then we cannot impose a geographic discount prohibition given that it has the same purpose of preventing predatory pricing, rather than excessive pricing or price squeeze. Therefore, TalkTalk disputed the legal issues that we consider relevant to adaptive regulation.[473]

Our assessment

A12.117 We do not agree with TalkTalk. Section 88 of the Act only permits the imposition of SMP conditions imposing price controls or rules about the recovery of costs and cost orientation[474] where it appears to us from our market analysis that there is a relevant risk of adverse effects arising from price distortion, in that the dominant provider might : (i) fix and maintain some or all of the its prices at an excessively high level; or (ii) impose a price squeeze, in each case as to

[472] 2020 Frontier Report for TalkTalk, section 4.2.3.
[473] TalkTalk response to January 2020 Consultation, paragraphs 5.93-5.94, 5.97.
[474] i.e. conditions falling within section 87(9) of the Act.

have adverse consequences for end-users of public electronic communications services.[475] The geographic discount prohibition which we have decided to impose is a no undue discrimination obligation which is imposed under section 87(6)(a). Section 87(6)(a) is not subject to the requirements of section 88.

Copper wedge

A12.118 In Vodafone's response to our January 2020 Consultation, Vodafone reiterated its preference for an alternative approach to pricing continuity. It highlighted the copper wedge approach, which "only rewards costs in line with actual incurred costs and 'ear-marks' or reserves the remaining revenue from regulated service for fibre investment."[476]

A12.119 It said that the copper wedge would seek to maintain higher prices but also to adjust prices "in a way that… increases funding for fibre build from commercial revenue".[477] Vodafone believed that this would be beneficial and mitigate the "risk of disturbing the industry's competitive dynamics by potentially handing one operator £2.5bn or more in excessive profits that they can then use to entrench their market dominance".[478]

A12.120 Vodafone considered that Ofcom did not particularly disagree with the copper wedge or adaptive regulation approaches in our January 2020 Consultation, other than they would be burdensome or difficult to implement.[479]

A12.121 Vodafone said that our lack of focus on copper wedge stemmed from our failure to consider, understand or analyse the negative impact of our pricing continuity approach.[480]

A12.122 Connect Fibre agreed with Vodafone and "strongly support the copper wedge".[481]

Our assessment

A12.123 A copper wedge would not be more likely to promote Openreach's FTTP investment than pricing continuity, for the reasons described at paragraph 1.79, and could provide less support for it. A copper wedge could also protect consumers and existing models of downstream competition, in the same way as pricing continuity.

A12.124 However, using the copper wedge to support network build via competitive tender would require a high administrative burden. For example, it could require Ofcom to determine how the wedge funds are to be delivered, the minimum criteria that proposals to use the funds must meet, the appropriate allocation method and the appropriate mechanism for ensuring winning participants deliver on their commitments. It would also be likely to require an ongoing role for Ofcom in assessing delivery and enforcing non-delivery through contractual mechanisms.

[475] Sections 88(1)(a) and 88(3) of the Act.
[476] Vodafone response to January 2020 Consultation, Part 3, paragraphs 7.1 and Section 10.
[477] Vodafone response to January 2020 Consultation, Part 3, paragraph 10.2.
[478] Vodafone response to January 2020 Consultation, Part 3, paragraph 10.3.
[479] Vodafone response to January 2020 Consultation, Part 3, paragraph 10.5.
[480] Vodafone response to January 2020 Consultation, Part 3, paragraph 10.6.
[481] Connect Fibre response to January 2020 Consultation, pages 2 – 3.

A12.125 We also remain doubtful that we would have the legal powers to implement a copper wedge. We do not think that the copper wedge could be implemented under our powers for the following reasons:

- We remain doubtful that an obligation on BT to ringfence a portion of the access price it receives and deploy these funds as Ofcom directs could be properly construed as a price control or a rule about the recovery of costs and cost orientation contained in SMP conditions.
- We also have concerns about our power to impose such conditions on BT as an exceptional measure.[482] We do not believe that this would be an exceptional circumstance making it appropriate for this type of SMP condition to be applied, in addition to those that are provided for specifically under the Act. As discussed above, our "non-exceptional" powers already allow us to impose SMP conditions that will address the competition problems our market analysis has identified.
- Further, we are concerned that the copper wedge proposal conflates two distinct regulatory frameworks, which are intentionally separate: the SMP framework which is designed to address competition problems arising from market power, and the universal service framework with its associated funding mechanism which is designed to ensure the provision of at least the minimum services to all end-users at an affordable price where their needs are not met by the market.

Leased Line Access in Area 2

A12.126 CityFibre supported our proposal to set the price cap for LL Access at CPI-0%, to support investment and provide "cross-regulatory consistency and certainty".[483] In addition, it highlighted its Capital Raising Prospectus 2017 which noted that the Ofcom's 2016-2019 BCMR imposed annual price reductions on Openreach in the range of 6% to 12%, resulting in some price reductions of CityFibre's connectivity services.[484] Internal CityFibre documents also suggested that it would not be economic to provide mobile backhaul if Openreach's price was to fall.[485]

A12.127 ACNI, BT Group , Cumbria County Council, Openreach , [✂], SSE , Virgin Media and [✂] all welcomed our proposal that the price cap for Area 2 LL Access should be set at CPI-0%.[486]

A12.128 Three also suggested that this regulation will enhance the investment case for new fibre rollout and that previous cost-based regulation may have disincentivised rollout in the past by making it cheaper to buy from Openreach.[487] Telefonica agreed that cost-based controls would fail to support altnet rollout.[488]

[482] Under section 89 of the Act.
[483] CityFibre response to January 2020 Consultation, paragraph 6.1.
[484] CityFibre,2017. *Capital Raising Prospectus 2017: Securing the UK's Digital Future*, page 89.
[485] CityFibre response dated 18 August 2020 to s.135 request dated 21 July 2020, question 4.
[486] ACNI, page 3; BT Group, paragraph 3.1; Cumbria County Council, page 7; Openreach, paragraph 7.16; [✂]; SSE, page 7; Virgin Media, paragraphs 1, 10, 11; [✂], in their responses to the January 2020 Consultation.
[487] Three response to January 2020 Consultation, paragraphs 2.1 – 2.15.
[488] Telefonica response to January 2020 Consultation, paragraph 6.1.

A12.129 A number of stakeholders disagreed with our approach. We set out these arguments and our responses below, grouped in the following broad themes:

- Impact of higher wholesale prices on competitive network investment
- Impact of higher wholesale prices on downstream competition
- Impact on consumers
- Proportionality of pricing continuity

Impact of higher wholesale prices on competitive network investment

The benefits of additional leased lines competition

A12.130 TalkTalk argued that we should not be promoting investment in leased line networks as the benefits of additional leased lines networks are minimal.[489] TalkTalk argued that the presence of existing leased lines networks in many parts of the country will mean that there are few, if any, quality improvements from additional leased line networks.[490] TalkTalk also argued that additional leased line networks tend to have limited competitive impact and pointed to several barriers as reasons for this.[491] Finally, TalkTalk argued that additional FTTP investment will not benefit leased line customers.[492]

Our assessment

A12.131 In Volume 4 Section 1, we explain that our objective is to support competition and investment in gigabit capable networks, which will typically serve both broadband and leased line services. We expect this investment to lead to significant long-term customer benefits in both the WLA and LL Access markets in Area 2.

A12.132 TalkTalk agreed that there are material benefits to promoting investment in broadband networks.[493] In relation to leased lines, we disagree that the benefits of additional competing networks offering leased lines – whether as part of a range of services or not[494] – will be small. The existing competition in the LL Access market in Area 2 comes mainly from Virgin Media, and in some parts of Area 2 there are no competitors. While we have seen some benefits from the network competition that already exists, it has not been effective in constraining BT's SMP. The deployment of new competing gigabit-capable networks is an opportunity for a substantial injection of competition in the provision of leased lines from large-scale providers with broad geographic coverage who compete for a broad range of leased lines customers. We consider that such additional competition could drive a material change in consumer outcomes in the long term.

[489] TalkTalk response to January 2020 Consultation, paragraph 7.116.
[490] TalkTalk response to January 2020 Consultation, paragraph 7.116.
[491] TalkTalk response to January 2020 Consultation, paragraph 7.116. These barriers include (i) lack of large scale customers who can switch their customer bases to new networks en masse; (ii) business customers being resistant to change as shown by longer contract periods and low churn; (iii) the need for credibility and track record of providing business grade services; and (iv) the cost and delay of extending networks into buildings.
[492] TalkTalk response to January 2020 Consultation, paragraph 7.143.
[493] TalkTalk response to January 2020 Consultation, paragraph 7.115.
[494] In Volume 4, Section 1, we explain why our approach to price regulation will support investment by providers deploying gigabit capable networks, as well as providers focused on leased lines.

A12.133 As explained in Volume 1, these benefits to consumers come from innovation (including innovation to increase efficiency and reduce costs), choice, stronger incentives to price keenly to attract customers and higher quality of service. We disagree that there are few, if any, quality improvements from additional leased line networks. Given the scope for innovation in fixed telecoms services, we consider that competition is very likely to deliver additional benefits in the long term, even if these are hard to predict now.

A12.134 In relation to the barriers facing new network competitors, we agree that the business case for competitive network investment is challenging. This is why we are seeking to support entry. However, we disagree with TalkTalk that additional networks offering leased lines will have limited competitive impact. Our market analysis suggests that there is the potential for material and sustainable competition in the provision of leased lines in Area 2. The barriers TalkTalk identifies are being overcome and – with enabling remedies – competitive network investment in Area 2 is expected to be material. We are seeing significant additional competition in the provision of leased lines emerging, and large customers of Openreach's active leased lines (MNOs) are actively considering opportunities to source dark fibre from alternative networks (including networks not yet built).[495]

A12.135 We also disagree with TalkTalk that leased line customers will not benefit from additional FTTP investment. TalkTalk said that our conclusion that FTTP services would not impose a competitive constraint on leased line products implies that there can be no more than marginal switching by SMEs to FTTP. However, our conclusion that FTTP and leased lines are in separate markets does not mean that some leased lines customers would not consider switching to FTTP. We expect FTTP to be an attractive alternative to some users of lower bandwidth leased lines.[496]

The impact of wholesale prices on leased lines investment

A12.136 TalkTalk argued that leased line network investment is likely to be relatively insensitive to setting higher wholesale prices in this market review period.[497] TalkTalk submitted that few circuits that were otherwise unviable will become viable as a result of higher wholesale prices.[498] As evidence for this, TalkTalk pointed to the limited investment by competing leased lines providers even though Ethernet prices, particularly for VHB circuits, have been substantially above cost.[499]

A12.137 [✂] disagreed that a lack of cost-based charge controls will lead to greater investment, suggesting that there is no evidence which says that a certain increase in prices will lead to a certain amount of investment. It also argued that we focused only on encouraging investment by network builders, rather than the wider industry (e.g. access seekers and networks, such as [✂] which construct and operate networks as well as relying on wholesale access where own build is not feasible).[500]

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[495] See Volume 2, Section 2.
[496] See Volume 2, Section 6.
[497] TalkTalk response to January 2020 Consultation, paragraph 7.123.
[498] TalkTalk response to January 2020 Consultation, paragraph 7.123-4.
[499] TalkTalk response to January 2020 Consultation, paragraph 7.126.
[500] [✂].

Our assessment

A12.138 We explain in Volume 4 Section 1 that we consider that price regulation will be an important consideration in the investment decisions by new and existing competitors to BT and their investors. Responses from a number of alternative network providers as well as Three, who is a large purchaser of leased lines, are consistent with this.

A12.139 We explain at paragraph 1.170 why reducing price caps from their current levels, particularly for VHB services, would risk undermining this investment and would not meet our objective of promoting competition and investment. There is potential for network investment, with significant competitive investment underway and more planned, including to provide VHB circuits. Our priority in areas that could support material and sustainable competitive commercial investment is to continue to promote network competition, given the significant benefits of this over competition based on regulated access to BT's network.

A12.140 TalkTalk's response appears to suggest that competitive leased lines investment is generally unviable. Our market analysis reaches a different conclusion. As set out in Volume 2, we conclude that Area 2 of the LL Access market includes those parts of the UK where there is, or where there is likely to be, potential for material and sustainable competition to BT in the commercial deployment of competing networks. Much of the planned investment will be in networks providing both broadband and leased lines services, reflecting the underlying economics of fibre network deployment.[501]

The impact of wholesale prices on FTTP investment

A12.141 TalkTalk disputed our view that leased lines could play an important role in enabling the business case for investment in these networks.[502] In particular, TalkTalk argued that the level of shared cost in building a joint FTTP and leased line network is low, and therefore any additional leased line build would have a negligible impact on the incremental cost of FTTP network deployment.[503]

A12.142 TalkTalk also questioned the extent to which higher revenue from leased lines would result in more FTTP investment.[504]

Our assessment

A12.143 We set out in Volume 4 Section 1 evidence that shows that leased lines play an important role in the business case for the deployment of networks providing both broadband and leased lines services – as an important source of additional demand (and revenue), as well as the ability to exploit economies of scope.

A12.144 With respect to the level of shared costs in building a broadband and leased line network, we disagree with TalkTalk that this is low. We considered this in detail in the 2018 WLA Statement

[501] See Annex 3.
[502] TalkTalk response to January 2020 Consultation, paragraph 7.128-142.
[503] TalkTalk response to January 2020 Consultation, paragraph 7.132-7.141.
[504] TalkTalk response to January 2020 Consultation, paragraph 7.131.

and concluded that the economies of scope in deploying and providing multiple services on a single network could be material.[505] In summary:

- Evidence on the extent of geographic overlap between different types of customers suggested that there is likely to be geographic overlap between demand for leased lines and demand for broadband, indicating that economies of scope should exist.
- As to the precise magnitude of economies of scope, indicative evidence from CityFibre and [✂] on the proportion of costs that are common across the provision of broadband services and leased lines over a single network suggested that the savings arising from economies of scope could be material.[506]
- Submissions from a number of stakeholders – including TalkTalk – suggested that not being able to realise economies of scope reduces the viability of the business case for full-fibre network deployment, limiting the extent that investments in ultrafast broadband networks could be justified.
- We also observed that technological innovation could give rise to further opportunities to exploit economies of scope in the future. For example, the deployment of small cells as part of a mobile network could represent a very significant source of economies of scope for a telecoms provider deploying full fibre, as it will already have fibre deployed close to the antennae locations.[507]

A12.145 Given the above, we concluded that by extending a broadband deployment to serve leased lines customers, a telecoms provider may be able to save a substantial portion of infrastructure costs and offer point-to-point leased lines at a modest incremental cost. Given the business case for investing in full-fibre networks is inherently marginal and risky, due to uncertainty around a range of factors, economies of scope may play an important role in de-risking a fibre based broadband business plan.

A12.146 We referred to this analysis and evidence in our January 2020 Consultation. TalkTalk did not comment specifically on any of the analysis or evidence set out above. TalkTalk did set out a number of reasons why it thought the extent of shared costs would be low, and estimated the reduction in FTTP costs from sharing with leased line network to be less than 1%.[508]

A12.147 In general, we recognise that the magnitude of economies of scope may vary according to the type of physical infrastructure and the required network architecture. We also recognise that PIA enables a competing network to share physical infrastructure costs with Openreach

[505] Ofcom, 2018. Wholesale Local Access Market Review, Volume 3, paragraphs 2.129 to 2.140.

[506] CityFibre estimated that approximately 20% of the total capital expenditure required to deploy an end-to-end mixed usage network is common across the provision of business connectivity and full-fibre services. Another stakeholder ([✂]) presented evidence of economies of scope in the deployment of the access network excluding lead-ins. Informed by its internal network cost modelling, this stakeholder considered that extending a residential-only network to serve business customers and point to point leased lines would involve very minimal incremental costs (equivalent to the 2% of the total capital expenditure required to deploy the residential network, excluding lead-ins). This is because they are served with fibre capacity installed at the time the FTTP infrastructure is rolled out. This indicates that a material proportion of the network route of leased lines (excluding the lead in) would be common to the network routes of a ubiquitous point-to-multipoint network.

[507] In its announcement of its recent partnership with Three to supply mobile backhaul connectivity, CityFibre states "the partnership will also mean that Three has access to small cell access points throughout each of CityFibre's dense city-wide networks". CityFibre, September 2020. *Three expands full fibre connectivity partnership with CityFibre* [accessed 3 March 2021]. [✂] CityFibre response dated 18 August to the s.135 notice dated 21 July 2020, question 4.

[508] TalkTalk response to January 2020 Consultation, paragraphs 7.137-140.

(although fibre costs are not shared). Nonetheless, the evidence set out in the 2018 WLA Statement, and in Volume 4 Section 1, suggests that the savings arising from economies of scope could be material.

A12.148 In addition, in relation to TalkTalk's specific reasons why the extent of shared costs would be low, we consider that these exaggerate the factors limiting the extent to which passive assets can be shared. For example:

- TalkTalk said that the two networks are often in different geographic areas. Our analysis in the WLA 2018 suggested there was geographic overlap.
- TalkTalk said that ducts used for FTTP networks are microtrenched which are not suitable for leased lines. Although some duct is microtrenched, the majority of BT's duct – which is relevant for users of PIA – is not microtrenched. A network operator deploying its own duct and wanting to exploit economies of scope can choose not to microtrench.
- TalkTalk said that the part of an FTTP network that is built using poles cannot be shared with leased lines. We recognise that operators may choose not to use poles to provide leased lines. However, for the same reason, we would expect BT to have deployed duct to most leased line customer sites.
- TalkTalk said that leased line duct needs to be deeper than FTTP duct for added fault resistance. Our understanding is that BT's duct network is used by Openreach to deploy both leased lines and broadband services, suggesting it is suitable for both. Where a network operator is deploying its own duct, it can deploy deeper to accommodate both.

A12.149 With respect to TalkTalk's estimate of the reduction in FTTP costs from sharing with a leased line network, we do not have the evidence required to comment on key assumptions made by TalkTalk. However, we place more weight on submissions and evidence from actual providers deploying networks, which suggests that economies of scope could be material.

A12.150 TalkTalk also pointed out that the absolute quantum of leased line network investment is substantially less than an FTTP network.[509] We recognise that the role of economies of scope may differ depending on the nature of the business case for deployment. Our position is that the economies of scope are material for an operator deploying an FTTP network. We recognise that the potential economies of scope facing a leased line provider considering expanding to FTTP are likely to play a different role.

A12.151 In relation to revenue, TalkTalk questioned the extent to which higher revenue from leased lines would result in more FTTP investment.[510] The evidence set out in Volume 4 Section 1 strongly suggests that revenue from leased lines represents a significant revenue stream for providers deploying new networks. This is also consistent with evidence considered in the 2018 WLA Statement.[511]

A12.152 TalkTalk questioned why we did not use our bottom up fibre network model to test the impact of higher leased line prices on returns.[512] We consider that the evidence set out in Volume 4 Section 1 is sufficient to conclude that leased lines play an important role in the business case

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[509] TalkTalk response to January 2020 Consultation, paragraphs 7.137.
[510] TalkTalk response to January 2020 Consultation, paragraphs 7.131
[511] 2018 WLA Statement, paragraph 2.129 and 2.132.
[512] TalkTalk response to January 2020 Consultation, paragraphs 7.132.

for the deployment of networks providing both broadband and leased lines services. We note that our bottom up fibre network model is a cost model and does not include revenue.

Efficiency of competitive network investment

A12.153 TalkTalk suggested that setting wholesale prices above cost will encourage inefficient investment, as it will attract entry by operators with higher costs than Openreach.[513] TalkTalk said that for any particular circuit entrants have higher costs than Openreach since they have lower economies of scale and will face higher duct costs (even in the presence of PIA).[514]

A12.154 Vodafone suggests that our proposal will promote inefficient investment from competing network providers, cautioning that "if network operators roll out network on the back of regulated prices that are above cost, it is only a matter of time before they run into financial difficulties".[515]

Our assessment

A12.155 We disagree with these views for the same reasons as discussed in relation to WLA services above.

Impact of Openreach pricing below fully allocated costs

A12.156 euNetworks, Axione and INCA noted that according to the 2019 BT's Regulatory Financial Statements, BT's wholesale leased line prices are already below BT's fully allocated costs. They suggested that this is likely to continue beyond 2021, requiring LL services to be cross subsidised by WLA services. euNetworks and INCA argued that this will disincentivise alternative providers from deploying competing infrastructure. euNetworks suggested that a CPI-0% charge control would be acceptable if it were combined with an up-front adjustment to compensate for the fact that BT's current charges are below costs. [516]

Our assessment

A12.157 As explained in Volume 4 Section 1, pricing continuity is expected to allow Openreach to price above costs. If the suggestion is that some of Openreach's prices are currently below cost, adjusting the level of the price cap would not affect this. If the suggestion is to impose a floor, we disagree that it is appropriate to impose a price floor for the reasons set out in relation to WLA services at paragraph 1.74.

Impact on consumers

Impact on take-up of leased lines and 5G roll out

A12.158 TalkTalk suggested that setting wholesale prices above cost will deter take-up.[517] Similarly, Vodafone disagreed with our proposal that the price cap for Area 2 LL Access should be set at

[513] TalkTalk response to January 2020 Consultation, paragraphs 7.121.
[514] TalkTalk response to January 2020 Consultation, page 146, footnote 182.
[515] Vodafone response to January 2020 Consultation, Part 3, paragraphs 9.1-9.5.
[516] Axione, paragraph 4.51; euNetworks response, paragraphs 14-17; INCA response, paragraphs 137-139, in their responses to the January 2020 Consultation.
[517] TalkTalk response to January 2020 Consultation, paragraphs 7.121.

CPI-0%, arguing that it would leave higher bandwidth leased line services priced higher than they otherwise would be, discouraging businesses and MNOs from upgrading. Vodafone argued that either adaptive regulation or the copper wedge option would be a more appropriate LL Access solution.[518]

A12.159 Vodafone argued that our approach would have particularly damaging consequences for 5G rollout and that, when considering different pricing approaches, we should address the risk that purchasers of wholesale services will delay the purchase of higher capacity products if they are priced above cost. [✂]. It noted that EE (a division of BT Group) is the only mobile operator to have announced that it will upgrade all of its 5G mobile base stations to 10Gbit/s backhaul from 1Gbit/s.[519]

A12.160 Telefonica and Three agreed that the price cap for LL Access should be set at CPI-0% in potentially competitive areas where there is an established rival to BT. However, both disagreed with our definitions of the relevant geographic areas and did not support the introduction of this charge control across the whole of Area 2. Three argued that in less competitive areas we should impose a dark fibre remedy with a price cap equivalent to the costs of an efficient sub-scale fibre provider, whilst Telefónica suggested that our regulation should place greater emphasis on protecting consumers from excessive prices, for instance by means of a tighter charge control on active services in this area.[520]

A12.161 Telefonica and Three argued that in these areas pricing continuity would risk VHB pricing inhibiting MNOs from upgrading their site capacity to meet the needs of 5G. Telefónica also argued that companies purchasing VHB products would need to pass on their higher costs to retail customers.[521]

Our assessment

A12.162 As set out at paragraphs 1.163 to 1.165, we expect prices to continue their downward trend and we consider that competition will increasingly offer alternatives to Openreach and constrain Openreach's prices for VHB leased lines over the review period.

A12.163 A number of stakeholders argued that our approach would affect the roll out of 5G and/or would result in higher retail prices. For most purchasers of VHB services, these services account for a relatively small proportion of their overall costs and so are unlikely to have a material effect on retail prices, or deployment of 5G which is a strategic priority.

Impact of higher wholesale prices on downstream competition

A12.164 Vodafone also argued that our proposal will lead to market damage from Openreach's excessive profitability, as it would be rational for Openreach to use the profits it makes from pricing above costs to gain a future competitive advantage, either through discounts or using enhanced services to increase its market share. Vodafone suggested that rather than enable

[518] Vodafone response to January 2020 Consultation, Part 3, paragraphs 4.1 and 10.1-10.6.
[519] Vodafone response to January 2020 Consultation, Part 3, paragraphs 7.13-7.15.
[520] Telefonica response to January 2020 Consultation, paragraphs 4.10-15; Three response to January 2020 Consultation, paragraphs 3.12 and 5.1-5.6.
[521] Telefonica response to January 2020 Consultation, paragraphs 2.18-2.23 and 6.5; Three response to January 2020 Consultation, paragraphs 2.27-2.37.

alternative operators to invest in competing networks, this proposal will increase Openreach's market control, by enabling Openreach to decide when it wants to reduce prices and eliminate the competition.[522]

A12.165 Vodafone and Telefónica also argued that allowing wholesale prices to rise above costs when the wholesale provider is also a retail provider (as is the case for Openreach and BT), hands a 'product advantage' to that provider.[523]

Our assessment

A12.166 We do not agree that pricing continuity would lead to market damage as suggested by Vodafone. We explain why we consider that pricing continuity will protect downstream competition in Volume 4 Section 1.

A12.167 In addition, Vodafone did not explain why any additional profits would affect Openreach's incentive and ability to harm competition on the downstream market, and it is unclear why this would be the case.

Proportionality of pricing continuity

Cost benefit analysis

A12.168 TalkTalk argued that we had not tested whether any consumer benefit resulting from more investment is likely to outweigh the costs in terms of higher prices or unavailability of DFA that Ofcom is proposing in order to stimulate such investment.[524]

A12.169 Vodafone also argued that we should seek to quantify the benefits of our pricing proposals, including the link between Ofcom's specific regulatory pricing approach and investment. It suggests we should calculate the benefits that allowing Openreach to price above cost will bring to the investment of alternative investors. [525]

A12.170 Vodafone and TalkTalk both suggested that we should seek to quantify the link between our regulatory pricing approach and investment with a cost-benefit analysis, in order to demonstrate the benefits that regulating prices above cost will bring. [526]

A12.171 [✂][527]

A12.172 Frontier argued that we understated the costs to consumers of our approach across both WLA and LL by not accounting for Openreach's excess profitability over leased line services.[528]

Our assessment

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[522] Vodafone response to January 2020 Consultation, Part 3, paragraphs 8.1-8.3.
[523] Telefonica response to January 2020 Consultation, paragraphs 6.1-6.3; Vodafone response to January 2020 Consultation, Part 3, paragraphs 7.14-7.15.
[524] TalkTalk response to January 2020 Consultation, paragraph 7.114.
[525] Vodafone response to January 2020 Consultation, Part 3, paragraphs 6.1-6.3.
[526] Vodafone response to January 2020 Consultation, Part 3, paragraphs 6.1-6.3; TalkTalk response to January 2020 Consultation, paragraph 7.159.
[527] [✂].
[528] 2020 Frontier Report for Vodafone, section 5.2.1.

A12.173 For the reasons set out in Volume 4 Section 1, we remain of the view that there is a significant and positive relationship between higher wholesale prices and network build.

A12.174 We disagree that we should have undertaken a detailed cost-benefit analysis for the reasons set out at paragraph 1.180.

A12.175 At paragraphs 1.182 and 1.183 we also explain why we are of the view, any costs to consumers compared to a counterfactual would be outweighed by the benefits that would arise.

Leased Lines Access in the HNR Area

A12.176 Telefonica and Virgin Media supported our proposal to impose a 'fair and reasonable prices' condition on LL Access in HNR areas. However, Telefónica also noted that rival presence does not always mean light-touch regulation is appropriate and recommended that we carefully evaluate the actual state of competition in HNR areas before reaching a decision.[529]

A12.177 BT Group and Openreach disagreed with our proposal to impose a 'fair and reasonable prices' condition on LL Access in HNR areas. Both argued that BT/Openreach does not have SMP over Leased Line Access in HNR areas and that consequently LL Access in HNR areas should not be regulated.[530]

A12.178 euNetworks disagreed with our proposal to impose a 'fair and reasonable prices' condition on LL Access in HNR areas. euNetworks argued that our definition of HNR areas as areas where two competitive providers are able to reach 65% of leased line customers leaves 35% of customers with no alternative provider. euNetworks also argued that competing providers are unlikely to be fully established in the relevant locations and thus would be vulnerable to anti-competitive pricing behaviour by BT. euNetworks said that a CPI-0% charge control, combined with an up-front adjustment to compensate for the fact that BT's current charges are below costs, should be applied across all areas where BT is found to have SMP, including HNR areas. [531]

A12.179 TalkTalk disagreed with our proposal to impose a 'fair and reasonable prices' condition on LL Access in HNR areas. TalkTalk argued that in HNR areas Openreach holds borderline SMP. It suggested that where this is the case, we should impose an obligation to provide DFA, without imposing price caps on DFA pricing.[532]

A12.180 Three did not support our proposal to impose a 'fair and reasonable prices' condition on LL Access in HNR areas. Three disagreed with our definitions of the different geographic markets and suggested the creation of an additional geographic area, covering part the HNR areas and Area 2, where competing fibre networks either do not offer or do not have formally approved plans to offer mobile access. Three argued that in this area we should impose a dark fibre remedy with a price cap equivalent to the costs of an efficient sub-scale fibre provider. [533]

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[529] Telefonica response to January 2020 Consultation, paragraphs 4.1-4.3; Virgin Media response to January 2020 Consultation, paragraphs 1 and 10-11.
[530] BT Group response to January 2020 Consultation, page 40; Openreach response to January 2020 Consultation, paragraph 7.48.
[531] euNetworks response to January 2020 Consultation, paragraphs 15-17.
[532] TalkTalk response to January 2020 Consultation, paragraph 7.170.
[533] Three response to January 2020 Consultation, paragraph 5.1-5.6.

A12.181 [✄] argued that loose charge controls, such as “fair and reasonable prices”, do not provide the market with any certainty and that this uncertainty could jeopardise rather than encourage investment over the next five years. It suggested that some access seekers do not have business models which support network rollout in response to a rise in Openreach’s wholesale prices. Leased line only networks, such as [✄], rely on wholesale access to complement their own networks, since expansion on a customer-win basis is not viable. In the short to medium term, such operators would have no option but to absorb the increased wholesale price and pass it on to customers. A “fair and reasonable prices” charge control would also make it difficult for providers such as [✄] to map their cost-bases going forward. [✄] argued that it is unclear how we propose to enforce a “fair and reasonable prices” charge control, or how a provider could prove a case of non-compliance. [✄] suggested that this lack of clarity, along with Ofcom’s “lack of interest in taking up disputes”, means there is very little pressure on Openreach to comply. [534]

Our assessment

A12.182 The majority of these arguments relate to our market definition and SMP analysis, set out in Volume 2.

A12.183 [✄] argued that fair and reasonable constraints on pricing give less certainty as to prices than would a charge control. Competition in the HNR Area is more developed than elsewhere, and that competition is likely to grow further in this review period. It is right to reflect this and encourage this process with less need for direct charge controls.

A12.184 We have explained how we would assess a fair and reasonable requirement and disagree that Openreach does not have a strong enough incentive to comply given the potential consequences of non-compliance.

[534] [✄].

A13. Stakeholder comments on the approach to price regulation in Area 3

A13.1 In Volume 4 Section 2, we set out our decisions relating to price regulation in Area 3 for both WLA services and Leased Line access services.

A13.2 In this annex, we set out stakeholder comments to our proposals and our assessment of those comments.

A13.3 This annex is structured as follows:

- We provide a brief summary of our proposals for WLA services from our January 2020 Consultation and our July 2020 Consultation;
- We group stakeholder comments by theme and provide our assessment of these;
- We provide a brief summary of our proposals for Leased Line access services from our January 2020 Consultation; and
- We set out stakeholder comments and provide our assessment of these.

Wholesale Local Access services

Summary of our proposals

January 2020 Consultation

A13.4 In our January 2020 Consultation, we considered that a Regulatory Asset Base (RAB) approach would meet our objective of ensuring consumers are protected whilst providing Openreach with incentives to invest.

A13.5 We outlined two possible variants of a RAB approach:

- a *forecast approach*, where the level of the price cap is set in advance to allow recovery of the fibre investment costs and based on a commitment from Openreach regarding the level of fibre deployment.
- a *post-build approach*, where a mark-up to allow recovery of fibre investment costs would be applied each year, with the level of the mark-up depending on whether Openreach achieves pre-specified investment delivery targets in that year.

A13.6 We considered either of the RAB options could meet our objectives but expressed a preference for adopting a forecast approach. However, at that time Openreach had not come forward with a firm fibre rollout plan for Area 3 that we considered would be needed to consider adopting a forecast RAB approach.

A13.7 We therefore proposed a post-build RAB approach.

July 2020 Consultation

A13.8 On 26 June 2020, Openreach wrote a letter to Ofcom.[535] In that letter:

- Openreach referred to our January 2020 Consultation and to the possibility of extending our proposed approach to charge controlling WLA services in Area 2 to Area 3 should BT come forward with a sufficient commitment to build a fibre network in Area 3.
- Openreach confirmed its plans to commercially build out a fibre network (i.e. without public subsidy) to at least 3.2m premises cumulatively by the end of 2025/26. We refer to this as the BT Commitment.

A13.9 In light of the BT Commitment, in the July 2020 Consultation we set out our proposals to adopt a forecast RAB approach in Area 3.

A13.10 We explained that the proposed forecast RAB aimed to allow the expectation of cost recovery across the fibre and copper network (over the lifetime of those networks).

A13.11 We considered that extending our proposed approach to setting a charge control in Area 2 to Area 3 sat within a range of cost recovery profiles that provided a reasonable expectation of cost recovery for a planned fibre build to 3.2m premises.

A13.12 We recognised that there were other sets of prices that were potentially consistent with providing BT with an expectation of this level of cost recovery. However, while we did not expect widescale competing fibre networks to develop in Area 3 to the same degree as in Area 2, we considered that having a consistent pricing approach in Area 3 as in Area 2 would be supportive of network investment.

A13.13 We proposed to adopt a forecast RAB approach. Under the forecast RAB approach, we proposed:[536]

- Pre copper retirement, to set charge controls on MPF and FTTC 40/10 rentals at CPI-0%; and allow pricing flexibility on Openreach's FTTC services at bandwidths above 40/10 and fibre services (FTTP and G.fast).

A13.14 We anticipated that our proposed RAB framework would extend into future charge control periods.

A13.15 In Volume 4 Section 2, we set out our decision to:

- adopt a forecast RAB approach, backed-up by the BT Commitment, where the asset base is comprised of WLA services (i.e. MPF, FTTC, G.fast, FTTP) and cost recovery is viewed across all services in aggregate.
- pre copper retirement, set charge controls on MPF and FTTC 40/10 rentals at CPI-0%; and allow pricing flexibility on Openreach's FTTC services at bandwidths above 40/10 and fibre services (FTTP and G.fast).

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[535] Letter from Clive Selley (CEO, Openreach) to Dame Melanie Dawes (CEO, Ofcom), 26 June 2020.

[536] In the July 2020 Consultation, we also proposed to prohibit BT offering geographic discounts on FTTP rentals charges in Area 3. All other proposals we set out in our January 2020 Consultation, including those relating to leased line services and dark fibre in Area 3, were unchanged.

Stakeholder comments and our assessment

A13.16 Stakeholder comments focused on the following broad themes:

- Potential for rival investment
- Evidence of Openreach fibre build
- Suggested modifications to forecast RAB
- Benefits of aligning prices across Area 2 and Area 3 as part of the forecast RAB
- Impact of RAB approach outside of Area 3
- The fair bet and long term signals
- Cross subsidies from copper to fibre customers
- Customer protection from charge controlling FTTC 40/10 services
- Best practice for a RAB
- Legal concerns
- Interaction with public subsidy schemes
- Transparency and reporting requirements
- Modelling issues

Potential for rival investment

A13.17 BT noted that its rivals had ambitious commercial plans to deploy fibre networks, including in Area 3. These are facilitated by several factors including a relatively flat cost of build curve up to around 80% of premises and the reduction in build costs due to regulated access to ducts and poles and innovative techniques such as micro-trenching.

A13.18 BT argued that these plans make it very hard to predict the future boundary between areas where two or more networks are viable, and areas where there is scope for commercial build by only one network. Indeed, the evidence today suggests that, come 2026, there will be areas within Area 3 where providers other than Openreach will have extended their network or built new network; similarly, in Area 2 there may turn out to be areas where Openreach has not built but others have.

A13.19 Given this uncertainty, BT did not see advantage in Ofcom trying to predict market boundaries now and designing a bespoke regulatory model for Area 3 (the 'forecast RAB' approach). BT argued that it is better (and simpler) to apply the regulatory package proposed for Area 2 nationwide, thereby taking a more agnostic approach to the question of who builds, but with the re-assurance that Openreach's committed plans will reduce uncertainty on when build will occur.[537]

A13.20 TalkTalk argued that it was incorrect to overlook existing and potential altnet FTTP investment in Area 3. [538] TalkTalk suggested that we adopt an adaptive regulation approach in Area 3. Under adaptive regulation, Openreach's prices would initially be subject to a cost-based cap and then, on an area-by-area basis, Openreach would be required to increase its prices to a minimum (floor) level after rival rollout has occurred.[539]

[537] BT response to July 2020 Consultation, paragraph 2.8-2.11.
[538] TalkTalk response to January 2020 Consultation, paragraph 5.128.
[539] TalkTalk response to January 2020 Consultation, paragraph 5.185.

A13.21 Several stakeholders raised issues over the proposed definition of Area 3 and the impact of the BT Commitment on altnet investment.

A13.22 Fern Trading argued that under the BT Commitment, Openreach was planning to build in towns and villages where commercial providers are already planning to go, and so does not extend the UK's fibre footprint and undermines competitors.[540]

A13.23 Fern Trading argued under the forecast RAB and BT Commitment, BT is incentivised to build past 3.2m properties in the most commercially attractive parts of Area 3, which is where other altnets have built or are planning to build. As a consequence, the commercial build by these alternative operators will no longer make sense as BT is being funded to overbuild them.[541]

A13.24 Fern Trading said that Ofcom had seemed to assume that BT can build more cheaply in Area 3 than its competitors. However, Fern Trading argued that the opposite was true since the costs of build have been reduced through access to BT's infrastructure and because of altnets being more efficient.[542]

A13.25 Fern Trading argued that its build locations should be reclassified as Area 2. This would maximise its chance of recovering its investment before fair competition arrives (since BT will almost certainly fulfil its commitment in Area 3 since it has an unfair advantage that distorts the market in its favour). Fern argued that the forecast RAB incentivised BT to build in Area 3 locations which might have been left until later (possibly after 2026).[543]

A13.26 INCA argued that a pre-commitment by BT would distort fair competition that did exist in Area 3 and reduce the likelihood of altnets deploying in these locations at all, or worse, overbuild altnets existing operations in Area 3 when two-full fibre networks are not sustainable. It argued that the BT Commitment would allow BT to select locations (for deployment), publish its intentions and effectively sit back and deploy to these locations whenever it fits with its plans with near certainty that no one else will deploy there.[544] Fern Trading also argued that the proposed approach would distort competition by giving BT an advantage in building in locations where competitors are building or planning to build.[545]

A13.27 INCA understood that in locations where there are no commercial incentives for altnets and/or BT to deploy fibre, it would be prudent for Ofcom to require a 'quid pro quo' commitment from BT to invest in return for higher prices for the 40/10 anchor wholesale access product. However, given that at least 4m of the premises currently categorised as Area 3 are already targets for commercial deployment by altnets, it was difficult to understand why a compensating commitment from BT is required for those locations.[546]

A13.28 Zzoomm argued that Openreach is under commercial pressure to deploy in Area 3 in advance of altnets as many Area 3 locations can only support a single fibre network. This means that timing is important in Area 3. There is clear competition for the market, even if there may not

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[540] Fern Trading response to July 2020 Consultation, paragraph 12.
[541] Fern Trading response to July 2020 Consultation, paragraph 14.
[542] Fern Trading response to July 2020 Consultation, paragraph 40-41.
[543] Fern Trading response to July 2020 Consultation, paragraph 57-61.
[544] INCA response to July 2020 Consultation, page 3-5.
[545] Fern Trading response to July 2020 Consultation, paragraph 37.
[546] INCA response to July 2020 Consultation, page 5.

be competition in the market at the infrastructure level. Therefore, focusing remedies on encouraging BT deployment is misguided and will only result in removal of competition for the market and so removing the existing pressures for BT to deploy quickly in advance of altnets. Ofcom's proposed position will thus slow down fibre investment and adoption across the UK and lead to the worst possible outcome for the UK nation, for its businesses and for its citizens.[547] Axione and County Broadband made similar points relating to Area 3 locations being only able to support a single network and the presence of competition for the market.[548]

Our assessment

A13.29 In Volume 2 Section 7, we have concluded that the competitive conditions in Area 2 and Area 3 are sufficiently different to define them as separate geographic markets. Our conclusions have been based on the available evidence, including that gathered from altnets since our January 2020 Consultation.

A13.30 In Area 2, we consider there is potential for material and sustainable competiton by rival networks. Therefore, our approach to pricing WLA services is aimed at incentivising investment in competing rival networks through setting a charge control on copper services at CPI-0%. Our view is that this will also promote BT's investment in fibre networks.[549]

A13.31 In Area 3, we do not consider there to be the potential for material and sustainable competition by rival networks to incentivise Openreach to build a fibre network in Area 3 or constrain its SMP. As a result, incentivising investment by rival networks is not our primary objective.

A13.32 We have decided to adopt a RAB approach to support BT's investment in a fibre network where we consider its incentives are weak given our assessment of the potential for competition in rival fibre networks in Area 3.

A13.33 Nevertheless, we recognise that given the forward looking nature of our market analysis, the boundary between Area 2 and Area 3 is inevitably an approximation of reality, and that there might be some future competitive investment in Area 3 which represents material and sustainable competition to BT. We also recognise that even to the extent that the boundary between Area 2 and Area 3 is accurate, there also might be some future competitive investment in Area 3 which will not represent material and sustainable competition to BT. We have been mindful of these factors when setting our regulatory framework.

A13.34 In particular, rival network builders are keen that we do not regulate down the prices of the services in the market. In general, they support us indexing current prices and this is the approach we are taking in Area 2, where we consider there to be the potential for material and sustainable competition by rival networks. We note that many respondents have suggested that we reclassify parts of Area 3 as Area 2.

A13.35 We do not believe that it would be right to reclassify parts of Area 3 as Area 2, for the reasons set out in Volume 2 Section 7. However, given the boundary between Area 2 and Area 3 is

[547] Zzoomm response to July 2020 Consultation, paragraph 8.
[548] Axione response to July 2020 Consultation, paragraph 3.11; County Broadband response to July 2020 Consultation, paragraph 29.
[549] See Volume 2 Section 1.

inevitably an approximation of reality and given that there will be some competitive investment in Area 3, we recognise that there are advantages for the same, or similar, pricing conditions to apply in Area 2 and Area 3. This would mean that rival network builders would face the same market prices whether they invest in Area 2 or Area 3. More specifically, since the charge control in Area 2 has been set at a level to incentivise investment by rival networks, by aligning the charge control in Area 3 this will also be supportive of investment by rivals seeking to extend their networks from Area 2 into Area 3 which will provide material and sustainable competition to BT. Furthermore, it will also help network build more generally including where this does not provide material and sustainable competition to BT. We therefore consider that our regulatory framework is supportive of rival investment in Area 3.

A13.36 More specifically, we consider that our pricing approach is supportive of competitive investment by rival networks by:

- Setting a charge control on MPF and FTTC services at 40/10 only at CPI-0%. As such, this provides the same price signals for altnet investment as in Area 2;
- As set out in Volume 3 Section 7, we have decided to prohibit BT applying geographic discounts in Area 3 (which could undermine altnet investment in local areas, to the extent that this develops).

A13.37 In summary, we consider our approach will reduce the impact of the regulatory boundary between Area 2 and Area 3 and support competitive investment by rival networks in Area 3.

A13.38 Several stakeholders suggested that a RAB approach backed-up by the BT Commitment incentivised BT to build in locations in Area 3 that might have been left until later (possibly after 2026). Our RAB approach is intended to support investment by BT in Area 3. However, this approach does not require BT to invest in Area 3, rather it merely takes account of the facts we observe in the market which include the BT Commitment. BT made the commitment to commercially build in Area 3 after it increased the scale of its rollout ambitions from 15m to 20m premises.

A13.39 Some stakeholders commented that Area 3 locations can only support a single network, the implication being that BT will not overbuild competing networks in some parts of Area 3 if a competing network gets there first. Our position is that Area 3 is comprised of locations where we are unlikely to see material and sustainable competition to BT. However, we know that certain network providers have plans for competitive investment in some parts of Area 3. Our overarching strategy is to promote competition and investment. Thus, notwithstanding our identification and assessment of Area 3, if it proves possible to have competing networks in some parts of Area 3, then we want to allow and encourage this. However, if it is right that BT will not overbuild competing networks in some parts of Area 3 if a competing network gets there first, then we want to create an environment where operators, including BT, have the incentive to invest quickly in order to 'win' the market. While we have set our regulation in Area 3 to favour an approach that promotes investment in gigabit-capable networks by Openreach based on our market analysis, we believe that our approach in Area 3 nonetheless still supports both of these situations.

A13.40 In Volume 4 Section 2, we explain why an adaptive regulation approach to pricing does not meet our objectives in Area 3.

Evidence of Openreach fibre build

A13.41 TalkTalk argued that Openreach has, or would, build to many of the premises included in its commitment without a RAB. As such, there was no justification for the approach.

- TalkTalk noted that in Openreach's letter to Ofcom setting out details of its plans, Openreach confirms that it will build to a cumulative total of 3.2m premises by the end of 2025/26 (not 3.2m premises more than today). This includes to 922,000 premises already built.[550]
- TalkTalk argued that there is likely to be additional build beyond the 922,000 premises as Openreach completes the build in exchange areas that it has already begun (which is not contingent on a subsidy). TalkTalk also referred to Openreach's plans to extend roll-out in Area 3 on 26 January 2020 (which was prior to any subsidy scheme being put in place or proposed).[551]

Our assessment

A13.42 We do not consider that Openreach would be incentivised to deploy a fibre network in Area 3 at scale given it does not face the threat of material and sustainable competition from rival networks. Our RAB approach is intended to support Openreach's investment in a fibre network.

A13.43 Openreach has currently deployed a fibre network passing [✂] premises on a commercial basis and passing [✂] premises with public funding in Area 3.[552]

A13.44 However, we do not consider that a clear line can be drawn whereby any commercial build prior to April 2021 is evidence that such build would have occurred without a RAB.

A13.45 In July 2019, we set out a proposed approach to adopting a RAB in Area 3 that will have had some bearing on BT's investment decisions since then. In this regard, we note that Openreach board papers on the business case for a commercial Area 3 investment indicated that the planned build in 2019/20 and 2020/21 was in anticipation of Ofcom establishing an acceptable investment framework for Area 3.[553]

A13.46 As such Openreach is likely to have made investments in Area 3 on the basis that a RAB approach might be adopted in Area 3 from April 2021 (and indeed will have borne the risks on that investment if we had decided not to implement a RAB approach).

A13.47 TalkTalk has referred to subsidies under the RAB approach. As we explain in Volume 4 Section 2, the forecast RAB approach we are adopting is a cost-based control but where costs are considered across fibre and copper services in Area 3. We therefore include existing full fibre and copper lines as well as forecast build in calculating the level of the RAB control.

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[550] TalkTalk response to July 2020 Consultation, paragraph 3.8-3.9.
[551] TalkTalk response to July 2020 Consultation, paragraph 3.15-3.16.
[552] Openreach response to s135 dated 5 March 2021.
[553] Openreach response to s135 dated 10 September 2020, slides 3 of attached PowerPoint document provided in answer to Q4a.

Suggested modifications to forecast RAB

A13.48 In light of the concerns over the impact of the proposed RAB on altnet build, several stakeholders, including Fern Trading, Zzoomm, Jurassic Fibre and County Broadband, suggested that the proposed forecast RAB with the BT Commitment should be modified in the following ways:

a) Re-categorisation of locations from Area 3 to Area 2, to better reflect credible roll-out plans of altnets.

b) Any locations where an altnet builds on a commercial basis should be classified as Area 2 (whether or not this forms part of BT's 3.2m commitment).

c) Where altnets commercially build in Area 3, Ofcom should either adjust the price control each year to ensure that BT does not over recover; or require BT to use the funds to build in the more costly locations in Area 3, where altnets are unlikely to build.[554]

Our assessment

A13.49 In relation to (i), we set out our assessment and conclusions regarding the approach to defining geographic areas and the set of locations that fall into Area 3 in Volume 2, Section 7. Our conclusions have been based on the available evidence, including that gathered from altnets since our January 2020 Consultation.

A13.50 We do not agree with the modifications suggested by either (ii) or (iii).

A13.51 The market review framework under the Act provides regulatory stability by allowing Ofcom to set regulation for as long as five (and in exceptional cases six) years based on a forward-looking assessment of markets, taking into account expected or foreseeable developments that may affect competition. Part of this involves defining economic markets where the conditions of competition are homogenous which form the basis for imposing remedies for the period of the review. In this review, our market analysis has found WLA Area 2 and WLA Area 3 to exhibit different competitive conditions such that we consider it appropriate to impose different remedies in each market to address BT's SMP.

A13.52 For the reasons set out in Volume 2, Section 7, having analysed the evidence, including that gathered from altnets, we do not believe that there will be material and sustainable competition to BT in the commercial deployment of competing networks in Area 3. We have reached this view having taken into account the altnets' plans to build commercially in Area 3. Consequently, we do not agree that any locations where an altnet builds on a commercial basis in Area 3 should be re-classified as Area 2.

A13.53 Further, the forecast RAB backed-up by the BT Commitment is intended to support BT's investment in a fibre network in Area 3 where its incentives are weak. As part of supporting that investment, we consider that a stable regulatory approach is needed (including the stable categorisation of locations between Area 2 and Area 3). As such, where BT makes an investment in a fibre network in Area 3 as part of meeting its commitment, our view is that this

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[554] Fern Trading response to July 2020 Consultation, paragraph 66; Zzoomm response to July 2020 Consultation, paragraph 59-61; County Broadband response to July 2020 Consultation, paragraph 53-61.

location should remain in Area 3 for the duration of the charge control period. This regulatory stability would be undermined under (ii) where locations are re-classified during the market review period.

A13.54 Regulatory stability would also be undermined under (iii) where prices are required to adjust in response to rival entry. Furthermore, as explained in Annex 16, our forecast RAB aims to provide BT with an expectation of cost recovery over the lifetime of the copper and fibre network given its fibre investment. As such, adjusting prices during the market review period would undermine this expectation.

Benefits of aligning prices across Area 2 and Area 3 as part of forecast RAB

A13.55 CityFibre supported an alignment of price regulation of WLA services across Area 2 and Area 3 under the forecast RAB. It considered that a consistent approach to price regulation (in terms of scope of price caps and level) will provide the clarity and certainty required for investors seeking to make multi-billion-pound investments in new fibre networks. It noted that the forecast approach will provide a more predictable path of prices for the coming years.[555] CityFibre considered that the proposals provided much better investment incentives, especially for rivals to BT (compared to a post-build RAB in Area 3).[556]

A13.56 Virgin Media considered that the proposed forecast RAB simplifies the regulatory remedies to be applied across the UK and avoids the previous approach of drawing a bright-line distinction between geographic markets; where competing infrastructure investment is encouraged on one side and effectively deterred on the other.[557]

A13.57 TalkTalk argued that from the perspective of a wholesale customer it did not see any particular benefit from price consistency across Area 2 and Area 3 since ISPs are able to manage different wholesale prices.[558]

Our assessment

A13.58 In Annex 16, we set out how we have assessed the BT Commitment to commercially deploy fibre in Area 3. We explain that our approach looks to assess the set of copper prices that provide BT with an expectation of cost recovery (given its fibre deployment) over the lifetime of the copper and fibre network.

A13.59 While there are various sets of prices that are potentially consistent with providing BT with an expectation of this level of cost recovery over the lifetime of the fibre and copper network (given its level of planned build in Area 3), we consider that there are benefits to a forecast RAB approach that results in consistent pricing for WLA services across Area 2 and Area 3.

A13.60 While promoting investment by rival networks is not a primary objective in Area 3, we are mindful that there will be some competitive investment in Area 3. As explained above, adopting the same set of prices from Area 2 in Area 3 would be supportive of that investment. Furthermore, we consider that the forecast RAB approach will provide for a predictable set of

[555] CityFibre response to July 2020 Consultation, paragraph 3.25-3.26.
[556] CityFibre response to July 2020 Consultation, paragraph 1.17.
[557] Virgin Media response to July 2020 Consultation, page 2.
[558] TalkTalk response to July 2020 Consultation, paragraph 7.5.

wholesale prices, which will benefit both telecoms providers that rely on access to Openreach's network and rival network builders.

Impact of RAB approach outside of Area 3

A13.61 TalkTalk argued that a RAB approach could impact investment levels in Area 2. It argued that:

- Industry overall and Openreach specifically face material supply side constraints in the ability to roll-out FTTP that arise from limitations on capital funding and barriers to rapidly increasing roll-out such as suitably skilled labour and readiness of the PIA remedy. This means that any increase in Openreach FTTP investment in Area 3 will generally result in less investment in Area 2 as capital and labour is diverted.
- The RAB approach will also tend to bid up the price for resources such as staff and equipment required to roll out FTTP networks and therefore will to some degree reduce altnet FTTP investments in Area 2. [559]

Our assessment

A13.62 As explained in Volume 1, we are required to exercise our functions to secure, among others, the availability throughout the United Kingdom of a wide range of electronic communications services. Our RAB approach is intended to promote investment in gigabit-capable networks by BT in Area 3. We consider that this approach will help secure such availability.

A13.63 In any event, we do not agree that the RAB, in and of itself, will have a material impact on bidding up the price of resources (and therefore reduce investments by altnets in Area 2). We also note that altnets have not raised this as a concern. Moreover, the BT Commitment to deploy a fibre network in Area 3 is part of a wider ambition to deploy fibre to 20m premises by the mid-2020s. Therefore, to the extent that there are limitations in resources, the RAB in Area 3 does not add to BT's overall fibre deployment target.

The fair bet and long-term signals

A13.64 Openreach raised concerns about the longer-term policy approach within Area 3 and whether this would provide an opportunity to earn returns that are consistent with the investment risk it was making.

A13.65 Openreach referred to Ofcom's proposal to "re-base" its assessments of the long-term cost recovery requirements at each 5-year review point. Openreach considered that if at each review point, Ofcom recalculated the 'shortfall' calculation based on actual data to date, revised forecasts and reassessed how much had been allowed to fund this 'shortfall' from the pricing approach adopted in earlier review periods, this could tend towards a form of "rate of return" regulation. As such, it was not clear how this approach would be consistent with allowing a fair bet given the risks faced at the point of making the commitment.[560]

[559] TalkTalk response to January 2020 Consultation, paragraph 5.158-5.159.
[560] Openreach response to July 2020 Consultation, paragraph 2.32.

Our assessment

A13.66 We recognise that Openreach's deployment of a fibre network is a long-term investment and the recovery of those costs will span beyond the forthcoming charge control period. Accordingly, while we cannot fetter our discretion, we anticipate that our RAB framework will extend into future charge control periods.

A13.67 Our RAB approach is aimed at supporting BT's investment in a fibre network where its incentives to invest are weak. Key to supporting BT's investment is allowing the costs of the fibre network to be recovered across both fibre customers and copper customers in Area 3. Our view is that a RAB approach truncates a significant part of any downside risks that is relevant to a fair-bet assessment. As set out in Annex 16, our approach to setting a forecast RAB is to set a charge control on copper prices that allows for an expectation of cost recovery across the lifetime of the fibre and copper networks.

A13.68 As such, in future charge control periods, we would anticipate regulating prices having regard to our typical considerations for setting cost-based controls. Therefore, we would expect to:

- Re-base our forecasts with reference to forward looking volumes, costs (and given our RAB framework forward looking revenues) to provide an expectation of cost recovery across the fibre and copper networks.
- Consider setting glidepaths to incentivise efficiency improvements.
- Set any charge controls by having regard to allowing the fair-bet on BT's investments.

A13.69 We do not consider that "re-basing" future charge controls with reference to forward looking costs and volumes would result in "rate of return" regulation or be inconsistent with allowing a fair bet (given the downside risks BT faces under a RAB approach).

A13.70 While we expect to re-base our forward looking estimates used to set our charge controls to allow for an expectation of cost recovery over the lifetime of the copper and fibre networks, within each charge control period, BT will have the opportunity to outperform the charge control (or indeed face a risk of underperforming). Where it outperforms the charge control it will retain the upside (and where it underperforms it will bear the downside). We would not off-set the upside earnings (or downside losses) when setting charge controls in future periods.

Cross-subsidies from copper to fibre customers

A13.71 Vodafone argued that it was difficult to understand how Ofcom's RAB proposal can ensure consumers are protected from excessively high prices. The mechanism Ofcom generally uses is a cost-based CPI-X charge control. However, the RAB model will enable Openreach to price FTTC broadband services above cost.[561]

A13.72 TalkTalk argued that Ofcom's proposals failed to protect consumers from excessive prices and the harm they cause through reducing consumer welfare and creating allocative inefficiencies. It argued that:

[561] Vodafone response to January 2020 Consultation, part 3 paragraph 12.13.

- The proposed approach inherently leads to excessive prices (across customers in aggregate) since MPF/FTTC prices are higher than they would be if they were at the competitive level or based on efficient costs.
- The level of excessive price and detriment to consumers is exacerbated by Ofcom's assumptions which significantly over-estimate the loss relating to the FTTP investment and so the required increase in wholesale MPF/FTTC prices above cost.
- The proposed approach creates a cross-subsidy from those customers who use MPF/FTTC (either because FTTP is not available in their locality or because it is available but they cannot afford or do not want FTTP) to customers taking FTTP. Thus, unequivocally some customers pay an excessive price but do not receive any off-setting benefit. Furthermore, TalkTalk considered that the cross-subsidy is likely to flow from lower income customers to higher income customers since Openreach's build is likely to be focused in more urban areas (where incomes are on average higher than rural areas).[562]

A13.73 TalkTalk argued that Ofcom should conduct a cost-benefit analysis that compared the value of the incremental FTTP roll-out with the harm to consumers from higher prices.[563]

A13.74 TalkTalk argued that the RAB approach means that wholesale MPF/FTTC prices will be set above the competitive level. Given only some - such as Sky, Vodafone, and TalkTalk - face these higher costs, they will not be fully passed through to the retail level and so retail competition will be distorted and weakened. [564]

Our assessment

A13.75 We have decided to adopt a RAB approach to support Openreach's investment in a fibre network in Area 3 where its incentives to invest are weak. Under the RAB approach, customers taking copper services in Area 3 contribute to the cost recovery of the fibre network. We consider that this approach is needed to deliver material investment in a fibre network in Area 3 which will bring benefits to consumers. Therefore, rather than aggravating the digital divide, our view is that a RAB approach will help mitigate the risk of parts of the UK being left behind from benefitting from the deployment of a fibre network.

A13.76 We have considered the forecast RAB approach against our objectives in Area 3. For the reasons set out in Volume 4 Section 2, we consider that the forecast RAB approach alongside the BT Commitment fulfils our objectives in Area 3.

A13.77 We do not consider that a cost-benefit analysis of the type suggested by TalkTalk is necessary to satisfy ourselves that our approach is appropriate in light of our objectives and proportionate. In particular, as explained in Volume 4 Section 2, we are satisfied on the basis of the analysis we have carried out that the forecast RAB approach alongside the BT Commitment is proportionate and would not produce adverse effects which are disproportionate to the aims pursued. We also explain why this approach satisfies the legal tests.

A13.78 As explained in Volume 4 Section 2, we do not think the RAB approach poses significant risks to retail competition. The RAB provides cost-based prices, but where costs are considered across

[562] TalkTalk response to July 2020 Consultation, paragraph 4.2-4.3.
[563] TalkTalk response to July 2020 Consultation, paragraph 4.5.
[564] TalkTalk response to January 2020 Consultation, paragraph 5.171.

the fibre and copper network. Movements in these wholesale prices do not in themselves threaten retail competition.

Customer protection from charge controlling FTTC 40/10 services

A13.79 TalkTalk and Vodafone argued that the proposed charge control on FTTC services at bandwidth of 40/10 only would not provide an effective anchor. [565]

A13.80 Vodafone argued that Ofcom's proposal to not charge control 80/20 services in Area 3, through accepting of Openreach's terms (as part of the BT Commitment), was not in the wider consumer interest. Concerns over the lack of an effective anchor span both Areas 2 and 3, however they are particularly concerning for consumers in Area 3, given the expected lack of infrastructure competition.[566]

A13.81 Virgin Media on the other hand considered that the 40/10 wholesale product to be the appropriate anchor for at least the forthcoming charge control period.[567]

Our assessment

A13.82 In Volume 4 Section 2, we set out our views on the customer protection given by charge controlling MPF and FTTC 40/10 services only.

Best practice for a RAB

A13.83 Vodafone argued that Ofcom has fundamentally mis-specified the barrier to investment, which appears to be that Openreach does not have an incentive to roll out fibre, when it can generate excess profits on its copper network, rather than a lack of ability to generate reasonable returns on fibre investments. This mis-specification had led to Ofcom proposing to accept the BT Commitment which would perpetuate Openreach's ability to generate excess profits rather than protecting customers from excessive prices.

A13.84 Vodafone considered that incentivising monopoly network operators to upgrade their networks is a problem that has been addressed by other UK regulators such as Ofgem and Ofwat. Ofcom should draw on the experience of others in implementing its own approach as this is new territory for Ofcom.

A13.85 Vodafone argued that by implementing a best practice RAB approach, Ofcom should set challenging outcome targets for fibre roll out and incentive mechanisms to ensure these targets are met, rather than passively accept an Openreach offer. As part of this, Openreach should be required to produce a detailed and well-justified business plan which is then critically assessed by Ofcom, as is the case for water companies and energy companies (as opposed to a simple acceptance of a two-page letter from Openreach with a superficial assessment of 'value for money').[568]

A13.86 Vodafone argued that the forecast RAB alongside the BT Commitment did not provide any real commitment to build at all and that Ofcom had no way of enforcing it. It noted that Ofcom had

[565] TalkTalk response to July 2020 Consultation, paragraph 7.18.
[566] Vodafone response to July 2020 Consultation, paragraph 17.
[567] Virgin Media response to July 2020 Consultation, page 7.
[568] Vodafone response to July 2020 Consultation, page 12-13.

not considered a direct licence condition obliging BT to roll-out its network or any other formal binding mechanism.[569]

Our assessment

A13.87 We do not agree that we have mis-specified the barrier to Openreach investing in a fibre network in Area 3. In Area 3 we do not consider there is potential for material and sustainable competition by rival networks. Given this, Openreach will have weak incentives to deploy a fibre network since it does face the threat of losing market share as it continues to sell copper services over its copper network.

A13.88 In Annex 16, we set out in detail our approach to assessing the BT Commitment. We consider that we have undertaken a detailed and robust assessment of the BT Commitment and that adopting a forecast RAB meets our objectives in Area 3.

A13.89 We acknowledge that the BT Commitment is a voluntary commitment to commercially deploy a fibre network in Area 3. Indeed, we do not have the regulatory power to require Openreach to build a fibre network (e.g. as an SMP remedy).

A13.90 While we are confident that Openreach has the capacity to meet its commitment and will make all reasonable efforts to meet the commitment, there are nevertheless risks outside of its control that mean it is unable to meet its commitment fully. In Volume 4 Section 6 we set out our approach to mitigating the harm to consumers where Openreach is unable to meet its commitment.

Legal concerns

A13.91 TalkTalk argued that the proposed RAB did not fulfil the requirements of section 47 of the Communications Act 2003 (“the Act”). To address this point, TalkTalk argued that Ofcom should have assessed whether the provision of a cross-subsidy from SMP assets, in the form of an uplift to MPF and FTTC pricing to fund FTTP rollout, unduly discriminates against inter alia altnets, which already have assets in Area 3, or wish to build FTTP networks in Area 3.[570]

A13.92 INCA referred to Ofcom’s duties under section 4 of the Act and section 3 of the European Electronic Communications Code not to discriminate for or against individual or types of communications providers. It considered that Ofcom had a clear preference for BT deployment over altnet deployment.[571] Several other stakeholders raised the same point as INCA.[572]

A13.93 TalkTalk argued that Ofcom appeared not to have considered whether the proposed approach in Area 3 constitutes State aid and is therefore illegal. The proposals could be characterised as a levy which is placed on MPF and FTTC customers in Area 3, and which is then provided to Openreach in order to subsidise its FTTP rollout. TalkTalk argued that Ofcom should undertake

[569] Vodafone response to July 2020 Consultation, paragraph 36-37.
[570] TalkTalk response to July 2020 Consultation, paragraph 7.15.
[571] INCA response to July 2020 Consultation, page 9.
[572] County Broadband response to July 2020 Consultation, paragraph 52; Axione response to July 2020 Consultation, paragraph 3.51-3.52; Zzoomm response to July 2020 Consultation, paragraph 48-51.

a full assessment of whether its proposed scheme —or any scheme like it —would represent State aid.[573]

Our assessment

A13.94 As explained in Volume 4 Section 2 and Volume 4 Section 7, we are satisfied that the forecast RAB approach we have decided to adopt meets the legal test set out in section 47 as well as our duties in sections 3 and 4 of the Act. We do not agree with TalkTalk's characterisation of its concern around pricing of copper and fibre services as a discrimination issue. We also do not agree as alleged by INCA and others that we are acting in discriminatory way and having a clear preference for Openreach deployment over altnet deployment.

A13.95 As explained above, based on our market assessment, we do not consider there is the potential for material and sustainable competition in rival networks that is sufficient to incentivise Openreach to build a fibre network in Area 3 or constrain its SMP. We have therefore decided to adopt a RAB approach to support the BT Commitment to invest in a fibre network. We believe that this approach meets our objectives most effectively as it will deliver the best outcomes for consumers in Area 3 in accordance with our duties. We explicitly recognise that there will be some competitive investment in Area 3 and we have been mindful of this when setting our regulatory framework.

A13.96 The EU State aid rules which are referred to by TalkTalk no longer apply in the UK as they were revoked at the end of the Brexit transition period.[574] In any event, we disagree with TalkTalk that our price regulation in cases where we find SMP could constitute State aid. We do not consider that a price control decision is capable of being categorised as aid granted by a Member State or through State resources.

Interaction with public subsidy schemes

A13.97 CityFibre argued that Ofcom should have in mind the wider impact of Openreach's planned deployment on BDUK's Outside In programme, as Area 3 regulation and that programme will co-exist and, in some aspects, overlap in the period to 2026. It argued that a logical approach for operators to pursue is to extend outwards from existing deployments via Area 3 exchange areas, to address rural exchange areas marked for intervention under the Outside In programme. As such, based on the information that Openreach put into the public domain on 29 July 2020 relating to its build plans, this may undermine the ability of operators to compete for Outside In intervention areas.[575]

A13.98 TalkTalk noted that while there may be more limited plans for rival FTTP investment in Area 3 than in Area 2, there is the possibility of some rival FTTP investment particularly with the planned £5bn government subsidy scheme which is intended to foster and depends on competition.[576]

[573] TalkTalk response to January 2020 Consultation, paragraph 5.166 – 5.167.
[574] See Regulation 3 of the State Aid (Revocations and Amendments) (EU Exit) Regulations 2020.
[575] CityFibre response to July 2020 Consultation, paragraph 3.48.
[576] TalkTalk response to January 2020 Consultation, paragraph 5.128.

A13.99 Mike Kiely referred to BT's Capital Deferral as part its 2012 BDUK bid strategy. Mike Kiely argued that BT's Capital Deferral was relevant in considering the cost recovery as part of the RAB in Area 3.[577]

Our assessment

A13.100 We consider that the forecast RAB approach with the BT Commitment will be complementary to the Government's public subsidy schemes. Under the BT Commitment, Openreach has committed to commercially deploy to 3.2m premises in Area 3 by 2025/26. The Government scheme will only intervene in areas where there has been no commercial deployment and where there are no commercial plans to deploy. The Government will therefore not be required to subsidise the 3.2m premises that Openreach deploys to under its commitment. Moreover, if Openreach does receive Government subsidies to deploy in parts of Area 3, these deployments would not contribute to meeting its commercial build commitment in Area 3.

A13.101 We consider that our regulation in Area 3 is supportive to rivals seeking to extend their networks in Area 3. We have decided to set a charge control in Area 3 on MPF and FTTC 40/10 services that aligns with the control we are setting in Area 2 (which has been set at a level to support rival investment). We have also decided to prohibit Openreach implementing geographic discounts on its FTTC and FTTP services in Area 3. Both these decisions reduce the impact of the regulatory boundary between Area 2 and Area 3 and will therefore support rival deployment in Area 3. As a consequence, we consider that rival networks will be able to compete to deploy networks that are publicly funded.

A13.102 Under the BT Commitment, Openreach has committed to commercially deploy (i.e. without public subsidy) to 3.2m premises and our cost recovery assessment is on that basis. Therefore, BT's Capital Deferral as part of BDUK funding is not relevant to our assessment of the forecast RAB.

Transparency and reporting requirements

A13.103 CityFibre referred to the Government securing a voluntary commitment from Openreach following the publication of the FTIR statement to publish its forward plans sufficiently in advance, and with sufficient granularity, to allow other investors to adapt their plans and strategies accordingly. However, Openreach appeared to no longer be complying with its voluntary commitment and will no longer provide a forward view beyond the first quarter of 2021 but merely provide a three-month advance notice of imminent build commencement.

A13.104 CityFibre argued that there was a need for Ofcom to take urgent measures to improve transparency across the board concerning build plans, specifically of Openreach. In this regard, it noted that the Government has now implemented Article 22 of the European Electronic Communications Code which creates a powerful transparency mechanism for national regulators to gather data from operators on their plans and as appropriate publish the results of this to provide clarity and confidence amongst investors. This being part based on other EU countries' own experiences of national rollout plans being affected by hold-up problems as well

[577] Mike Kiely response to July 2020 Consultation, page 1.

as strategic behaviour in the form of operators either understatement or overstatement of plans, to obtain strategic advantage over their rivals.

A13.105 CityFibre argued that these powers would also allow Ofcom to take enforcement action if that kind of 'strategic' behaviour becomes apparent. This is crucial not to just to address the hold-up problem but also to underpin investor confidence in bidding for Outside In procurements where a previously undeclared commercial build in all or part of an intervention area post-dating an award could leave the awardee facing substantial, unanticipated operational and commercial risk in fulfilling the contract.[578]

A13.106 KCOM argued it was important that Openreach is required to provide an up to date public list of its committed fibre build locations with new locations and/or amendments added in a timely manner. It considered that it is important that Ofcom keeps build activity and announcements under careful review and that measures are put in place to address the risk of strategic overbuild by Openreach in Area 3. KCOM suggested that where there was any evidence of Openreach altering its planned deployments in an Area 3 location for anti-competitive reasons (for example, overbuilding an area of planned or actual deployment by an alternative network that was not in its original build plan), Ofcom should make clear that it will require Openreach to explain any such deviations, and that it will take swift action if necessary (e.g. through an ex-post Competition Act 1998 investigation).[579]

Our assessment

A13.107 We note that the Act has been amended to require Ofcom's reports on infrastructure to include any proposals that providers of UK networks may at any time have to do any of the following within the next 3 years: to bring into operation a new very high capacity network, other than a mobile network; or to extend or upgrade any part of a fixed line network or its equivalent, such as a fixed wireless access network, so as to provide a download speed of at least 100 megabits per second. We do not consider it is appropriate to impose any further transparency requirements on Openreach to address the competition concerns identified by our market analysis.

A13.108 Where we have evidence that Openreach has engaged in anti-competitive behavior, we will investigate this and take action as appropriate.

Modelling issues

A13.109 We received stakeholder comments relating to our cost modelling as part of assessing the BT Commitment and the path of prices that would provide an expectation of cost recovery. These are set out, alongside our assessment, in Annex 16.

[578] CityFibre response to July 2020 Consultation, paragraph 3.51-3.53.
[579] KCOM response to July 2020 Consultation, paragraph 2.8-2.10.

Leased line access services

January 2020 Consultation proposals

Active leased line access services

A13.110 Since we proposed dark fibre as our primary remedy and to require BT to offer dark fibre access at cost, we did not propose to impose a cost-based charge control on BT's active leased line services. However, we recognised that customers have traditionally been reliant on having network access to BT's leased lines and it will take time for telecom providers to transition to using new dark fibre services.

A13.111 We considered that maintaining stable prices (in real terms) provided the right balance between providing customer protection while also encouraging take-up of dark fibre and allowing for a smooth transition as customers increasingly migrate to using dark fibre from 2021.

A13.112 We proposed a CPI-0% control on LL access services.

A13.113 In Volume 4 Section 2, we set out our decision to:

- charge control dark fibre access services at cost.
- charge control LL access services at CPI-0%.

Stakeholder responses and our assessment

Active leased line access services

A13.114 INCA noted that BT's 2018/19 RFS indicated that regulated Ethernet services were below cost. Given this, if business connectivity services were priced below cost, this would represent a cross subsidy whereby WLA consumers are subsidising business services which is inappropriate. It argued that prices must as a minimum be set to a level to cover BT's costs.[580]

A13.115 TalkTalk noted that Ofcom had proposed to allow leased line prices to remain above cost because telecoms providers can use cost-based dark fibre instead. However, given Ofcom's proposals in the November 2020 Consultation, this opportunity will not exist until well into the market review period.[581]

Our assessment

A13.116 We are setting a charge control on leased line access services at CPI-0%. This will allow for the recovery of costs (including a share of common costs and a return on its capital employed) of providing the services. Our cost modelling is set out in Annex 14.

A13.117 We do not agree with TalkTalk's suggestion that customers will not have the opportunity to purchase dark fibre access until well into the market review period. Openreach is required to fully automate the dark fibre access product by 1 June 2022 (i.e. just over a year after this statement) and offer automated provision much earlier than this, from 17 August 2021 (i.e.

[580] INCA response to January 2020 Consultation, paragraph 138-139.
[581] TalkTalk response to November 2020 Consultation, paragraph 4.4.

four and a half months after this statement). Given access seekers typically require some time to operationalise their consumption of a new product, we consider these timescales to be appropriate in view of our approach to remedies.

A14. Cost modelling for active legacy services

A14.1 We have undertaken cost modelling to understand the likely evolution of efficient costs of the relevant services[582] over this review period. The purpose of the modelling is to:

- Provide the 2019/20 and 2025/26 cost inputs for the EAD and EAD LA services that are used as the starting points within our dark fibre modelling (see Annex 17).
- Provide the cost inputs for copper services for our Area 3 RAB modelling see Annex 16.
- Understand the cost of providing copper services if there was no further investment in gigabit networks and no competition enters the market in Area 2.

A14.2 We have calculated the cost of services in Area 2 and Area 3 by forecasting the unit cost by service on a national basis and then applying our forecast volumes for Area 2 and Area 3 respectively to these national costs.

A14.3 Consistent with the January 2020 Consultation, we use the 2019 LLCC and 2018 WLA top-down cost model as a starting point and largely follow forecasting methodologies established in previous leased line charge controls and the 2018 WLA charge control. We refer to this model as the 'cost forecast model'.

A14.4 In this annex we set out our:

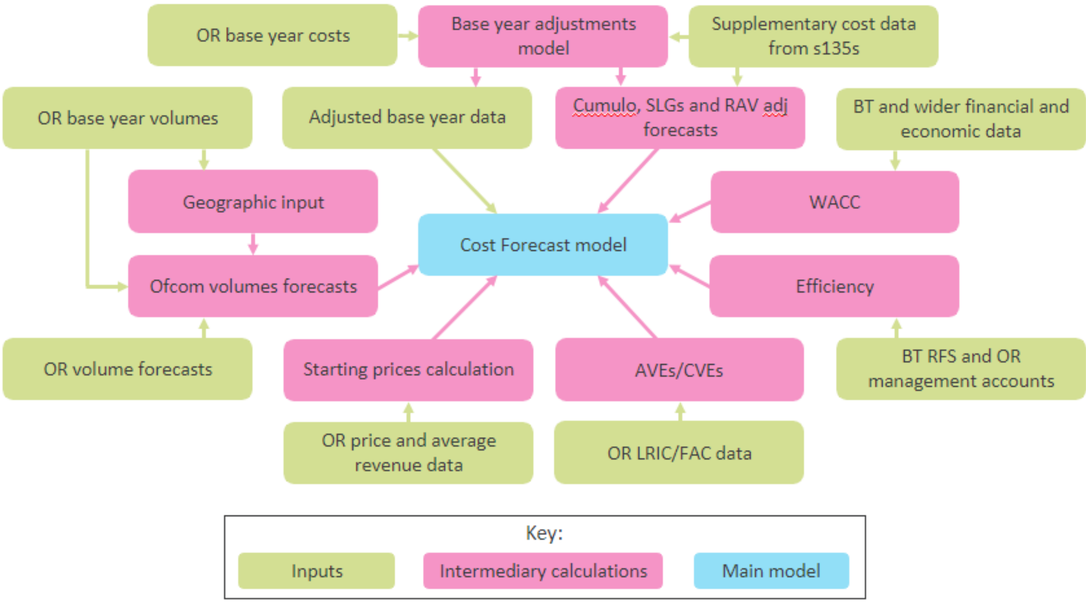
- overall approach to cost modelling; and
- key modelling assumptions.

Overall approach to cost modelling

A14.5 The objective of our modelling exercise is to forecast BT's efficient costs of providing copper-based WLA services (e.g. MPF and FTTC services) and leased line services over the charge control period. We have structured our model as illustrated in Figure A14.1 below.

[582] Within this annex we refer to relevant services, these consists of: all rentals and connections including main link outside of the CLA, all FTTC rentals covering all bandwidths and MPF SML1.

Figure A14.1: The Cost forecast model structure



Note: in this Figure 'OR' refers to Openreach. Other acronyms are described later in this annex.

Approach to modelling

A14.6 Consistent with the January 2020 Consultation and previous reviews, we have built our model using a top-down cost modelling approach based on cost data from BT's regulatory financial reporting systems. The top-down modelling approach is an accounting approach that forecasts how BT's efficiently incurred costs may change over time relative to the base year. We have used the 2019 LLCC Model and 2018 WLA Model as our starting point and have updated it to take into account market developments as outlined in the rest of this annex.

Cost standard

A14.7 Our typical approach to setting charge controls on BT has been to allow it to recover the incremental costs of provision plus an appropriate allowance for the recovery of common costs.[583] This is based on forward-looking costs plus some relevant sunk costs, such as the cost of duct.

A14.8 As in previous leased line and WLA charge controls, we consider Current Cost Accounting (CCA) Fully Allocated Cost (FAC) to be the most appropriate standard for estimating the cost of providing leased lines, MPF and FTTC.

A14.9 The use of a CCA FAC approach values BT's assets on the basis of their current replacement costs. We consider that a CCA FAC approach has the advantages of being transparent and practicable to implement as BT's costs are known and are based on its Regulatory Financial Statements (RFS) which are publicly available to stakeholders each year. We consider that

[583] Common costs are those which arise from the provision of a group of services, but which are not incremental to the provision of any individual service.

current costs give better signals for efficient investment and entry than historical costs. Using BT's costs also has the benefit of leading to consistent cost recovery decisions, both over time and between other regulated markets. We therefore use BT's CCA FAC as the cost standard in our model.

Key steps in our cost modelling

A14.10 Our modelling approach consists of six key steps:

a) First, we calculate the base year costs for each set of relevant services. These costs use BT's RFS as a starting point, with some adjustments.

b) Second, we forecast costs for each year until the end of the charge control period. We forecast operating and capital costs starting from the base year, taking into account our volume forecasts, efficiency assumptions, input price changes, asset volume and cost volume elasticities (AVEs and CVEs), as well as our view of the appropriate forward-looking weighted average cost of capital (WACC).

c) Third, to reduce the risk of asset stranding due to copper retirement, we add in our estimate of the accelerated cost for stranded copper assets capitalised from 2017/18 through to the end of the charge control period.

d) Fourth, to keep prices more stable, we reallocate costs between services: holding the unit costs of MPF and WLR rentals at a maximum level of 2020/21 start prices by allocating costs to FTTC rentals.

e) Fifth, we forecast revenues in each year (assuming that there was no charge control).

f) Finally, we compare revenues and costs for each set of relevant services.

A14.11 We describe each of the steps and key assumptions used in more detail below.

Base year costs

A14.12 The first step in our top-down modelling is establishing the relevant costs in the base year. These base year costs are based on regulatory accounting data provided by BT.

Our proposals

A14.13 For the January 2020 Consultation we used BT's 2017/18 restated RFS costs as the starting point for our base year. We proposed to update this base year data to the most up-to-date available data for the Statement.

Stakeholder comments

A14.14 No stakeholder raised comments on either our proposed RFS base data or the adjustments we proposed to make.

Our decision

A14.15 We use BT's 2019/20 RFS costs as the starting point for our base year. We then adjust the data to reflect our view of BT's efficiently-incurred costs. These adjustments are quantified in Table A14.1 and discussed separately below. There were several adjustments which were made to the January 2020 Consultation base year costs which are no longer required as we are now using the 2019/20 RFS costs as our base year data.

Table A14.1: Summary of adjustments to our base year model on Relevant Services (£m)

	PI* Operating costs (opex)[584] (£m)	PI CCA Depreciation (£m)	PI Mean Capital Employed (MCE) (£m)	Active Operating costs (opex)[585] (£m)	Active CCA Depreciation (£m)	Active Mean Capital Employed (MCE) (£m)
2019/20 RFS total unadjusted	54.5	51.0	2,060.4	749.6	695.0	4,566.9
Remove cumulo costs[586]	-	-	-	-134.8	-	-
Restructuring charges and property provision costs smoothed for 3-year average	-0.7	-	-	-3.5	-	-
Adjustment to Ethernet Provision SLG costs	-	-	-	-5.1	-	-
Additional auto compensation costs	-	-	-	4.3	-	-
Reverse IFRS 16 impacts	-	-	-	34.3	-44.1	-58.1
Core and backhaul fibre reallocation	-	-		-	4.6	18.3
Reallocate Excess Construction costs	-	-	-	8.9	-	-
2019/20 revised total	53.7	51.0	2,060.4	653.5	655.6	4,527.0

** PI refers to physical infrastructure, such as Openreach's ducts and poles.*

Source: Ofcom figures calculated from analysis on BT data.

[584] Excluding holding gains and losses and other CCA adjustments.
[585] Excluding holding gains and losses and other CCA adjustments.
[586] The removal of all cumulo costs is the first adjustment made to the 2019/20 base data. All other adjustments below have been made excluding cumulo costs.

Adjustment to remove cumulo costs

A14.16 BT's cumulo rate costs are the non-domestic rating costs BT pays on its rateable network assets.

A14.17 BT's rates bill is expected to increase over the charge control period, explained in more detail in the cumulo section below. Due to this, we have removed the cumulo costs from the base year data and forecast them separately in the cost forecast model. [587] This is consistent with the approach taken in the January 2020 Consultation, 2019 BCMR and 2018 WLA charge control modelling.

Adjustment to smooth restructuring charges and property rationalisation provision costs

A14.18 Restructuring costs are associated with changes in BT's organisational structure that result in employee redundancies (with costs from redundancies known as leaver payments).

A14.19 Property rationalisation provision costs relate to BT's strategy of consolidating its office space to enable the mothballing and subletting of buildings.

A14.20 As in the January 2020 Consultation, 2019 BCMR and the 2018 WLA Statement, we consider that leaver payments, restructuring costs and property rationalisation provision costs are forward looking and efficiently incurred if they produce future efficiency benefits and reduce future property related costs (and we are not aware of any information suggesting these costs may be inefficient). These costs fluctuate year on year therefore these costs have been included in the base year for the Statement by smoothing them over a three-year period.[588][589]

Adjustment to Ethernet SLG Provision costs

A14.21 Under SLG schemes, Openreach pays compensation to customers if it fails to meet agreed performance criteria – such as time taken to complete an installation – as set out in the SLAs.[590] These SLG payments are part of BT's operating costs.

A14.22 In previous charge controls we have allowed BT to recover an appropriate forward-looking estimate of these costs. Within this Statement, we have decided to continue to include these costs in the base year, but to adjust 2019/20 base year provision SLG costs for Ethernet as, consistent with previous charge controls, we do not consider the costs within the base year to be reflective of the efficient level of cost.[591][592] We then forecast forward Ethernet SLG costs separately which is discussed in the SLG section below.

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[587] BT response to Q1 of the s135 notice dated 11 September 2020.

[588] The calculation for this adjustment has been made in the same way as described in the BCMR 2019 Statement, Annex 19, paragraphs A19.18-20.

[589] BT response to Q4&5 of the s135 notice dated 11 September 2020, BT response to Q5&6 of the s135 notice dated 22 February 2020 and BT response to Q10&11 of the s135 notice dated 11 July 2019.

[590] For example, see page 68 of BT's 2019/20 AMD.

[591] We have reviewed the repair SLG costs and do not consider there to be an issue with the level of repair SLG costs.

[592] Our calculations for what an efficient level of SLG provision costs in the base year is consistent with that described in the 2019 BCMR Statement, Annex 19 Paragraph A19.74 except we have since obtained updated data from Openreach through to June 2020. Despite having data to June 2020, we have used a 4 month run rate to February 2020 as Openreach declared a 'matters beyond our reasonable control' situation in relation to Covid-19 on 23 March 2020 which ran until 4 August 2020 making SLG payments within this time period atypical.

Additional auto compensation costs

A14.23 Currently, internet service providers (ISPs) can sign up to a voluntary commitment[593] to pay automatic compensation to their customers for:

- delay in activation of a fixed line or broadband service;
- delayed repair following loss of service to a fixed line or broadband service; and
- missed engineer appointment relating to the provisioning or repair of a fixed line or broadband service.

A14.24 The current costs included within the 2019/20 RFS base year are only those which ISPs can claim back from Openreach.

A14.25 However, as not 100% of ISPs have signed up to the scheme[594] and there are new automatic compensation plans for Continuous Delayed Repair and Major Service Outage blanket currently being negotiated, we cannot use the costs within the 2019/20 base year.

A14.26 Instead, we have uplifted the costs within the 2019/20 base year to reflect these missing costs and then forecast forward in the cost forecast model as normal.[595]

IFRS 16[596]

A14.27 We have adjusted our base year costs to reverse out the effects of IFRS 16 from our base year data. This adjustment means that operating lease expenses are included within operating expenses and not capitalised i.e. they are accounted for consistently with previous charge controls.[597]

A14.28 This treatment is consistent with previous charge controls and ensures that no under- or over-recovery for lease related costs occurs due to a change in accounting standard.

Adjustment to reallocate non direct excess construction costs (ECC)

A14.29 Within Volume 4 Section 5 we have decided to impose a CPI-0% control on the Direct ECC basket.

A14.30 Consistent with the approach we took in the January 2020 Consultation and BCMR 2019, to allow full cost recovery, we have reallocated any non-direct ECC costs[598] to EAD connections.

Core and Backhaul fibre reallocation

A14.31 In its 2019/20 RFS, BT allocated the costs of some fibre classes of work between 'backhaul' and 'core' fibre based on a 2006/07 snapshot of the relative proportion of fibre kilometres used by

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[593] See Communications Providers' voluntary code of practice for an automatic compensation scheme

[594] The largest CP currently not signed up to the scheme is Vodafone, however we expect close to 100% sign up during the charge control period.

[595] BT response to Q3 of the s135 notice dated 18 January 2021 and Openreach response to Q15 of the s135 notice dated 8 December 2020.

[596] IFRS 16 specifies how an IFRS reporter will recognise, measure, present and disclose leases. The standard provides a single lessee accounting model, requiring lessees to recognise assets and liabilities for all leases unless the lease term is 12 months or less or the underlying asset has a low value.

[597] BT response to Q1,2&3 of the s135 notice dated 18 November 2020.

[598] Costs which are not already captured by the balancing charge.

backhaul and core circuits.[599] BT said that using data from 2006/07 resulted in the split of these fibre costs between core and backhaul fibre being 31.1% core fibre and 68.9% backhaul fibre. BT told us that using 2019/20 data to estimate the proportion of fibre kilometres used by backhaul and core circuits, the split would result in 9.1% core fibre and 90.9% backhaul fibre. – i.e. a reallocation of these fibre costs from core fibre to backhaul fibre.[600]

A14.32 We consider that using data from 2019/20 would give a better reflection of how fibre is currently used by backhaul and core circuits and we have made an adjustment to reallocate these fibre costs using the 2019/20 data provided by BT.[601]

Forecasting costs

Overall approach

A14.33 BT's costs consist of operating and capital costs (opex and capex). We forecast each of these cost types separately. We have taken a similar approach to forecasting costs as we took in the 2019 BCMR and 2018 WLA.[602]

A14.34 While we are ultimately interested in service-level costs, our cost forecasts are calculated at a network component level. We consider that this is more robust than forecasting at a service level as BT's services are made up of a common pool of network components such as lengths of fibre. By forecasting how the costs of these 'building blocks' are expected to change, we can build up the costs of each service. This allows our forecasts to, for example, account for economies of scale due to volumes growth of multiple services all of which make use of a single component; these economies of scale might be missed were we to treat each service as separate.

A14.35 We forecast costs in each year until the end of the charge control period. We do this in two steps after we have established the base year costs:

a) First, we forecast costs assuming volumes remain constant in all years. This takes into account changes in input prices and expected efficiency gains.

b) Second, we add the effects of our volume forecasts. We use AVEs and CVEs to estimate the impact of changes in volumes on costs.

Stakeholder comments

A14.36 Only Openreach commented on our overall approach to forecasting costs. They raised three concerns with our modelling approach.

A14.37 First, they believed that the modelling equation used for calculating return on mean capital employed (MCE) was incorrect, as in year holding gains or losses are added to the asset base to which the weighted average cost of capital is applied:

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[599] BT response to Q29c of the s135 notice dated 18 November 2020.
[600] BT response to Q29e of the s135 notice dated 18 November 2020.
[601] BT response to Q4 of the s135 notice dated 18 January 2021.
[602] 2019 BCMR Statement, Volume 3, Annex 18.

A14.38 'In Ofcom's Top Down model, appropriate assets are inflated in-line with the FCM convention and this is reflected as a holding gain (i.e. a reduction to the operating costs). However, the holding gain is also subtracted from the Net Replacement Cost (NRC). This is an incorrect treatment as the Net Replacement Cost should reflect the asset value. Subtracting the holding gain reverses the NRC increase for that year'.[603]

A14.39 Next, Openreach raised concerns with how the RAV element of the physical infrastructure cost stack had been forecast:

A14.40 'As Ofcom uses 2017/18 as its base year cost inputs, the RAV adjustment in 2017/18 will reflect duct assets that are older than c.21 years (and hence have 19 years or less remaining asset life). For the final year of the FTMR modelling (2025/26), the RAV adjustment should relate only to duct assets that are older than 29 years at that time (and hence would have 11 years or less remaining asset life). Openreach would therefore expect the size of the (negative) RAV adjustments to reduce in size significantly between 2017/18 and 2025/26. However, this does not happen in Ofcom's model.'[604]

A14.41 Finally, Openreach commented on the approach to how legacy Ethernet services (WES and BES) are mapped to Modern Equivalent Assets (MEA) services:

A14.42 'there are legacy components in the model that have not been mapped to the "MEA components", meaning that the costs taken into the service and basket calculations are understated.'[605]

Our decision

A14.43 Firstly, we found that within the January 2020 Consultation model there was an inconsistency in the treatment of depreciation cashflows when converting to real terms from nominal.

A14.44 Depreciation cashflows are assumed to occur at the start of the year within our modelling equations. However, in the January 2020 Consultation modelling, they were converted into real terms using an end-year conversion.

A14.45 This correction ensures that the cashflows over the life of an investment result in a net present value of zero. Correcting this for the Statement does not impact the nominal costs modelled but does result in more real costs being modelled for all years within the charge control period.

A14.46 In terms of the RAV adjustment, we agree with Openreach's expectation that the size of the (negative) RAV adjustment should reduce between the base year and 2025/26 as the assets to which the RAV adjustment relate would only have 11 years or less left of their asset lives compared to 17 years or less in our base year cost stack for 2019/20.

A14.47 For the Statement, we have decided to model the RAV adjustment at a service level rather than component level as was the case in the January 2020 Consultation.

A14.48 We have calculated the RAV adjustment by:

[603] Openreach response to January 2020 Consultation, paragraph numbers 9.143-9.146, Page 253.
[604] Openreach response to January 2020 Consultation, paragraph numbers 9.150-9.152, page 253.
[605] Openreach response to January 2020 Consultation, paragraph numbers 9.165-9.168, pages 255 and 256.

A14.49 First, forecasting forward the total RAV adjustment for our relevant services at a total level for the charge control period.

A14.50 Next, we forecast the RAV adjustment forward for each individual service using the change in the individual service volumes.

A14.51 Finally, we scale the individual service level RAV forecasts from (b) to ensure that the total RAV adjustment for our relevant services is the same as that calculated in (a).

A14.52 This method ensures that the change in service mix is captured. While also ensuring that, at a total level, the RAV adjustment is declining as would be expected.

A14.53 As for Openreach's final comment, within the January 2020 Consultation we proposed to adopt a MEA approach for the purpose of modelling the costs of legacy WES and BES services. We proposed to model the costs of these services using the costs of what we consider to be the modern equivalent following a consistent modelling approach with that used in the 2019 BCMR Statement.

A14.54 Within the January 2020 Consultation the steps for the MEA modelling were:

a) we produced two service volume forecasts: (1) without MEA mapping, and (2) with MEA mapping;

b) we applied volume usage factors to the service volume forecasts in (2) to generate component volume forecasts;

c) we forecast forward the base year network component costs using the component volume forecasts on the basis of the Ofcom forecasting equation;

d) we calculated unit network component costs by dividing (c) by the component volumes calculated in (b);

e) these were converted into unit service costs by applying cost usage factors; and

f) we calculated the forecast of total service costs by multiplying the unit costs by the service volume forecast in (2) (i.e. volume forecasts with MEA mapping applied).

A14.55 Since the January 2020 Consultation we have identified that step (d) above understates the unit component costs. The understatement occurs because the base year costs are only for the modern equivalent technology (Ethernet), while the volumes are for both the Ethernet and the WES/BES volumes converted to their modern equivalent.

A14.56 For the Statement we have decided to change step (b) to instead apply the volume usage factors to service volume forecast (1). This approach ensures that the component unit cost is found by dividing a cost by a consistent volume base. The remaining steps to our MEA modelling have been kept the same as those proposed within the January 2020 Consultation.

Key modelling assumptions

Volume forecasts

A14.57 Volume forecasts are required for our top-down cost model, driving both cost and revenue forecasts. Due to the presence of fixed costs, changes in volumes are likely to affect unit costs.

A14.58 We forecast the costs and revenues of Openreach’s regulated relevant services, on a service-by-service basis.

A14.59 For leased lines, this results in a long list of services, so we base our volume forecasts initially on Openreach’s own forecasts. We consider that Openreach’s forecasts of service volumes provide the best starting point for our leased line forecasts.

A14.60 For our WLA rentals, where the list of services is significantly shorter than leased lines, we consider it appropriate to determine our own input assumptions which then drive our service volume forecast. For WLA services, we then cross-check our forecasts against those provided by ([✂]) multiple communication providers.

Leased Lines forecasts

A14.61 Openreach provided us with two sets of volumes forecasts[606][607]:

- a short-run forecast covering 2020/21, broken down by individual service both internal and external; and
- a long-run forecast covering 2021/22 to 2024/25, broken down by individual service.

A14.62 Both forecasts were created assuming Openreach’s draft estimate of the impact of COVID and the Openreach target of 8m FTTP rollout achieved by 2024/25. The forecasts further assumed both dark fibre inter-exchange (DFX) and unrestricted PIA are provided by Openreach but dark fibre access (DFA) is not.

A14.63 Detailed updated forecasts were requested from Openreach. However, updated approved forecasts were not in existence at the time of request so these were not able to be provided.[608] Instead Openreach were able to provide their ‘market guidance document’ which contains a forecasts out to 2025/26, at bandwidth level, for leased line services.

A14.64 The market guidance document assumes an updated Openreach target of 20m FTTP rollout to be achieved by mid to late 2020s and that the COVID impact will be slower to take effect due to continued government support for business. Consistent with previous forecasts, no impact on volumes for dark fibre access in Area 3 is included.

Adjustments to Openreach’s Leased Lines forecasts

A14.65 We have identified some areas where we consider adjustments are needed to Openreach’s Leased Lines forecasts to make them appropriate for use in our cost forecast model[609]:

- a bespoke forecast of main links; and
- an adjustment to reflect the impact of the dark fibre remedy on leased line volumes in Area 3.

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[606] Openreach response to Q3 of the s135 notice dated 26 February 2020. Forecasts were requested up until the end of the charge control 2025/26 however only to 2024/25 were available.
[607] Neither forecast breaks services down by geography with both sets of data providing forecasts on a national basis.
[608] Openreach response to Q6 of the s135 notice dated 8 December 2020.
[609] In the 2019 BCMR Statement we were required to make an adjustment to account for volumes in Northern Ireland as the forecast and actual volumes were provided on an inconsistent basis. For this Statement, both forecast and actual volumes were provided excluding Northern Island and then growth rates applied to the RFS 2019/20 restated actuals. As such, no separate specific adjustment is required to align the two data sets.

Main link forecast

A14.66 Openreach's forecasts do not include forecasts for main link services. To forecast main link volumes, we have set the growth rate for these services at the same rate as the services which use them. We have based this on a mapping of such services provided by Openreach. We consider this is a reasonable predictor for the growth of main link services because they are always purchased alongside other services and the average main link length per circuit appears to have remained relatively constant over the past five years.

Impact of the access dark fibre remedy

A14.67 Given our approach to setting dark fibre charges (see Annex 17), we do not consider it necessary to account for any 1-to-1 substitution of active leased line circuits to dark fibre circuits. We expect any fixed costs (excluding the active layer) that were previously recovered from an active circuit will now be recovered from the dark fibre circuit that replaced it on a 1-to-1 basis.[610]

A14.68 However, we note that the introduction of a dark fibre service in the access part of Openreach's network might result in a greater amount of aggregation of existing leased lines into a smaller number, which could have a volume impact for Openreach. Therefore, we consider it appropriate to account for this impact.

A14.69 Based on 2019 BCMR circuit data, we have estimated that ([✂]) routes in Area 3 share circuit ends in the same postcode as one other circuit where both circuits are owned by the same telecoms provider. We have assumed that aggregation will result in all of these pairs of circuits being replaced with a single dark fibre circuit[611], and have reduced leased line volumes in Area 3 by ([✂]) in 2025/26 accordingly. We have assumed this will reduce each bandwidth at 1Gbit/s or below by the same proportion and also assumed that it will take five years for the full impact to occur.[612]

A14.70 We do not expect dark fibre to have a significant incremental effect on aggregation for inter-exchange circuits or circuits which share routes with two or more other circuits and so we have not made specific adjustments in these areas.[613]

[610] DFA and DFX costs are derived from EAD costs calculated in the top-down model. If we reduced EAD volumes due to 1-to-1 substitution, this would incorrectly model a reduction in total business connectivity service volumes when in fact the costs are now being recovered through dark fibre services rather than EAD.

[611] We note that some of these circuits may already face aggregation opportunities with the use of active leased lines which we would expect to be captured within Openreach's forecasts. Therefore, making an adjustment to Openreach's forecasts to account for all of these circuits is an upper bound estimate.

[612] This is consistent with the 17% per annum rate of aggregation for access circuits to dark fibre assumed in the 2016 BCMR which was based on historic WES to EAD migration rates, see A33.143 of 2016 Business Connectivity Market Review.

[613] This is because we expect the incentive to aggregate these circuits already exists without dark fibre so is already captured in Openreach's volume forecasts.

WLA forecasts

A14.71 We have taken a similar approach to forecasting WLA service volumes as in the 2018 WLA Statement.[614] However, we now forecast ultrafast services separately from FTTC, we forecast over a longer time period (up to 2035/36), and we no longer forecast ancillaries.[615]

A14.72 An important driver of our forecasts is the rate of migration from copper to fibre services over the review period. Another important element is the impact that competing networks will likely have on the number of Openreach lines. Both are subject to a high degree of uncertainty. We have collected data from a wide range of sources to estimate the impact of these elements on WLA line volumes.

A14.73 In the interest of transparency, we use publicly available data, where possible. In order to forecast service volumes, we have used the following sources of information:

- Household forecasts from the Ministry of Housing, Communities and Local Government (MHCLG);[616] and number of businesses from the Department for Business, Energy and Industrial Strategy (BEIS);[617]
- Copper and GEA service volume data from Openreach[618] for the financial years 2013/14 through to 2024/25 using our statutory information gathering powers, of which the final five years are forecast data.
- Actual and forecast volumes provided by competitive network providers including ([✂]). We have used this data to forecast the impact that competitive networks might have on the number of purchased Openreach lines over the review period.
- Forecasts provided by [✂] which, alongside Openreach's forecasts, are used to cross-check against our modelled forecasts. This allows us to test the robustness of our model and whether our modelling assumptions are reasonable.

A14.74 We have projected volumes of WLR, MPF, SMPF, and GEA rentals using the following steps in our volumes model:

- **Step 1: forecast the number of fixed line UK premises:** including small and medium enterprises (SMEs) and households, excluding mobile-only households.
- **Step 2: forecast the number of Openreach lines:** calculating the average number of Openreach lines per SME site and residential household, and multiplying these by the BEIS business site forecasts and MHCLG fixed line household forecasts to estimate the number of future Openreach lines.[619] We make some adjustments to this forecast to account for the impact of future competitor network roll-out.

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[614] 2018 WLA Statement, Annex 10, 28 March 2018
[615] We do not consider it necessary to add further complexity to the volumes model by forecasting ancillary services given that we have found revenues and costs for ancillary services to be broadly aligned see Volume 4 Section 6 for more detail on our charge controls for ancillaries.
[616] MHCLG, 12 July 2016, Live tables on household projections. [accessed 22 January 2021].
[617] BEIS, 8 October 2020, *Business population estimates 2020*. [accessed 22 January 2021].
[618] Openreach response to questions 6, 8 & 10 of the s.135 notice dated 21 August 2019. This information was then updated with 2019/20 actuals and new forecasts up to 2024/25 by Openreach.
[619] BT's RFS based volume data does not differentiate between business and residential lines. We therefore split them into business and residential lines using the split at the overall industry level.

- **Step 3: forecast individual rental volumes:** we forecast broadband penetration and take-up of fibre services to estimate how our Openreach line forecasts are split between MPF, WLR, SMPF and GEA FTTC and GEA FTTP.

A14.75 In summary, we estimate the following key trends from 2019/20 to 2025/26:

- For the base case Area 2 scenario and Area 3 RAB modelling:
  - the total number of Openreach lines will fall from 16.3 million to 13.0 million in Area 2 and increase from 8.6m to 8.8m in Area 3;
  - the total number of customers on alternative networks will increase from around six million to around ten million;
  - broadband penetration on Openreach's network will reach 87% by 2025;
  - the proportion of Openreach broadband lines that use fibre (i.e. FTTC, G.fast and FTTP) will reach 93% by 2025/26; and
  - we assume that the Area 3 split for service volumes increases (from 2019/20 actuals) by around one percentage point each year to account for the disproportionate impact that alternative networks have on Openreach volumes in Area 2 compared to Area 3.[620]
- For the counterfactual scenario that is used for our Area 2 analysis[621]:
  - the total number of Openreach lines will fall from 16.3 million to 15.2 million in Area 2 and increase from 8.6m to 8.9m in Area 3;
  - the total number of customers on alternative networks will increase from around six million to around seven million;
  - broadband penetration on Openreach's network and the proportion of Openreach broadband lines that use fibre is unchanged (87% and 93% by 2025/26, respectively) but absolute volumes are different (see Table A14.6 below); and
  - we assume that the Area 3 split for service volumes increases by 0.5 percentage points each year.

A14.76 Openreach argued that our January 2020 Consultation forecasts for FTTP did not account for Openreach's updated fibre rollout ambitions.[622] We have updated the FTTP growth in our top-down modelling base scenario to reflect Openreach's current FTTP ambitions.

A14.77 Table A14.2 below sets out our estimated base case impact of these forecast key trends on the main rental volumes.[623] These forecasts are for the average number of lines in each year, to be consistent with BT's RFS.

[620] We note that the Area 3 split varies across the different services, i.e. the split for MPF volumes is different to the split for WLR volumes.
[621] No further investment in gigabit networks by Openreach and no additional competitive entry into the market.
[622] Openreach response to January 2020 Consultation, paragraphs 9.158 and 9.159.
[623] For the purposes of calculating our charge controls, we have constructed a range for the service volume forecasts based on different growth rates for Openreach FTTP and different impacts from alternative networks.

Table A14.2: Summary table of 2019/20 WLA and WFAEL national volume forecasts broken down by service (base case, mid-year rentals)

	2019/20 Actuals	
	Number of lines (millions)	Share of all Openreach lines
MPF lines[624]	3.5	14%
WLR lines[625]	4.4	18%
WLR + SMPF	3.3	13%
MPF + GEA FTTC[626]	6.2	25%
WLR + GEA FTTC	7.0	28%
FTTP	0.5	2%
Total Openreach lines	**24.9**	

Source: Ofcom 2021 WLA Volumes Module.

Table A14.3: Summary table of 2025/25 WLA and WFAEL national volume forecasts broken down by service (base case and counterfactual scenarios, mid-year rentals)

	Area 2 base case & Area 3 RAB modelling		Counterfactual scenario for Area 2 analysis[627]	
	Number of lines (millions)	Share of all Openreach lines	Number of lines (millions)	Share of all Openreach lines
MPF lines[628]	0.7	3%	0.8	3%
WLR lines[629]	2.8	13%	3.0	12%
WLR + SMPF	0.6	3%	0.7	3%
MPF + GEA FTTC[630]	7.1	32%	11.3	47%
WLR + GEA FTTC	4.7	22%	6.9	29%
FTTP	5.9	27%	1.4	6%
Total Openreach lines	**21.8**		**24.1**	

[624] Includes only MPF lines that are not purchased with GEA.
[625] Includes both residential and business lines that use WLR but without a SMPF or GEA service, as well as SOTAP.
[626] Note that our MPF + GEA FTTC and WLR + GEA FTTC includes GEA-FTTC, Gfast, SOGEA, and SOGfast volumes.
[627] No further investment in gigabit networks by Openreach and no competition enters the market in Area 2.
[628] Includes only MPF lines that are not purchased with GEA.
[629] Includes both residential and business lines that use WLR but without a SMPF or GEA service, as well as SOTAP.
[630] Note that our MPF + GEA FTTC and WLR + GEA FTTC includes GEA-FTTC, Gfast, SOGEA, and SOGfast volumes.

Efficiency

A14.78 As part of our cost forecasting, we take a view on the cost savings (efficiency) we expect BT to achieve over the review period.

Our proposals

A14.79 Within the January 2020 Consultation we took the view that the evidence and analysis we used to support our assumptions in the 2019 BCMR Statement and 2018 WLA Statement, continued to provide an appropriate basis to inform our modelling.

A14.80 We proposed that the following efficiency rates be used:

- For business connectivity services:
  - 4% to 7% per annum for our operating cost efficiency target; and
  - 3% to 6% per annum for the capital cost efficiency target.
- For WLA services:
  - 3.5% to 6.5% per annum for our operating cost efficiency target; and
  - 1% to 5% per annum for the capital cost efficiency target.

Stakeholder comments

A14.81 Openreach responded to the January 2020 Consultation stating that it was important for Ofcom to consider the results of more up to date analysis. They said that their analysis shows that more recent years have a much lower level of efficiency than those used to set our proposed rate in the January 2020 Consultation:

A14.82 'We have conducted an updated analysis of historic efficiency of WFTMR products from 2016/17 to 2018/19. We show below that Ofcom's analysis is not representative of the true efficiency Openreach has delivered in the past or is able to achieve in the future. Openreach believe a more appropriate operating efficiency to be in the range of 0.5% to 3.5%'.[631]

Our decision

A14.83 Within the January 2020 Consultation we stated that 'if further data becomes available that will materially change our view on efficiency, we will update our estimates for the Statement.'

A14.84 Openreach responded to the January 2020 Consultation stating, if our operating costs efficiency analysis was updated to reflect data from more recent years, this would produce lower efficiency levels. On top of this, both Covid-19 and Brexit need to be considered for any efficiency levels we choose to set for the charge control period. We consider the combination of these factors to be sufficient for us to update our efficiency analysis from that relied on in the January 2020 Consultation.

A14.85 To arrive at our revised operating cost efficiency targets we have:

[631] Openreach response to January 2020 Consultation, paragraph 9.133, page 251.

- analysed changes in component costs via sets of 'pairwise' comparisons over the historic period 2015/16 to 2019/20 using BT regulatory accounting information.[632]
- analysed both historical and forecast Openreach management accounting information over the historic period 2015/16 to 2019/20 and forecast period 2020/21 up to 2024/25.
- reviewed documents and analysis provided to the BT Group board or the Openreach board to identify actual or potential impacts of COVID-19 and Brexit.

BT regulatory accounting pairwise comparisons

A14.86 The basic methodology that underpins our analysis has not changed from that used within the 2019 BCMR Consultation and 2018 WLA Statement.

A14.87 We have estimated the impact of inflation and changes in volumes on the annual movement in component costs and assumed efficiency accounts for any remaining movement. We have again used the formulae that underpin the cost forecast model, estimating the effects of volumes using CVEs and specific inflation assumptions for each year.[633]

A14.88 Consistent with previous charge controls, we consider that our regulatory cost analysis provides an important source of evidence when assessing efficiency levels Openreach has achieved in the past and attach a relatively high weight to it in forming our efficiency assumptions. This analysis has the benefits that it is consistent with the way we model costs and covers the same services. We estimate the average annual cost savings achieved between 2015/16 and 2019/20 had a compound annual growth rate (CAGR) of 5.0% for leased line and 3.5% for copper services.[634]

A14.89 Our analysis showed there were large cost increases in 2018/19. Upon investigation cost increases related to ''Openreach undertaking a recruitment drive for engineers to support an increased investment in fibre rollout. [……] this caused a significant increase in pay costs in 2018/19. This increase in costs does not immediately result in increased volumes as the engineers require extensive upfront training.''[635] We would not expect the large cost increases seen in 2018/19 and early 2019/20 to reoccur in future years as the major recruitment and training of engineers has now taken place.

A14.90 This view is supported by Openreach who stated in its response to the January 2020 Consultation, 'Looking further ahead to 2020/21 – 2023/24, the trend of increased hires is not forecast to continue and as a result we forecast a resumption in year-on-year efficiency.'[636]

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[632] Consistent with how we have modelled costs, cumulo and Service Level Guarantee (SLG) costs have been removed from this analysis.
[633] A number of adjustments have been made to the underlying component cost data to ensure like for like comparisons are made in each set of pairwise years.
[634] BT response to Q22 of the s135 notice dated 11 September 2020, BT response to Q1&2 of the s135 notice dated 18 January 2021 and BT response to Q2 of the s135 notice dated 18 November 2020.
[635] BT response to question 11 of the s135 notice dated 18 January 2021.
[636] Openreach response to January 2020 Consultation, paragraph number 9.139, page 252.

Openreach management accounting analysis

A14.91 We consider our analysis of Openreach's historical and forecast internal management accounting data should also provide relevant and reliable evidence for forming our efficiency assumptions for this review period.

A14.92 This analysis provides a view of both Openreach's recent past efficiency achievements and its forecast internal efficiency and cost transformation targets out to 2024/25.[637] [638]

A14.93 We have reviewed Openreach's unadjusted PVEO analysis and have also restated the results using our estimates of inflation.[639]

A14.94 Openreach's unadjusted analysis suggested efficiency of 3.1% p.a. has been achieved historically and forecasts efficiencies of 4.1% p.a. going forward. Restating inflation to be consistent with the assumptions in the cost forecast model, suggested efficiency of 4.4% p.a. has been achieved historically and 5.3% p.a. going forward. We attach a relatively high weight to this analysis in forming our efficiency assumptions but recognise that these efficiencies are levels achieved by Openreach as a whole and are not specific to our relevant services.

BT Group and Openreach Group board paper review

A14.95 Our review of both the Openreach and BT board papers has shown that Covid-19 has had an impact on costs incurred and costs saving initiatives within the business. Brexit appears not to have had a material impact on the business.

A14.96 In relation to Brexit, while early 2020/21 board papers indicated cost increases due to Brexit contingency planning[640], Philip Jansen stated within the Q3 2020/21 trading update that the agreed Brexit deal would not have a material impact on the business, "With no material impact expected from the Brexit deal and our resilient results so far this year I remain confident in our EBITDA expectation of at least £7.9bn for 2022/23".[641]

A14.97 In relation to Covid-19, there are a number of areas where reductions in productivity and/or cost increase were reported within Openreach's board papers[642]:

- "Resourcing in all programmes was impacted due to higher absence and self/household isolation, although has now returned to normal levels. Productivity has been impacted through the introduction of safe working practices (e.g. wiping down tools between uses,

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[637] We have not performed the analysis required to weight the management accounts to attempt to make them specific to our relevant services as has been done in previous charge controls.

[638] Openreach response to Q16,17&18 of the s135 notice dated 11 September 2020.

[639] We have overwritten the inflation assumptions to ensure consistency with the inflation assumptions used within the forecast model.

[640] Costs expected to increase as a result of increasing inventory to protect against import delays and changes required to contracts and processes so that the company can continue to transfer customer data to and from the EU. BT response to question 36 of the s135 notice dated 18 November 2020, document 'BT Results Release Q4 2019_20_300420 blackline vs BARC'.

[641] BT Q3 2020/21 trading update news release https://www.bt.com/bt-plc/assets/documents/investors/financial-reporting-and-news/quarterly-results/2020-21/q3/q3-20-21-release.pdf

[642] A sample listed below, not all areas identified have been listed.

eliminating vehicle sharing) and, in the early period of lockdown, access to basic materials (e.g. quarries, builders merchants) was difficult"[643];

- "Lower headcount and strong cost control is offset by higher overtime due to higher repair workstacks and lower Alterations income as a result of customers not being ready for engineers to enter their premises after lockdown"[644];
- Higher repair levels: "The link to coronavirus is that these volumes represent currently underperforming lines which are more likely to be reported with additional strain on service from increased homeworking / self-isolation etc"[645]; and
- Increased bad debt provisions to prepare for business insolvencies.

A14.98 We note that the review of the BT board papers and quarterly financial reports also identifies areas where cost transformations could be achieved in order to mitigate the impacts of Covid-19. "Further cost reduction opportunities being developed (e.g. procurement benefits, Better Workplace programme & network capex phasing) either to fund new revenue opportunities (e.g. [✂]) or to mitigate deeper external impacts".[646] "Alongside our modernisation programme, we continued to take short-term actions to challenge every element of our cost base, to reduce discretionary costs and to mitigate the financial impacts of Covid-19. In particular we have cancelled or delayed planned recruitment across BT; worked with our suppliers to identify opportunities to deliver significant and sustainable cost reductions along the supply chain; focused and rephased our marketing spend; and rigorously reviewed and reprioritised discretionary spend on travel, training, and external fees."[647]

A14.99 What is not always clear from the documents reviewed is the quantum of these impacts. Where impacts on EBITDA have been presented, it is impossible to know how much of the impact would already be captured by our updated volume forecasts. Further, it is uncertain how far into our charge control period Covid-19 will be a factor.

A14.100 It is our regulatory judgement that the impact of Covid-19 will have an overall negative impact on the efficiency levels Openreach will be able to achieve over the period from 2020/21 to 2025/26. As such, when setting the efficiency rates, we have chosen efficiency rates towards the low end of our modelled ranges to reflect this.

Our decision

A14.101 Our chosen operating cost efficiency assumptions reflect the different weights we give to each source of evidence that we have reviewed. Given the current economic environment, we further recognise that while it is not possible to quantify all the effects, we do acknowledge that cost savings may be harder to achieve over the charge control period.[648]

[643] Openreach response to question 12 of the s135 notice dated 8 December 2020, document '5.OLB(20)59 Fibre First Jun2020 FINAL.docx (June 2020)'.
[644] Openreach response to question 12 of the s135 notice dated 8 December 2020, document '11.OLB20-40i P04 Finance Report.docx'.
[645] Openreach response to question 12 of the s135 notice dated 8 December 2020, document '1.OLB(20)39 COVID19 Scenarios MARCH2020.pptx (March 2020)'.
[646] BT response to question 36 of the s135 notice dated 18 November 2020, document 'MTP20 1st May Board Presentation_FINAL V1.1'.
[647] BT Half year release 202021
[648] Supported by review of the BT and Openreach board papers.

A14.102 As no responses were received to the January 2020 Consultation, we have used the same capex efficiency assumptions as those proposed within the January 2020 Consultation.

A14.103 The resulting assumptions are outlined below.[649]

- For business connectivity services:
  - A base case of 5.0% per annum for our operating cost efficiency target; and
  - A base case of 4.5% per annum for the capital cost efficiency target.
- For WLA services:
  - A base case of 3.5% per annum for our operating cost efficiency target; and
  - A base case of 3.0% per annum for the capital cost efficiency target.

Asset Lives

A14.104 In informing the asset lives in our Top-Down cost modelling, and in any cost modelling exercise for charge control purposes more generally, we are interested in understanding the economic life of the modelled network assets. This represents the time period over which we would expect an efficient operator to use an asset in light of the asset's physical life as well as the possible technological developments which could accelerate the asset's replacement.

Our proposals

A14.105 Consistent with previous charge controls, we were largely of the view that depreciation as a proportion of the gross replacement cost of the asset is a reasonable proxy for the economic life of the modelled assets. The exception to this was for GEA DSLAMs.

A14.106 In the 2018 WLA[650] we undertook analysis to assess the actual replacement time of GEA DSLAM cabinets and concluded that the appropriate asset life to use for this asset was within the range of 7.1 to 9.1. In the January 2020 Consultation we adjusted the asset life of the GEA DSLAM asset to reflect this revised asset life.

Stakeholder comments

A14.107 No stakeholder raised comments on our proposed approach to calculating asset lives.

Our decision

A14.108 Consistent with the January 2020 Consultation, we have decided to use depreciation as a proportion of the gross replacement cost of the asset as a reasonable proxy for the economic life of the modelled assets. Although, again we make an exception for GEA DSLAMs.

A14.109 Since the January 2020 Consultation, we have also decided to make another exception, this time for poles assets. We have decided that poles should have an asset life of 40 years. See Annex 18 for more information as to why a 40-year asset life for poles is appropriate.

[649] For PIA components efficiency rates consistent with those used in the PIA modelling have been used. See Annex 18 for more information.
[650] See Annex 14, paragraphs A14,143 to A14.148 of the 2018 WLA Statement.

Asset volume elasticities (AVEs) and cost volume elasticities (CVEs)

Overall approach to calculating AVEs/CVEs

A14.110 We would expect changes in the volume of a service provided to impact the costs associated with providing that service. However, where fixed or common costs are incurred, costs may not change by the same proportion as volumes. Therefore, when we forecast costs, we need to appropriately reflect the underlying relationship between forecast changes in service volumes and changes in the number of assets and costs of providing those services.

A14.111 We convert forecast changes in service volumes to changes in network component volumes using usage factors. The impact the change in these forecast network component volumes have on forecast costs (before considering the impact of inflation or cost savings) is determined by AVEs and CVEs.

Our decision

A14.112 For this Statement, we use the same methodology to calculate AVEs and CVEs as we did in the January 2020 Consultation, 2019 BCMR Statement and 2018 WLA Statement. [651]

A14.113 As discussed above, we have used the base data for 2019/20 from the 2019/20 RFS. We have used LRIC to FAC ratios as a proxy for AVEs and CVEs based on BT's LRIC model outputs.

A14.114 Given we forecast pay and non-pay operating costs separately in the model, we need to estimate separate CVEs for pay and non-pay operating costs. We therefore apply separate pay and non-pay CVEs for each component we are forecasting.[652] This is consistent with the approach we adopted in the January 2020 Consultation and in the 2014 FAMR, 2016 BCMR, 2018 WLA and 2019 BCMR.

A14.115 AVEs can be calculated in the same manner as CVEs (i.e. separately for each component). We calculate AVEs using the same approach that we adopted in the 2019 BCMR and 2018 WLA charge controls by weighting together LRIC to FAC ratios for each cost category within each super-component by the gross replacement costs (GRCs) of that cost category.[653] We have excluded cumulo costs and SLG payments when calculating non-pay CVEs as these are forecast separately to other non-pay costs in the cost forecast model.

Cross checks and adjustments

A14.116 We generally expect that the relationship between component volumes and costs is, as a maximum, equi-proportionate (i.e. a 10% increase in volume for a component leads to a maximum increase of 10% in cost for that component). We also expect that the relationship is, as a minimum, zero (i.e. an increase in volumes for a component should not lead to a decrease

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[651] See Annex 18 of the 2018 WLA Statement. See Annex 18, Paragraphs A18:64-A18:77 of the 2019 BCMR Statement.
[652] Or to be more precise super-component specific; BT's LRIC model does not contain information on individual components, but rather for super-components which may be an amalgamation of several individual components. Therefore, references below to component information in relation to BT's LRIC model should strictly be taken as referring to super-components, rather than components.
[653] BT defines a 'cost category' within its LRIC model as a "Grouping of costs into unique cost labels by identical cost driver for use in the LRIC model." See page 33 of BT, 2016, *Long Run Incremental Cost Model: Relationships & Parameters*.

in total cost for that component). We have therefore checked that all the estimated CVEs and AVEs are between zero and one.

Adjustment to non-pay CVE for Openreach Admin Fee component

A14.117 As in the January 2020 Consultation, 2019 BCMR and the 2018 WLA Statement, we set the non-pay CVE for the component Openreach Admin Fee (CO801) to one. This is because the Openreach Admin Fee costs are attributed to service revenues[654] and we would therefore expect that, in the long run, changes to these costs (after removing inflation) are likely to be closely correlated to changes in revenues and hence, to changes in service volumes.

Adjustment to AVE FTTC Fibre Rollout Funding component

A14.118 The component 'FTTC Fibre Rollout Funding' works in combination with the component 'FTTC Funded Fibre Rollout Spend' to capture the cost and subsidy of the non-commercial FTTC build.

A14.119 Within the January 2020 Consultation we proposed to set the AVE for the component FTTC Fibre Rollout Funding to zero as we did not anticipate there to be any further subsidised FTTC build and hence no further funding associated with any changes in FTTC rentals volumes. We have done this again within the Statement modelling.

A14.120 By setting the AVE of the component that captures the subsidy to zero while keeping the AVE of the component that captures the spend and clawback of the subsidy as non-zero will result in an increase in the cost base for FTTC lines. This is what we would expect as the demand for FTTC increases: activity that had been funded will eventually become more "commercial" and require repayment of previously received subsidies.

Adjustment to AVE for Access Fibre cost category

A14.121 We make an adjustment to the AVE for access fibre similar to, and for the same reasons as, the one we made in the January 2020 Consultation and 2019 BCMR Statement.[655] Access fibre costs are used by a number of Ethernet and FTTC/P components and are an important element of the respective cost stacks. Using BT's LRIC model outputs and our standard methodology, the estimated AVE for access fibre costs used by the following components is very low suggesting costs are very inelastic to volumes, see column 1 in Table A14.4 below.

A14.122 We consider that our standard approach of using BT's LRIC model outputs is likely to understate the AVEs in these cases, as we consider that the decremental approach used in BT's LRIC model approach is not suitable for estimating the access fibre elasticity. We consider costs are likely to respond differently to volume increases than to volume decreases: while volume increases would be likely to require an increase in the footprint of the network, volume decreases would be unlikely to result in assets being completely removed. Instead, we would expect less intensive use of existing assets.

A14.123 In this Statement we have used the AVEs below for access fibre, Column 2 in Table A14.4. The estimates are for the adjusted AVE for access fibre costs used by each of the components and

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[654] See the description of the base LICENCEFEE in BT's 2017 AMD, page 47.
[655] See paragraphs A18.75 of the 2019 BCMR Statement.

not to the overall AVE for each component (which is a weighted average across all cost categories it uses including access fibre). We present a range for confidentiality reasons.

A14.124 Using our point estimates for the AVE of access fibre costs used by the affected components results in an estimate of the overall AVE for each component of:

Table A14.4: Adjusted component AVEs

	2019/20 BT LRIC model AVE output[656]	Ofcom Calculated AVE Access Fibre[657]	Ofcom Calculated Component AVE
Ethernet Access Direct Fibre	[✂] (0-0.1)	[✂] (0.6-08)	[✂] (0.6-08)
GEA DSLAM & Cabinets	[✂] (0-0.1)	[✂] (0.2-0.4)	[✂] (0.2-0.4)
GEA FTTC Distribution Fibre	[✂] (0-0.1)	[✂] (0.4-0.6)	[✂] (0.4-0.6)
FTTC GEA Electronics	[✂] (0-0.1)	[✂] (0.4-0.6)	[✂] (0.4-0.6)
GEA FTTC Access Fibre Spine	[✂] (0.2-0.4)	[✂] (0.4-0.6)	[✂] (0.6-0.8)

A14.125 We have used these values across all our scenarios for cost modelling for active services.

Dynamic AVEs/CVEs

A14.126 If the same set of component AVEs and CVEs are used to forecast the impact of changes in volumes on costs in each year of the charge control period (i.e. 'static' AVEs and CVEs), then this assumes that fixed and common costs are a constant proportion of total costs throughout the review period. Forecast changes in volumes would therefore result in forecast changes in the level of fixed and common costs. This may be a reasonable simplifying assumption if volume growth is likely to be low over the charge control period.

A14.127 However, as volumes are forecast to change quite significantly, then this approach will assume significant changes in costs that should be fixed. To ensure that this does not occur, we have implemented 'dynamic' AVEs and CVEs which allow our elasticity assumptions to vary year-on-year and maintain a fixed level of fixed and common costs across all years. This is the same approach taken in the 2019 BCMR. In the presence of rising volumes, our AVEs/CVEs will grow over time, reflecting the smaller proportion of total costs that fixed and common costs represent over time. The reverse is true when volumes are falling.

Input price inflation

A14.128 In our model, costs in each year are adjusted using our estimates of the impact of inflation, changes in volumes and cost savings (efficiency). In this subsection, we describe the inflation assumptions we have used for the different cost items. We consider pay operating cost inflation, non-pay operating cost inflation, and asset price inflation separately.

[656] Ofcom calculations on BT LRIC model.
[657] No stakeholders commented on our adjustments to the Access Fibre AVE. We have therefore used the same adjustments proposed in the Consultation for the Statement.

Our proposals

A14.129 We proposed to keep our approach to forecasting inflation consistent with that adopted in both the 2019 BCMR Statement and the 2018 WLA Statement. In summary:

- **Pay operating cost inflation.** We considered a range of evidence when setting our pay cost inflation assumptions, including historical and forecast BT data and external pay cost indices. We proposed to adopt a pay cost inflation rate within our forecasts which had a compound annual growth rate of 3.1% per annum across the forecast period.
- **Non-pay operating cost inflation.** To estimate non-pay cost inflation assumptions that reflect the cost mix for the services in the top-down model, we proposed to weight separate inflation estimates for energy, accommodation and all other non-pay costs. We proposed to adopt a non-pay cost inflation rate within our forecasts which had a compound annual growth rate of 2.3% per annum across the forecast period.
- **Asset price inflation.** We proposed to adopt asset price change assumptions that ensured duct and copper assets were valued consistently with how they are revalued for current cost accounting (CCA) purposes in BT's RFS (i.e. an indexed historical methodology using the Retail Price Index (RPI)). We proposed to use the geometric means of the OBR's RPI between 2020/21 to 2022/24 which was 3% per annum. We proposed that all other asset prices, including those for fibre assets[658], stay constant in nominal terms.

Stakeholder comments

A14.130 No stakeholder raised comments on our proposed approach to calculating input price inflation.

Our decision

A14.131 Our decision is consistent with methodology proposed within the January 2020 Consultation, although the numbers have been updated for the latest forecasts available.

A14.132 The input price inflation rates used within the Statement are as follows:

- We adopt a pay cost inflation rate within our forecasts which has a compound annual growth rate over the review period of 2.7% per annum.
- We adopt a non-pay cost inflation rate within our forecasts which has a compound annual growth rate over the review period of 2.0% per annum.
- We adopt asset price change assumptions that ensure duct and copper assets are valued in CCA terms. The geometric mean of the OBR's RPI over the review period 2021/22 to 2025/26 is 2.3%. All other asset prices, including those for fibre assets[659], stay constant in nominal terms.

[658] Fibre assets have been forecast to stay constant in nominal terms to align with our decision in the BCMR 2019 Statement to use a HCA value for the CCA valuation.
[659] Fibre assets have been forecast to stay constant in nominal terms to align with our decision in the BCMR 2019 Statement to use a HCA value for the CCA valuation.

WACC

A14.133 The cost forecast model requires an estimate of the appropriate weighted average cost of capital (WACC) for the various services included in the model.

Our proposals

A14.134 We proposed to use a pre-tax nominal WACC of 7.8% for Other UK Telecoms, which would cover active wholesale leased lines and FTTP (including G.fast) and a pre-tax nominal WACC of 7.1% for Openreach, which would cover copper access lines, DFA, DFX, PIA and FTTC services.

A14.135 A range of 6.9% to 8.9% for the Other UK Telecoms WACC and 6.1% to 8.1% for the Openreach WACC was proposed for the purposes of the cost forecast model.

Stakeholder comments

A14.136 We explain our estimation of the WACC for these services, along with our responses to stakeholder comments, in Annexes 20 and 21.

Our decision

A14.137 We have decided to use a pre-tax nominal WACC of 7.8% for Other UK Telecoms, which will cover active wholesale leased lines and FTTP (including G.fast) and a pre-tax nominal WACC of 7.0% for Openreach, which will cover copper access lines, DFA, DFX, PIA and FTTC services.

Costs forecast separately

Cumulo

A14.138 Cumulo rates are the non-domestic rates BT pays on its rateable assets (primarily passive assets such as duct, fibre, copper and exchange buildings) in the UK. It is called a 'cumulo' assessment because all the rateable assets are valued together. They are usually calculated by multiplying a Rateable Value (RV) for the property by a 'rate in pound'.[660]

A14.139 RVs are specific to each property and are assessed by the relevant rating authority in each nation, for example, the Valuation Office Agency (VOA) in England and Wales. They are reassessed every few years, with the latest reassessment in England, Wales and Scotland in 2017, and in Northern Ireland in 2020. The next reviews are expected to take effect from April 2025 in Northern Ireland and April 2023 in England[661], Wales and Scotland. The following

[660] Rates in the pound are set centrally by each nation and are the same for all ratepayers in a nation. By rate in the pound (sometimes also called the rate poundage) we mean the standard non-domestic rating multiplier. For an introduction to how rates liabilities are calculated see https://www.gov.uk/introduction-to-business-rates [accessed 27 January 2021]. Northern Ireland is different in that the rate poundage in each of the 11 districts is made up of two separate rates: a regional rate poundage that is the same in each district and a district rate poundage that is different for each district.

[661] See for example England: https://questions-statements.parliament.uk/written-statements/detail/2020-07-21/HCWS400 [accessed 27 January 2021]; Wales: https://gov.wales/written-statement-non-domestic-rates-revaluation-wales [accessed 27 January 2021]; Scotland: https://www.gov.scot/policies/local-government/non-domestic-rates/ [accessed 27 January 2021]

reviews are then expected to take effect at least three years later, i.e. after the end of the charge control period.

Forecasts of BT's cumulo rates costs

A14.140 We have forecast BT's cumulo rates costs in a way that is very similar to that we adopted in the 2018 WLA Statement and 2019 BCMR Statement. We have taken BT's latest published RVs, applied assumptions about rates in the pound, and estimated the impact of the English transition scheme.[662]

A14.141 The 2017 revaluation in England, Wales and Scotland increased BT's cumulo RVs from £201m at 31 March 2017 to £602m from 1 April 2017.[663] We have assumed that these RVs remain at this level over the control period out to 2025/26. In both the 2018 WLA Statement and 2019 BCMR Statement we estimated the impact of two material changes in circumstances[664] to reflect growth in MPF connection and VULA rollout. We have not done so for this review as there have been no changes to BT's RVs in any of the four nations since they were last reset in 2017 (and 2020 in Northern Ireland), despite there having been significant growth in VULA volumes. It therefore seems inappropriate to forecast changes in RVs when there have been none over the lives of the current rating lists. The implicit assumption within our constant RV assumptions is also that BT's cumulo RVs are not revised as a result of future reviews – for example the April 2023 reviews in England, Wales and Scotland referred to above. We have no evidence to support what the impact of these future reviews might be.

A14.142 We have used the rates in the pound published over the period 2017/18 to 2021/22[665] and have forecast them forward as we did in the 2018 WLA Statement by indexing by CPI out to 2025/26.

A14.143 We have again estimated the effect of the English transition scheme. The scheme is complex, but essentially limits increases on a ratepayer's bill, measured using the final RV in England in the previous rating list. Our calculations suggest that the large increase to BT's English RV means that BT's cumulo rate payments in England will be subject to these transition rules until 2019/20, but not from 2020/21 onwards.

A14.144 Overall, we forecast BT's cumulo costs increased from around £167m in 2017/18, to £310m in 2020/21 and will increase further to £315m in 2021/22 and then to £332m in 2025/26.

[662] Rating and Valuation, England The Non-Domestic Rating (Chargeable Amounts) (England) Regulations 2016 SI No. 1265, Part 2, http://www.legislation.gov.uk/uksi/2016/1265/pdfs/uksi_20161265_en.pdf [accessed 28 January 2021].
[663] See Table A21.1 in the 2018 WLA Statement. The values in England and Wales, for example, can be found on the Central list pages of the OVA website here: https://www.gov.uk/government/collections/the-central-rating-list [accessed 27 January 2021]
[664] Once assessed and, absent any appeals, RVs generally stay constant unless there have been 'material changes in circumstance' (MCC). Historically BT's RVs have changed fairly regularly as a result of MCCs, although as we note above there have been no changes to BT's RVs since they were reset as a result of the last reviews in England, Wales and Scotland.
[665] The English, Welsh and Scottish governments have all recently announced that rates in the pound in 2021/22 will be frozen at their 2020/21 levels as has the Northern Ireland government with respect to the regional element of its rates. A decision on the district council element of NI rates has not yet been made. We have assumed that these will also be frozen at 2020/21 levels. We do not consider this a material assumption.

Attributions of BT's cumulo costs

A14.145 Our approach to the attribution of BT's cumulo costs is very similar to that we adopted in the 2018 WLA Statement and 2019 BCMR Statement. The changes we have made reflect that, as a result of reporting directions we made following the WLA 2018 Statement, cumulo costs are no longer included within other component costs but are captured within specific cumulo components. So rather than allocating cumulo costs to network component costs and then onto services we attribute them directly to services.

A14.146 Our attribution method has three steps:

- Attribute cumulo costs between GEA and non-GEA services in proportion to their shares of the cumulo RV. The GEA Services' RV is calculated assuming each FTTC connection has an RV of £18 and every other GEA connection an RV of £20. The non-GEA services RV is what remains.
- Attribute the cumulo costs apportioned to GEA services across relevant GEA services based on their contributions to the GEA services' RV calculated in step a) above. This then maintains the relationship that each FTTC connection has an RV of £18 and all other GEA connections an RV of £20.
- Attribute the cumulo costs apportioned to non-GEA services using the Profit Weighted Net Replacement Methodology that we have described in previous consultations and Statements[666]. This requires forecasts of NRCs for all BT's services that attract attributions of BT's cumulo costs. For services within the cost forecast model we have used the forecast growth in service NRCs generated from the cost forecast model. For services outside the cost forecast model we have derived growth rates from a simple analysis of trends in NRCs for the relevant markets as reported within BT's RFS.[667]

Ethernet provision Service Level Guarantee (SLG) costs

Our proposals

A14.147 We proposed to remove Ethernet provision SLG costs from the base data and then add our forecasts of Ethernet SLG costs back into our total operating cost for each year in the model. Our proposed treatment of Ethernet SLG costs was similar to our treatment of BT's cumulo costs, except that Ethernet SLG costs also form part of the costs for dark fibre services.

Stakeholder responses

A14.148 Openreach raised two concerns in response to how Ethernet Provision SLG costs were forecast in the January 2020 Consultation. The first, that Optical service connections were not included

[666] See for example, paragraph A21.69, in Annex 21 to the 2018 WLA Statement, [accessed 5 December 2019]

[667] For example, some cumulo rates costs are attributed to WBA services. To generate an appropriate growth rate for NRCs for WBA services we have analysed the change in the total non-current assets within the Access-Copper, Access-Fibre, Access-Duct and Transmission sectors attributed to WBA services over the period 2014/15 to 2019/20 as reported in the Attribution of Wholesale Current Cost Mean Capital Employed schedules published annually in BT's RFS. For example, we compared the 2016/17 and 2017/18 restated amounts as published in BT's 2018 RFS for TISBO services. This process gave a set of 5 'pairwise' comparisons. We calculated the overall average annual growth rate and used that as the annual growth in NRCs for WBA services over the charge control period.

in the volume driver. The second, that connection volumes were all considered the same regardless of rental prices:

- ‘The volume of Optical service connections should be included in the volume driver (this would be consistent with the fact that SLG costs are allocated to Optical services later in the model)’; and
- ‘The connections volumes should be weighted by average rental price (i.e. to calculate a revenue base) in order to get an accurate driver of forecast SLG costs. Whilst Ofcom’s approach includes a factor for changing rental prices, this does not account for the change in the connection volume mix by bandwidth over time.’[668]

Our decision

A14.149 Consistent with the January 2020 Consultation we have removed Ethernet provision SLG costs from the 2019/20 base data and then added our forecasts of Ethernet SLG costs back into our total operating cost for each year in the model.

A14.150 For the Statement we have changed the way we forecast Ethernet Provision SLG costs to forecast at a service level rather than at a component level. This results in each service being forecast individually with its own forecast volume (we would expect more connections overall to lead to more connections that incur an SLG payment) and forecast price changes (SLG payments are a function of monthly rental prices[669]) driving the cost.

Sale of scrap copper

Our proposals

A14.151 In the January 2020 Consultation we proposed to make an adjustment to the copper line services to reflect the other operating income BT will receive when they sell any scrap copper.

A14.152 Within the 2018 WLA Statement[670] we explained that historically, BT has received proceeds from the sales of copper recovered from its core network where that copper was no longer required or had been replaced.

A14.153 Within the 2018 WLA Statement we estimated the total net proceeds from the sale of copper to be £240m. This reflected our expectations that BT would be able to extract and sell a proportion of its E-side copper network once the PSTN is switched off sometime after 2025.[671] We proposed not to perform any updated analysis to revise this estimated other operating income as we had not identified any new information which could materially change our previous estimate.

Stakeholder responses

A14.154 No stakeholders commented on our proposed approach to other operating income from scrap copper.

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[668] Openreach response to the January 2020 Consultation, paragraph number 9.162, page 255.
[669] We note that this introduces an endogenous element to our calculations, as forecast rental prices are an output of the model. We ran the model to get an initial output (assuming no rental price change for the SLG forecast) and then used this output to inform the input assumption of rental prices for SLG forecasts in final runs of the model.
[670] 2018 WLA Statement, Annex 22.
[671] 2018 WLA Statement, Annex 22, paragraph A22.57.

Our decision

A14.155 Within this Statement we again make an adjustment to reflect this income BT will receive in the future. We have used the £19m other operating income figure within the 2019/20 RFS[672] as a per annum amount of other operating income and have allocated this to copper line services based on volumes.

Accelerated copper depreciation

A14.156 As explained in Volume 3 Section 2, BT's copper retirement is expected to occur between 2025/26 and 2030/31. This switch off date means that there is a possibility not all capital expenditure spent on copper assets will be able to be recovered through depreciating assets over their useful lives (this is commonly referred to as 'asset stranding').

Our proposals

A14.157 We proposed that it was appropriate and in line with our objectives to give Openreach the opportunity to recover any efficiently incurred costs which may become stranded.

A14.158 To allow BT to fully recover its forward-looking capital expenditure on copper assets, we proposed to accelerate the depreciation and return on capital profiles for all copper assets capitalised from 2017/18 through to the end of the charge control in 2025/26.[673]

A14.159 Under our proposal, we assumed that any additional depreciation that was required to bring the asset's net book value to zero after 2030/31 would be recovered in this charge control period. We referred to the recovery of this additional required depreciation as 'accelerated depreciation'. To avoid over-recovery, we proposed that, to the extent we set charge controls in the future, we would not allow any further recovery of this capital expenditure post 2025/26; we also proposed that the accelerated depreciation be spread across the 5 years of the charge control and all copper line services based on volumes.

Stakeholder comments

A14.160 Openreach was the only stakeholder to respond on our approach to accelerating copper depreciation. It agreed with the principle of accelerating the depreciation however, due to the glide path within the cost forecast model, full recovery of these costs couldn't be achieved:

A14.161 'We agree that Ofcom should accelerate depreciation to account for the fact that Openreach will build FTTP to 3.2m homes in Area 3 by 2025/26 and therefore need to recover the cost of legacy assets used to serve those homes by 2025/26. However, the mechanism Ofcom used to take accelerated depreciation into account in the January consultation modelling would, if applied here to the £130m, actually result in recovery of £88m rather than £130m. This is because the X follows a glide path, but these costs are evenly spread (in present value terms). The shortfall is greatest in year 1, reducing to year 5.'[674]

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[672] 2019/20 BT RFS page 43.
[673] Forecast copper capital expenditure has been calculated using actual copper capital expenditure for 2019/20 from Openreach response to Question 16 FTMR/OR/06052020s.135 forecast forward using our assumed copper efficiency, inflation and the AVEs calculated from BTs LRIC model for components 'D-side copper capital', 'E-side copper capital', Dropwire capital & analogue NTE' and 'NGA E-side copper capital' applied to our forecast copper volumes.
[674] Openreach response to the July 2020 Consultation, paragraph number 4.15, page 24.

Our decision

A14.162 For the counterfactual Area 2 scenario[675], copper lines would not be stranded by 2030/31 as Openreach would continue to rely on its coper network rather than build fibre. Under this scenario no accelerated depreciation or return on capital has been added to this charge control period.

A14.163 For the base case Area 2 scenario and Area 3 RAB modelling, we have decided to accelerate the depreciation and return on capital profiles for all copper assets capitalised from 2017/18 through to the end of the charge control in 2025/26.[676]

A14.164 For Area 2 any additional depreciation[677] that is required to bring the asset's net book value to zero after 2030/31 has been included in this charge control period.[678]

A14.165 For Area 3, for the 3.2m homes where Openreach would have built FTTP to by 2025/26, any additional depreciation[679] that is required to bring the asset's net book value to zero after 2025/26 has been included in this charge control period.[680] For the remaining lines in Area 3, any additional depreciation[681] that is required to bring the asset's net book value to zero after 2030/31 has been included in this charge control period.[682]

A14.166 In the January 2020 Consultation we ensured that the net present value of the costs added were equal to the net present value of the depreciation profile plus the net present value of the return on capital profile were the assets to be recovered over their normal book lives. We have again done this to allow full recovery of the accelerated deprecation brought into the charge control period.

A14.167 However, due to the glide path in prices, allocating the costs over the 5 year period based on volumes did not allow full recovery of the accelerated depreciation. We have corrected the modelling such that the costs in the final year of the charge control are at the correct level to allow full recovery via the glide path.

A14.168 Table A14.5 below shows the accelerated fully allocated costs (FAC) for the relevant stranded assets that have been brought into the charge control period for both Area 2 and Area 3.[683]

Table A14.5: Modelled accelerated FAC brought into the charge control period

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Area 2	£77m	£81m	£86m	£90m	£125m	£459m
Area 3	£64m	£70m	£77m	£84m	£130m	£425m

[675] No further investment in gigabit networks by Openreach and no competition enters the market in Area 2.
[676] Including additional costs for the accelerated depreciation and return on capital will result in lower recovery profiles.
[677] And associated return on capital.
[678] Copper is assumed to become stranded from 2030/31 for lines in Area 2.
[679] And associated return on capital.
[680] Copper is assumed to become stranded from 2025/26 for these lines as FTTP has been built.
[681] And associated return on capital.
[682] For the remaining lines in Area 3, copper is assumed to become stranded from 2030/31.
[683] FAC costs presented in nominal terms and includes both return on capital and depreciation. Return on capital accounts for approximately 30% of the total FAC brought into the charge control.

A14.169 Consistent with the January 2020 Consultation proposal, to avoid over-recovery, to the extent that we set charge controls in future periods, we will not allow any further recovery of this capital expenditure post 2025/26.

MPF and WLR unit costs

Our proposals

A14.170 When we previously set the MPF and 40/10 FTTC charge controls as part of the 2018 WLA Statement we reallocated common costs between copper and fibre services. To maintain consistency, we model a similar reallocation to avoid price instability in Area 3 that may arise from transitioning between two different modelling approaches.[684]

A14.171 We proposed to keep the MPF and WLR rental charges equal to 2021/22 start price level over the charge control period.

Stakeholder comments

A14.172 No stakeholders commented on our proposal to cap MPF and WLR unit costs.

Our decision

A14.173 Consistent with our January 2020 Consultation proposal, we have decided to keep the MPF and WLR rental charges equal to 2021/22 start price level[685][686] over the charge control period.

A14.174 To implement this, we first forecast total cost recovery over the charge control period before any reallocation. This results in MPF and WLR unit costs increasing, mainly driven by expected volume declines in copper services and our accelerated depreciation, as explained above. We then compare this level of total cost recovery with total cost recovery if we were to keep MPF/WLR unit costs at the 2021/22 start price level. It is this difference in total recovery that we reallocate to FTTC rental services.

A14.175 Where accelerated FAC costs have been included, this results in moving c.£800m nominal costs over the 5-year charge control period into FTTC rentals. Where accelerated FAC costs have not been included, this results in moving c.£100m nominal costs over the 5-year charge control period into FTTC rentals. Using this approach leads both to prices remaining stable and to BT being able to recover its efficiently incurred costs.

Revenue forecasting

A14.176 We need to forecast revenues in each year until the end of the review period. These forecasts are based on two inputs: the charges for each service that we expect to be in place during the period; and the volumes of each service.

A14.177 In forecasting revenues, we project revenues to the final year of the review period (2025/26) by applying our volume forecasts for each year of the period to the prices at the beginning of the period (i.e. by assuming prices would remain constant over the period in nominal terms).

[684] In the 2018 WLA Statement, we used two models – a top down copper cost model and a bottom-up FTTC model.
[685] In nominal terms.
[686] Where the unit cost is below the 20/21 start price, we have not altered the unit cost.

We then compare the projected revenues and costs in the final year of the period to work out the value of X.

A14.178 We have explained how we have produced our volume forecasts above. Our approach to forecasting service level prices is described below.

Prices

A14.179 The cost forecast model calculates prices from 2019/20 through to the start of the charge control 2021/22.

A14.180 The published 2019/20 RFS contains volume and revenue data. For this year the price for each relevant service has been calculated by dividing the revenues by the volumes with no further adjustments.

A14.181 In the BCMR 2019 Statement price controls for both the Ethernet less than 1Gbit basket and the Ethernet VHB basket were set for 2019/20 and 2020/21 at CPI-CPI.

A14.182 In the WLA 2018 Statement, prices for FTTC 40/10 rentals were required to reduce by CPI-4% in 2020/21. MPF rentals with SML1 were required to reduce by CPI-2.1% in 2020/21. FTTC Other bandwidth rentals did not have cost-based charge controls.

A14.183 We requested Openreach price list data for all relevant services which showed the price of each individual service from 1 April 2020 for each month through to 1 March 2021.[687][688]

A14.184 In 2018/19 Openreach introduced volume related discounts for its GEA services. We recognise that, for FTTC rentals, we need to use the price including discounts when considering Openreach's potential over or under recoverability as this is the average price Openreach will actually charge.

Headline prices

A14.185 We calculated the 2020/21 leased line prices by calculating the average price for 2020/21 for each service using the Openreach price list data assuming no further price changes in 2020/21, other than those announced up to 23 December 2020.

A14.186 For the headline 2021/22 start prices we use the same price as calculated for 2020/21.

Discounted prices

A14.187 We calculate the 2020/21 FTTC discounted prices by taking the Openreach forecast revenue for 2021 (including discounts) and dividing by the forecast volume for 2021.[689]

[687] Openreach response to Question 4 FTMR/OR/08122020 S.135
[688] The price list data supplied includes all prices notified up to 23 December 2020 by Openreach. Price changes are required to be announced in advance with, 3 months prior notice for price increases and 1-month prior notice for price decreases, required. Given this, it is possible that prices could be reduced in February or March and not be captured within our modelling, however we believe the chances of this occurring are low.
[689] Openreach response to Question 7 FTMR/OR/06022020 S.135

A14.188 For the FTTC discounted 2021/22 start prices, we use the same discounted price as calculated for 2020/21.[690]

Stakeholder responses

A14.189 Only Openreach commented on our proposed methodology for calculating start prices. They stated the following:

A14.190 'The blended price across all bandwidths to be used at the start of the charge control period, including appropriate discounts, is £[✂] per annum. This would have the effect of reducing the expected revenues by £[✂] and the value of X would reduce (i.e. become less negative) by c. [✂]%.'[691]

A14.191 Openreach also commented that we should not be using the calculated headline prices when calculating an X for FTTC rentals in Area 3:

A14.192 'We do not agree that the headline price Ofcom proposed is the correct starting price for the cost-based charge control for FTTC rentals because approximately half of our FTTC rentals in Area 3 already have discounts applied. Any discounts must therefore be applied when calculating the glidepath for the FTTC Area 3 charge control. Were Ofcom not to do this, it would set a control which would be intended to forecast the headline prices to be aligned to cost when actual prices are significantly lower than the headline price, and hence would be well below cost'.[692]

Our decision

A14.193 We are no longer proposing to set a CPI-X cost-based charge control on FTTC rentals in Area 3 using the cost forecast model. As such we no longer calculate 'headline prices' for FTTC services. Consistent with the January 2020 Consultation, when evaluating levels of cost recovery we use the 'discount prices' for FTTC services.

A14.194 We have not changed our methodology for calculating start prices. However, we have updated the start prices for all services within the forecast cost model based on 9 months of actuals and 3 months of forecast data for 2020/21.[693]

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[690] The 2018 WLA Statement required charge control price cuts were made by Openreach on 1 April 2020 resulting in the average price for 2020/21 being the same as the maximum price allowed on the last day of 2020/21 to satisfy compliance.
[691] Openreach confidential response to January 2020 Consultation, paragraph number 9.130.
[692] Openreach confidential response to January 2020 Consultation, paragraph number 9.129.
[693] Openreach response to Question 1 of the s135 notice dated 8 December 2020.

A15. Fibre network cost modelling

A15.1 In Volume 4 Section 1, we set out our approach to charge controlling Wholesale Local Access (WLA) services and leased line access services in Area 2. We consider it appropriate to set a charge control on MPF and GEA FTTC 40/10 at a level to support investment by an entrant deploying a fibre network.

A15.2 In Volume 4 Section 2, we set out our approach to setting charge controls in Area 3 in relation to WLA services and leased line access services including dark fibre. We consider it appropriate to adopt a forecast RAB approach to support BT's deployment of a fibre network where it does not face the potential of material rival competition.

A15.3 In this annex we set out our approach to modelling the costs of deploying a network that offers a range of services over a common underlying infrastructure which is used to inform our decisions in Volume 4. Specifically, we have used our modelling to:

- verify that our charge controls for Area 2 are consistent with our policy objective of promoting investment in gigabit-capable networks by other telecoms providers (i.e. the entrant cost cross-check); and
- help estimate the potential returns for Openreach following an investment in a fibre network for Area 3.[694]

A15.4 We have developed a bottom-up cost model that allows us to understand:

- The costs of deploying a fibre network in different geographic areas and at different scales and network configurations.
- The costs of individual services to residential, SMEs and large businesses provided over a fibre network (and how these vary by geography and scale of the network).
- How the costs of deploying a fibre network vary in response to a decision to reuse existing physical infrastructure (i.e. using Duct and Pole Access (DPA)) as opposed to building physical infrastructure.

A15.5 In this annex, we set out:

- the structure of the model;
- our approach to modelling service volumes;
- our approach to dimensioning and costing the fibre network;
- our approach to verifying the outputs of our modelling; and
- the scenarios and outputs we have used for our entrant cost cross-check.

A15.6 The scenarios and outputs relating to estimates of potential Openreach returns from investing in a fibre network in Area 3 are set out in Annex 16.

A15.7 We published our proposals on our approach to modelling a fibre network in the January 2020 Consultation. In this annex, we respond to comments raised by stakeholders regarding that consultation.

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[694] We use our estimate of the cost to deploy an FTTP network alongside our estimate of the cost of Openreach's copper network (discussed in Annex 14) to understand Openreach's potential returns in Area 3.

Key modelling choices

Bottom-up approach to cost modelling

A15.8 We could model the costs of deploying a fibre network using either a bottom-up approach or a top-down approach to modelling:

- **Bottom-up model** estimates how much network equipment is needed for a forecast level of volumes or traffic based on technical assumptions in relation to network capacity and dimensioning algorithms. It then calculates total network costs using evidence of the capital and operating costs of each piece of equipment.
- **Top-down model** uses total network cost data and allocates these costs to services based on service usage factors. It does not rely on detailed assumptions about how the network is constructed, instead it is based on estimated cost-volume elasticities which determine how network costs change as demand changes.

A15.9 We have taken a bottom-up approach to modelling a fibre network. We consider that a bottom-up approach provides better flexibility to assess the costs across different geographies and for different scales of deployment. Furthermore, it would be difficult to conduct top-down modelling for estimating the costs of a large-scale fibre network since one does not exist yet in the UK, i.e. total network cost information is unavailable.

A15.10 As explained below, we have sought to calibrate our bottom-up cost modelling using information from telecoms providers' business plans, as well as using information relating to actual network rollout where this is available.

Services and network scope

Services in scope

A15.11 We consider that fibre networks will be able to offer a wide range of services, to both residential and business customers. The model has the functionality to dimension a fibre network that can offer the following types of services:

- Fibre to the premises (FTTP) services.
- Leased line services using Ethernet and/or WDM[695] technology.
- Dark fibre services.
- Duct and Poles Access (DPA) services.

A15.12 The model has the flexibility to reflect different business models including mixed deployment (e.g. active leased lines, dark fibre, and FTTP services) as well as FTTP only deployments.[696] The demand assumptions can be changed to replicate different types of deployment in different geographic areas.

A15.13 We have used this flexibility in assessing the costs of deploying an FTTP network in different geographic areas. For Area 2, we consider it unlikely that an entrant operator would offer DPA

[695] Wavelength Division Multiplexing.

[696] We note that the model is unable to estimate the costs of a leased lines only network.

services so for our entrant cost cross-check we assume that no DPA services are offered. For Area 3, we have modelled the costs of deploying an FTTP only network for Openreach, i.e. leased lines and DPA services are assumed to be provided with the existing network.

Network scope

A15.14 We have restricted the span of the modelled network to the following network segments:

- The access segment, which we model for all the services in scope. This is split into three segments; Segment 1 is from the Access Node to the Splitter Node; Segment 2 is from the Splitter Node to the Distribution Point; and Segment 3 is from the Distribution Point to the Customer Premises.
- The segment from the Access Node to an Aggregation Node (i.e. Inter-Exchange fibre connections to deliver dedicated business services using leased lines or dark fibre).

A15.15 In response to our January 2020 Consultation, some stakeholders raised concerns regarding the exclusion of network elements beyond the Aggregation Node.[697] Specifically, they argued that the model fails to account for the non-access costs of serving a town such as the Point of Presence (PoP), backhaul, and system costs.

A15.16 Firstly, we note that the model does include the costs associated with Inter-Exchange fibre connections which will at least partly include PoP and backhaul costs. Furthermore, we consider that modelling the costs beyond the Aggregation Node is not needed to achieve the goals set out in paragraph A15.3 above.

A15.17 For the entrant cost cross-check, we are using the model outputs to evaluate whether our price controls are consistent with incentivising new entry build plans in the access network. These price controls refer to Openreach's wholesale access services, for which access seekers need to invest in their own backhaul and core networks in order to use them. Therefore, in this case we are interested in the costs faced by an entrant to build its own access network, as opposed to using Openreach's, so consider it appropriate to exclude any costs beyond the Aggregation Node.

A15.18 In addition, we do not consider that modelling the costs beyond the Aggregation Node is relevant for assessing potential returns that Openreach could face following an investment in a fibre network in Area 3. In this case, our aim is to model the costs of extending Openreach's fibre network from the fibre exchange to the premises and does not involve incurring costs in the core network.

Network coverage

A15.19 The model offers the flexibility of estimating the costs of deploying a fibre network with national or subnational footprints (i.e. particular geographic areas only).

A15.20 We have used postcode sectors as the geographic unit for our cost modelling. This aligns with our approach to assessing competition in geographic areas as set out in Annex 4. We consider

[697] INCA response to January 2020 Consultation, paragraph 172; and Axione response to January 2020 Consultation, paragraph.8.3.

that this provides sufficient geographic granularity whilst avoiding too much complexity to our cost modelling.

Scorched node/Scorched earth approach

A15.21 Given we are interested in understanding the costs of deploying a fibre network at different scales and for different footprints, our bottom-up model can support both a scorched node and a scorched earth approach.

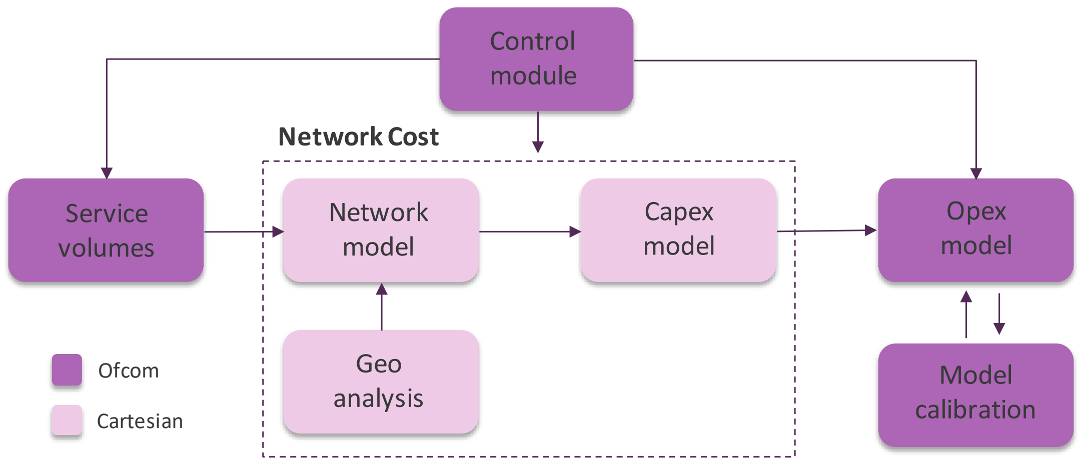
- Under the scorched node approach the fibre network is deployed assuming the location of existing Access Nodes. This has the advantage of being more grounded in reality; recognising that network operators are likely to place importance on the topology of their existing networks when deciding how to deploy a new fibre network.
- Under a scorched earth approach the network is dimensioned so that the location of the Access Node minimises the costs of deployment. A scorched earth approach may be more appropriate when modelling the costs of deploying a fibre network for a new entrant which starts with a network of limited scale or has no network at all.

A15.22 We have used scorched node for our modelling of Openreach fibre investments in Area 3 and scorched earth for our entrant cost cross-check in Area 2.

Model structure

A15.23 The fibre network model comprises four modules, three of which have been developed by Ofcom (‘Control’, 'Service Volumes' and 'Opex'), with the other one ('Network Cost') being developed by Cartesian. The module structure for the model is shown in the figure below.

Figure A15.1: Module structure of the fibre network model



Source: Ofcom.

A15.24 Each module is responsible for the following:

- **Control** – this consolidates the key assumptions that are used across all the other modules. It is used to calculate the final outputs under different scenarios and assess the sensitivity of our modelled assumptions.
- **Service volumes** – computes the speed of fibre deployment to end customers by geographic area (i.e. premises passed) and calculates the associated volumes of each

relevant fibre service (e.g. number of rentals, connections, and ancillary services) in each modelled year.

- **Network Cost** – combines the service volumes with network capacity and coverage parameters to dimension the fibre network. It then calculates the capital expenditure required to build the dimensioned fibre network.
- **Network Opex** – uses the outputs from the Network Cost module (along with the Volumes module) to calculate the ongoing costs of running the modelled network.

A15.25 We set out more information about the workings of each module below. Further details about the Network Cost module, built by Cartesian, can be found in the Cartesian report (Annex 26).

Service volume forecasts

A15.26 Below we set out our approach to:

- creating different deployment scenarios;
- creating different take-up profiles;
- modelling the demand for passive services; and
- consolidating some services under a common label.

A15.27 When determining the deployment scenario and take-up profile used to assess the cost of fibre deployment by Openreach in Area 3, we have ensured that the fibre volumes are consistent with the copper volumes produced by our top-down modelling.

Deployment scenarios

A15.28 Service volumes are a function of network deployment and take-up. In our approach to forecasting service volumes, we first make assumptions about the scale of network deployment, i.e. how many premises are reached in the long run, and the speed of network deployment. This allows us to determine the coverage of the network in each year. We then apply a take-up profile to the modelled deployment to determine the number of connections.

FTTP

A15.29 We are using the model to cross-check our approach to charge controlling WLA services in Area 2 and the costs of deploying a fibre network in Area 3.

A15.30 We are interested in understanding the costs of deploying a fibre network by both an incumbent operator and by an entrant operator since we expect deployment may vary by type of operator (and by geographic market).[698]

A15.31 The model can sequence the deployment of a network in two ways:

- by lowest cost to highest cost exchange area; and
- by lowest cost to highest cost postcode sector.

[698] Based on the evidence gathered, we consider it likely that an incumbent operator can roll-out faster and achieve greater coverage than an entrant operator.

A15.32 Our preferred approach is to sequence by exchange area rather than postcode sector which results in a flatter cost profile as the scale of deployment increases. This is discussed further below and in the Cartesian report.

Leased Lines

A15.33 We model leased lines deployment as a proportion of total fibre deployment, where the proportion can vary by geographic market (i.e. Area 2 and Area 3). We have considered the data provided by network operators based on their business plans and find that the number of leased lines as a proportion of fibre deployment quickly reaches a stable ratio or stays quite flat throughout the deployment. Therefore, we have not varied this assumption over time.

Take-up profiles

FTTP

A15.34 Based on our examination of telecoms providers' business plans, we consider it appropriate to assume that the long-run take-up of FTTP is reached within ten years for a given deployment.[699]

A15.35 We expect take-up to vary by geographic area, for example, due to the differing levels of network competition. For example, we expect the long-run take-up for the average entrant to be 33% in Area 2, i.e. equal share for three competing networks, and 90% for Openreach in Area 3, i.e. full market share but accounting for mobile-only households.

Leased Lines

A15.36 As mentioned above, we model total demand for leased lines as a proportion of FTTP coverage. The total demand for leased lines is then broken down by:

- Bandwidth – ethernet electronic costs may vary depending on the bandwidth required, specifically, 100Mbit/s, 1Gbit/s, and 10Gbit/s bandwidths. For optical services, we do not model the breakdown by bandwidth given that the network model assumes the same wavelength card for all optical services; [700]
- Circuit type – we model the proportion of leased lines that are local access (LA), inter-exchange, and non-LA circuits with two access tails. This then determines the total number of access tails and inter-exchange circuits; and
- Dark fibre.

Network dimensioning and costing

Network dimensioning

A15.37 We have commissioned Cartesian to build the model module that (i) dimensions the size of the fibre network (based on our service volume forecasts and network rollout assumptions); and

[699] In other words, if the network deploys to one million homes in Year 1 then the proportion of those homes that purchase a service will not change after Year 10. We note that take-up can be modelled to stabilise sooner, e.g. by Year 5.
[700] From a cost modelling perspective, this means that the bandwidth mix for optical services is not important.

(ii) estimates the capex for the dimensioned network. Further details of our approach are set out in the Cartesian Report (Annex 26).

A15.38 We dimension the network as follows:

- For FTTP, to size the network based on coverage first and then capacity.
- For leased lines, to size the network based on capacity alone. The underlying assumption is that the network is deployed to reach FTTP customers first and then, as demand for FTTP and leased lines grows, additional network elements are added to support this.

FTTP

A15.39 Our model can sequence network deployment in two ways.

A15.40 Firstly, the model can sequence network deployment by ranking the postcode sectors from lowest to highest cost to deploy. It then uses geospatial analysis to calculate the number of metres of fibre cable, splitter nodes and aggregation nodes required to pass all premises within each postcode sector. However, we consider this approach to sequencing deployment to be too simplistic and unlikely to reflect how networks are deployed in the real world.

A15.41 Alternatively, the model can sequence network by ranking whole exchange areas from lowest to highest cost to deploy (i.e. an exchange area approach). More specifically, the model includes a ranking of groups of postcode sectors by exchange area and assumes that the network is deployed from the lowest to most expensive exchange area. This is aimed to better reflect how an operator might deploy its network by sequencing deployment across postcode sectors that are localised and thereby avoid the sequencing of deployment by postcode sectors that are potentially scattered in different parts of the country.

A15.42 In response to our January 2020 Consultation, some stakeholders raised concerns that the exchange area approach does not reflect reality but agreed that it is preferred to the postcode sector sequencing approach.[701] Specifically, they raised concerns that the exchange area approach still results in significant variation in costs for deployments less than five million premises.

A15.43 We recognise that the exchange area approach may not reflect the exact way in which an entrant would deploy its network but consider that it provides a good approximation. We do not consider the variation in costs for smaller scale deployments distorts our entrant cost cross-check as our calibration exercise shows significant variation in costs for different deployments by entrants.

A15.44 We have used the exchange area sequencing approach to inform both our entrant cost cross-check and Openreach’s fibre costs on Area 3.

A15.45 Network elements such as fibre and duct can span across multiple postcode sectors. For example, to connect a customer to an Access Node, a network operator may need to deploy duct and fibre across more than one postcode sector.

[701] Axione response to January 2020 Consultation, paragraph 8.6; INCA response to January 2020 Consultation, paragraph 176.

A15.46 The model has been developed to provide the functionality to estimate the costs for any possible coverage scenario, i.e. coverage scenarios are not predefined in the model. Such flexibility comes at a cost as there is the risk that network elements which span across multiple postcode sectors are counted more than once when selecting a broader coverage scenario.

A15.47 To deal with this issue, the model dimensions the network across the whole of UK first and then apportions the network infrastructure elements to each postcode sector based on the relative length of the underlying infrastructure. Although this reduces the accuracy of our cost estimates for small geographic areas, it avoids the problem of double counting costs when assessing the costs for broader geographic areas. We consider this to be an acceptable trade-off given the primary aim of the model is to assess relatively broad geographic deployments for an entrant in Area 2 or Openreach in Area 3.

Leased Lines

A15.48 We model network elements for supplying leased lines (including dark fibre) as an overlay to the FTTP network, i.e. leased lines are incremental to FTTP deployment. While FTTP network elements are mainly driven by coverage, network elements which are specific to leased lines tend to be driven by take-up.

A15.49 In determining how much network capacity to build in the initial phase of deployment, a network operator is likely to consider the potential demand it could face for both FTTP and leased line services. This is because building in potential demand into an initial deployment can avoid expensive re-engineering works in the future (i.e. digging and fibre installation) at the point when leased lines are taken-up. As such, there is a risk that our approach may overstate the costs of deployment over time.

A15.50 However, we have not included the demand for leased lines in our entrant cost cross-check, which addresses this potential overstatement of costs. We consider that this means our cost estimate for an entrant operator is overstated as leased lines could help in the recovery of common costs. This reinforces our conclusion that the entrant cost cross-check is not failed.

Determining the amount of new physical infrastructure

A15.51 Once the total amount of fibre cables needed to satisfy the demand for each service modelled is calculated, the model calculates the amount of physical infrastructure required to carry these fibre cables. Physical infrastructure, such as ducts and poles, is a key input in the building of a fibre network.

A15.52 An operator deploying a fibre network can either (i) reuse existing physical infrastructure; (ii) build new physical infrastructure; or (iii) a combination of both. We consider that an operator planning to build a fibre network would seek to reuse as much physical infrastructure as possible (given the higher costs of building new physical infrastructure).

A15.53 The model has the flexibility to change the balance of new physical infrastructure versus reuse of physical infrastructure by varying the assumptions around spare existing capacity. These assumptions are applied at the Exchange Geotype level.

A15.54 To work out the amount of new infrastructure, the model compares the amount of physical infrastructure required against the capacity assumed to be available in existing infrastructure.

This is done at a postcode sector level. If enough capacity is found to be available, the model assumes no new physical infrastructure is required. If there is not enough capacity, the model assumes new physical infrastructure will need to be built.

A15.55 Where the modelled network reuses existing physical infrastructure, we include the costs of renting the space used in the physical infrastructure as an operating cost at the level of Openreach's Physical Infrastructure Access (PIA) charges.

A15.56 In response to our January 2020 Consultation, some stakeholders raised concerns around the uncertainty and significance of our duct reusage assumptions.[702] Specifically, they suggested that our assumptions should be reviewed and refined using the latest data from operators using PIA.

A15.57 To inform the level of reusage in our analysis we have drawn on the evidence that we have gathered relating to the potential reuse of existing physical infrastructure. The reuse of infrastructure is also a key parameter that is adjusted as part of our calibration process. We have made the following reusage assumptions for the modelled network (averaged across all network segments, including the final drop):

- For the entrant cost cross-check, in our base case we assume the reuse of physical infrastructure is around 60% which is supported by the information that we have received from entrant operators.
- We assume that BT can, on average, reuse around 75% of its physical infrastructure in Area 3 which is based on our calibration of capex per home passed and home connected using Openreach data.

Network costing

Capex

A15.58 Network capex is calculated in the Network Cost model. Details on the approach taken are set out in the Cartesian Report (Annex 26).

Opex

A15.59 Network opex is calculated in the Network Opex model. We consider that the following opex costs are incurred by the modelled network:

- **Repair costs** – costs of repairing network faults arising at both the passive and active layers of the network;
- **Maintenance costs** – costs associated with maintenance activities across the network, including those associated with the monitoring of network performance;
- **Power and accommodation** – costs in relation to the power and physical space taken by the equipment located at the network node/exchange;
- **General Management** – corporate overheads such as management, finance and legal costs;
- **PIA payments** – costs associated with the use of Openreach's PIA services;

[702] Axione response to January 2020 Consultation, paragraph 8.14; INCA response to January 2020 Consultation, paragraph 178.

- **Systems and per order processing costs** – costs associated with processing and recording new orders;
- **Provisions costs** – costs associated with the provisioning of new services not captured in the capex model; and
- **Service Level Guarantee (SLG) costs** – costs faced by the network provider when it fails its service level guarantees.

A15.60 For those costs for which a clear cost driver[703] could not be identified, we have modelled these as a percentage of the network's Gross Replacement Cost (GRC), i.e. the cumulative network investment in a given year. These costs include repairs, maintenance, power and general management costs. We consider this approach is appropriate given that we expect these costs to be proportionate to the size of the network, which can be proxied by the GRC.

A15.61 For operating costs with a clear driver, e.g. SLG costs, we have combined those drivers with modelled unit costs to calculate the total operating costs for those network elements. We set out these drivers and unit costs in detail below.

A15.62 Table A15.1 sets out the drivers and unit costs we have used to model each opex cost element identified in the list above.

Table A15.1: Opex cost elements, drivers and unit costs (£ in 2019/20)

Opex cost element	Driver	Unit cost (2019/20)	
		FTTP	Leased Lines
SLG costs	New connections	£7	£10
	Line rentals	£0.50	£5
System and processing costs	Software configuration volumes	£3	
PIA Duct – Seg1	Metres of duct reused (seg 1)	£0.25	
PIA Duct – Seg 2	Metres of duct reused (seg 2)	£0.39	
PIA Duct – Seg 3	Metres of duct reused (seg 3)	£0.79	
PIA Poles	Metres of poles reused	£0.13	
Cumulo	Line rentals	£9.89	
Other opex: repair, maintenance, power and general management	% of GRC	£1	

Source: Ofcom estimates.

A15.63 To estimate PIA payments for the modelled network we have used the following unit costs:

[703] A cost driver is something which can be easily observed and quantified, e.g. metres of fibre cable, and can then be directly converted into a cost, e.g. £ per metre multiplied by total metres of fibre cable.

- **PIA Duct:** we use Openreach's PIA rental charges for different duct types. For Segment 1, we use the two bore PIA rental charge for multi-bore duct. For Segment 2, we use the PIA rental charge for single-bore duct. For Segment 3, we use the PIA rental charge for lead-in duct. For other costs associated with the use of PIA (e.g. facility hosting, ancillary PIA charges), we load these costs into our per metre cost assumptions by applying a 40% uplift based on the FAC estimates in our PIA model.
- **PIA Poles:** we use Openreach's PIA rental charges for single and multi-user pole attachments[704] and divide this by 0.90 (i.e. 11% uplift) to account for pole top equipment and cable up a pole charges. We then divide this unit cost by 50 metres to convert to a per metre cost.

A15.64 In response to our January 2020 Consultation, Axione argued that the lack of detailed bottom-up analysis for operating costs undermines the credibility of our cost estimates and considered the cost recovery profile for opex to be unrealistic.[705] In response to our July 2020 Consultation, TalkTalk argued that cost savings for FTTP should be greater than for FTTC and suggested a 5% efficiency for opex.[706]

A15.65 We have verified the credibility of our simplified approach to modelling opex by comparing our model outputs against the information we have received from operators in relation to their business plans, cost modelling and forecasts. We believe that our approach to modelling opex results in levels that are broadly consistent with the cost evidence provided by operators.

A15.66 As part of our calibration exercise, we have adjusted some of the parameters in our opex modelling to better align the outputs of our model with operators' data. Our base case assumption for opex costs modelled as a percentage of GRC is 3% for our entrant cost cross-check and 5% for Openreach's fibre deployment. We have allowed this percentage to be higher for the initial years of rollout in line with operators' data.

A15.67 In our top-down cost modelling analysis set out in Annex 14 we have assumed an efficiency factor in the WLA market of 3% for capex and 3.5% for opex. These assumptions relate to Openreach's existing copper and fibre network, which we consider to be a good starting point for our modelling assumption. As part of our calibration exercise, we have adjusted the opex trend (resulting in a greater decline in opex over time) to align the opex per line in the fibre cost model with the opex per line found in business plans from network operators.

A15.68 Our base case assumption for our modelled FTTP network is an efficiency factor of 1.5% for capex cost elements such as fibre, duct, passive components and civils[707], and 3% for opex cost elements such as SLG, system and processing costs. These efficiency factors are captured within the model as MEA cost trends. For opex cost elements modelled as a percentage of GRC, we have not applied an efficiency factor but note that the change to the assumed opex cost trend results in these costs reducing by 1% per annum.[708]

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[704] We calculate a blended charge based on the national profile of single and multi-user pole attachments.
[705] Axione response to January 2020 Consultation, paragraph 5.17.
[706] TalkTalk response to July 2020 Consultation, paragraphs 3.62 to 3.64.
[707] We have not applied an efficiency factor to capex related to network equipment as efficiencies are already captured in the price trends assumed for these network assets.
[708] We note that the GRC measure captures efficiencies applied to capex elements which then indirectly gets applied to 'other opex'.

Outputs and cross-checks

A15.69 Bottom-up cost models are good for assessing how costs change as service volumes change, but they necessarily entail simplifications. We therefore consider that it is important to verify that the outputs of our cost modelling are reflective of reality. We have sought to validate the assumptions in our cost model by comparing our model outputs against the information we have received from operators in connection with their business plans, cost modelling and forecasts.

A15.70 We have considered the following cost metrics for our cost verification exercise:

- Capex per home passed;
- Final drop cost per connection;
- Opex as a % of cumulative capex; and
- Opex per line.

A15.71 We conducted our analysis in two stages. First, we verified the outputs of our cost modelling for a national deployment, by comparing our model outputs against the information we received from Openreach. We then went on to do the same for a smaller scale deployment in Area 2, more akin to the deployment of an entrant operator.

A15.72 As a result of our cross-check with Openreach figures, we have reduced the reusage assumption for underground duct at the final drop, increased the modelled time to install, and increased SLG costs for connections. These changes have the combined impact of increasing the final drop costs in 2020/21 from £267 to £396 for underground deployment and increase overhead final drop costs from £150 to £213. Furthermore, the most recent BT business plans show a greater forecast decline (post 2025) in opex per line than our fibre cost model. Therefore, we have used the low scenario for opex cost trends for the RAB model.

A15.73 The updated business plans from alternative network providers does not suggest that any further calibration is needed for the entrant scenario. However, we have adjusted our deployment assumptions for the low, high, and base case scenarios.

A15.74 Tables A15.2 and A15.3 below compare the cost metrics of our calibrated model against the cost evidence received from operators. Table A15.2 shows the comparison for a national FTTP deployment, while Table A15.3 shows it for a subnational FTTP deployment. Note that we have excluded PIA payments from the opex cost metrics as operators typically assume different levels of PIA usage.

Table A15.2: Cost verification for national deployment (£ in 2025, nominal)

	Ofcom	Openreach
Capex per home passed	£396	[✄]
Final drop cost per connection	£284	£[✄] (£250 - £350)
Opex as % of cum. capex	5%	[✄]% (around 5%)

Opex per line excluding PIA payments (average between 2025 and 2030)	£46	£[✂] (£40 - £50)

Source: Ofcom based on information provided by Openreach in response to our s.135 information notice. Data regarding Openreach FTTP cost modelling relate to Openreach's Chief Engineer's Model, FTTP business plan, and final drop estimates.

Table A15.3: Cost verification for a sub-national deployment

	Ofcom (2025)	Cityfibre	Hyperoptic	Comparator range
Homes passed	5m	[✂]	[✂]	2m to 5m
Capex per home passed	£297	£[✂]	£[✂]	£[✂] (£250 - £350)
Final drop cost per connection	£256	£[✂]	N/A	£[✂] (£200 or more)
Opex as % of cum. capex	5%	[✂]%	[✂]%	[✂]%
Opex per line excluding PIA payments (average between 2025 and 2030)	£49	£[✂]	£[✂]	£[✂] (£25 - £75)

Source: Ofcom based on information provided by Cityfibre and Hyperoptic in response to our s.135 information notices. PIA payments were removed from opex metrics.

A15.75 We consider that the outputs of our calibrated model are reasonably in line with the cost information received from operators. Therefore, we consider that our cost model is well calibrated.

Entrant cost cross-check

A15.76 In this sub-section, we provide outputs from the Fibre cost model for the entrant cost cross-check described in Volume 4 Section 1.

A15.77 We set out our approach to converting the modelled costs to a unit basis first, followed by the key assumptions we have made under our base case scenario. We then outline the assumptions we have adjusted to derive our cost range estimate.

Approach to cost recovery

A15.78 To convert our modelled capex and opex to a service unit cost basis we have calculated a flat annuity over the modelled period. In other words, we have calculated the monthly rental charge that an entrant would have to set in order to recover its incurred costs.

A15.79 We have excluded some costs from the annuity calculation. This is to mimic the price structure that we currently observe in the market whereby operators recover a portion of their costs upfront in the form of a one-off connection charge. To this end, we have assumed that £27 of the final drop capex is recovered through connection charges. This is consistent with our RAB model for Area 3. All other FTTP costs are assumed to be recovered from rental charges.

Base case scenario

A15.80 In relation to base case scenario assumptions, INCA and Axione argued that we had understated the WACC.

A15.81 Axione stated that the Other UK Telecoms (OUKT) WACC did not provide an adequate premium over the WACC for copper and FTTC services to fully reflect the risks that Openreach would face. Axione noted that we used the same WACC for the entrant cost cross-check scenarios as for the Openreach-only scenarios. In its opinion as new entrants would start with zero customers and would face the risks and uncertainties of building market share, the risk profile was higher for altnet investment than for Openreach and a further premium should be applied to the WACC. Axione also stated that the use of reduced asset lives in the REO scenarios (which in its analysis was equivalent to an increase of 20 basis points on the WACC) did not compensate new entrants for the extra risks faced.[709]

A15.82 INCA also agreed that using reduced asset lives in the REO scenarios was not enough to compensate [new entrants] for understating the WACC. INCA argued that there were strong reasons to allow for a larger risk premium for new entrants investing in FTTP networks and that a significantly higher WACC should be used to reflect this.[710]

A15.83 We make the following assumptions in relation to the entrant's network under our base case scenario:

- **Scale of deployment:** we assume the entrant rolls out to 5 million premises by 2025/26.
- **Take-up:** we assume that the entrant achieves a take-up of 33% by year 5 of the deployment (i.e. the market is evenly split amongst three rival networks).
- **Infrastructure reusage:** we assume that 43% of the entrant's network (excluding final drop) is built using Openreach's physical infrastructure (i.e. PIA). We consider that this assumption is conservative given that Operators' FTTP business plans and forecasts suggest that this percentage could be as high as 70%.
- **WACC:** We assume that the entrant's cost of capital for FTTP will be similar to Openreach. This is because we consider that an entrant is unlikely to face a different systematic risk profile to Openreach. The risk differences suggested by stakeholders relate to non-systematic risks (such as take-up and competition risks) and we have captured these in other assumptions. We use a pre-tax nominal OUKT WACC of 7.8% in our FTTP modelling in this review.[711] We recognise that an entrant operator may be required to pay its investment back sooner than an incumbent operator would. To capture this, we have assumed a shorter asset life of 7 years for electronic equipment and 10 years for passive equipment

[709] Axione response to January 2020 Consultation, paragraphs 8.20 to 8.24

[710] INCA response to January 2020 Consultation, paragraphs 145 to 146.

[711] As set out in Annex 21, this estimate covers a range of services and we recognise that FTTP could have a higher asset beta and WACC than the 'average risk' activity captured within OUKT. However, identifying an explicit beta for FTTP is difficult because of the absence of listed pure play FTTP comparator companies. Any separate modelling to derive an explicit beta for FTTP requires significant assumptions. Therefore, for the purposes of this review, we have retained FTTP within OUKT (benchmarked to BT and other telecoms companies).

(compared to 10 and 20 years, respectively, for Openreach). This is equivalent to increasing the WACC to 8.3% (i.e. by 50bp).

- **Network opex and overheads:** to model general network opex (such as repairs, power and maintenance) as well as business overheads we assume these costs are equivalent to 3% of the Gross Replacement Cost (GRC) in each year, once the network rollout is complete.[712]

Low and High cost scenarios

A15.84 To derive our range of cost estimates we have adjusted the assumptions in our base case scenario as follows:

- **Scale of deployment:** we assume the entrant rolls out to two million premises by 2025/26 in our low case and eight million by 2028/29 in our high case, compared to five million by 2025/26 in our base case.
- **Take-up:** we have assumed 40% take-up in our low case scenario and 30% take-up in our high case scenario, compared to the 33% take-up in our base case scenario.
- **Infrastructure reusage:** for our low scenario, we have used higher reusage assumptions for physical infrastructure in Segments 1 and 2. These assumptions apply at the Exchange Geotype level. We have used the same assumptions in our high case scenario as in our base case scenario.[713]

A15.85 Based on the assumptions above we estimate that the entrant operator would have to charge between £9.53 and £13.67 per month (in 2020/21 prices) in order to recover its efficiently incurred costs over the modelled period.

[712] We allow for a higher percentage in the initial years of rollout as suggested by the information we received from operators.
[713] Given the different coverage in our base case and high cost scenarios, the percentage of physical infrastructure (excluding final drop) that is reused varies across our base case and high scenario; average reusage is 43% and 47% respectively. For the low-cost scenario, average reusage is 48%.

A16. Our modelling and assessment of the BT Commitment

A16.1 In Volume 4 Section 2, we set out BT's Commitment to commercially deploy to 3.2m premises and our decision to set a cost-based control that we describe as a "forecast RAB approach".

A16.2 The following charge controls will apply under the forecast RAB approach:

- Pre-copper retirement, charge controls will be set on MPF and FTTC 40/10 rentals at CPI-0%; and there will be pricing flexibility on Openreach's FTTC services at bandwidths above 40/10 and fibre services (FTTP and G.fast).[714] We refer to these controls collectively as "indexed pricing".

A16.3 In this annex, we set out the modelling we have undertaken to assess cost recovery under indexed pricing, given the BT Commitment to commercially deploy to 3.2m premises and our intention to set a cost-based control.

July 2020 Consultation

A16.4 In the July 2020 Consultation, we assessed the BT Commitment to commercially deploy fibre to 3.2m premises in Area 3. We estimated the shortfall in Openreach's investment case for its planned commercial fibre deployment to 3.2m premises in Area 3 ("the fibre shortfall"). To calculate the fibre shortfall, we considered Openreach's incremental costs and revenues from building a fibre network to 3.2m premises, compared against the costs and revenues from continuing to operate the copper network.

A16.5 Based on our analysis, we estimated that:

- In deploying FTTP to 3.2m premises in Area 3, Openreach would face a fibre shortfall ranging between £886m and £1,502m on a present value basis over 20 years.
- The additional revenues from indexed pricing during the charge control period 2021-26 will be around £313m under our central cost scenario (on a present value basis over the 5 years).

A16.6 We considered that adopting the same charge controls in Area 3 as in Area 2 (charge controls of CPI-0% on MPF and FTTC 40/10 rentals, with pricing freedom for higher bandwidth services) sat within a reasonable range of cost recovery profiles that provided an expectation of cost recovery for a planned FTTP build to 3.2m premises.

Modelling for this Statement

A16.7 Since the July 2020 Consultation, we have gathered up-to-date information on costs and revenues and have carried out further analysis in light of stakeholder responses.

[714] Where 40/10 FTTC services are not available, 40/10 FTTP will be charge controlled at a premium to the 40/10 FTTC charge control level. See Volume 3, Section 2 for further details on copper retirement.

A16.8 Our updated modelling estimates cost recovery over the 2021-2026 review period, and what this might mean for cost recovery over the lifetime of the FTTP and copper networks. In summary, our analysis indicates that:

- With a FTTP network covering 7m premises in Area 3 (with 3.2m premises covered by 2026), Openreach's total costs across FTTP and copper services will range between £12.7bn and £15.6bn on a present value basis over 20 years.
- During the period 2021-26, indexed pricing on copper services (through setting a CPI-0% cap on MPF and FTTC 40/10 services) will allow cost recovery of £5.5bn across FTTP and copper services on a present value basis over this 5-year period.[715]
- This is likely to be consistent with cost recovery over the lifetime of the networks, with our indicative modelling suggesting total cost recovery of between £13.6bn and £14.4bn on a present value basis over 20 years where prices remain flat in nominal terms post-2026, or between £14.2bn and £15.0bn on a present value basis over 20 years where prices continue to be indexed during 2026-2031 then remain flat in nominal terms post-2031.

Stakeholder responses

A16.9 CityFibre considered that Ofcom's proposal to impose a CPI-0% price cap in Area 3 on the 40/10 variant was reasonable in terms of ensuring that BT is able to recover its costs, while simultaneously managing the risk that BT may over-recover (by being able to adjust the price cap beyond the initial 5-year period if necessary).[716]

A16.10 BT and Openreach agreed with the modelling approach in principle but raised a number of concerns with the modelling of the fibre shortfall and the revenue from indexing prices.[717] In particular, Openreach listed the following points where it disagreed with Ofcom's assessment:[718]

- **FTTP build and connection costs:** Openreach agreed that Ofcom's stated approach of estimating the average build and connection costs for the 7m cheapest premises in Area 3 and scaling this down for a 3.2m build was reasonable as it reflected its planned commercial build programme for Area 3 which will cover a mixture of postcodes with low and high build costs. However, it noted that Ofcom's modelling erroneously estimated costs on the basis of the cheapest 3.2m premises. Openreach noted that the estimated build costs for Area 3 from its business case (£[✂] per home passed) is within Ofcom's (corrected) range: £370-£490 (mid-point of £430).
- **Connection costs:** Openreach stated that the average FTTP connection cost per premises used in the model was erroneously low at £250, when compared to the £280 per premises stated in the July 2020 Consultation document. Openreach stated that even a £280 connection cost is vastly understated, as Openreach's business case estimate is £[✂] per connection.

[715] Split between £5.0bn from copper services and £0.5bn from FTTP services.
[716] CityFibre response to July 2020 Consultation, paragraphs 3.29-3.36.
[717] BT response to July 2020 Consultation, paragraphs 3.1-3.8.
[718] Openreach response to July 2020 Consultation, paragraphs 4.9-4.12.

- **The X in the CPI model:** Openreach agreed that it was appropriate to use discounted prices to estimate the proposed X for FTTC and the cost-based baseline for the cashflow model, but stated that correcting for errors in the CPI-X model would increase the X to -3.75% (from -2.75%).
- **Accelerated depreciation of copper costs:** Openreach agreed in principle that depreciation for copper assets stranded by the 3.2m FTTP build should be brought forward to the charge control period. Noting that this accelerated depreciation was not included in the estimate of costs used, Openreach estimated that correcting for this would reduce the X by an additional 1.00% over the next 5 years.
- **Line loss:** Openreach argued that it is unrealistic to assume that it will retain all lines in Area 3 over the next 20 years, given that there will be a competitive bid process for public subsidy areas in Area 3 and altnets announced plans to "overbuild" gigabit capable networks in parts of Area 3. In addition, Openreach said that it anticipated material line loss due to multi-line decline.
- **Inconsistent FTTP volumes:** Openreach argued that there was an inconsistency between the FTTP build volumes assumed by Ofcom in its estimate of the shortfall and those used to estimate the additional revenue resulting from indexed pricing in the Cash Flow model. In particular, the build and connection costs were estimated in the shortfall model on the basis of 3.2m homes passed with fibre, whereas the additional revenue from indexing was estimated on the basis of 4.8m homes passed with FTTP (with the 1.6m additional homes intended to capture publicly funded build).

A16.11 Openreach estimated that these errors understate the NPV of the shortfall by c.£300m and overstate the NPV of additional revenue from indexing by c.£450m and argued that it would therefore be necessary to index existing WLA anchor prices to CPI for two control periods from 2021 to give an expectation of cost recovery over 20 years.[719]

A16.12 Openreach also raised various points regarding the forecasting of Area 3 copper services in the cost forecast model and Area 3 FTTP costs in the fibre model. These are relevant to our modelling of the Area 3 BT Commitment, and we set out our detailed assessment of these points in Annex 14 on the cost forecast model and Annex 15 on the fibre model.

A16.13 BT and Openreach commented that the use of its higher estimate of an FTTP WACC of [✂]% would increase the difference between the fibre shortfall and the revenue uplift from indexed pricing by a further £[✂]m. We set out our detailed assessment of the level of WACC in Annexes 20 and 21.

A16.14 Axione did not object to Ofcom's modelling approach in principle but considered that estimating the exact level of investment to compensate for the additional revenues to BT from the CPI-0% charge control is highly uncertain.[720] Axione noted that Ofcom's modelling calculated the fibre shortfall on the basis of the least expensive 3.2m lines in Area 3, as opposed to the stated approach of basing on the least expensive 7m of the 8.8m lines and scaling down to 3.2m on a pro-rata basis.[721]

[719] Openreach response to July 2020 Consultation, paragraphs 4.2-4.5, 4.10-4.12.
[720] Axione response to July 2020 Consultation, paragraphs 3.21-3.22.
[721] Axione response to July 2020 Consultation, paragraphs 3.25-3.28.

A16.15 UKCTA and Vodafone said that Ofcom had used a number of high level modelling assumptions which appeared to pragmatically favour a result of lower overall returns, citing Ofcom's use of an 'average cost per premises' figure in the excessive returns calculation instead of the most economically viable 3.2m premises as an example of this.[722][723]

A16.16 Vodafone also commissioned Frontier Economics to review Ofcom's proposal. Frontier Economics argued that Openreach's assertion that it needs excess profits from existing copper customers to subsidise its fibre build costs to roll out to 3.2 million homes, i.e. that there is a 'fibre shortfall', is neither logical nor supported by empirical evidence.[724]

A16.17 TalkTalk raised concerns about the costs to consumers of Ofcom's proposals with the commitment to subsidise Openreach by around £1.2bn over the next 20 years by allowing Openreach to set wholesale prices in excess of its costs.[725]

A16.18 TalkTalk also said that Ofcom overestimated the subsidy needed for BT's proposed rollout to 3.2m premises in Area 3 and that a subsidy of £370m would be sufficient to cover any losses and incentivise investment due to the following reasons:

- **Inclusion of premises already built to:** TalkTalk argued that no subsidy should be paid for the 0.9m premises that BT has already built or will anyway build to absent subsidy (due to it being commercially profitable).[726]
- **FTTP Build costs:** TalkTalk noted that Ofcom's estimate of the FTTP build capex assumes Openreach will build in many high cost exchanges rather than follow its natural commercial incentive to cherry pick the lowest cost exchanges, which are both more profitable and more likely to see altnet entry. TalkTalk argued that BT was more likely to naturally focus on building to premises in the 0-1 million banding costing £270 on average, rather than premises in the 4-5 million band that cost £470.[727]
- **Volumes/take-up:** TalkTalk argued that Ofcom's assumption of BT reaching 90% FTTP take-up after 8 years was too conservative. In particular, it argued that [✂].[728]
- **Connection costs:** TalkTalk queried Ofcom's assumption of a £280 per premises connection cost, noting that Ofcom had provided no supporting evidence and that Fibre Nation's estimates for small cities and mid-sized and larger towns were lower ([✂], depending on whether premises were located in MDUs or required a trench or a pole for SDUs).[729]
- **Connection revenue:** TalkTalk disagreed with Ofcom's assumption that Openreach will charge no connection fee for any FTTP service. In support of this view, TalkTalk pointed out that Openreach charges between £98 and £500 today; has never chosen to permanently charge zero connection on any product; and has no commercial or economic incentive to materially reduce charges.[730]

[722] UKCTA response to July 2020 Consultation, paragraphs 15-19.
[723] Vodafone response to July 2020 Consultation, paragraphs 6-8.
[724] Vodafone response to July 2020 Consultation, paragraphs 15-16.
[725] TalkTalk response to July 2020 Consultation, paragraphs 2.1-2.5.
[726] TalkTalk response to July 2020 Consultation, paragraphs 3.7-3.24.
[727] TalkTalk response to July 2020 Consultation, paragraphs 3.32-3.36.
[728] TalkTalk response to July 2020 Consultation, paragraphs 3.37-3.46.
[729] TalkTalk response to July 2020 Consultation, paragraphs 3.47-3.50.
[730] TalkTalk response to July 2020 Consultation, paragraphs 3.51-3.56.

- **Rental revenue:** TalkTalk noted that Ofcom's additional rental revenue estimate assumes Openreach will on average only earn £2.75 more per customer month across the period from FTTP than from FTTC. TalkTalk argued that this is inconsistent with Ofcom allowing the entry level FTTP 40/10 to be priced £1.50-£1.85 more per month than FTTC 40/10 and Openreach's FTTP pricing gradient for different bandwidths, which will result in a much larger difference between average revenue on FTTC and FTTP products. [✂]).[731]
- **Other issues:** TalkTalk noted an inconsistency with the FTTP build profile assumptions in the different models, with the shortfall model assuming all build occurs in 2021, whilst the Cashflow model assuming it occurs uniformly across the period from 2021 to 2026. It argued that BT may have an incentive to delay build to reduce the present value of FTTP losses. TalkTalk also argued that it was unrealistic to assume all FTTP investments are fully recovered by 2041 and noted the potential for a material difference between forecasts and outturns to arise.[732]

A16.19 In addition, TalkTalk commented on the operating cost efficiency assumptions for FTTC and FTTP. We consider these points in Annexes 14 and 15.

Our assessment and decisions

We have updated our modelling

A16.20 As set out in Volume 4 Section 2, we are implementing a forecast RAB approach in Area 3 to promote competition and investment in gigabit-capable networks by Openreach and other operators, while seeking to protect consumers and existing models of competition.

A16.21 The forecast RAB approach is a cost-based charge control. In many ways, it is similar to the typical approach we take to setting a CPI-X price cap, in that it is set in advance based on cost and revenue forecasts and remains for the duration of the control. However, what is different about this particular control is that:

- the cost forecasts upon which price caps are set include the costs of a FTTP network that does not yet exist but that Openreach has committed to deploy during the review period; and
- the price caps are intended to allow the expectation of cost recovery across the FTTP and copper networks in aggregate and over the lifetime of those networks.

A16.22 Openreach's June 2020 letter set out its plans to commercially build out a fibre network in Area 3 (i.e. without public subsidy) to at least 3.2m premises cumulatively by the end of 2025/26. In that letter, Openreach referred to a number of enablers for the commitment, including the charge controls being set at the level of indexed pricing. On 8 March 2021, Openreach confirmed to Ofcom that it was not proposing to change its commitment to commercially deploy a fibre network to 3.2m premises in Area 3 in light of the updated set of postcode sectors in Area 3 (set out in this Statement).

A16.23 Our assessment of the BT Commitment considers the following:

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[731] TalkTalk response to July 2020 Consultation, paragraphs 3.57-3.58
[732] TalkTalk response to July 2020 Consultation, paragraph 3.66.

- what is a reasonable level of cost recovery that is required during the next charge control period (given the BT Commitment to deploy a fibre network in Area 3) that would allow an expectation of cost recovery over the lifetime of the fibre and copper network; and
- what this means in terms of setting a charge control on copper services for the next five years.

A16.24 We recognise that there are various sets of prices that are potentially consistent with providing Openreach with an expectation of cost recovery over the lifetime of the fibre and copper networks (given its level of planned build in Area 3). However, as set out in Volume 4 Section 2, we consider that there are additional benefits to a forecast RAB approach that results in consistent pricing for WLA services across Area 2 and Area 3. We have therefore considered whether indexed pricing sits within a reasonable range of profiles providing cost recovery when viewed over 20 years.

A16.25 Stakeholder responses mainly related to the accuracy of the modelling and whether indexed pricing would likely result in under- or over-recovery of costs. To assess these issues, we have modified and updated our modelling approach for the statement:

- Firstly, we have forecast total costs and revenues of FTTP and copper services in Area 3. The consultation fibre shortfall model differed in that it estimated BT's incremental costs and revenues. Our forecasts cover the 5-year review period, as well as a longer 20-year period which we consider to be helpful in understanding possible paths to cost recovery over the lifetime of the networks. To account for the uncertainty when forecasting over such long timescales, we present ranges for the long-term cost and revenue forecasts.
- Secondly, we have forecast total FTTP and copper costs and revenues under a scenario where BT commercially deploys FTTP to 3.2m premises by 2026 and continues to commercially deploy to a further 3.8m premises, reaching a total of 7m premises by 2031. Although the extent of future commercial FTTP build in Area 3 is uncertain, we believe that a realistic assumption is that BT will continue to build commercially beyond 2026. In our modelling we have assumed that BT will commercially build to 7m premises as our estimates indicate that average build and connection costs up to this point are not disproportionately high (as set out below, we estimate build capex of c.£388-£607 per premises passed). We also expect there to be Government funded FTTP build in Area 3 and recognise that in practice the boundary between commercial and Government funded build could be different.

A16.26 By making these changes to the modelling, we can more easily assess the level of cost recovery under indexed pricing during this review period and whether this sits within a reasonable range of profiles that are consistent with an expectation of cost recovery over the lifetimes of the FTTP and copper networks.

A16.27 Below, we set out our detailed assumptions for the different parts in our modelling:

- **Full fibre cost assumptions:** covering the costs of building and operating a full fibre network covering 7m premises in Area 3 (with 3.2m premises covered by 2026) over the next 20 years.
- **Copper cost assumptions:** covering the costs of operating the copper network (providing MPF, WLR and FTTC services) in Area 3 over the next 20 years as customers migrate to FTTP

services. The copper service cost estimates use input data on the costs of copper services from the 'Active services model' (which is described in more detail in Annex 14).

- **Volume and revenue assumptions:** covering our assumptions on the take-up of FTTP and copper services and our revenue estimates over the 5-year review period and the next 20 years. Our long-term revenue estimates consider a scenario where prices are indexed for the next 5 years then held flat in nominal terms, and a scenario where prices are indexed for the next 10 years then held flat in nominal terms.

A16.28 To calculate the present value of costs and revenues over the review period and the next 20 years we have discounted the cashflows as follows:

- Copper services: we have used our pre-tax nominal WACC for Openreach (applicable to copper services) of 7.0% to discount copper service costs and revenues; and
- FTTP services: we have used our pre-tax nominal OUKT WACC of 7.8% to discount FTTP costs and revenues.[733]

A16.29 Below we provide details of this modelling. This includes the updates we have made in light of stakeholder responses and the changes we have made to inputs/assumptions as we have obtained more up-to-date information.

FTTP costs

A16.30 We have used Ofcom's fibre model to estimate Openreach's costs for its Area 3 FTTP network reaching 7m premises in Area 3, of which 3.2m premises are reached by 2026. (the fibre model is described in more detail in Annex 15). Full fibre costs are made up of build capital expenditure (capex), connection capex and operating costs, which we detail below.

FTTP build and connection capex

A16.31 Our fibre model calculates the total cost of deploying and running a FTTP network by estimating the number of network components needed to deploy the FTTP network (e.g. civil costs, fibre, exchange equipment) and combining this with estimates of the capital and operating costs for each component.

A16.32 As in the January 2020 Consultation version of the fibre model, we have used a scorched node approach which assumes the FTTP network is deployed from the location of Openreach's existing access nodes and assumes that Openreach reuses existing physical infrastructure, such as ducts and poles, where spare capacity is available and only builds new physical infrastructure where this is not available or feasible. We assume Openreach can reuse 70% of existing ducts and poles in our high cost scenario, 80% of existing ducts and poles in our low-cost scenario, and 75% in our central scenario.

A16.33 In relation to the footprint of the rollout, in the July 2020 Consultation we said that to estimate the fibre shortfall, we would calculate build and connection costs for 7.0m of the 8.8m Area 3

[733] As set out in Annex 21, this estimate covers a range of services and we recognise that FTTP could have a higher asset beta and WACC than the 'average risk' activity captured within OUKT. However, identifying an explicit beta for FTTP is difficult because of the absence of listed pure play FTTP comparator companies. Any separate modelling to derive an explicit beta for FTTP requires significant assumptions. Therefore, for the purposes of this review, we have retained FTTP within OUKT (benchmarked to BT and other telecoms companies).

premises and scale this down to 3.2m on a pro-rata basis. We agree with stakeholders that this was not implemented correctly, with the model calculating build and connection costs for the cheapest 3.2m premises in Area 3 (according to our fibre model).

A16.34 However, we believe that this is no longer an issue as we have updated our methodology to use more precise information. In particular, for the period 2021-2026 we have estimated build and connection costs in our fibre model using the specific postcode sectors that BT plans to cover in its commitment to cover 3.2m premises (gathered under statutory information powers).

A16.35 In terms of implementation in the model, we assumed that these postcode sectors would be deployed to in alphabetical order and that build would be spread out over the period 2021-2026. We consider this assumption to be reasonable as it takes into account that BT's FTTP deployment is likely to contain a mixture of lower- and higher- cost premises and will likely be sequenced according to BT exchange areas. Table A16.1 below sets out our assumptions on the cumulative commercial Area 3 FTTP build we have assumed for 2021-2026.

Table A16.1: Assumed cumulative number of Area 3 premises BT builds FTTP to commercially, 2021-2026

2021/22	2022/23	2023/24	2024/25	2025/26
631,656	1,303,339	1,910,814	2,475,839	3,202,050

A16.36 TalkTalk has queried whether commercial FTTP build prior to the 2021-2026 review period should be included in the assessment. In Annex 13, we explain why we consider it appropriate to include pre-existing FTTP build in the assessment. As of March 2021, Openreach has deployed a fibre network covering [✂] premises on a commercial basis in Area 3.[734] As our modelling period begins in 2021/22, as a simplifying assumption we have spread the build to these premises evenly across the years 2021-2026.

A16.37 We think that a realistic scenario is that BT will continue to deploy commercially beyond 2026. Therefore, we assume that BT will continue to commercially build to another 3.8m homes during 2026-2031 to reach a total coverage of 7m premises by 2031. We have assumed that during 2026-2031 BT will deploy to the cheaper c.7m of the c.9m premises in Area 3, excluding premises that would already have been covered by the first 3.2m deployment during 2021-2026. Post-2031, we assume no additional BT commercial FTTP build. Table A16.2 below sets out our assumptions on the cumulative commercial Area 3 FTTP build we have assumed for 2026-2031.

Table A16.2: Assumed cumulative number of Area 3 premises BT builds FTTP to commercially, 2026-2031

2026/27	2027/28	2028/29	2029/30	2030/31
4,088,996	4,953,145	5,565,880	6,240,304	6,995,245

[734] Openreach response to s135 dated 5 March 2021.

A16.38 In relation to connection capex, we have updated the assumptions in our Fibre model to reflect the latest available information. In particular, we have considered evidence collected from Openreach on its actual connection costs for its Area 3 deployments and Openreach's latest assumptions in its Chief Engineer's model. This evidence indicates that connection capex in Area 3 is higher than previously assumed in the January 2020 Consultation and the July 2020 Consultation. BT has explained that this is because [✂][735].

A16.39 As regards TalkTalk's comments, we would expect connection costs in more rural areas to be higher than in more urban areas as the distance between premises and distribution points tends to be farther. Based on the evidence we have gathered from BT on actual build, this appears to be the case in practice. Consistent with our aim to allow the opportunity for cost recovery, we consider it appropriate that our Fibre model fully reflects these geographic variations in costs in calculating connection costs in Area 3. We note that the Fibre Nation FTTP deployments TalkTalk has referred to have mainly been in towns and small cities, which are likely to more closely align with the type of build in Area 2.

A16.40 Table A16.3 below sets out our estimates of build and connection capex for a commercial deployment to 7m premises in Area 3.

Table A16.3: Forecast unit build and connection capex for 7m commercial Area 3 FTTP deployment

Cost type	Unit	Low cost	Central cost	High cost
Build costs	Premises passed	£388	£477	£607
Connection costs	Connections	£363	£363	£363

Source: Ofcom fibre model.

FTTP operating costs

A16.41 In order to calculate total FTTP costs, we now include operating costs in our forecasts. Full-fibre operating costs cover "lead-to-cash opex" which is the operating cost associated with connections (e.g. SLGs), and "other opex" which covers activities such as maintenance, non-domestic rates, power, and overhead costs.

A16.42 As set out in Annex 15, we modelled certain operating costs on the basis of assumed cost-drivers such as, for example, connection costs (where we used connection volumes) and system and processing costs (where we used software configuration volumes). For operating costs where we could not identify clear cost drivers, such as maintenance, power and overheads, we modelled these as a percentage of the network's Gross Replacement Cost (GRC), i.e. the cost of replacing the whole network in a given year.

A16.43 Table A16.4 below sets out our estimates of operating costs for a commercial deployment to 7m premises in Area 3.

Table A16.4: Forecast unit opex for 7m commercial Area 3 FTTP deployment

Cost type	Unit	Low cost	Central cost	High cost
Lead-to-cash opex	Connections	£27	£27	£27

[735] Openreach response to Q1 of s135 entitled "FTMR-38" dated 7 December 2020, received on 21 December 2020.

Other opex[736]	Per customer, per annum	£57	£59	£63

A16.44 Table A16.5 below sets out our forecast of total capex and opex for a commercial deployment to 7m premises in Area 3 over the next 20 years on a present value basis.

Table A16.5: 20-year total FTTP capex and opex forecasts (£ billion, present value basis)

	Low cost	Central cost	High cost
Build capex	2.0	2.4	3.0
Connection capex	1.8	1.8	1.8
Opex	2.0	2.1	2.2
Total capex + opex	**5.7**	**6.3**	**7.0**

A16.45 In terms of the profile of these cashflows, build capex is weighted towards the beginning of the period with £1.0bn-£1.6bn in present value terms being incurred in the first 5 years as BT deploys to 3.2m premises by 2026. Connection capex and opex is more evenly spread over the 20 years as these costs are driven by the number of connections and customers on the network.

Copper costs

A16.46 We have used Ofcom's cost forecast model to estimate Openreach's Area 3 copper network costs over the next 20 years, assuming that it builds a commercial FTTP network reaching 7m premises (the cost forecast model is described in more detail in Annex 14). Our estimates are based on Fully Allocated Costs (FAC) which include operating costs, depreciation, holding gains/losses and a return on capital.

A16.47 We directly use the cost forecast model to forecast costs for 2020/21 - 2025/26. As detailed in Annex 14, we have updated the cost forecast model since the July 2020 Consultation. These updates include:

- **Base year cost data:** we have used 2019/20 RFS data and made adjustments to remove errors.
- **Efficiency:** based on our updated analysis of BT's regulatory accounts, Openreach's management accounts and taking into account factors such as COVID-19 and Brexit, we have updated our assumption on opex efficiency to a base case of 3.5% per annum, with a range of 2.5% to 5%.

[736] This includes the annualised cost associated with reusing existing BT physical infrastructure, i.e. the PIA payments referred to in Annex 15.

- **Inflation:** we have revised our forecasts to reflect updated external cost indices evidence, namely the November 2020 Office of Budget Responsibility 'Economic and fiscal outlook' report.
- **Accelerated depreciation:** as set out in Volume 4 Section 6 and Annex 14, under our approach we bring forward depreciation for copper assets stranded by migration to FTTP into the charge control period. This has the effect of increasing costs by £365m (in present value terms) in total, of which we estimate £117m relates to the committed build of 3.2m premises by the end of 2025/26.
- **Cumulo:** we have updated our estimates of BT plc's cumulo payments over the period in the light of more recent public information from the English, Welsh, Scottish and Northern Irish governments about various matters such as rate poundages and future revaluation dates. These revised estimates are almost identical to those we had previously. We have not updated our forecasts of how these forecast payments are attributed to services. We have therefore used our approach from the January 2020 Consultation relating to attributions of cumulo costs.

A16.48 Table A16.6 sets out our copper cost forecasting assumptions for 2020/21-2025/26.

Table A16.6: Low, Central and High cost scenario assumptions for copper costs 2020/21-2025/26

	Efficiency	Opex pay inflation	Opex non-pay inflation	WACC
Low cost	5.0%	2.2%	1.7%	6.0%
Central cost	3.5%	2.7%	2.2%	7.0%
High cost	2.5%	3.2%	2.7%	8.0%

A16.49 Given the uncertainties around forecasting costs far into the future, we have used a simplified approach to forecast copper costs beyond 2026. In particular, to forecast costs for 2026-2036 we use a formula that assumes that the cost stack moves in line with volumes according to the weighted average CVEs for MPF and FTTC services, and that it will inflate each year by CPI and efficiency. As detailed below, we forecast that copper retirement will have concluded by the end of 2035/36, meaning copper volumes and costs are assumed to be zero from this point onwards. Table A16.7 provides our cost trend assumptions used to forecast copper costs beyond 2026.

Table A16.7: Copper cost forecasts – average unit cost trend per annum post-2026

	2026-2036
Low cost	+1.3%
Central cost	+3.4%
High cost	+5.4%

A16.50 Table A16.8 below sets out our forecast of total FAC for copper services in Area 3 over the next 20 years on a present value basis, assuming a 7m commercial FTTP deployment in Area 3.

Table A16.8: 20-year total copper cost (FAC) forecasts (£ billion, present value basis)

	Low cost	Central cost	High cost
Total FAC	7.0	7.7	8.5

Volumes and revenues

A16.51 In this section, we firstly set out our assumptions on FTTP and copper volumes (i.e. take-up). We then set out our assumptions on pricing to estimate revenues across FTTP and copper services.

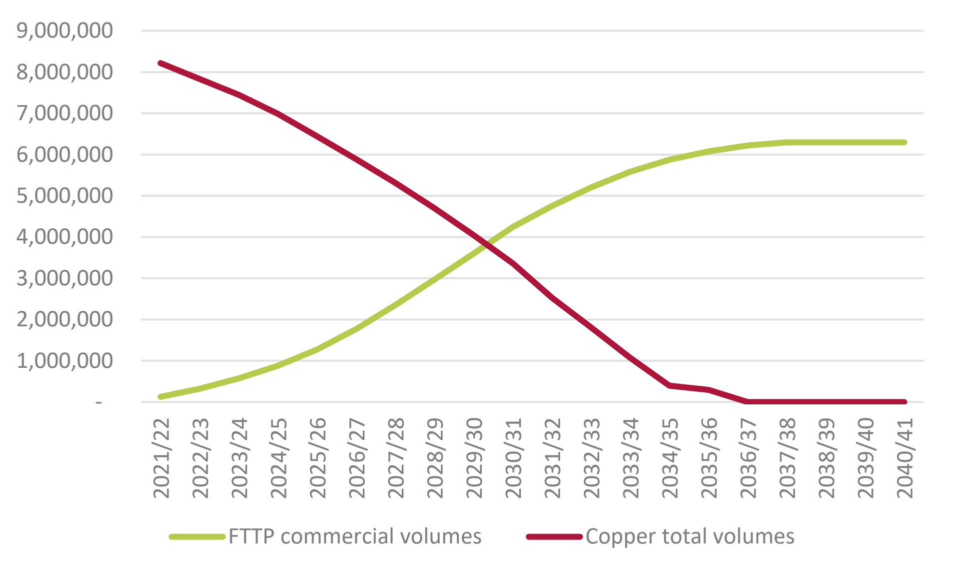
Volumes

A16.52 Service volumes are a key input to the cost forecasts set out above as well as to the revenue forecasts detailed below. The starting point for our Area 3 volume forecasts was our forecast of BT's commercial FTTP deployment to 3.2m premises by 2026 and 7m in total by 2031, as outlined above. We applied our FTTP take-up assumptions to this whereby for the amount of FTTP build in each year, take-up would occur over the next eight years (inclusive) to a maximum of 90%, with the remaining 10% of customers within the footprint assumed not to take a fixed broadband service.

A16.53 For the purposes of this modelling, we have forecast Area 3 copper volumes on the basis of the total number of active lines in 2021 (c.8.3m). We project this forward taking into account a number of factors including a forecast reduction in the number premises taking multiple lines, migration from Openreach's copper services to FTTP services (provided by Openreach and altnets, either commercially or through Government funding). Our copper volume forecasts also take into account a general trend of an increasing proportion of lines moving onto higher bandwidths over time.

A16.54 Figure A16.1 below sets out our forecast of FTTP and copper lines in Area 3 over the 20-year period. It shows that we forecast c.6.3m commercial FTTP lines by the mid-2030s when copper retirement has been fully completed.

Figure A16.1: Forecast of Area 3 FTTP and copper service volumes



Revenues

A16.55 To assess whether indexed pricing is likely to be consistent with a reasonable range of cost recovery profiles over the lifetime of the copper and FTTP networks, we have considered two possible pricing scenarios:

- Indexed pricing for 5 years: where the prices of MPF, WLR and FTTC products (all bandwidths) inflate with CPI for the next 5 years, and then from 2026 onwards prices stay flat in nominal terms.
- Indexed pricing for 10 years: where the prices of MPF, WLR and FTTC products (all bandwidths) inflate with CPI for the next 10 years, and then from 2031 onwards prices stay flat in nominal terms.

A16.56 To estimate copper revenues, we used 2020/21 start prices inclusive of GEA FTTC discounts as the starting point – to calculate these we gathered Openreach's actual revenues and volumes up to December and forecast revenues and volumes for the remaining three months of 2020/21 to generate average discounted prices. These average prices (including discounts) are used as the prices in 2021/22.

A16.57 We then projected these prices forward based on the pricing scenarios above and combined with our volume forecasts for MPF, WLR and FTTC as set out above. Figure A16.2 sets out average copper prices assumed under both the "indexed pricing for 5 years" scenario and for the "indexed pricing for 10 years" scenario.

Figure A16.2: Assumed average copper prices (£ per month, nominal)

A16.58 Table A16.9 sets out our forecast of copper revenues for the two scenarios for the 5-year review period and our indicative forecast looking over the next 20 years.

Table A16.9: Copper revenue forecasts (£ billion, present value basis)

Scenario	Review period 2021-2026	20-year forecast 2021-2041
Indexed pricing for 5 years	5.0	7.8
Indexed pricing for 10 years	5.0	8.0

A16.59 In terms of FTTP rental revenue, as set out above under indexed pricing Openreach will have pricing flexibility for FTTP services above 40/10 Mbit/s during this review period. For this modelling we have assumed that the average FTTP price will track the average copper price under the two scenarios above plus a specified premium. We have constructed a range of possible FTTP prices as follows:

- For the bottom of the range, we assume that Openreach will not be able to charge much above the FTTP 40/10 charge control. Specifically we assume that the average FTTP price will be set at the level of the average copper price (across all bandwidths) plus the "40/10 fibre premium" of £1.70 (per month), with this premium assumed to inflate with CPI for the next 5 years (in line with our "40/10 fibre premium" decisions).
- For the top of the range, we assume that the average FTTP price will be set at the level of the average copper price (across all bandwidths) plus a premium of £4 (per month) which remains flat in nominal terms.
- For the central case, we simply use the mid-point between the top and bottom of the range in each year.

A16.60 Figure A16.3 sets out average FTTP prices assumed under the "indexed pricing for 5 years" and Figure A16.4 sets out scenario average FTTP prices for the "indexed pricing for 10 years" scenario.

Figure A16.3: Assumed average FTTP prices – indexed pricing for 5 years (£ per month)

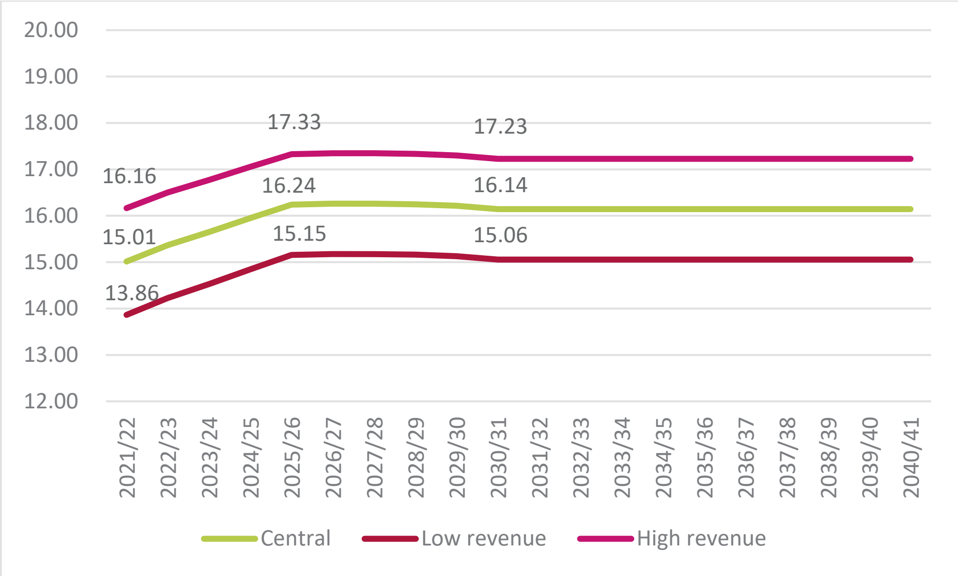
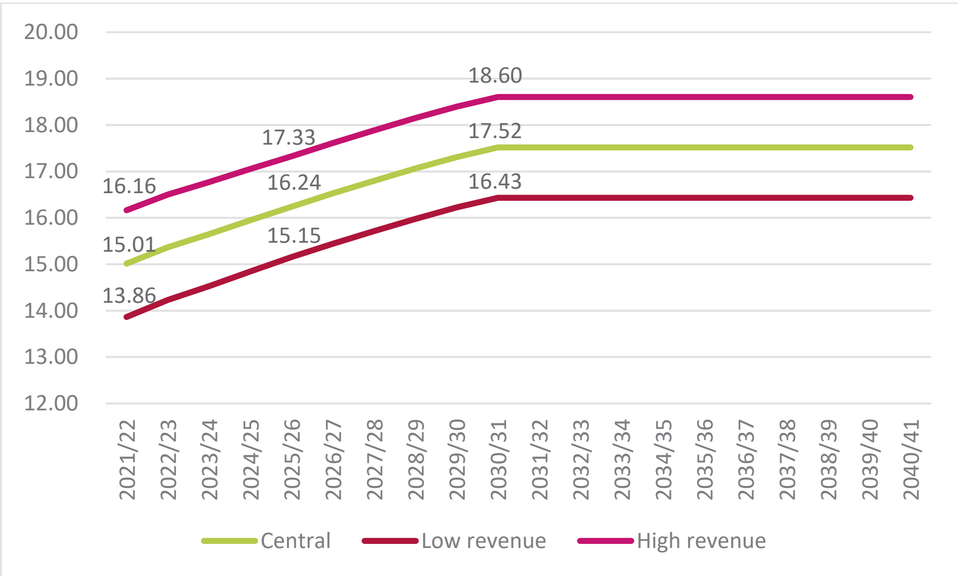


Figure A16.4: Assumed average FTTP prices – indexed pricing for 10 years (£ per month)



A16.61 In terms of FTTP connection revenue, in our July 2020 Consultation we assumed Openreach would set a £0 connection charge on the basis of the information we had at the time. Having gathered more up-to-date business plan information, we now assume that Openreach will charge on average £[✂] per connection.[737]

A16.62 Table A16.10 below sets out our forecast of FTTP revenues over the 5-year review period.

[737] Openreach response to Q4 of s135 entitled "FTMR-27" dated 10 September 2020, received on 8 October 2020.

Table A16.10: 5-year 2021-2026 FTTP revenue forecast (£ billion, present value basis)

	Low revenue	Central	High revenue
Indexed pricing for 5 years	0.49	0.52	0.56

A16.63 Table A16.11 below sets out our indicative forecast of FTTP revenues under our two modelled scenarios for the next 20 years.

Table A16.11: 20-year 2021-2041 FTTP revenue forecasts (£ billion, present value basis)

	Bottom of the range	Central	Top of the range
Indexed pricing for 5 years	5.75	6.16	6.56
Indexed pricing for 10 years	6.17	6.58	6.99

Summary of results

A16.64 As discussed above, there is a level of uncertainty around our cost and revenue forecasts particularly since these stretch out over the lifetime of the network. Given this, we have not sought to determine a single estimate of the level of cost recovery required during the next control period and beyond (and thereby a single level of copper prices needed to allow for that cost recovery).

A16.65 Rather, our modelling seeks to understand what a plausible range of costs for FTTP and copper services is over the lifetimes of those networks and whether indexed pricing over the next 5 years sits within a reasonable range of cost recovery profiles.

A16.66 With this purpose in mind, we present our long-term forecasts of total copper and FTTP costs in Table A16.12 below.

Table A16.12: Summary of 20-year cost forecasts (£ billion, present value basis)

	Copper	FTTP	Total
Low cost	7.0	5.7	12.7
Central	7.7	6.3	14.0
High cost	8.5	7.0	15.6

A16.67 In terms of cost recovery, Figure A16.5 and Figure A16.6 below set out how our revenue forecasts compare to our cost range, over the 5-year review period and over a 20-year period.

Figure A16.5: Estimated FTTP and copper cost recovery under 5-year indexation scenario (£ billion, present value basis)

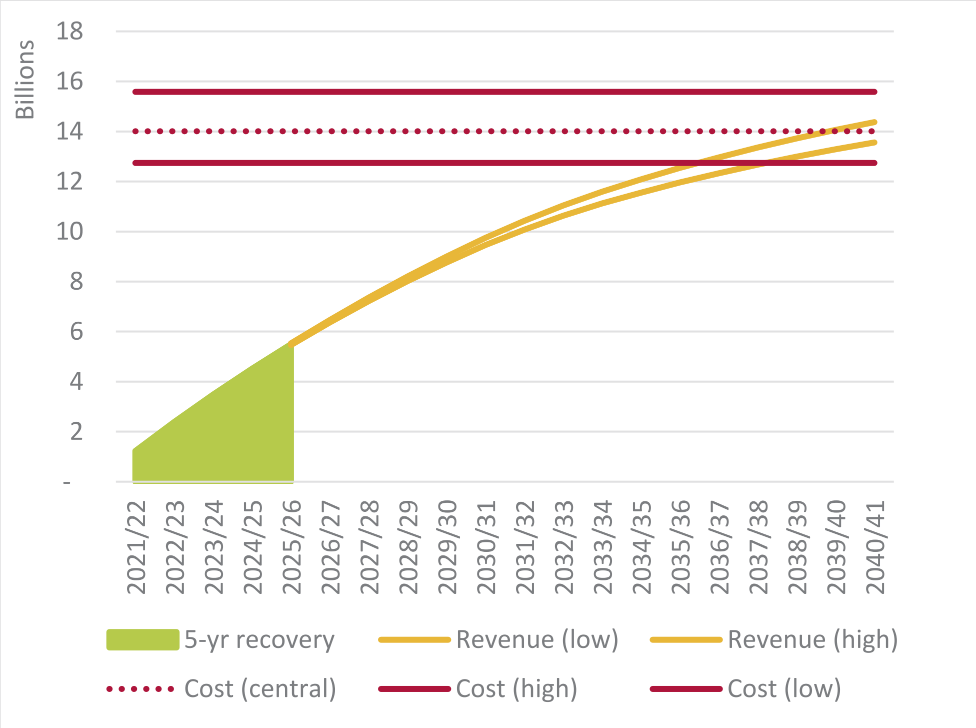
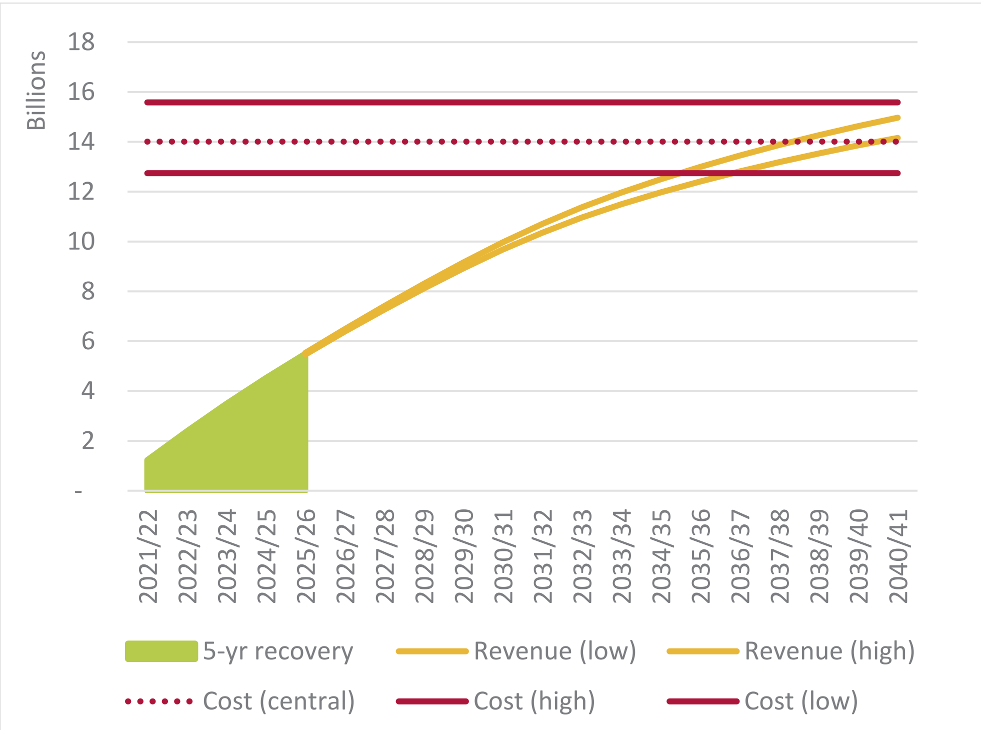


Figure A16.6: Estimated FTTP and copper cost recovery under 10-year indexation scenario (£ billion, present value basis)



A16.68 Based on the above, we conclude that indexed pricing is likely to sit within a reasonable range of cost recovery under the forecast RAB charge control. In particular, our estimates indicate that:

- With a FTTP network covering 7m premises in Area 3 (with 3.2m premises covered by 2026), Openreach's total costs across FTTP and copper services will range between £12.7bn and £15.6bn on a present value basis over 20 years.
- During the period 2021-26, indexed pricing on copper services (through setting a CPI-0% cap on MPF and FTTC 40/10 services) will allow cost recovery of £5.5bn across FTTP and copper services on a present value basis over this 5-year period.[738]
- This is likely to be consistent with cost recovery over the lifetime of the networks, with our indicative modelling suggesting total cost recovery of between £13.6bn and £14.4bn on a present value basis over 20 years where prices remain flat in nominal terms post-2026, or between £14.2bn and £15.0bn on a present value basis over 20 years where prices continue to be indexed during 2026-2031 then remain flat in nominal terms post-2031.

[738] Split between £5.0bn from copper services and £0.5bn from FTTP services.

A17. Dark fibre cost modelling

A17.1 In Volume 3 Section 6, we set out the requirement for Openreach to provide network access to dark fibre services connecting to the local exchange (dark fibre access or DFA) in Area 3 and inter-exchange connectivity (dark fibre inter-exchange or DFX) from BT Only exchanges. We also concluded that charges should be cost-based using Openreach's costs. In Volume 4 Section 5, we impose CPI-0% controls on dark fibre ancillary services having set cost-based charges for ancillary services that are specific to dark fibre.

A17.2 We received a small number of responses to our consultation proposals on dark fibre cost modelling. We have addressed these responses within this annex. This annex also sets out our decisions for the following aspects of the dark fibre charge control:

- **Cost standard –** we set charges for dark fibre services based on BT's current cost accounting (CCA) fully allocated costs (FAC). We separately estimate costs for new assets and activities that Openreach will undertake when providing dark fibre services as these costs are not currently captured in its Regulatory Financial Statement (RFS).
- **Basing costs on Ethernet services –** we set prices for dark fibre services using a similar charging structure as for an EAD circuit, i.e. a connection charge, a fixed annual rental charge and a distance-related annual main link charge.
- **Methodology for estimating efficient costs –** we identify two elements which make up the cost stack for dark fibre rental and connection services: passive infrastructure costs and costs that are shared across all Ethernet services but not specific to dark fibre.
- **Charge control design –** we set maximum charges for each dark fibre service as we do not consider a basket approach to be appropriate for these services.
- **Pricing of ancillary services –** we identify several ancillary services specific to providing dark fibre services: a cessation charge, a right when tested (RWT) charge, an initial testing charge, and a patch panel charge. We set prices for these services on a FAC basis using data provided by Openreach. Where existing ancillary services are relevant to providing dark fibre services (e.g. TRCs and ECCs), we consider it appropriate that they are offered and charged on the same basis as those charged in respect of active services.

A17.3 We set the charge control for dark fibre services in relation to the underlying segments needed for a circuit, i.e. we set a charge control for:

a) Dark fibre access (DFA) segment which is defined as dark fibre for the supply of leased lines access, i.e. between the customer end site and the nearest BT exchange, in Area 3.

b) Dark fibre inter-exchange (DFX) segment which is defined as dark fibre for the supply of inter-exchange connectivity from BT Only exchanges with no rival networks close by.

c) All combinations of DFA and DFX segments.

A17.4 When a dark fibre circuit requires a combination of DFA and DFX segments, the rental and connection charges of the DFX segment should be excluded to avoid double counting of costs. As such, the costs of a dark fibre circuit that spans between two customer sites, where each customer site is connected to a different BT exchange, would be derived as:

- twice the DFA segment rental and connection charges; plus

- the appropriate number of patch panel and initial testing charges; plus
- the DFX segment main link rental charge.

A17.5 The table below summarises the maximum charges relating to the segments that are needed to supply various dark fibre services.

Table A17.1: Initial charges in 2021/22 and CPI-X control for segments needed for dark fibre services

	DFA segment (single fibre)	DFA segment (dual fibre)	DFX segment (single fibre)	DFX segment (dual fibre)
Connection (per circuit)	£1,364 (CPI-5.2%)	£2,728 (CPI-5.2%)	£245 (CPI-3.1%)	£490 (CPI-3.1%)
Rental (per circuit per year)	£1,030 (CPI-4.1%)	£2,060 (CPI-4.1%)	£36 (CPI-5.5%)	£72 (CPI-5.5%)
Main link (per metre per year)	n/a	n/a	£0.10 (CPI+0.6%)	£0.20 (CPI+0.6%)
Patch panel at customer premises (per panel per year)	£19 (CPI-0%)	£19 (CPI-0%)	n/a	n/a
Patch panel at exchange (per panel per year)	£85 (CPI-0%)	£85 (CPI-0%)	£85 (CPI-0%)	£85 (CPI-0%)
Initial testing	£123 (CPI-0%)	£123 (CPI-0%)	£123 (CPI-0%)	£123 (CPI-0%)
Cessation charge	£172 (CPI-0%)	£172 (CPI-0%)	£172 (CPI-0%)	£172 (CPI-0%)
RWT charge	£307 (CPI-0%)	£307 (CPI-0%)	£307 (CPI-0%)	£307 (CPI-0%)
TRCs for dark fibre	Same as for actives	Same as for actives	Same as for actives	Same as for actives
ECCs for dark fibre	Same as for actives	Same as for actives	Same as for actives	Same as for actives

Cost standard

A17.6 We set a cost-based charge control with reference to the relevant components of Openreach's underlying passive infrastructure, as opposed to adopting an active-minus approach.

A17.7 To inform our choice of cost standard, we note that setting all charges at incremental cost for a multiproduct firm with economies of scope would not be sustainable as the firm would not be able to recover its common costs.

A17.8 Charges set on a CCA FAC standard have the advantages of being transparent and practicable to implement as Openreach's costs are known and are based on the BT RFS which is publicly available to stakeholders each year.

A17.9 We therefore consider it appropriate to start from BT CCA FAC data and use data from BT's RFS where possible when estimating the unit FAC for DFA and DFX. As explained below, Openreach is likely to incur additional costs that are not currently captured in the RFS when providing dark fibre. We estimate these separately and, as far as practicable, use publicly available information to estimate the unit FAC of these additional costs.

Basing costs on active Ethernet services

A17.10 Openreach's wholesale Ethernet products (or EAD) are the main products that Openreach currently supplies for a range of services spread across lower bandwidths and some VHB circuits. We consider that Ethernet products provide a suitable benchmark for calculating dark fibre costs for DFA and DFX.

A17.11 The typical charging structure for Openreach's EAD product is a one-off connection charge, an annual rental charge per circuit, and a distance-related annual main link charge which applies if the two ends of an EAD circuit are served by different BT exchanges.[739]

A17.12 In order to avoid double counting of costs, we consider it appropriate to separate out the initial testing costs from the dark fibre connection charges and the per annum patch panel costs from the rental charges. Therefore, we also include the following charges:

- rental charge for each patch panel at the customer end;
- rental charge for each patch panel at a BT exchange; and
- a one-off initial testing charge.

Dual fibre circuits

A17.13 Openreach is required to offer both single and dual fibre dark fibre circuits. The per circuit rental, connection, and main link charges for the two fibre variants should be twice those for the one fibre variant. This is demonstrated in Table A17.1 above.

A17.14 We would expect a dual fibre circuit not to require twice as much initial testing. Therefore, the initial testing charge (which is per connection) should be the same for both single and dual fibre circuits. The same applies to the dark fibre cessation and RWT charges. We note that the patch panel charges are per panel so independent of whether single or dual fibre circuits are purchased. We would also expect a patch panel charge to only occur when a patch panel is necessary.

[739] The main link charge depends on the radial distance between the two BT exchanges.

Methodology for estimating efficient costs

A17.15 We construct the cost stack for dark fibre connection, rental and main link services from the following two elements:

- **Element A:** Costs relating to passive infrastructure required for a dark fibre circuit. For example, this would include the costs of the fibre that runs between exchanges; or between the customer end site and an exchange.
- **Element B:** Other costs (e.g. overheads) that are required for, but not specific to, a dark fibre circuit as they are shared across multiple services. For example, this would include the costs of service centre staff who manage provision and maintenance queries or product management people. The costs of such people are generally allocated across a range of different services.

A17.16 We use CCA FAC information on EAD services derived from BT's RFS to inform our estimates of elements A and B.[740] More specifically, we estimate starting charges by using 2019/20 costs of:

- EAD LA 1 Gbit/s service to calculate the costs of elements A and B for the DFA segment; and
- EAD 1 Gbit/s service to calculate the costs of elements A and B for the DFX segment.

A17.17 We consider it appropriate to use the most recent cost information, i.e. the 2019/20 RFS, which means the use of 2019/20 costs rather than the 2017/18 costs used in the January 2020 Consultation. As set out in the November 2020 Consultation, the 2019/20 RFS includes a few methodological changes to the allocation of fibre costs which result in a significant increase in DFA costs and a decrease in DFX main link costs.

A17.18 TalkTalk and Vodafone both raised concerns regarding the changes to the allocation of fibre costs in the 2019/20 RFS. TalkTalk argued that changes to cost allocation in BT's regulated accounts should be scrutinised, especially when the movement of costs is from services that do not face cost-based charges (i.e. FTTC) to services that do (i.e. dark fibre).[741] Vodafone argued that the costs that are reallocated in the 2019/20 RFS are shared network costs, i.e. they are not directly incurred by dark fibre. It also argued that the allocation of spine fibre should be based on the number of fibres rather than cables given that cables can have differing fibre counts.[742]

A17.19 We recognise that the changes in the 2019/20 RFS have a significant impact on the dark fibre charges but consider the 2019/20 costs to be an improvement on the 2017/18 costs. We note that the change in allocation of access fibre between EAD LA and EAD non-LA represents roughly half of the overall change to EAD LA. No stakeholders disagreed with this specific change and we think this change results in a more appropriate allocation of access fibre costs across EAD LA and EAD services.

A17.20 We have also determined that the other changes to fibre cost allocation in the 2019/20 RFS are reasonable given that in the 2019/20 RFS:

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[740] Although BT launched an inter-exchange connectivity dark fibre product in December 2019, it has yet to report information within its RFS. We weren't therefore able to rely on BT's RFS to inform our estimates.
[741] TalkTalk response to November 2020 Consultation, paragraphs 3.1 to 3.8.
[742] Vodafone response to November 2020 Consultation, paragraphs 24 and 25.

- BDUK funded assets are allocated separately via BDUK components. The ring-fencing of BDUK assets and volumes suggests that any shared fibre costs should not also be allocated to BDUK if this results in a double counting of costs. Therefore, we agree with the removal of BDUK funded assets from the calculation of Access Fibre Spine Cable (LFSC) and Fibre Distribution Cable (LFDC) cost allocations.
- BT only includes the first cable segment when calculating its allocation of spine fibre costs where multiple distribution cables are 'chained' together and only one is directly interfacing with the spine network. We consider this to be an improvement as the previous inclusion of FTTC daisy-chain segments when determining the use of spine fibre distorts the allocation of spine fibre costs to WLA.[743]

A17.21 In light of the above, we consider it appropriate to use the 2019/20 RFS when estimating costs for dark fibre as this means that our estimates use the most up-to-date information. We consider the changes in cost allocation, for shared costs and otherwise, to be an improvement on the methodology used in the previous RFS.

Adjustments to BT's RFS information

A17.22 In Annex 14, we set out the adjustments that we have made to BT's RFS information to reflect our view of BT's efficiently incurred costs. Our calculations of dark fibre costs are based on RFS information reflecting those base year adjustments.

A17.23 We have made an adjustment to our leased lines volume forecasts to account for the potential aggregation of access circuits due to the availability of dark fibre. We have based our adjustment on the number of access circuits in Area 3 that terminate at the same postcode.[744]

A17.24 We do not consider it necessary to account for any 1-to-1 substitution of active and dark fibre circuits given our approach to estimating costs of a dark fibre circuit. If we did account for this type of substitution in our top-down modelling, this would incorrectly increase the unit costs for some components in the DFA or DFX segments.[745]

A17.25 In response to both our January 2020 Consultation and November 2020 Consultation, Openreach argued that the dark fibre charges should include an allocation of the costs incurred due to stranding of active equipment and increased migration costs.[746] Openreach also argued that the dark fibre charges should reflect Area 3 specific costs and not include CLA costs.[747]

A17.26 Given the expected demand for dark fibre over this review period, we consider it likely that the charge control on active leased lines in Area 3 allows for the recovery of these costs in a way

[743] We note that the allocation of spine fibre costs is based on the count of distribution fibres, not cables, across services and markets.
[744] We consider this to be an upper bound as leased lines terminating at the same postcode level may still be sufficiently far apart to not make it practical to aggregate onto a single dark fibre circuit.
[745] DFA and DFX costs are derived from EAD costs calculated in the top-down model, which does not capture dark fibre volumes. Therefore, if we reduced EAD volumes due to 1-to-1 substitution, this would incorrectly model a reduction in total business connectivity service volumes when in fact the costs are now being recovered through dark fibre services rather than EAD.
[746] Openreach response to the January 2020 Consultation, paragraphs 9.259 to 9.265, and Openreach response to the November 2020 Consultation, paragraphs 3.5 to 3.10.
[747] Openreach response to January 2020 Consultation, paragraphs 9.192 to 9.220.

that best meets our objectives.[748] We also consider it appropriate that any potential impact from stranding of active costs should be recovered through active services. This is similar to adjusting the asset lives for active equipment to account for the lower economic life compared to the book life.

A17.27 We note that the additional migration costs suggested by Openreach are due to the increased pool of engineers needed to ensure rapid migration to dark fibre. Firstly, we consider these migration costs to be transitional costs, i.e. a one-off, so including them in the dark fibre charges would not reflect the long-run costs for these services. Secondly, as discussed in Annex 9, we expect a gradual take-up of dark fibre over this review period and not the rapid migration suggested by Openreach.

A17.28 We note that TalkTalk agreed that there is no cost recovery concern from stranding or migration costs given the CPI-0% control on actives.[749] Vodafone argued that it is unnecessary to cease and re-provide when migrating from an active to dark fibre thus Openreach's additional migration costs are significantly overstated.[750]

A17.29 The objective of this modelling exercise is to forecast Openreach's efficient costs of providing leased lines services (including EAD circuits) over the charge control period. We consider that the relevant costs that Openreach incurs when supplying an EAD circuit provide the best reference point for estimating the likely costs of a dark fibre circuit. In the January 2020 Consultation, we proposed to use national CCA FAC information on EAD services derived from BT's RFS to inform our estimates of a national cost for dark fibre.

A17.30 We continue to consider it appropriate to set the charge control for dark fibre services based on Openreach's national costs. This will provide Openreach the opportunity to recover its FAC overall (i.e. across Area 2 and Area 3) and is consistent with cost recovery over time. FAC includes costs that are common across services as well as markets, so we consider it appropriate to assess FAC recovery on a national basis rather than by geographic area. We also consider that setting charges based on national costs will allow for recovery of forward-looking incremental costs in Area 3. However, we agree that national costs in this context should exclude the CLA as this is an unregulated market so it should not impact the charges we set in regulated markets. Therefore, we have removed CLA costs and volumes when estimating dark fibre costs.

A17.31 Having determined base year costs, which we use to set initial charges for dark fibre, we then forecast 2025/26 costs for elements A and B using cost forecasts from the top-down cost model. We use these forecasts to determine the appropriate CPI-X charge controls for dark fibre services.

A17.32 We explain how we have estimated the costs for dark fibre ancillary services at the end of this annex.

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[748] This is supported by a sensitivity analysis of these costs, where we assess the magnitude of the impact using Openreach estimates of the underlying costs applied to our expectations regarding the likely magnitude of dark fibre take-up.
[749] TalkTalk response to November 2020 Consultation, paragraph 3.8.
[750] Vodafone response to November 2020 Consultation, *Clarifications dark fibre remedy*.

Classification of components

A17.33 We classify the components used to provide EAD services in BT's RFS as relating either only to the active or passive elements of an EAD circuit or as being 'shared' between the active and passive elements. Below we set out our classification for the components used to provide EAD and EAD LA services in BT's 2019/20 RFS.

A17.34 Active components relate to the active elements of an EAD circuit and do not appear to include any costs relevant to a dark fibre circuit. These include:

- Ethernet Electronics Current and Ethernet Electronics Capex, which covers costs associated with operating and maintaining active equipment, including the capital costs of that equipment (and overheads related to the Ethernet electronics).
- Ethernet Monitoring Platform, which covers costs associated with a platform that performs remote diagnostic testing and reconfigurations of EAD and OSA circuits.
- Cumulo, i.e. non-domestic rates (NDRs), are a form of property tax paid by ratepayers on their rateable assets which include telecoms assets such as fibre and duct.

A17.35 Passive components relate to the passive elements of an EAD circuit and may therefore include costs that are relevant to a dark fibre circuit (but may vary between the DFA and DFX segments). These include:

- Existing physical infrastructure assets such as ducts and poles;
- Ethernet Main Links, which covers costs associated with providing connectivity between BT exchanges where the ends of an Ethernet circuit are in different BT exchange areas;
- Routing and Records, which covers costs associated with the physical verification and initial recording of routings within the network;
- EAD Fibre, which covers costs associated with the fibre used to provide an access segment between a served location and its local BT exchange for EAD services; and
- Ethernet Excess Construction, which covers costs associated with the construction of additional duct and fibre when there is no existing BT infrastructure connecting a served location to its local BT exchange.[751]

A17.36 Shared components relate to both the active and passive elements of an EAD circuit and so may include costs that are relevant to a dark fibre circuit. These include:

- Openreach Sales Product Management, which covers the costs of staff who work in the Sales Product Management division of Openreach;
- Openreach Systems & Development (Ethernet), which covers the development costs for Openreach Ethernet products which are predominantly related to software such as ordering, billing and task allocation systems;
- Openreach Service Centre Assurance (Ethernet), which covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints relating to fault reporting and repairs for Ethernet services;

[751] Since 2014, we have directed BT to exempt EAD orders from excess construction charges (ECCs) below a threshold charge and to recover the resulting loss of revenue by including a balancing charge in the connection price.

- Openreach Service Centre Provision (Ethernet), which covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints relating to provisions for Ethernet services;
- SLG Ethernet Assurance and SLG Ethernet Provision, which cover costs associated with Service Level Guarantee (SLG) payments made to customers if Openreach fails to meet contractually agreed timescales for repair and provision activities respectively.
- Ofcom Administration Fee (Openreach), which covers the costs of the Network and Services Administrative Charges that Ofcom charges BT; and
- Revenue receivables, which cover part of the working capital for a service. These costs are an estimate of the amounts that service users (whether BT's own downstream businesses or other providers) owe to BT for each service based on BT's standard payment terms.

Table 17.2: Classification of components required for dark fibre services based on EAD components found in BT's 2019/20 RFS

EAD component	Classification	Dark fibre connections	DFA rental	DFX rental	Main link rental
Ethernet Electronics (Current and Capital)	Active				
Ethernet Monitoring Platform	Active				
Cumulo Non NGA	Active				
PI Non RAV	Passive		✓		✓
PI RAV	Passive		✓		✓
TC_Poles	Passive		✓		✓
Ethernet main links	Passive				✓
Routing and Records	Passive	✓			
Ethernet Access Direct Fibre	Passive		✓		
Ethernet Excess Construction costs	Passive	✓[752]			
Openreach sales and product management	Shared	✓	✓	✓	✓
OR Systems and Development - Ethernet	Shared	✓	✓	✓	✓
OR Service Centre – Provision Ethernet	Shared	✓			
OR Service Centre – Assurance Ethernet	Shared		✓	✓	

[752] We include ECCs for the DFA segment but exclude these costs for the DFX segment.

EAD component	Classification	Dark fibre connections	DFA rental	DFX rental	Main link rental
SLG Ethernet Assurance	Shared		✓	✓	
SLG Ethernet Provision	Shared	✓			
Ofcom Administration fee – Openreach	Shared	✓	✓	✓	✓
Revenues Receivables	Shared	✓	✓	✓	✓

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A17.37 We set out below the rationale for including and excluding these components in the various dark fibre services.

Passive infrastructure costs (element A)

A17.38 For each dark fibre service (e.g. connections, rental, main link) we include the unit FAC of any passive components used to provide the corresponding EAD service or EAD LA that we consider would also be required to provide DFX or DFA respectively.

Physical infrastructure assets

A17.39 The dark fibre main link service should include the full unit FAC of the PIA components attributed to the EAD main link service given that a (single fibre) dark fibre circuit uses up the same amount of space as an EAD circuit. For the same reason, the DFA segment should include the full unit FAC of the PIA components attributed to the EAD LA service.

A17.40 The DFX segment should exclude the full unit FAC of the PIA components attributed to the EAD rental service. EAD rental services include duct costs that are not part of inter-exchange connectivity thus not relevant for the DFX segment.[753]

Ethernet Main Links

A17.41 The dark fibre main link service should include the full unit FAC of the Ethernet Main Links component attributed to the EAD main link service, whilst the DFA segment should not.

Routing and Records

A17.42 The DFX and DFA connection services should include the full unit FAC of the Routing and Records component that is attributed to the EAD and EAD LA connections, respectively. This is because we do not expect any significant difference in the time, and therefore cost, associated with routing and recording connections for dark fibre compared to EAD circuits.

[753] These costs are included within the main link component.

EAD fibre

A17.43 The DFX segment should not include the costs of the EAD Fibre component that are attributed to the EAD rental service. DFX will not require any fibre other than that required to connect the circuit between the two BT exchanges. The costs of that fibre are included within the Ethernet Main Links component.

A17.44 The full unit FAC of the EAD Fibre component that are attributed to the EAD LA rental service should also be recovered through the DFA segment. The dark fibre service from the served customer location to the BT exchange will require fibre.

Ethernet Excess Construction and Ethernet Excess Construction Capex

A17.45 We consider that there will be little, if any, extra construction work that will be required for DFX as the infrastructure supporting connectivity between BT exchanges is already in place. Therefore, we do not include the costs of the Ethernet Excess Construction Capex components in the DFX segment.

A17.46 We consider that Ethernet Excess Construction will be relevant to the DFA segment since there will be circumstances where infrastructure is needed to support connectivity between a customer site and a BT exchange. Therefore, we include the full unit FAC of the Ethernet Excess Construction costs attributed to the EAD LA connection service in the connection charge of the DFA segment.

Other costs not specific to dark fibre services (element B)

A17.47 For DFA and DFX, we include an appropriate proportion of the unit FAC of any shared components used to provide the corresponding EAD LA / EAD service. Below we set out our treatment of the costs for each of the following components:

- Openreach Systems and Development (Ethernet);
- Openreach Service Centre – Assurance (Ethernet) and SLG Ethernet Assurance;
- Openreach Service Centre – Provision (Ethernet) and SLG Ethernet Provision;
- Openreach Sales and Product Management;
- Ofcom Administration Fee; and
- Revenue Receivables.

A17.48 Some or all of the costs of the above components can be viewed as being common with active Ethernet services or indeed common with other non-Ethernet services.

Openreach Systems and Development (Ethernet)

A17.49 In BT's RFS, Openreach Systems and Development (Ethernet) costs are attributed to Ethernet connection, rental and main link services based on service volumes.[754] However, some systems

[754] Costs are attributed to connection services based on the number of circuits ordered during the year and to rental and main link rental services based on the number of rentals during the year (main link rental volumes are measured in kilometres, so the usage factor is based on the average circuit length).

are only relevant for active services thus not appropriate to allocate to dark fibre. We proposed to only apply a fraction of the EAD development costs to dark fibre.

A17.50 Our analysis of systems expenditure data between 2015/16 and 2017/18 (provided by Openreach) suggested that around [✂]% of these costs are specific to active services. Therefore, we proposed to allocate [✂]% of the unit EAD service costs for the Openreach Systems and Development to dark fibre services.

A17.51 Openreach argued that it is inappropriate to apply our proposed scaling factor which was based on historical development costs as these are not forward looking and do not reflect future costs associated with the launch and operation of dark fibre.[755]

A17.52 We recognise that the introduction of dark fibre could result in additional systems and development costs on top of those found for EAD and EAD LA. We also find, based on our analysis of historical costs, that some of the previous systems and development costs will not be required for dark fibre. Given the cost uncertainty and very limited impact on dark fibre charge, we do not consider it appropriate to apply a scaling factor.

Openreach Service Centre – Provision (Ethernet) and SLG Ethernet Provision

A17.53 Ethernet Provision costs are attributed to Ethernet connection services based on service volumes.

A17.54 We do not consider there would be material differences in the number of provisioning-related calls made per circuit to Openreach customer contact centres (or the activities involved in handling such calls) between EAD / EAD LA and dark fibre services. We therefore include the unit FAC of the Openreach Service Centre – Provision (Ethernet) component in the dark fibre connection charges based on the allocation to EAD / EAD LA service in the RFS.

A17.55 However, provisioning SLG payments for EAD / EAD LA circuits are currently a function of the rental price of the EAD circuit whose installation has been delayed. We have therefore adjusted the unit FAC of the SLG Ethernet Provision component based on the difference in rental charges between the DFX segment and EAD service; and DFA segment and EAD LA service.

A17.56 We adjust for differences in rental charges using the ratio of the sum of unit costs across rental and main link services as a proxy for rental and main link prices. These unit costs exclude the costs of SLG Ethernet Provision, as well as those of other components we estimate based on relative prices (e.g. Ofcom Administration Fee and Revenue Receivables as discussed below).

Openreach Service Centre – Assurance (Ethernet) and SLG Ethernet Assurance

A17.57 Ethernet Assurance costs are attributed to Ethernet connection services based on service volumes. We consider that the appropriate framework for estimating the unit costs of this component for dark fibre rental services is to consider the relative number of faults per circuit likely to be incurred on DFX or DFA relative to an EAD circuit or EAD LA circuit respectively.

[755] Openreach response to the January 2020 Consultation, paragraphs 9.238 to 9.241.

A17.58 In the 2019 BCMR, we examined the number of reported EAD / EAD LA faults split by the clear code submitted by the Openreach engineer upon handling the fault. Based on this fault rate information, we consider dark fibre SLGs to occur 52% of the time when compared to EADs.

A17.59 However, repair SLG payments for EAD/EAD LA circuits are currently a function of the rental price of the EAD circuit whose repair has been delayed. Therefore, consistent with our approach to SLG Ethernet Provision, we have also adjusted the unit FAC of the SLG Ethernet Assurance component based on the difference in rental charges between the DFX segment and EAD service; and the DFA segment and EAD LA service.

Openreach Sales and Product Management

A17.60 In BT's RFS, Openreach Sales Product Management costs are attributed to connection, rental and main link services based on a survey of expected time allocation of staff in the Openreach Sales Product Management team.

A17.61 In the BCMR 2019, we assumed a split of Openreach Sales Product Management costs between active Ethernet services and dark fibre services using Openreach assumptions relating to the likely split of time between Ethernet and dark fibre services in a world where the latter were introduced.

A17.62 We proposed to only apply a fraction of the EAD sales and product management costs to dark fibre. Openreach has argued that the BCMR 2019 data used would need to be further adjusted to account for the different service volumes for active and dark fibre services.[756] Making such an adjustment could mean a scaling factor of 73% rather than 19%.

A17.63 Given that some of the sales and product management costs are fixed and shared across multiple services, it is unclear what the exact adjustment to the scaling factor should be. The 73% calculated by Openreach suggests that most, if not all, of these costs should be allocated to dark fibre services. We find that there is insufficient evidence to suggest that a scaling factor is appropriate and have allocated the same unit cost of EAD Openreach Sales Product Management to dark fibre. As with the Systems and Development costs, we find that this has a very limited impact on the dark fibre charges.

Ofcom Administration Fee and Revenue Receivables

A17.64 In BT's RFS, the cost of the Ofcom Administration Fee (Openreach) is attributed to connection, rental and main link services based on revenue. Revenue Receivables costs are also attributed to connection, rental and main link services based on revenue.

A17.65 We adjust the unit FAC of the Ofcom Administration Fee (Openreach) and Revenue Receivables components to reflect the relative prices of EAD and the DFX segment; and the prices of EAD LA and DFA segment. We consider that this approach would be consistent with BT's approach to attributing the costs of these components in its RFS.

[756] Openreach response to the January 2020 Consultation, paragraphs 9.242 to 9.249.

Treatment of non-domestic rates

A17.66 We provide more background on NDRs when discussing our approach to forecasting BT's cumulo costs (see Annex 14).

A17.67 In general, the NDR liability is calculated by multiplying a rateable value (RV) by a 'rate in the pound'. RVs are assessed by the relevant rating authority in each nation, for example the Valuation Office Agency (VOA) in England and Wales. In the case of BT, and some other telecoms providers, all contiguous rateable assets are valued together in what is called a 'cumulo assessment'. BT's NDR costs on its rateable network assets are therefore commonly referred to as its cumulo costs.

A17.68 With respect to fibre assets, rating precedent has determined that as a general rule of thumb, the party who lights the fibre is considered to be in rateable occupation. This means that if BT sells an active leased line service, it is liable for the NDRs, whereas if BT sells a dark fibre service, the purchasing telecoms provider is liable for the NDRs once it lights that fibre. Prices for dark fibre services should therefore not include any contribution to BT's NDR costs.

A17.69 As we adopt a cost-based approach to setting dark fibre prices in this control, we therefore do not include BT's attribution of its cumulo rates costs to EAD services in the cost stack for dark fibre services. This primarily affects rental services because relatively little of BT's cumulo costs are attributed to connection services.

Charge control design

A17.70 In Volume 4 Section 3, we set out our charge control design. In summary, we set:

- A 5-year control for dark fibre services.
- Charges are at cost at the start of the control period and thereafter charges are aligned to our forecast of costs over the 5-year control period.
- Single service charge controls for DFA and DFX.

Pricing of ancillary services

A17.71 For Openreach to provide dark fibre services, it would also need to provide a number of ancillary services. These ancillary services can be divided into two groups.

A17.72 The first group relates to services that Openreach already offers to provide active services (e.g. TRCs and ECCs). This group should be offered and charged for on the same basis as for active services. The second group relates to those that are specific to dark fibre services, i.e. patch panels, initial testing, Right When Tested (RWT), and cessation.

A17.73 To estimate the costs for the second group, we have constructed cost estimates using an engineering-led approach. We note that most of these costs are labour based which we expect will roughly trend with CPI, further supporting our decision to use a CPI-0% control.

Costs specific to dark fibre ancillary services

A17.74 We consider it appropriate to calculate the costs associated with dark fibre ancillary services using a bottom-up approach as the costs for these services cannot be easily derived from BT's RFS. The cost for these services will be driven by labour rates and the estimated cost of a patch panel.

Labour rates

A17.75 All ancillary services involve engineers performing activities as part of the provisioning process for dark fibre circuits. To estimate these costs, we need to make assumptions about labour rates.

A17.76 We have followed the approach used in the BCMR 2019 that relied on Openreach cost estimates specific to dark fibre services in its DFA Reference Offer that was required as part of the BCMR 2016 but was not implemented. In the DFA Reference Offer, Openreach used LRIC labour rates for two engineering grades with different skillsets; we refer to these as 'less qualified' and 'more qualified' engineers.

A17.77 We use the direct labour rates published in BT's RFS for TRCs as a proxy for these labour rates. We use the TRC Total Direct Cost per hour for TRCs relating to Fixed Access markets as a proxy for the less qualified engineer pay rates which in 2019/20 was £41.05 per hour. Similarly, we use the TRC Total Direct Cost per hour for Ethernet TRCs as the proxy for the more qualified engineer pay rates which we estimate to be £51.13 per hour in 2019/20.

A17.78 As we are setting charges using a FAC cost standard, these labour rate assumptions should include contributions to indirect and support costs. We note that the amount of overheads attributed to TRCs varies from year to year. We have decided to adopt the proposed 20% uplift.

A17.79 Openreach has argued that the task times for these ancillary services is based on a national level rather than being Area 3 specific.[757] As set out in paragraph A17.30 above, we consider it appropriate to set charges based on national costs (excluding CLA).

Patch panel

A17.80 The handover point for Openreach's EAD service to the purchasing telecoms provider is the EAD Network Termination Equipment (NTE) installed at each of the two served locations. The purchasing telecoms provider can then connect its own equipment to the NTE via either an Ethernet or optical interface.

A17.81 To provide DFA and DFX, Openreach needs to install some form of passive NTE to hand over the service to the purchasing telecoms provider. We estimate the unit FAC for patch panels by:

- Calculating the cost of installing a patch panel: this is the sum of the patch panel equipment cost plus the FAC cost of labour, assuming the work would be undertaken by a less qualified engineer; and

[757] Openreach response to the January 2020 Consultation, paragraphs 9.276 to 9.279.

- Converting this to an annual cost per circuit by assuming the costs would be capitalised over an assumed life of 7 years.

A17.82 Openreach has argued that our patch panel equipment costs do not reflect the variety of patch panels offered. It also argued that the assumed task times for the exchange-based patch panel does not account for the need to pre-splice all fibres.[758]

A17.83 We find that patch panels can cost both above and below our estimates and do not consider the specific examples highlighted by Openreach to be appropriate proxies. Given the relative charge of patch panels compared to the main rental charges, it would not be proportionate to have multiple patch panel charges to account for the different types. We also do not consider it likely that patch panels at BT exchanges where regulated dark fibre is available will reach full utilisation, i.e. not all fibre will need to be spliced.[759]

A17.84 Therefore, the specific charges for dark fibre ancillary services are:

- **Patch panel charges** – To provide DFA and DFX, Openreach needs to install some form of passive NTE to hand over the service to the purchasing telecoms provider. We have used our estimates of the annualised cost for patch panels, set out above, to determine charges for this service.
- **Initial testing charges** – A dark fibre circuit would need to be tested when it is connected for the first time. We assume that initial testing takes 2.5 hours and use our estimate of the FAC labour rate for a less qualified engineer of £49.26 per hour.
- **RWT charges** – A RWT charge is intended to incentivise purchasing telecoms providers experiencing faults on dark fibre circuit to carry out diagnostic tests eliminating their own networks and/or equipment as potential causes before reporting such faults to Openreach. We assume that 5 hours, in total, of a more qualified engineer is required at a FAC of £61.36 per hour.
- **Cessation charges** – A dark fibre circuit would need to be physically ceased by an engineer to stop it from being used when it is no longer being charged for. We assume that 2 hours of planning is required, with a more qualified engineer, and 1 hour is required for a less qualified field engineer to physically cease.

A17.85 These four dark fibre ancillary services will be set at cost in the first year and charge controlled at CPI-0% thereafter.

[758] Openreach response to the January 2020 Consultation, paragraphs 9.273 to 9.275.
[759] Furthermore, we consider it likely that the CPI-0% charge control would allow some additional cost recovery due to potential efficiency gains in either the task time or cost of the equipment. This additional cost recovery could allow for the rare occasion that an installed patch panel needs to be spliced again.

A18. The calculation of PIA maximum charges

A18.1 In Section 4 of Volume 4 we set out the maximum charges for PIA rental services. These maximum rental charges are based on a 'cost based' approach that involves the calculation of two components:

- Network adjustment costs – associated with necessary adjustments undertaken by Openreach to make the PIA infrastructure ready for use by other telecoms providers.[760]
- Asset costs – these relate to the cost of the existing physical infrastructure to which access is granted.

A18.2 In previous reviews we included a third component – productisation costs. However, as discussed in Volume 4 Section 4 we no longer need to identify these separately as any productisation costs are included within the revised base data we are using.[761]

A18.3 This annex explains in more detail the calculations that we make to estimate the costs of both of the above elements. We discuss network adjustments first and then asset costs but before we do so, we set out issues that affect the calculation of both elements.

- We are setting maximum charges for PIA rental services for the forward-looking period including 2025/26. For both components we therefore forecast costs over the charge control period up to and including 2025/26. The maximum charges we calculate for each year of the control period are rounded to the nearest penny, consistent with the approach adopted on Openreach's pricing website.
- When we calculate fully allocated costs we include a return on capital employed assuming a WACC of 7.0%. We consider this to be the most appropriate assumption for the purpose of controlling PIA charges over the review period, as this WACC most closely reflects the risk associated with physical infrastructure.
- We differentiate between what we call PIA cost components and PIA services. We set maximum charges for PIA services. PIA cost components are the cost categories under which we collect costs and from which we derive maximum charges. The PIA cost components are: lead-in duct, single bore duct, 2 bore duct, 3+ bore duct, manholes, junction boxes and poles. For some PIA services the component is the same as the service – for example single bore and 2 bore duct. However, for others the PIA component provides costs for several services. For example, the poles cost component provides costs for the four poles PIA services: cables up a pole, manifolds and single- and multi-user attachments.

Network Adjustment costs

A18.4 As we explain in Volume 4, Section 4, we have decided that the costs of network adjustments should be recovered across all SMP products that use the physical infrastructure, subject to a

[760] These costs are essentially asset costs which Openreach has not incurred to date and so are not reflected in the base cost data for the asset component. We therefore estimate these separately.
[761] Openreach's response dated 4 June 2019 to the s.135 notice entitled "Promoting competition and investment in fibre networks" dated 17 April 2019, question 3. Openreach noted that it had identified two types of productisation costs in its 2017/18 RFS and "had included these productisation costs in the duct and pole components" costs that it had provided.

financial limit. We explain that we include an allowance for the costs that Openreach incurs when making network adjustments below that financial limit (appropriately capitalised) in the regulatory cost base that we use to calculate PIA rental charges. Any expenditure above the financial limit is not included in this cost base.

A18.5 In this calculation we only estimate the cost of incremental network adjustments incurred below the limit by external, i.e. non-Openreach, telecoms providers. The costs of any network adjustments below the limit incurred by Openreach are included within our forecasts of Openreach's PIA related capital expenditure that we use when assessing asset component costs – see below.

A18.6 To estimate these external network adjustment costs, we use a very similar methodology to that we employed in the 2018 WLA, except that we estimate the costs of network adjustments each year from 2020/21 to 2025/26.

- We assume that network adjustment costs to be recovered were £67.74 per premise passed in 2019/20. This is the same value that we assumed in the 2018 WLA.[762] We also assume, as before, that £16.66 relates to the pole element and the remainder, £51.08 to work relating to duct and footway boxes. We increase all cost elements by RPI every year, consistent with our asset inflation assumptions for all direct PIA assets.
- Using our statutory information gathering powers, we obtained telecoms providers' fibre network roll-out plans and their assessment of the extent to which they might use Openreach's physical infrastructure to do so.[763] We have used these plans to inform our estimates that around [✂] million premises will be passed by new networks built using Openreach's physical infrastructure over the period from 2020/21 to 2025/26.[764]
- We multiply the forecasts of homes passed using PIA by the relevant unit costs to estimate the total incremental network adjustment costs in each year separately for pole activities and for duct and footway activities.
- We assume these costs will be capitalised and so we depreciate this capital expenditure using an asset life of 40 years for poles related activities and 40 years for duct and footway boxes activities.
- We generate a profile of gross replacement costs, net replacement costs and CCA depreciation and holding gains and losses from the cumulative expenditure over the period.

A18.7 As in previous models, these incremental network adjustment costs are then added to asset components costs, effectively forming an overhead on these. These network adjustment costs are therefore attributed to PIA services in exactly the same way as all other costs. We treat duct and footway related network adjustment costs as relating to assets post 31 March 2018 when attributing these to PIA services.

[762] Ofcom, 2018. *Statement: Wholesale Local Access Market Review*, Volume 3, paragraph 5.91.
[763] [✂].
[764] Telecoms providers plans involve a mixture of PIA and self-build. We estimate the equivalent number of premises passed using 100% PIA by multiplying the number of premises passed by the expected proportion of the deployment that will use PIA.

Asset costs

A18.8 The calculation of the asset cost component of PIA is carried out using the following 4 steps.

- **Step 1:** Determine the regulatory cost base for every year of the review period for the relevant infrastructure (assets) being accessed. The regulatory cost base comprises a return on capital, depreciation (net of holding gains), and operating costs. Consistent with BT's RFS we use costs prepared on a Current Cost Accounting (CCA) basis. The base cost data we have used has been derived from BT's 2019/20 RFS[765] and we then make some adjustments to this.
- **Step 2:** We forecast the resulting capital and operating costs over the period. These forecasts require various assumptions, notably about what future volume growth and capital expenditure will be.
- **Step 3:** Attribute the regulatory cost base between different PIA services. BT's systems do not record costs separately for different duct bore sizes or for footway boxes, so we attribute total duct and footway service costs to individual services in each year. Similarly, BT's systems do not record costs for the different pole services such as manifolds, attachments or cables up poles so again we attribute total poles costs to the three main poles services.
- **Step 4:** Calculate unit costs for each service in each year and set rental charges as a share of these unit costs. The unit costs are measures such as cost per metre of single bore duct or the costs of attachments per pole. Final charges are calculated as the shares of each unit cost.

A18.9 Although these steps are, at a high level, the same for both duct and footway PIA services and for pole PIA services there are some detailed differences. Below, we therefore go through each of these steps separately for duct and footway box assets and for pole assets.

Duct and footway box assets

Step 1: Determination of the regulatory cost base for ducts and footway boxes

A18.10 The base data provided by BT included both operating costs and capital costs. BT currently capitalises most costs associated with duct and footway boxes and records these under the LDD class of work.

A18.11 Operating costs were split as follows:

- Pay and non-pay costs.[766] These include contributions from Openreach and corporate overhead costs.
- CCA depreciation for the main duct class work (LDD) with HCA depreciation, Supplementary depreciation, Holding Gains and Losses, and Other CCA adjustments identified separately.

[765] BT's response dated 8 October 2020 to the s.135 notice titled *Promoting competition and investment in fibre networks* dated 11 September 2020, question 10.

[766] Costs excluded any of BT's cumulo rates costs as non-domestic rates are generally not payable on passive assets. It is only once "active" equipment is attached to these passive assets that a rating liability is triggered.

- A small amount of CCA depreciation associated with other assets required to provide PIA services. This mainly consisted of depreciation associated with the funding of BDUK assets plus some support assets such as software. None of these other assets are revalued on a CCA basis within BT's RFS.

A18.12 Capital costs included the following items:

- GRCs (Gross replacement costs) and NRCs (Net replacement costs) for the duct class of work (LDD);
- GRCs and NRCs for other assets;
- Net Current assets.

A18.13 The base data BT provided on duct and footway boxes was consistent with the way BT reports the costs of PIA assets in its RFS. It excluded CCA depreciation and capital costs on:

- Duct that connects copper cables to fibre cabinets since this infrastructure is used for cabinet connectivity only.[767]
- ECCs and Repayment costs: the revenues for both activities recover any expenditure on assets "up front". Any spend on PIA assets associated with these revenue streams is not considered part of the PIA market and should not be recovered via PIA rental charges. Within its RFS, BT adjusted for both revenue streams on an HCA basis.

A18.14 We make several adjustments to the base data:

- Wayleaves: Openreach's wayleaves are legal agreements that allow it to site its infrastructure on third party property. Openreach requires wayleaves both for its physical infrastructure, such as ducts, footway boxes and poles but also for its fibre and copper cables. In its 2020 CCN BT said that it was going to change "the treatment of wayleave costs, now allocating these to the PIA components rather than to the dropwire component".[768] Within the 2020 RFS BT therefore allocated all of Openreach's wayleave costs to the PIA market. However, we do not consider that attributing 100% of these costs to the PIA market is reasonable: we consider that some should be attributed to non-PIA market infrastructure, such as fibre and copper cables. We have therefore removed 50%[769] of total wayleaves cost allocated to all PIA services.
- We split LDD costs GRCs, NRCs and CCA depreciation into those relating to assets pre and post 31 March 2018[770]. For those prior to 31 March 2018, we split the assets into Pre 1997 access, Pre 1997 non-access and post 1997 using information from BT's RAV model.
- Excess Construction Charges (ECCs) and Repayment Costs: BT currently attributes the costs and revenue of Repayment work activity to the Openreach residual market, as we directed

[767] BT's response dated 17 December 2020 to the s.135 notice titled *Promoting competition and investment in fibre networks* dated 18 November 2020, question 26.
[768] See change 3.04 of BT's 2020 CCN, on page 18, https://www.bt.com/bt-plc/assets/documents/about-bt/policy-and-regulation/our-governance-and-strategy/regulatory-financial-statements/2020/change-control-notification-2019-20.pdf [accessed 2 March 2020].
[769] The net replacement costs of all fibre and copper cable assets was roughly the same as that of duct and poles assets in 2020/21.
[770] By assets installed pre 31 March 2018 we mean assets installed up to and including 31 March 2018.

it to. BT also no longer capitalises its ECC costs.[771] The revenues for both of these activities recover any expenditure on assets "up front" so any spend on PIA assets should not be recovered via PIA rental charges. We reviewed BT's adjustments and found that it had not removed some historical capex on ECCs and further that both the repayment and ECC adjustments had been undertaken on an HCA basis.[772] We have therefore removed the missing capex and converted both adjustments to a CCA basis.

- Project Management (PMO) costs: Openreach told us that there has been some PMO costs that had been incorrectly booked to the LDD class of work over three years 2017/18 to 2019/20 and that this had been corrected for 2020/21 onwards.[773] We have removed these costs from the GRC, NRC and CCA depreciation in our base year.
- Misclassification of supplementary depreciation: BT told us that in the 2019/20 RFS it had overstated the 'Supplementary depreciation' for the PIA market and understated 'Other CCA adjustments'. We have therefore corrected for this error.[774]

Step 2: Forecast the regulatory cost base over the charge control period

A18.15 We forecast the adjusted pay and non-pay operating costs in the base year over the charge control period in the same way as we forecast operating costs in other top-down charge controls.[775] In applying our standard formulae, we assume efficiency (or cost savings) of 3.5% per annum,[776] apply a cost volume elasticity (CVE) of 0.74 for PIA pay and non-pay costs, based on our analysis of outputs from BT's LRIC model[777] and assume operating cost inflation of CPI across both pay and non-pay operating costs. Finally, we have set volume growth to be the year-on-year change of installed base (rental) volumes, derived from our capex forecasts. None of these assumptions are particularly critical to the final maximum charges we estimate as operating costs are a relatively low proportion of the duct and footway boxes cost base.

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[771] See change 3.08 of BT's 2020 Change Control Notification, page 23, https://www.bt.com/bt-plc/assets/documents/about-bt/policy-and-regulation/our-governance-and-strategy/regulatory-financial-statements/2020/change-control-notification-2019-20.pdf [Accessed 2 March 2021]

[772] BT response dated 2 December 2020 to s.135 notice titled *Promoting investment and competition in fibre networks* dated 18 November 2020, questions 30 and 32. BT response dated 23 February 2021 to s.135 notice titled *Promoting investment and competition in fibre networks* dated 16 February 2021, question 2.

[773] Openreach's response dated 16 December 2020 to the s.135 notice titled *Promoting competition and investment in fibre networks* dated 8 December 2020, question 14.

[774] BT response dated 2 December 2020 to s.135 notice titled *Promoting investment and competition in fibre networks* dated 18 November 2019, question 33.

[775] See for example Table A11.11, Annex 11 of the 2018 WLA market review, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/112491/wla-statement-annexes-1016.pdf [Accessed 25 February 2021]

[776] In Annex 14 we have decided to adopt a base case of 5% as our operating cost efficiency target for business connectivity services and 3.5% for WLA services. The analysis on which this was based included costs of PIA services so it can be argued that adopting an efficiency target somewhere in the range 3.5-5% would be consistent. When analysing efficiency or cost savings we do so by removing the impacts of cost inflation and volume growth. We have decided to adopt the WLA value of 3.5% and apply that to PIA services, as volume growth for PIA assets has been lower and more comparable to that of WLA services than to business connectivity services.

[777] We have estimated this CVE using information from BT's Additional Financial Information schedules AFI-A1 and A3 that it provides to us privately every year as the ratio of LRIC to FAC costs (as we have done in other charge controls). The costs relate to the PIA market increment. We do not have separate LRIC cost results for duct and footway boxes and poles. We have therefore calculated one CVE for all PIA pay and non- pay costs. To ensure consistency with the way we treat these costs we have removed half the costs of wayleaves (to be consistent with our base data adjustment) and all pole testing costs (as we forecast the latter separately) from the PIA market FAC and LRIC costs.

A18.16 We forecast the adjusted capital costs GRCs, NRCs and CCA depreciation, including Holding losses and gains – from the base year over the charge control period as follows:

- We assume all duct and footway box assets have a life of 40 years, and that asset price inflation for all of these assets is RPI.[778]
- Capital costs associated with LDD assets installed pre 31 March 2018: we forecast pre 1997 access assets, pre 1997 non access assets and post 1997 assets installed over the period 1997 to 2018 separately. For each we forecast opening and closing GRCs and NRCs for each year of the charge control period, and then calculate the mean NRC in each year as the average of the opening and closing balance. To forecast opening and closing balances we use a very similar approach to that we have used in other top-down charge control models and one that is consistent with BT's RAV model that is used for the valuation of duct assets on a CCA basis within BT's RFS. We forecast OCM depreciation and holding gains and losses using our assumptions about asset lives and asset price inflation noted above. We assume that there are no write-outs (or disposals) associated with post 1997/98 assets, as these assets have a life of 40 years, but we do forecast some disposals of pre 1997/98 assets. Other CCA adjustments have historically been very low and consistent with our approach in other top-down models we forecast these to be zero in the future. We assume no new capex on these historical assets as this is forecast in the next category. We classify all these costs – OCM depreciation and mean NRCs – as associated with assets installed pre 31 March 2018.
- Capital costs associated with "LDD" assets installed post 31 March 2018: we forecast these using the same process as for historic LDD assets except that we include the forecast capital expenditure. As we explain in Volume 4, Section 4 Openreach provided us with forecasts of capital expenditure that were consistent with BT's full-fibre roll out plans announced in May 2020.[779] These included estimates of how much of this spend related to PIA assets and estimates of forecast volumes of duct and footway assets. As explained in Volume 4, Section 4 we have used Openreach's forecasts for LDD assets. Again, we assume there are no write outs over the period as these assets have a life of 40 years. Finally, we add a small allowance for assets in the course of construction (AICC) based on historic trends.[780]
- Capital costs associated with "non-LDD" assets: These are a mix of a "negative" assets, associated with the funding on BDUK assets, and support assets such as software and computing.[781] As these assets are not revalued in BT's RFS, for simplicity we assume both depreciation and NRCs grow in line with volumes over the charge control period. This is not a critical assumption because these account for a small percentage of depreciation and an even smaller percentage of mean capital employed.

[778] In Volume 4 Section 4 we discuss and reject the call from some stakeholders to move indexation of PIA assets to CPI. We have some evidence from Openreach that asset price inflation for duct and pole asset has been higher than both CPI and RPI over the 10 years. Openreach response dated 8 October 2020 to s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 8 and Openreach's response dated 5 March 2021 to s.135 notice titled *Promoting investment and competition in fibre networks* dated 26 February 2021, question 1.
[779] Openreach's response dated 18 December 2020 to s.135 titled *Promoting investment and competition in fibre networks* dated 8 December 2020, question 13.
[780] This is included in the base year MCE figures and is included within estimates of mean capital employed within BT's RFS.
[781] Openreach response of 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 6.

- Net current assets are forecast using the standard formulae that we have applied in other recent top-down charge control models.

A18.17 In the next step we attribute costs associated with assets installed pre 31 March 2018 separately to those installed after that date. The final stage in this step is then to attribute all non-LDD costs to assets installed in one of those two periods. We attribute pay and non-pay operating costs and depreciation on non-LDD assets using the relative OCM depreciation on LDD assets installed pre and post March 2018 in each year. We attribute other MCE and net current assets using the corresponding LDD NRCs in each year.

A18.18 The output of the above process is two sets of operating costs (including depreciation and holding gains and losses) and mean capital employed (including net current assets). These form the regulatory cost base for assets installed pre 31 March 2018 and the other for assets installed post 31 March 2018 respectively.

Step 3: Attribute the duct and footway regulatory cost base between different PIA services

A18.19 As we explain in Volume 4 Section 4, Openreach provided us with updated estimates of the attribution of its duct and footway costs between PIA cost components using a methodology analogous to that we and Openreach had used in previous market assessments. The attributions were in proportion to relative GRCs as estimated by a bottom-up evaluation using total installed volumes and standard unit costs for each duct and pole component in 2019/20. The standard unit costs were derived from Openreach's Network Inventory Management System. Openreach also provided us with similar information over the period 2012/13 to 2018/19.[782] Whilst the attributions over this period were relatively stable, they were however very different to those that Openreach had provided previously, implying significant increases in the proportion to be attributed to single bore duct and much less to 3+ bore duct.

A18.20 As we noted in Volume 4 Section 4, we have decided to apply the "old" attributions used to set charges in the 2018 WLA to costs associated with assets installed pre 31 March 2018. For assets post 31 March 2018, we calculate revised attributions each year to take account of volumes of each duct and footway box component growing at different rates.

A18.21 When calculating the revised "post 31 March 2018" attributions each year we have also:

- Assumed all unit costs in 2019/20 increase by RPI each year.
- Assumed the unit cost of lead-in duct remains the same as that for single bore spine duct.[783] This is an assumption that has been used in previous assessments.[784]
- Revised the standard unit costs of multi-bore services to reflect Openreach's product definitions. For example, a length of 2-bore duct is usually formed of one 2-bore duct but is

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[782] Openreach's response dated 15 May 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 6 May 2020, question 14. Openreach's response dated 30 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 17 October 2019, question 3.
[783] Openreach currently does not separately record the costs for lead-in duct. However, Openreach has confirmed that this is a reasonable assumption to make by undertaking a bottom-up comparison of the activities and relative costs of installing a metre of lead-in duct and single bore spine duct. Openreach's response dated 1 October 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 13.
[784] See for example paragraph A25.6, Annex 25 of WLA 2018 Statement, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/112491/wla-statement-annexes-1016.pdf [Accessed 25/2/2021]

occasionally formed by two single-bore ducts laid next to each other. In both cases, a customer would pay the 2-bore charge.[785] To ensure consistency with this charging approach, we have adjusted the standard unit cost of 2-bore duct to reflect that, in practice, it will be a mix of these different configurations.

A18.22 So, to attribute the duct and footway regulatory cost base between different PIA services each year we:

- Calculate the attribution to apply to the costs of assets installed pre 31 March 2018 and post 31 March 2018;
- Attribute the forecast operating costs and mean capital employed associated with assets installed pre 31 March 2018 using the pre 31 March 2018 allocation basis;
- Add the forecasts of network adjustment costs associated with duct and footway boxes to the forecast mean capital employed costs associated with assets installed post 31 March 2018;
- Attribute the overall forecast operating costs and mean capital employed associated with assets installed post-31 March 2018 using the post 31 March 2018 allocation basis for this year; and finally
- Add the results of the two sets of attributions together and calculate a fully allocated regulatory cost base for each PIA cost component by adding together operating costs and a return on mean capital employed, using a WACC of 7.0%.[786]

A18.23 The outputs are a single set of fully allocated costs in each year of the charge control period for each PIA cost component. In the next sub-section, we shall refer to this as the regulatory cost base for each PIA cost component.

Step 4: Calculate unit costs for each service in each year and set rental charges as a share of these unit costs

A18.24 Firstly, we calculate a set of unit costs by dividing the regulatory cost base in each year for each cost component by the volumes forecast in each year for that cost component.

A18.25 We then estimate maximum charges that telecoms providers should pay as what we consider should be a fair share of this unit cost. We explain the reasoning for the shares we have used in Volume 4, Section 4. The shares we have used are given in Tables A18.1 and A18.2 below.

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[785] BT's response dated 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 8.

[786] In the PIA charging model, we calculate fully allocated costs as operating costs (including depreciation) plus mean capital employed times the relevant WACC. We calculate mean capital employed as the mid-year value, i.e. as the average of start year and end year balances. The approach in the PIA model is consistent with that adopted in the previous PIA model used in the WLA 2018 and PIMR 2019 statements and with how BT reports PIA market performance in its RFS. This approach is slightly different to the top-down Cost Forecast Model (see Annex 14). That model uses an approach consistent with that used in our historical top-down charge control models, but this difference does not make a material difference to the model outputs.

Table A18.1: Share of duct PIA services

PIA Service	Share of unit costs
Lead-in duct	90%
1 bore duct	50%
2 bores ducts	25%
3+ bore ducts	10%

Table A18.2: Share of footway services

PIA Service	Share of footway box unit costs per sub-duct
Manholes	3.3%
Joint boxes	15%

Calculation of ducted lead-in charges

A18.26 Telecoms providers using a lead-in cable to connect into one or more premises currently need to purchase a combination of PIA services. In Volume 4 Section 4, we have decided to set prices for ducted lead-in services as a flat charge per connection. This fixed price rental service will apply from the telecoms provider's optical distribution point all the way to the building entry point of the end-customer premises.

A18.27 The calculation of this charge requires information on maximum charges and average volumes per premise for each of the following PIA components:

- Lead-in duct (charged per metre): this is any duct section that is dedicated to serving a single premise;
- Shared duct (charged per metre): this is either shared spine duct or shared rider duct. We explain the difference between these in Volume 4 Section 4;
- Facility Hostings to enter and exit the distribution point and pass through any intermediate footway boxes or chambers.

A18.28 Openreach provided us with the following estimates of these average volumes, calculated from a large and representative sample of 386,952 premises across the UK:[787]

- Lead in duct: [✂] (5 – 15m) per premises;
- Shared duct: [✂] (5 – 20m) per premises;[788]

[787] Openreach response of 10 December 2019 to question 2 of the s.135 notice titled *Promoting investment and competition in fibre networks* dated 2 December 2019.

[788] Openreach explained that, based on information on the 386,952 premises included in their inventory systems shared ducts are, on average, passed by 3 cables. The average length of shared duct is then calculated by using the average total lead-in cable length minus the lead-in duct element divided by 3. Openreach response of 10 December 2019 to question 1 of the s.135 notice titled *Promoting investment and competition in fibre networks* dated 2 December 2019. Openreach explained how it had classified and then estimated shared duct average lengths in its response dated 12 January 2021 to questions 1, 2 and 3 of the s.135 notice titled *Promoting investment and competition in fibre networks* dated 21 December 2020.

- Joint Box exits: [✂] (between 0 and 2) (i.e. Facility Hostings) per premises.[789]

A18.29 The estimated charge for the ducted lead-in service each year is then calculated by multiplying the above average volumes by the estimated charge for the relevant PIA service in that year.[790]

Poles

Step 1: Determination of the regulatory cost base for poles

A18.30 As noted above, our base data is derived from BT's 2019/20 RFS. However, the way this data has been derived for poles is different to that we used in previous market review assessments. The changes reflect analysis that we and Openreach have undertaken over the last couple of years to understand the costs of poles better.

A18.31 Openreach originally believed that the costs of poles had been recorded under the main copper cable class of work, LDC. However, on further investigation it transpired that the costs were recorded under several other cable classes of work, notably copper dropwires plus an increasing proportion under various fibre classes of work.

A18.32 Openreach provided us with estimates of the capital cost of installing a new pole based on detailed planning and costing data used by Openreach going back several years.[791] This revealed that the unit cost of installing a pole had increased by 85% since 2015/16, largely as a result of increased costs for road works and traffic management as well as general cost inflation. The cost of road works has increased from £[✂] to £[✂] (15 fold) since 2015/16 due to increased costs relating to requirements from local authorities and work taking place in areas where the costs of road closures is higher.[792]

A18.33 This analysis also revealed that previous estimates had included the cost of re-cabling activities. Re-cabling occurs when a pole needs to be replaced and cables removed from the old pole and attached to the new one. As discussed in Volume 4 Section 4, we have decided that poles costs should exclude the costs of re-cabling. This reduces the costs of poles significantly. The costs of any re-cabling activities will be charged separately, and Openreach's internal re-cabling costs will be recovered through fibre and copper costs.

A18.34 Openreach also provided us with the numbers of poles registered in each year and estimates of the splits of these by the different classes of work under which these had been recorded, with

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[789] Based on information on the 386,952 premises included in their inventory systems Openreach estimates that there are [✂] (between 1 and 2) Facility Hostings per chamber (Openreach's response dated 10 December 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 2 December 2019, question 1). For the reasons explained in the previous footnote, this is again divided by 3 to provide a per lead-in cable price.

[790] Shared duct is priced at the single bore duct rate. We use the same average volumes in each year as those given above.

[791] BT's response dated 8 October 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 8. This data is sourced from Openreach's Network Inventory Management System which is used to plan, schedule, execute, control and monitor the work related to network infrastructure enhancement and installation.

[792] BT's response dated 8 October 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 9 and BT's response dated 9 December 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 18 November 2020, question 31.

the number of poles funded by repayment works and those which had been expensed also separately identified.[793]

A18.35 Using this volume information, the unit cost information described above, and historical asset price inflation indices used by BT in its RFS for the relevant classes of work, Openreach provided us with estimates of the GRC, and NRC associated with the installed base of poles as at 31 March 2020.[794] It is this data that we have used to assess the main regulatory capital cost base for poles in 2019/20: the GRCs, NRCs and CCA depreciation (together with the information on the asset lives for the relevant cable classes of work under which the poles assets were estimated to have been originally recorded).[795] [796]

A18.36 The remaining base year cost data we have used for poles was supplied by BT and is consistent with the way BT reports the costs if PIA assets in its 2019/20 RFS. For operating costs these were:

- Pay and non-pay costs.[797] These included pole testing costs, which are separately identified as these are forecast separately from other pay and non-pay operating costs, and contributions from Openreach and corporate overhead costs.
- CCA depreciation associated with other assets required to provide PIA poles services. This mainly consisted of depreciation associated with support assets such as software.[798] Only a very small proportion of these assets are revalued on a CCA basis within BT's RFS.

A18.37 The other capital costs included in our base year regulatory costs were GRCs and NRCs for other assets and net current assets.

A18.38 Finally, we make the same adjustment to wayleaves that we have made to the costs of duct and footway boxes: we have removed 50% of total wayleaves cost allocated to poles PIA components. We also separately identify pole testing costs as we forecast these separately. None of the other adjustments we make to duct and footway services are relevant to poles.

Step 2: Forecast the regulatory cost base over the charge control period

A18.39 We forecast most of the adjusted pay and non-pay operating costs for poles services in the base year over the charge control period in the same way as we have forecast operating costs

[793] BT's response dated 8 October 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 8. Openreach noted that the data actually related to the preservation year but it took this as a "proxy for installation year".
[794] BT's response dated 8 October 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 8. We have replicated and checked Openreach's calculations.
[795] As these costs exclude poles installed as a result of repayment works activities, we do not make any other adjustments to remove repayment works costs as have had to do with duct and footway assets.
[796] The depreciation that we have in the model is very close to that within BT's 2019/20 RFS. Our NRC estimates are however higher. BT generated the poles NRC in its 2019/20 RFS from allocations of other classes of work costs but using depreciation as the allocation basis (for LDC). BT's response dated 22 May 2020 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 6 May 2020, question 3. Openreach is planning to start recording costs for poles separately under a new class of work from 1 April 2021. We understand it will use similar estimates of unit costs and volumes as we have used to derive our GRC and NRC numbers. We therefore believe that our estimates of NRCs and GRCs provide a better estimate of what the values will be when Openreach and BT move reporting to the new poles class of work than what is in the RFS currently.
[797] Costs excluded any of BT's cumulo rates costs as non-domestic rates are generally not payable on passive assets. It is only once "active" equipment is attached to these passive assets that a rating liability is triggered.
[798] BT's response dated 8 October 2020 to the s.135 notice entitled "*Promoting investment and competition in fibre networks"* dated 11 September, question 11.

for duct and footway boxes. We have again assumed efficiency (cost savings) of 3.5% per annum, apply a cost volume elasticity (CVE) of 0.74, and assume operating cost inflation of CPI.[799] Finally, we have set volume growth to be the year-on-year change of the installed (rental) base of poles, as derived from our capex forecasts.

A18.40 The exception is pole testing pay and non-pay operating costs where we have used a forecast provided by Openreach.[800] These forecasts of pole testing costs were generally relatively flat over the period.[801]

A18.41 We forecast capital costs - GRCs, NRCs and CCA depreciation, including holding losses and gains – from the base year over the charge control period as follows:

- We assume that Openreach will book all of its pole assets to a new poles class of work from 1 April 2021 and that the asset life of poles from that date will be 40 years.[802] Prior to 1 April 2021 we assume that Openreach will continue to book poles costs to a variety of different cable classes or work as it has previously done.
- We assume that asset price inflation for all pole assets is RPI from 1 April 2021. We use this to generate revised GRCs, NRCs and CCA depreciation using CCA accounting principles.[803]
- We forecast total volumes of new poles installed each year from 2020/21 to 2025/26, broken down by how many of those are replacement poles and how many are new poles. The volume growth we generate to forecast operating costs is calculated from the net additions, i.e. it reflects the new poles only, or total additions less replacements.[804]
- We also forecast the number of different types of poles (for example cable poles, DP and feeder poles), attachments and manifolds.[805] We do this by growing the volumes in the base year by the average annual growth rate of all poles. This keeps the number of attachments and manifolds per pole constant over the period.
- We forecast opening and closing GRCs and NRCs for each year with the mean NRC in each year being the average of the opening and closing balance. To forecast opening and closing balances, we use a very similar approach to that we have used for duct and footway boxes

[799] See the discussion on duct and footway boxes above for the basis for the efficiency target of 3.5% and AVE of 0.74.
[800] Openreach response dated 15 October to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 11 September 2020, question 2.
[801] Openreach noted that people testing schedules are constantly under review depending on resource and demand.
[802] BT has told us that from April 2021, instead of booking poles against four different classes of work, they will instead be booking new poles against one, new class of work. This will also mean that going forward all new poles will now have one asset life. Openreach is planning to set the asset life at 40 years given the mean life of current poles, the asset life for duct infrastructure alongside other factors. Openreach's response dated 18 February 2021 to the s.135 notice entitled "*Promoting investment and competition in fibre networks"* dated 8 February 2021, question 1.
[803] As noted above the unit cost of installing a pole has been growing at more than both CPI and RPI over the last 10 years.
[804] As we explain in Volume 4, Section 4, Openreach provided us with capex forecasts that were consistent with BT's full-fibre roll out plans announced in May 2020. These included estimates of how much of this spend related to PIA assets and forecast estimates of volumes of new and replacement poles in each year. As explained in Volume 4, Section 4, we have used Openreach's pole installation forecasts, excluding any poles provided for Repayment Works and ECCs to drive our pole capital expenditure forecasts. We have also used the split of demand by COW from Openreach's model from 2020/21 to 25/26. The model includes forecasts of splits by COW in future years though effectively these are not used from 2021/22 onwards as, post 1 April 2021, all poles are assumed to be booked to the new poles class of work and have an asset life of 40 years.
[805] Openreach provided data on the number of attachments and manifolds on its network as at 31 March 2020 in its response of 5 June 2020 to question 10 of the s.135 request issued on 6 May 2020. Openreach provided data on the numbers of different types of poles in its network as at 31 March 2020 in its response of 5 June 2020 to question 7 of the s.135 request issued on 6 May 2020.

by forecasting capital expenditure and CCA depreciation including price movements.[806] As for duct and footway boxes we make no forecasts of any other CCA adjustments.

- Our capital expenditure forecasts are derived from our volume forecasts by multiplying the number of poles installed each year (excluding any repayment work volumes) by the assumed unit cost of installing a pole. We use the latest 2019/20 unit cost as provided by Openreach and index this up annually by RPI, consistent with our asset inflation assumptions for all direct PIA assets.
- For all poles installed before 1 April 2021, we estimate CCA depreciation in 2020/21 (and hence NRCs) using the installation profile provided by Openreach and the relevant asset life to which the relevant poles assets were originally booked. From 2021/22 onwards, we depreciate the NRC balances as at 1 April 2021 for each annual cohort over their remaining useful lives, assuming that asset lives of all poles will be reset to 40 years from that date. This also means that there are no further write outs of assets beyond those that will have been fully depreciated in 2020/21.
- For all poles installed after 1 April 2021 we depreciate the relevant capital expenditure over 40 years.
- Capital costs associated with other assets: As for duct footway boxes these consist of a mix of assets, including some grant funded (negative) assets and support assets such as software and computing.[807] For simplicity we assume these – depreciation and MCE - remain constant in nominal terms over the charge control period.
- Net current assets: These are forecast by using the standard formulae that we have applied in other recent top-down charge control models.[808]

A18.42 The output of the above process is operating costs (including depreciation and holding gains and losses) and mean capital employed (including net current assets) in each year. In what follows we refer to this as the regulatory cost base for poles.

Step 3: Attribute the poles regulatory cost base between different PIA services

A18.43 In this step we first add network adjustment costs associated with poles to the regulatory cost base. This mirrors what we do for duct and footway box assets.

A18.44 The unit cost of a pole is attributed between the different attachment types. We attribute the majority (90%) of all pole costs to cable attachments (dropwires connecting to a premises, and aerial cables – usually between poles – ultimately serving multiple premises). However, cables can also be run up poles for example, to connect a fibre in an underground duct to the pole network. A telecoms provider may also wish to place equipment at the top of a pole to aggregate cables connecting multiple premises. We attribute 3% of pole unit costs to cables up

[806] We calculate price movements from our estimates of GRCs at the start of the year.
[807] Openreach's response dated 11 October 2019 to the s.135 notice entitled "*Promoting investment and competition in fibre networks"* dated 27 September 2019, question 6.
[808] We calculate holding gains and losses from our estimates of GRCs at the start of the year with the value in the base year being our revised estimate of GRC, not the one Openreach originally supplied. We also assume that poles recorded under fibre classes of work are not revalued in the future, consistent with how these assets are currently treated within BT's RFS. This results in no price movements or holding gains or losses for these "fibre related" poles.

a pole, with the remaining 7% of attributed to manifolds. We believe these assumptions contribute to incentivising efficient use of space on a pole.[809]

A18.45 We attribute the updated regulatory cost base for poles across attachments, manifolds and cables up poles using the above proportions and then calculate a fully allocated regulatory cost base for each poles service by adding together operating costs and a return on mean capital employed, using a WACC of 7%.[810]

A18.46 The outputs of this step are then the regulatory cost base for each poles service in each year of the charge control period.

Step 4: Calculate unit costs for each service in each year and set rental charges as a share of these unit costs

A18.47 Firstly, we calculate poles unit costs in each year by dividing the regulatory cost base allocated to each pole service by the volumes forecast in each year. This produces a regulatory unit cost per pole for attachments, cables up poles and manifolds.

A18.48 We outline in Volume 4 Section 4 how we set the maximum charges for each service as a share of these unit costs. The methodology we adopt is slightly different for each poles service but is the same as that we used in the 2018 WLA.

Cable Attachments

A18.49 There are two different types of cable attachments depending on the number of end-users connected: single-premises attachments and multi-premises attachments. Some types of poles are only used to carry single-premises attachments. These are 'pure' DP poles and 'pure' feeder poles. Similarly, cable poles are only used to carry multi-premises attachments. There are also 'mixed' DP poles and 'mixed' feeder poles that carry both single- and multi-premises attachments.

A18.50 We calculate unit charges and shares separately for single-premises attachments and multi-premises attachments. The calculations are complex but are the same as those undertaken in the WLA 2018 and PIMR 2019 statements. There are two main stages.

A18.51 In the first stage poles costs attributed to cable attachments are allocated between single and multi-user attachments based on the average number of those attachments per pole. The output of this stage is a set of initial relative unit costs. This stage has several steps.

[809] For example, if a telecoms provider wishes to connect several homes to a distribution point (DP) pole, it will be incentivised to use pole top equipment to aggregate incoming cables, rather than attaching several independent incoming cables to the DP pole. The relative proportions allocated to cable up a pole attachments and manifold attachments determines the point at which it becomes cheaper to use pole top equipment to aggregate incoming cables. Under these attribution rules if a telecoms provider is to attach three or more dropwires to a pole, it is cheaper to use pole top equipment to aggregate incoming cables than to run separate cables down the pole.

[810] In the PIA charging model, we calculate fully allocated costs as operating costs (including depreciation) plus mean capital employed times the relevant WACC. We calculate mean capital employed as the mid-year value, i.e. as the average of start year and end year balances. The approach in the PIA model is consistent with that adopted in the previous PIA model used in the WLA 2018 and PIMR 2019 statements and with how BT reports PIA market performance in its RFS. This approach is slightly different to the top-down CPI Model (see Annex 14). That model uses an approach consistent with that used in our historical top-down charge control models, but this difference does not make a material difference to the model outputs

- First, the regulatory costs for attachments is divided by the total number of poles to give the overall unit costs per pole for attachments (UCA)
- Secondly, the number of attachments per pole is calculated separately for single-premises attachments and multi-premises attachments. For single-premises attachments this is the number of single-premises attachment on ’pure’ DP and ‘pure’ feeder poles divided by the number of ‘pure’ DP and ‘pure’ feeder poles (SPAPP). For multi-premises attachments it is the number of attachments on cable poles divided by number of cable poles.
- Thirdly, the average attachments per pole for multi-premises attachments is increased by 1 reflecting the expected additional PIA attachments (MPAPP). The uplift by one attachment per pole is applied as multi-premises PIA attachments are not assumed to be fully substitutional to Openreach’s existing attachments.[811]
- Lastly, initial unit costs per attachment are calculated for single premises attachments (UCSPA) by dividing the unit costs per people for attachments (UCA) by the number of single premises attachments per pole (SPAPP). Similar calculations are undertaken for multi-premises attachments: the initial unit cost per attachment for multi-user premises (UCMPA) is calculated by dividing UCA by MPAPP.

A18.52 In the second stage the initial unit costs per attachment (UCSPA and UCMPA) are adjusted to avoid over-recovery due to the additional attachments on ‘mixed’ poles by multiplying by total single-premises and multi-premises attachment volumes and comparing to the total costs to be recovered in the year.[812]

A18.53 For single-premises attachments rental charges are payable if the telecoms provider has an attachment in place. As a result, when a customer churns, a competing telecoms provider is likely to continue paying rental charges even though they are not receiving any revenue from the premises. We consider that this raises similar issues as those set out in relation to ducted lead-ins. For the same reasons set out in Volume 4 Section 4, we have decided to reduce the charge for single-end-user attachments by 10%.

A18.54 For single end-user-attachments the share of the unit cost that we use when setting prices is therefore 90%. For multi-user it is effectively the ratio of the number of (Openreach) multi-user attachments per pole divided by the number of multi-premises attachments per pole after the uplift for PIA use. This is equal to 63% over the forecast charge control period.

Cables up poles

A18.55 The regulatory unit cost per pole allocated to cables up poles is divided by the average expected number of those attachments per pole. This is based on the estimated total number of cables up pole in each year scaled up by 80% and divided by the total number of all poles, reflecting the expected additional PIA cables up a pole. The 80% uplift recognises that a cable up a pole attachment may not be substitutional to Openreach’s existing attachments and that Openreach poles also carry transmission cables (hence a 100% uplift is not appropriate). The

[811] No uplift is applied to number of single-premises cable attachments per pole.

[812] For more information see paragraphs A25.29 to A25.31 of Annex 25 of the 2018 WLA Market Review Statement. Openreach provided information on the number of attachments as at 31 March 2020 in its response of 5 June 2020 to question 10 of the s.135 request issued on 6 May 2020. Openreach provided data on the volumes of different types of poles as at 31 March 2020 in its network in its response of 5 June 2020 to question 7 of the s.135 requests issued on 6 May 2020.

estimated total number of cables up a pole in each year is based on the total number of poles in each year multiplied by the average number of cables up a pole per pole, which we assume remains constant over the period.[813] The implication of this calculation is that the share of the unit cost we use to set the cable up pole price is 56%.[814]

Manifolds

A18.56 For manifolds the regulatory unit costs per pole allocated to manifolds are divided by the average expected number of those attachments per pole. The latter is calculated as the total number of Openreach's manifolds in each year plus the total number of DP poles in each year, as an estimate of the expected additional PIA manifolds.[815] The uplift by the total number of DP poles recognises that PIA manifold attachments may not be substitutional to Openreach's existing attachments, assuming one additional manifold for each existing DP pole. The implication of this calculation is that the share of the unit cost we use to set the pole top equipment price is the ratio of the total number of Openreach manifolds in each year divided by the total of Openreach's Manifolds and the number of DP poles. Over this charge control period this results in a share of 54%.

[813] The average number of cables up a pole is assumed to be 0.29. This is the value that has been assumed in previous PIA market assessments. Openreach have told us that this number is not stored on its Piper or Artisan systems. Openreach's response dated 5 June 2020 to the s.135 notice entitled "*Promoting investment and competition in fibre networks"* dated 6 May 2020, question 10 and Openreach's response dated 15 October 2020 to the s.135 notice entitled "*Promoting investment and competition in fibre networks"* dated 11 September 2020, question 7.
[814] 56% = 1/(1+0.8), where 0.8 is the 80% uplift referred to previously.
[815] The total number of manifolds and DP poles in each year is calculated as part of the volume forecasts as outlined in Step 2 above. Openreach's response dated 5 June 2020 to the s.135 notice entitled "*Promoting investment and competition in fibre networks"* dated 6 May 2020, question 7 and 10.

A19. Estimating the 40/10 fibre premium

Introduction

A19.1 In Volume 4 Section 1 and Section 2, we set out our reasoning for including a fibre premium (the 40/10 fibre premium) in setting FTTP 40/10 prices to reflect the additional benefits from FTTP relative to FTTC services. We consider that the 40/10 fibre premium is relevant when:

- setting the maximum price of the charge controlled 40/10 FTTP service in circumstances where the copper service has been withdrawn (i.e. as part of our proposals around copper retirement and moving to a fibre-based charge control).
- an FTTC 40/10 service is not available (see specification of Wholesale Local Access (WLA) charge control in Volume 4 Section 6).

A19.2 In this annex we explain how we have estimated the level of the 40/10 fibre premium.

A19.3 In the January 2020 Consultation, we proposed a 40/10 fibre premium of £1.50-£1.85, explaining that the additional value of fibre services relative to copper services is due to the value to consumers and cost savings to access seekers.

A19.4 As explained below, we have since reviewed stakeholder responses and updated the analysis and concluded on a 40/10 fibre premium of £1.70.

Stakeholder responses

A19.5 There is general support from stakeholders for a 40/10 fibre premium. Stakeholders agree that FTTP 40/10 provides additional benefits to end-users and retail providers compared to FTTC 40/10, and that a fibre premium will support the objective of promoting competition and investment in fibre networks.

Value to consumers

A19.6 Openreach supports a 40/10 fibre premium but believes the premium should be at least £2, stating that we did not capture the value of improved service levels (and the resulting lower costs for CPs and reduced churn) or the increasing value that customers will place on receiving at least a 40Mbit/s connection over time. Openreach believes that these factors should be included, and the premium should be at least £2.[816]

A19.7 BT supports a 40/10 fibre premium but states that[817]:

- The premium is too low. it believes the premium will be above the upper end of the estimate when including consumer benefits from lower fault rates and uninterrupted service.
- The premium should remain stable in real terms to ensure support for investment in FTTP does not reduce over time.

[816] Openreach response to the January 2020 consultation, paragraph 3.22
[817] BT response to the January 2020 consultation, paragraphs 3.16-3.20

A19.8 TalkTalk suggests Ofcom should conduct a conjoint analysis to better evaluate the level of premium consumers would be willing to pay. It raised some concerns regarding our current estimate.[818] Specifically, that:

- While we use retail prices to confirm that part of our proposed fibre premium is consistent with the value consumers may place on receiving higher speeds, TalkTalk believes retail prices do not perfectly reflect consumers' willingness to pay.
- Ofcom assumes customers who get over 25Mbit/s are not willing to pay an additional amount for FTTP over FTTC. TalkTalk notes that the estimate could be improved by estimating the amount that these customers might on average be willing to pay.
- Ofcom has not considered consumer benefits from increased speed consistency over time and reliability of the FTTP service. TalkTalk suggests that value of reliability can be estimated based on level of faults and the auto-compensation payment.

A19.9 Cityfibre agrees that there are significant benefits from full fibre services and states that the range of £1.50-£1.85 is consistent with their own modelling, which Cityfibre states estimates a speed uplift of £0.80-£1.50, noting that with the addition of various non-speed benefits, it finds our range is reasonable.[819]

A19.10 Gigaclear believes the introduction of a fibre premium is necessary to achieve the objective of supporting investment in fibre networks through promoting investment in competing networks. It states the FTTP 40/10 price needs to reflect the higher value of the FTTP service in comparison to the FTTC 40/10 service, in order to maintain the relative profitability of building a network in comparison to buying from BT Openreach.[820]

Cost savings to access seekers

A19.11 Generally, stakeholders agree that 40/10 FTTP brings additional benefits to retail providers from cost-savings through delivering a more reliable service to customers and lower exchange-based costs.

A19.12 TalkTalk agrees there will be cost savings from engineering and repair costs but is less certain whether there will be lower exchange-based costs, as those are shared costs between offering broadband services and leased lines.[821] [✂]

Our assessment and decision

A19.13 We consider that the additional value of fibre services relative to copper services is comprised of:

- The additional benefits to end-users from having a more reliable broadband service with higher and more stable speeds (relative to broadband provided over copper with the same stated headline speed).

[818] TalkTalk response to the January 2020 consultation, paragraphs 6.8-6.15
[819] CityFibre response to the January 2020 consultation, paragraphs 6.89-6.94
[820] Gigaclear response to the January 2020 consultation, paragraph 123
[821] TalkTalk response to the January 2020 consultation, paragraphs 6.16-6.19

- The additional benefits to access seekers purchasing a fibre broadband service as a result of cost-savings through delivering a more reliable service to customers; and lower exchange-based costs.

Value to consumers

Higher and more stable speeds

A19.14 Consumers who purchase an FTTC service with a headline download speed of 40Mbit/s may in practice receive slower speeds than this. This is due to the degradation of the speed of the service as a result of relying on the copper network between the cabinet and the premises (with the level of degradation increasing as the distance between the cabinet and the premises increases). By contrast, consumers on FTTP are likely to receive the headline speed (or very close to the headline speed) of the service they purchase.

A19.15 While we recognise that it is difficult to estimate the customer benefit of fibre broadband over copper broadband precisely, we consider the speed of the customer's service and how important speed is to them is relevant to estimating the benefits.

A19.16 To estimate the benefits, we need to make a projection of the fibre premium that will take strongest effect towards the end of the review period (when the potential for copper switchover to occur is greater). This is necessarily uncertain.

A19.17 As discussed in Volume 2 Section 2, at present customer willingness to pay for higher bandwidths is limited. However, it is more apparent at lower bandwidths, as evidenced by the rapid migration that we have seen away from low bandwidth standard broadband services to FTTC.

A19.18 In the January 2020 Consultation, we proposed that an average differential of £1.10 per month would be reasonable to allow for the higher speeds that 40/10 FTTP would deliver as compared to 40/10 FTTC services.

A19.19 We noted that this figure would be broadly consistent with 22% of customers getting actual speeds around or below ADSL2+ speeds (25Mbit/s) valuing a full 40/10 FTTP speed at £5 per month more.[822] These customers comprise of:

- 20% of 36Mbit/s FTTC lines having a minimum speed around or below the headline ADSL2+ speeds (25Mbit/s).[823]
- 2% of premises to which FTTC services are not available.[824]

A19.20 We do not explicitly estimate the value to customers from having a more reliable service with fibre, which is difficult to quantify. We use the estimates based on speed as a conservative proxy for the value to consumers of 40/10 FTTP.

A19.21 We have since reviewed stakeholder responses and continue to believe an average differential of £1.10 per month would be reasonable to allow for the higher speeds that a 40/10 FTTP

[822] Our £5 value was a simple average of the price differential (initial offer price) between standard broadband and superfast broadband across five telecoms providers.
[823] UK Home Broadband Performance, measurement period Nov 2018, Ofcom, published May 2019
[824] Connected Nations Update Summer 2019, Ofcom, September 2019

service would deliver as compared to 40/10 FTTC services. We found that the £1.10 per month speed differential is still broadly consistent with updated actual speed and price differential figures, as detailed below.

Our assessment and decision

A19.22 Firstly, we looked at more recent estimates of the actual speeds received by 40/10 FTTC consumers. We found that in May 2020, it was reported that 20% of consumers on 40/10 FTTC lines received minimum speeds below the headline ADSL2+ speed (25Mbit/s)[825], the same proportion that we stated in the January 2020 Consultation.

A19.23 We also found in December 2020 that a similar number of premises do not have access to FTTC and we continue to include the above 2% of premises to which FTTC services are not available.[826]

A19.24 Secondly, we looked at price differentials for retail standard broadband and superfast broadband services. We found that the updated initial offer price differentials had decreased to approximately £1.60 per month on average (from the £5 found for the January 2020 Consultation).[827]

A19.25 However, we believe that this lower differential likely reflects a move by providers to encourage migration of remaining standard broadband consumers to superfast broadband (by charging similar prices for standard and superfast packages).

A19.26 Consistent with this, we found that this price differential between standard broadband and superfast broadband services is higher when reviewing actual prices consumer pay in September 2019 in Volume 2 Section 2. We found an average actual price differential of £5.98 per month between standard broadband and superfast broadband consumers.

A19.27 We also believe that consumer's value of the higher, consistent speeds provided by 40/10 FTTP will be greater towards the end of the review period[828] (when the fibre premium has a larger impact due to increased copper switchover).

A19.28 Based on the above, we believe that the more recent data is consistent with our previous estimate of 22% of consumers receiving below or around ADSL2+ headline speeds (25Mbit/s) valuing a full 40/10 FTTP speed at £5 a month more, i.e. a speed differential of £1.10 per month.

A19.29 Regarding Openreach and TalkTalk's point that we not do not consider the benefit to consumers of receiving consistent high speed over time, while we do not explicitly estimate the value of receiving a consistent speed, some of this value is likely to be captured by considering 40/10 FTTC consumers whose minimum speeds drop below headline ADSL2+ speeds (rather than average peak-time speeds) in our estimates above.

[825] UK Home Broadband Performance, measurement period Nov 2019, Ofcom, published May 2020
[826] Connected Nations 2020, Ofcom, published December 2020
[827] The £1.60 is a simple average of the price differential (initial offer price) between standard broadband and superfast broadband across five telecoms providers in February 2021, from prices in Figure 2.10 in Volume 2 Section 2.
[828] As discussed in Volume 2 Section 2

A19.30 There are also likely to be additional benefits to consumers due to the reliability of an FTTP service which are difficult to quantify. While TalkTalk suggests using fault rates and the auto-compensation payment to estimate consumers' value of reliability, the fault rates only capture major faults and we consider that there is an additional value to consumers from fewer intermittent disruptions in service.

A19.31 As these benefits are difficult to quantify, we consider the speed differential acts as a conservative proxy for the value to consumers of 40/10 FTTP.

Cost saving for access seekers of FTTP

A19.32 In the January 2020 Consultation, we said that we expect that telecoms providers purchasing access to Openreach's network would experience savings as a result of purchasing a 40/10 FTTP service instead of a 40/10 FTTC service. These savings arise as a result of two factors:

- Lower ancillary costs: the need to purchase fewer ancillary services due to the greater reliability of an FTTP network; and
- Lower exchange-based costs: telecoms providers purchasing access to an FTTP network need to connect to fewer exchanges than a copper network. This will lead to lower network costs for the purchasing telecom provider.

A19.33 In order for the 40/10 FTTP service to be equivalent to the 40/10 FTTC services, we will need to capture these lower costs in the 40/10 fibre premium. However, it is difficult to precisely estimate the level of these cost savings. In the January 2020 Consultation, based on telecoms provider information we estimated that access seekers will realise a saving of between £0.40 and £0.75 per line per month,[829] and noted that there is significant uncertainty over the extent of these cost savings.

Our assessment and decision

A19.34 Since the January 2020 Consultation, we have requested additional information from stakeholders on the potential benefits and operational cost savings from switching residential customers from a copper-based broadband service to a full-fibre service.

A19.35 While stakeholders agreed in the January 2020 Consultation that in principle there are cost savings for the retail providers, they were not able to provide additional evidence to further inform our previous figures.

A19.36 In relation to TalkTalk's point on exchange-related cost savings, we continue to believe that there are likely to be operational savings to access seekers. We believe that access seekers will be able to exit some exchanges, and in exchanges where that is not the case, we expect that there will be cost savings in the form of reduced power and space requirements.[830] We recognise that in some cases providers will need to maintain a presence in certain exchanges to support their leased line businesses, however we would expect some of these costs to be recovered from leased lines customers.

[829] [✂]
[830] This occurs as DSLAMs are removed from copper exchanges.

A19.37 Taking into account these factors, we believe a figure towards the centre of our range of 60p per month is appropriate to capture the different types of cost savings but recognising the uncertainty around the cost estimates.

A19.38 Adding this to the consumer value, we get an estimate for the total 40/10 fibre premium of £1.70 per line per month.

A19.39 The £1.70 fibre premium is our estimate of the current additional value of 40/10 FTTP over 40/10 FTTC. We expect this value to endure over the review period as higher speeds will be necessary to support consumers' increasing technology usage. We will therefore maintain the £1.70 40/10 fibre premium in real terms (in line with CPI in each year).

Treatment of G.fast

A19.40 As stated in the January 2020 Consultation, in some circumstances, Openreach might choose to offer a G.fast service to replace the current FTTC 40/10 service. In these instances, we do not propose to apply the 40/10 fibre premium to the price of Openreach's G.fast service.

A19.41 As set out in Volume 3 Section 1, our objective in setting remedies is to promote competition and investment in gigabit-capable networks by Openreach and other operators, while seeking to protect consumers and existing models of competition. We are not seeking to promote investment in G.fast services.

A19.42 In addition, while we acknowledge that G.fast can offer higher speeds than FTTC for some consumers, for many consumers the ability to receive higher speeds will be limited by the length of copper connection to the premises and other factors, such as internal wiring, (unlike FTTP).

A19.43 Therefore, our analysis of the additional speeds that customers taking an FTTC service might obtain using an FTTP service are likely to be overstated if applied to G.fast since the lower speeds they currently receive are likely to reflect (at least to an extent) the degradation in speeds as a result of the length of the copper connection.

A19.44 Similarly, since G.fast continues to rely on a copper connection between the cabinet and the premises, we do not expect the improvements in quality of service or the reduction in ancillary costs (for access seekers) that apply to FTTP relative to FTTC will be relevant to G.fast.

A20. Cost of capital for BT Group

A20.1 This annex explains our estimates of the cost of capital for BT Group. Estimating the cost of capital for BT Group is the foundational step in reaching our decisions on the cost of capital for the regulated services, which are detailed in Annex 21.

A20.2 In most market reviews the main purpose of estimating the cost of capital is to inform the appropriate rate of return on the mean capital employed (MCE) to be included in cost-based charges. This rate of return should reflect the return required by investors to remunerate them for the risks of investing in the relevant assets.

A20.3 In this review, we require an estimate of the appropriate rate of return on the MCE for those services that are subject to cost-based charge controls. In Volume 4, Sections 3 and 4 we explain our decision to set cost-based charge controls on dark fibre access (DFA) and on dark fibre inter-exchange (DFX), respectively. In Volume 4, Section 5 we also explain our decision to set cost-based charge controls on PIA services. Both for dark fibre and PIA services, the starting charges are calculated using the latest available cost information and are then subject to a CPI-X control over the review period.

A20.4 We also require an estimate of the appropriate rate of return on the MCE for other services (MPF, FTTC, and FTTP), which are used as an input for the creation of a RAB for Area 3, and for some cross checks in Area 2 (as set out in Volume 4, Sections 1 and 2).

A20.5 We use the Capital Asset Pricing Model (CAPM) to estimate the appropriate rate of return on equity. Under the CAPM the cost of equity (*Ke*) is a function of the risk-free rate (*RFR*), the expected return on the equity market above the risk-free rate i.e. the equity risk premium (*ERP*) and the systematic risk of the relevant activity i.e. equity beta (*βe*):

$$Ke = RFR + ERP * \beta e$$

A20.6 If the relevant business or project is entirely funded by equity, then the cost of equity is the cost of capital.

A20.7 In practice, most firms are funded by a combination of debt and equity. In this case the weighted average cost of capital (WACC) combines the cost of finance from debt (*Kd*) and equity (*Ke*), each weighted by their relative share of enterprise value (i.e. the sum of the value of debt and equity). The value of outstanding debt relative to enterprise value (gearing) is denoted by *g* in the formula below and the rate of corporation tax is denoted by *t*. The pre-tax WACC is obtained by scaling the post-tax cost of equity by 1 / (1 *t*), the cost of debt already being pre-tax[831]:

$$WACC = \frac{Ke * (1 - g)}{1 - t} + Kd * g$$

[831] Given our cost modelling is done in nominal terms without explicit modelling of tax, we require a forecast of the pre-tax nominal WACC. This differs from the approach of some other UK regulators and that used by some equity analysts who may use the vanilla WACC or the post-tax WACC. The vanilla WACC is a weighted average of the post-tax cost of equity and the pre-tax cost of debt; while the post-tax WACC is a weighted average of the post-tax cost of equity and the post-tax cost of debt.

A20.8 The WACC provides a benchmark against which the (risk-adjusted) expected return on any investment is judged. As the WACC is a forward-looking concept, the cost of debt is the marginal cost of new borrowing for the project in question, at a given investment horizon. The cost of debt can typically be estimated with reference to observed market yields on corporate bonds. The observed yield differs from the expected return on bonds due to the risk of default in any corporate bond. However, when estimating the return necessary to cover the cost of capital, we reflect this risk of default in regulated prices – since we are concerned with the costs faced by the issuer (in this case BT).[832]

A20.9 When setting the allowed return, we use a cost of debt which reflects both forward-looking and historical debt costs (for reasons explained later in this annex). In large part, this explains why the regulatory allowed return will not typically align with the forward-looking WACC.

A20.10 For consistency with previous notation and because the allowed return is most significantly determined by the forward-looking WACC, we typically refer to the WACC in this annex and in Annex 21.[833]

Summary of our WACC decision for BT Group

A20.11 Our estimate of the BT Group WACC is shown in Table A20.1 below.

[832] In 2018, the UK Regulators Network (UKRN) published a study by academics and consultants on estimating the cost of capital for price controls (2018 UKRN Report). The 2018 UKRN Report noted that the difference between observed and expected yields was expected to be small (10 to 20 bps) for the credit ratings expected for UK regulated companies (i.e. A to BBB). 2018 UKRN Report, Section 4.7.1, pages 59 to 60.

[833] In the 2018 UKRN Report, one of the recommendations was to differentiate the WACC, i.e. the concept of a purely forward-looking expected cost of capital, from the regulatory allowed return (RAR) which represents the regulator's view on the appropriate return on capital employed. 2018 UKRN Report, page 6.

Table A20.1: Summary of WACC and component parameters

WACC component	BT Group	Source
Real (RPI-based) RFR	-2.0%	See A20.28
RPI inflation forecast	3.0%	See A20.24
Nominal RFR	0.9%	= (1+ real (RPI-based) RFR)*(1+RPI inflation)-1
Real (CPI-based) expected market return (EMR)	6.7%	See A20.56
CPI inflation forecast	2.0%	See A20.24
Nominal EMR	8.8%	= (1+real EMR)*(1+CPI inflation)-1
Nominal ERP	7.9%	= Nominal EMR – Nominal RFR
Debt beta (βd)	0.10	See A20.139
Asset beta (βa)	0.62	See A20.130
Gearing (forward looking) (g)	45%	See A20.138
Implied equity beta (βe)	1.05	= (βa - βd*g)/(1-g)
Cost of equity (post-tax) (Ke)	9.2%	= Nominal RFR + Nominal ERP *βe
Cost of equity (pre-tax)	11.3%	= Ke / (1-t)
Corporate tax rate (t)	19.0%	See A20.144
Cost of debt (pre-tax) (Kd)	3.6%	See A20.107
WACC (pre-tax nominal)	7.8%	=(Ke*(1-g))/(1-t)+(Kd*g)
January 2020 Consultation	*8.1%*	

Source: Ofcom[834]

A20.12 The main changes from the January 2020 Consultation relate to the following, which we explain in more detail later in this annex:

- A reduction in the nominal risk-free rate from 1.5% to 0.9%;
- A reduction in the BT Group asset beta from 0.68 to 0.62;
- An increase in the corporate tax rate from 17% to 19%;
- A slight increase in the cost of debt from 3.5% to 3.6%; and
- A slight increase in the forward-looking gearing assumption from 40% to 45%.

Our decisions on key principles and methodology

A20.13 As set out in the January 2020 Consultation, the key objectives guiding our cost of capital estimation include the following.

- **Efficient price and investment signals** – the allowed return is an important input in setting cost-based regulated charges (particularly in capital intensive industries). Regulated charges

[834] Note: Intermediate calculations are unrounded. We round the pre-tax cost of equity, the pre-tax cost of debt and the pre-tax nominal WACC to one decimal point. For comparison purposes, the UKRN annual update reports real vanilla WACCs used by UK regulators. The real vanilla WACC (with respect to CPI inflation of 2.0%) is 4.6% for BT Group.

should provide the regulated firm with the opportunity to finance efficient investment and provide access seekers with efficient 'build-vs-buy' price signals.

- **Stability** – financing telecoms infrastructure and services involves making long-term investments where demand may be uncertain and wholesale prices are limited by ex-ante regulation. It is important for investors to be able to commit risky capital in the knowledge that our approach to price regulation provides an expectation, but not the guarantee of recovery of efficient costs, including the cost of finance.
- **Consistency** – we aim to ensure that there is consistency in our decisions, both between parameters in a given decision and, as far as reasonably possible, with other regulatory decisions.
- **Transparency** – we aim to clearly explain our approach to stakeholders and seek to avoid overly elaborate methodologies.

A20.14 We consider that these key objectives are consistent with our statutory duties, including our principal duty: to further the interests of citizens in relation to communications matters; and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A20.15 BT Group agreed with our objectives of promoting efficient investment signals and consistency of decisions in estimating the WACC. However, it had concerns as to whether our WACC estimates met these objectives. [835] We respond to BT Group's arguments on specific parameter choices in each section below.

A20.16 TalkTalk noted that our WACC estimates would be primarily used to set price caps in Area 3.[836] TalkTalk agreed with our objectives, but noted that in Area 3, which it described as 'a natural monopoly' area, we should also pursue the goal of maximising benefits to consumers through setting the WACC no higher than required to enable efficient cost recovery.[837] We discuss the issues around picking a point estimate for the WACC given the range of uncertainty in individual parameters later in this annex.[838]

A20.17 Following our long-standing methodology for fixed-telecoms charge controls, we start with estimating the WACC for BT Group since we do not have a pure play comparator[839] for the lines of business regulated in this review and the regulated activities within BT represent a large part of the company.[840] Any disaggregated WACC for the regulated lines of business should be compatible with the overall WACC for BT Group (weighted by the relative value of the underlying assets for each line of business).

A20.18 For reasons explained in detail in Annex 21, we disaggregate the BT WACC between three lines of business, as in previous reviews.

[835] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.6-A6.7.
[836] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 1.3.
[837] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 2.2.
[838] TalkTalk also stated that our approach appeared unlikely to be consistent with a goal of providing efficient investment signals for build/rent decisions, since it inflated Openreach price caps to a level well in excess of its underlying costs. We respond to TalkTalk's views on our overall pricing approach in Volume 4, Section 1 and Annex 12. TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 2.2-2.3.
[839] A pure play comparator would be a listed company that only provides the regulated services in question.
[840] According to BT's 2020 Regulatory Financial Statements, markets in which BT was found to have SMP represented 40% of returns and 37% of MCE.

A20.19 Our WACC estimates reflect our view of required returns over a relatively long investment horizon (reflecting the long asset lives of telecoms investments), accounting for the expected market developments over the market review period.

A20.20 As in recent charge control decisions, we estimate the cost of debt with reference to both historical and recent debt yields. An efficiently financed firm may not have anticipated the extent to which interest rates fell following the global financial crisis. Given the long investment horizon associated with telecoms investments, a cost of debt based only on spot rates may not allow for an opportunity to recover efficiently financed debt costs.

A20.21 The main reasons for estimating a WACC in this review are to feed into cost-based price caps (for DFA, DFX and PIA) and to evaluate the cost recovery implications of our other pricing decisions (including when prices are not set to align with projected costs). Therefore, we have maintained this approach for estimating the cost of debt, and we present our estimates for the BT Group WACC and its constituent parts (which are applied to regulated services and described in the next annex) on this basis.

Inflation assumptions

A20.22 Based on the March 2019 OBR forecasts we proposed to assume CPI inflation of 2.0% and RPI inflation of 3.0% (based on the OBR's 1% RPI-CPI wedge).

A20.23 TalkTalk agreed with our proposal to use the most recent OBR forecasts. However, it disagreed with the 1% wedge between RPI and CPI citing Ofgem's RIIO-2 proposals that set a wedge of 0.813%.[841]

A20.24 We have decided to use the November 2020 RPI and CPI forecasts from the OBR. The OBR's forecast for RPI in 2025/26 is 3% and for CPI it is 2%.[842] We have used these RPI and CPI forecasts in our WACC calculations. Ofgem's 0.813% wedge was based on the March 2020 OBR forecasts for the year 2024 and therefore does not represent a like for like comparison.[843]

RFR

Our proposals

A20.25 In the January 2020 Consultation, we used a nominal RFR of 1.5% in line with the then recent 2019 BCMR Statement, recognising that while the yield on a ten-year index-linked gilt continued to fall, our estimate of RPI inflation was higher on the basis of a new forecast.[844] We signalled that we would update our estimate of the RFR for the latest market evidence and

[841] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.12.
[842] OBR, Economic and fiscal outlook – November 2020, updated on 25 November 2020. RPI and CPI forecasts can be found in the supplementary economy tables, tab 1.7. We note that the OBR recently published revised inflation forecasts in March 2021. We have not updated our inflation assumptions but note that inflation at the end of the price control (2025/26) is in line with the November 2020 forecast.
[843] RIIO-2 Draft Determinations – Finance Annex, page 8
[844] The 2019 BCMR Statement assumption of 2.8% RPI inflation in 2020/21 was lower than the longer run OBR estimates of around 3%.

proposed to adopt a similar methodology to estimating the RFR as we did in the 2019 BCMR Statement.

Stakeholder responses

A20.26 BT highlighted that a RFR estimate based on short-term averages could lead to volatile estimates over time, which would create regulatory instability at a time when investors required long-term certainty over key investment parameters. BT also highlighted the current volatility following the COVID-19 outbreak meant that using short-term averages would lead to even more volatile estimates in this market review. BT advocated placing more weight on long-term averages along with forward-looking interest rates to estimate the RFR. BT considered that a nominal RFR of 1.5% was reasonable, as it aligned with the Bank of England forecast for the middle of the review period.[845]

A20.27 TalkTalk considered our estimate of the RFR to be untenable and legally unsustainable on the grounds that it was markedly different from current market evidence and the approach of other regulators. TalkTalk noted that our estimate of 1.5% was about one percentage point higher than Ofgem's proposed estimate of a real RFR of -1.48% in RIIO-2 (TalkTalk estimated that we had used a real RFR of -0.5% assuming 2% CPI). TalkTalk stated that an attempt to subsidise Openreach in Area 3 by setting such an excessive RFR would harm consumers and distort investment decisions without any offsetting benefits. Further, TalkTalk noted that our approach would increase regulatory risk through inconsistency with other regulators' decisions. TalkTalk proposed that we should use an approach aligned with that of Ofwat and Ofgem.[846]

Our reasoning and decisions

A20.28 In this section, we explain our methodology and updated market evidence on the RFR. We conclude on a nominal RFR of 0.9%, based on a real (RPI-based) RFR of -2.0% and assumed RPI inflation of 3.0%. This is equivalent to a real (CPI-based) RFR of -1.0%.

Appropriate benchmarks

A20.29 The RFR is approximated by finding an established and (as far as possible) riskless asset which is highly liquid (i.e. regularly traded). Typically, government bonds (known in the UK as 'gilts') have been used as a proxy for the RFR. If held to maturity, the return on a gilt is known with near certainty (i.e. it is close to risk-less), since the probability of the UK government defaulting on its debt is very low.

A20.30 In previous regulatory decisions we have estimated the real (RPI-based) RFR by reference to average yields on index-linked gilts, consistent with regulatory practice more generally.[847] Where appropriate and relevant for the purposes of our analysis, we have cross checked our approach with that taken by the CMA and other regulators in their decisions (i.e. in relation to market parameters like the RFR and the EMR), and set this out below.

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[845] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.21-A6.26.
[846] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.11.
[847] By using index-linked gilts we observe the yield net of compensation for (RPI) inflation – itself a source of risk.

A20.31 For example, in the CMA's latest (provisional) decision on the WACC ('PR19 PFs') [848], the CMA concluded that index-linked gilts remain a relevant and useful input in estimating the RFR, and that they closely, but imperfectly match the requirements of a RFR in the CAPM. Specifically, the CMA's provisional view was that the 'true' RFR is likely to be higher than current yields on index-linked gilts. The CMA also used the yields on AAA-rated corporate bonds as an input in estimating the RFR, recognising that yields on these bonds are likely to be higher than the 'true' RFR. [849]

A20.32 Any available market benchmark is ultimately a proxy for the 'true' RFR. However, the overwhelming weight of theory and practice regarding RFR estimation supports the use of gilts.[850] As such we continue to estimate the RFR with reference to gilts.

Investment horizon

A20.33 An important consideration in estimating a CAPM-based cost of capital is the investment horizon. Telecoms investments have relatively long asset lives and an efficient network operator would be expected to finance investments (whether network renewals or enhancements) steadily through time. For example:

- BT's network infrastructure assets have accounting asset lives of between two and 40 years, while the main assets used to deliver wholesale local access and business connectivity services which are price controlled (fibre and duct) have accounting asset lives of around ten and 40 years respectively[851];
- Planned investments in FTTP involve long-lived assets, with the majority of the investment in assets with lives between 20 to 40 years;[852]
- the average remaining maturity on BT's debt is around ten years[853]; and
- the average maturity from issuance on BT's debt is around 16 years.[854]

A20.34 Recognising the long asset lives of fibre and duct and the fact that the maturity on BT's debt has been increasing, we consider a reasonable investment horizon would be between ten and 15 years. This is why we use evidence on ten- and 15-year yields on gilts to estimate the RFR. We apply a consistent approach in estimating the cost of debt. [855]

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[848] Provisional Findings regarding the price control redetermination for the four water companies which appealed the 2019 price review. CMA provisional determination PR19, 29 September 2020. This is the latest CMA view on WACC available at the time of performing our analysis for this decision.
[849] PR19 PFs, paragraphs 9.134 to 9.137.
[850] See for example: Armitage, S. The Cost of Capital Intermediate Theory. Cambridge UP. 2005. Ch 13.1 p. 278. Koller, T. Goedhart, M. Wessels, D. Valuation Measuring and Managing the Value of Companies. John Wiley & Sons. 2010. pp. 236-238. Brealey, R. Myers, S. Principles of Corporate Finance. 7th Ed. 2003. McGraw-Hill. pp. 192-194. Damodaran, A. Valuation. 2nd Edition. Ch7 pp. 1-2. 2018 UKRN Report, Page 8.
[851] Page 152 of BT's 2020 annual report shows the asset lives used by BT for network infrastructure assets. Page 34 of the 2020 Regulatory Financial Statements shows that fibre and duct represent the majority of assets used to provide wholesale local access (c.58%) and business connectivity services (c.61%). Book lives are taken from BT's 2019/20 Regulatory Financial Statements – AFI 10.
[852] See Ofcom Fibre Cost Model for more detail on asset lives used in the modelling.
[853] Based on Ofcom analysis of S&P Capital IQ data as at 31 October 2020.
[854] Based on Ofcom analysis of S&P Capital IQ data as at 31 October 2020.
[855] In the 2019 BCMR Statement the average remaining maturity on all BT's debt was around 8 years and the average maturity from issuance was 14 years.

Appropriate measurement period for market data

A20.35 In the 2019 BCMR Statement we considered evidence on average yields on index-linked gilts as well as spot yields. Using averages avoids relying only on spot rates which may introduce unnecessary volatility into the RFR decision. We also considered forward market evidence in reaching our final view on the RFR. We adopt the same framework in this Statement.

A20.36 As shown below, the RFR benchmarks have continued to trend downwards, and it is appropriate to take this into account in our estimation. Therefore, we do not agree with BT that we should keep the RFR at the same level as in the 2019 BCMR Statement. Further, we are not relying solely on spot rates, but are considering the available evidence in the round.

A20.37 We also disagree with TalkTalk's suggestion that our proposal was radically divorced from market evidence and the approach of other UK regulators. In the January 2020 Consultation we stated that we would reassess the RFR based on updated market information closer to our decision.

A20.38 BT argued that HM Treasury's consensus forecasts of the official Base Rate would support our proposed estimate of the RFR from the January 2020 Consultation. While the latest Treasury Consensus forecasts suggest that interest rates are expected to increase by 2024, the forecast Base Rate is now 0.68 percentage points lower in absolute terms compared to the forecasts presented by BT. This reflects that interest rates have declined since the January 2020 Consultation, with a corresponding effect on the expected future path of interest rates.[856]

A20.39 Therefore, it is appropriate to reduce the RFR relative to the 2019 BCMR Statement and the January 2020 Consultation. Further, we take into account market expectations of changes in yields over the review period in choosing a RFR estimate (discussed below).

Market evidence on yields on index-linked gilts

A20.40 Spot yields on ten and 15-year index-linked gilts were -3.0% and -2.8% respectively in October 2020.[857]

A20.41 Yields on ten and 15-year index-linked gilts averaged over a period of one year to five years are in the range of -1.8% to -2.7% (as shown in Table A20.2).

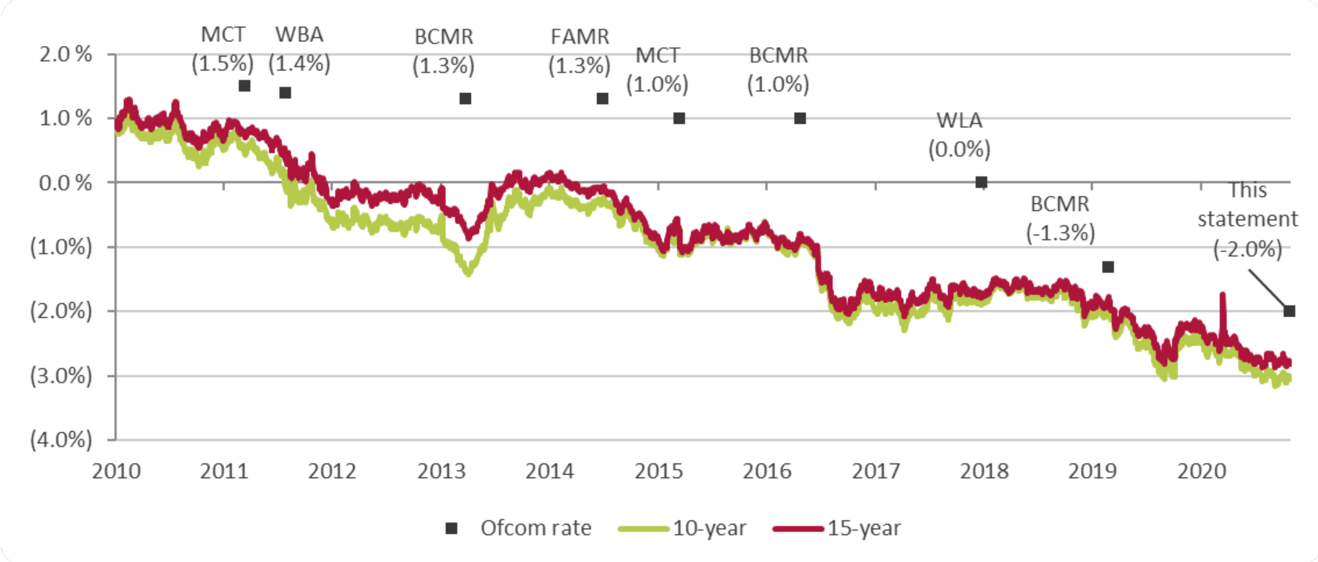
Table A20.2: Real (RPI-based) yields on ten and 15-year gilts

Averaging period	ten-year gilt %	15-year gilt %
Spot rate	(3.0)%	(2.8)%
1 Month	(3.0)%	(2.8)%
6 Months	(2.9)%	(2.7)%
1 Year	(2.7)%	(2.5)%
5 Years	(2.0)%	(1.8)%

Source: Ofcom analysis based on data from Bloomberg Finance L.P., TradeWeb and Bank of England calculations. Data as at 31 October 2020.

[856] Forecasts for the UK economy, HM Treasury, February 2021, Table M4.
[857] We use a cut-off date of 31 October 2020 in our estimation.

Figure A20.3: Real (RPI-based) yields on ten and 15-year gilts and our RFR decisions



Source: Ofcom analysis based on data from Bloomberg Finance L.P., TradeWeb and Bank of England calculations. Data as at 31 October 2020.

A20.42 The market yield curve can be used to estimate the expected change in ten and 15-year gilts over the review period. We are concerned with an appropriate RFR over the review period, and therefore we use this information as an indication of likely changes in gilt yields, when we interpret the recent and historical yields described above.

A20.43 Real forward rates on ten and 15-year gilts for the end of the control period are in the region of -2.6% (based on forward rates at the end of October 2020), above the spot and shorter-term averages shown in Table A20.2. [858] This suggests that interest rates are expected to increase over the review period.[859]

A20.44 Nominal forward rates at the end of October 2020 are also consistent with the expectation of market rates increasing over the review period, with forward yields between 0.95% and 1.10% at ten and 15-year maturities respectively.[860]

Our decision

A20.45 Taking the evidence on gilt yields (including recent and historical averages as well as forward rates) in the round, we consider that a real (RPI-based) RFR of -2.0% is appropriate. Combined with our RPI inflation forecast for 2020/21 of 3.0% (see above), the nominal RFR is 0.9%. The equivalent real (CPI-based) RFR is -1.0% (based on 2.0% CPI).

A20.46 We recognise that for any investment started today, a lower risk-free rate based on spot yields would be more consistent with capital asset pricing theory. However, because we are

[858] The end of the charge control is 31 March 2026, which is in 5 years' time. We also note the recent recovery in gilt yields with spot rates in February above those shown in Table A20.2, however, they remain below -2% (real, RPI-based). Ofcom analysis based on data from Bloomberg Finance L.P., TradeWeb and Bank of England calculations.
[859] The forward rate on a 15 year gilt in 5 years time is calculated using the following formula: (((20 year gilt spot rate+1)^20)/(5 year gilt spot rate +1)^5))^(1/15)-1.
[860] Ofcom analysis based on data from Bloomberg Finance L.P., TradeWeb and Bank of England calculations.

concerned with investments over a number of periods (not just today), and because the main purpose is to set price caps which are fixed in real terms over the review period, we do not consider it appropriate to use a RFR based solely on spot rates or very short term averages.

A20.47 The forward rate evidence suggests gilt yields are expected to increase from the spot yields of last year and placing too much weight on spot rates for the purposes of setting price caps could mean our decisions are unduly affected by noise in the current data, which does not align with our principles of stability and consistency.

A20.48 We have also cross-checked our estimate against the range published by the CMA in its PR19 PFs. The CMA's range was between -1.4% and -0.8% (CPIH real).[861] Our real (CPI-based) RFR of -1.0% is close to the midpoint of the CMA's range (which is -1.1%).

EMR and ERP

Our proposals

A20.49 We proposed a real (CPI-based) EMR of 6.7% in line with the 2019 BCMR Statement. Our approach placed most weight on historical *ex post* approaches but also had regard to other estimates (for example, historical *ex ante* approaches and forward-looking calculations such as the Dividend Growth Model (DGM)).[862] We said we would review any new evidence on the EMR and implications for the ERP but stated that we expected the real EMR (CPI-based) to remain in the 6% to 7% range recommended in the 2018 UKRN report.

A20.50 Based on our proposed values for the RFR, EMR and inflation, the nominal EMR was 8.8% and the nominal ERP was 7.4%: a slight increase on the nominal EMR and ERP used in the 2019 BCMR Statement of 8.7% and 7.3% respectively. The increase in nominal values was the result of updating our CPI assumption from 1.9% to 2.0%.

Stakeholder responses

A20.51 BT reiterated its views on the EMR which it made in its response to the 2018 BCMR Consultation. On methodology, BT was of the view that we should place most weight on long-run historical *ex post* evidence, as it remained the most reliable method for estimating the expected return going forward and provided the most objective evidence (being based on realised returns). BT cautioned against placing weight on forward-looking indicators, such as the DGM.

A20.52 BT also referenced the 2018 UKRN Report which set out a view that the harm from disincentivising investment by setting allowed returns too low was greater than the harm to consumers of high prices from setting allowed returns too high. BT quoted the following: 'when the consequence of setting too low a RAR [Regulatory Allowed Return] is a complete loss of investment, the optimal choice of the RAR (and hence, in this simplified framework the RER

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[861] PR19 PFs, Page 534. The CMA's range includes yields on AAA bonds as a proxy for upper bound the risk-free rate. We have not relied on these in our estimate.
[862] Our 6.7% estimate was derived from a range of 6.0% to 7.3%, where the low end of the range (6%) was as proposed by the authors of the 2018 UKRN Report (from a range of 6% to 7%) while the upper end of the range (7.3%) represented the top end of the range as proposed by Europe Economics' October 2018 report for Ofcom.

[Regulatory Expected Return]) is high, in terms of the percentile within the range of distribution of the true WACC'.

A20.53 BT stated that we were developing a long-run regulatory framework for incentivising investment in FTTP. Underestimating the expected market return (and hence the WACC) may chill investment if it is taken as a signal that 'bets' may not be treated fairly in the future. As such BT proposed a point estimate for the real EMR at the top end of the 2018 UKRN range of 7.0% (real, CPI-based).[863]

A20.54 TalkTalk stated that we had not evidenced why the nominal ERP had increased from 7.3% in the 2019 BCMR Statement to 7.4%, implying a nominal EMR of 8.8%. It concluded that it was therefore difficult to comment on the appropriateness of the proposed values. TalkTalk noted that, if anything, the EMR should be reduced rather than increased, given that it is at the top end of the range proposed by Ofgem in RIIO-2.[864]

Our reasoning and decisions

A20.55 The EMR represents the sum of the RFR and the ERP. While the expected EMR and expected ERP are not directly observable, in recent decisions we have placed more weight on estimates of the EMR, consistent with a view that the long-run market return is likely to be more stable than the ERP.[865]

A20.56 We recognise that the views of experts can differ when it comes to estimating the level of the EMR and the relationship between the RFR, ERP and EMR. We summarise the available evidence and respond to stakeholder comments below. We conclude that a real (CPI-based) EMR of 6.7% remains appropriate.

Historical *ex post* evidence

A20.57 Historical *ex post* approaches assume that realised equity returns are a good proxy for the forward-looking expected EMR. Since equity returns are volatile, it is reasonable to consider long periods of history (if data permits).

A20.58 As BT points out, the 2018 UKRN report recommends that regulators base their estimate of the EMR on historical averages calculated over a very long period.[866] This recommendation reflects the authors' view that this approach is likely to be both defensible and implementable. However, the authors also recognised that expected returns may deviate from the long-run historical average.

[863] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.10-A6.20.
[864] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.13.
[865] In section 4.4.1 of the 2018 UKRN report, the authors present evidence on the relative stability of long-run mean returns on mature stock markets, in contrast with considerably lesser stability of returns on other asset classes (such as bonds and cash), implying that the *ex post* ERP has been far from stable. This suggests that assuming that the long-run market return is stable (rather than that the forward-looking ERP is stable) might be a reasonable methodology. Indeed, this is one of the recommendations of the 2018 UKRN Report (Page 48).
[866] 2018 UKRN report, page 47. This is consistent with the recommendation in the 2003 report by Wright et al, February 2003. *A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK*, page 48.

A20.59 In the 2019 BCMR Statement, we concluded that historical *ex post* evidence could support estimates of the EMR in a relatively broad range of 6.0 to 7.3%, based on the following.

- The 2018 UKRN report, which recommends a CPI-real EMR range of 6% to 7%.[867] The report estimates the geometric average of annual historical returns in the UK[868] and then adds a volatility adjustment to arrive at an arithmetic average return. The size of the volatility adjustment depends on the choice of the investment horizon. For example, for a one-year investment horizon, the appropriate EMR would be at the top end of the UKRN range of 6 to 7%, while for longer investment horizons it would be lower. [869]
- Europe Economics' October 2018 report, which presents a CPI-real EMR of 7.0 to 7.3%. These estimates are based on the arithmetic averages of annual historical returns, with the range reflecting some differences in the choice of the inflation index used to derive real historical returns. [870] These values of the EMR would be appropriate proxies for a forward-looking EMR assuming a one year investment horizon but would overestimate returns required over longer investment horizons.[871]

A20.60 Since the publication of the 2019 BCMR Statement, other regulators and the CMA have issued decisions or proposals on EMR estimation. These decisions draw on a similar evidence base to the one we used in the 2019 BCMR Statement, with the CMA's PR19 PFs providing a comprehensive review of the evidence on historical realised returns.

A20.61 An issue in estimating historical realised real returns is the measure of inflation used to deflate nominal returns.[872] The CMA uses the consumption expenditure deflator (CED) as its preferred measure to deflate returns over the 1900-1947 period; and then in subsequent years either CPI or RPI. [873] The 2020 Yearbook reports UK real returns using the Cost of Living Index (COLI) until 1949, back history of CPI from 1949 until 1988, and CPI from 1988 onwards to deflate UK nominal returns.[874] Finally, the 2018 UKRN report recommends the use of the Bank of England's long-term CPI series.[875]

A20.62 These different measures of inflation, as well as different averaging techniques, produce the following estimates.

- The CMA estimates a range for historical realised real returns of 6.1 to 6.9% (by deflating nominal returns by CED/CPI series) or 5.9 to 6.6% (by deflating nominal returns by CED/RPI

[867] 2018 UKRN report, Appendix E.
[868] 2018 UKRN report, Appendix E, page 125. The historical geometric return used by the UKRN report as the starting point is around 5.5% although the authors note that a figure of not much more than 5% looks increasingly persuasive.
[869] The 2018 UKRN report notes that "long-horizon returns have distinctly lower volatility than would be the case in a random walk stock market". This is why the size of the volatility adjustment varies with the investment horizon. UKRN report, Appendix, page 125.
[870] See Europe Economics, 2018. *Cost of Capital: Total Market Return*, (Europe Economics' October 2018 report), pages 14-15.
[871] PR19 PFs, paragraph 9.176. The CMA notes that "where returns are serially correlated and investors have a holding period of more than a year, the arithmetic mean return for a single year will be an upwards biased estimator of returns."
[872] For historical nominal returns data, the main source of evidence is Credit Suisse Global Investment Returns Yearbook 2020, Dimson/Marsh/Staunton, February 2020 (2020 Yearbook).
[873] PR19 PFs, paragraphs 9.158-161.
[874] The 2020 Yearbook refers to this as the 'Retail Price Index', which is understood to be the same as the COLI index (e.g. see PR19 PFs, paragraph 9.196 and footnote 1417).
[875] 2018 UKRN Report, page D-110.

series). The overall range captured by these estimates is 6.1 to 7.6% (CPI-based), using the CMA's inflation assumptions.[876]

- The 2020 Yearbook reports historical returns for the UK market of 5.5% and 7.3% (geometric mean and arithmetic mean respectively).[877] If returns for the first half of the 20th century are deflated using CED rather than COLI (consistent with the CMA), realised returns would be 0.35% lower, i.e. 5.15% and 6.95% respectively. [878]
- The 2018 UKRN report estimates a geometric mean return of 5.2%. This forms the basis of the recommended range of 6 to 7% as an estimate of future CPI-based returns (derived by adding a volatility adjustment to the geometric mean return).[879]

A20.63 It is difficult to assess the impact of changes in measuring inflation on real realised returns over the period of more than one century for which equity returns have been measured. However, RPI is no longer a national statistic and is an inconsistent and an upwardly biased measure of inflation due to various methodological concerns. While over the 20th century, the estimated difference between the UK CPI and UK RPI has been relatively modest (0.14%)[880], the wedge between RPI and CPI has been more significant in recent years.[881] Based on our inflation forecasts taken from the OBR (see A20.24), the future expected RPI-CPI wedge is 1.0%. For these reasons, RPI-deflated returns are likely to overstate expected future returns on an RPI-basis and this is the reason the CMA places less weight on the upper end of its overall range.[882]

A20.64 Overall, we consider that the evidence on historical *ex post* returns has remained broadly unchanged since the 2019 BCMR Statement, with most estimates still being captured by the 6.0% to 7.3% range (CPI-real) which we relied on in that decision. However, estimates towards the top end of this range either place some weight on RPI-deflated realised returns (which are likely to overstate future returns, when combined with forward-looking RPI inflation expectations), and/or require an assumption of relatively short investment horizons.

Historical *ex ante* evidence

A20.65 In the 2019 BCMR Statement we also considered historical *ex ante* approaches to estimating the real EMR. These approaches also use historical data but try to account for one-off good or bad 'luck' that investors might not expect to be repeated in the future. We noted that the historical *ex ante* approaches generally suggested a forward-looking EMR lower than that supported by historical *ex post* evidence.

[876] PR19 PFs, paragraph 9.183. The CMA converts the CED/CPI range of 6.1 to 6.9% into an RPI-based range of 5.2 to 5.9%, which produces an overall (RPI-based range of 5.2 to 6.6%. The forward-looking RPI-CPI wedge assumed by the CMA is 0.90%.
[877] 2020 Yearbook Table 71, page 211.
[878] PR19 PFs, paragraph 9.159 and 9.201.
[879] The CMA also presents an EMR range of 6.4 to 7.2% (CPI-real) based on a methodology from PwC comparable to that used in the 2018 UKRN report. PwC applies a slightly different volatility adjustment to the historical geometric return, compared to the 2018 UKRN report. PR19 PFs, paragraph 9.184.
[880] 2018 UKRN report, page 122.
[881] The wedge between RPI and CPI has increased in recent years and averaged at 0.7% over the 2000-16 period (2018 UKRN report, page 122).
[882] PR19 PFs, paragraph 9.161.

A20.66 The historical *ex ante* estimates are typically derived from the Fama and French approach, which assumes that the real EMR can be approximated as the sum of average dividend yields and the average real rate of dividend growth.

A20.67 The most up to date source of evidence on historical average dividend yields is the 2020 Yearbook, which covers the 1900-2019 period. The 2020 Yearbook reports an average historical dividend yield for the UK of 4.6%, and an average real rate of dividend growth of 1.0%. Taken together, these numbers would imply a real EMR of around 5.6%.[883]

A20.68 As discussed by the CMA, there is some debate whether to add a volatility adjustment to this figure. The appropriateness and the size of the adjustment depends on the expected relative volatility of dividend yields and capital price growth.[884] We do not think it is necessary to take a definitive view on this issue, but we note that the maximum adjustment suggested by the CMA is 150bp for the DMS dataset, with a notably smaller adjustment necessary in the context of investment horizons longer than one year. This would imply a CPI-real EMR of at most 7.1%. If we further accept the CMA's conclusion that the DMS dataset overstates real figures by 0.35% due to the use of COLI rather than CED (as explained above), the implied EMR is less than 7%.

A20.69 We also note the conclusion by DMS that, going forward, once they adjust for non-repeatable factors of the past, globally diversified investors might expect an arithmetic average ERP over treasury bills of around 5.0%.[885] Combined with any reasonable measure of the expected real (CPI-based) return on a treasury bill[886], this would imply that future returns are expected to be below historical *ex post* returns.

A20.70 Overall, the historical *ex ante* evidence suggests that the upper end of the 6.0 to 7.3% range for the EMR implied by the historical *ex post* analysis is likely to be overstating future expected returns.

Other evidence

A20.71 In the 2019 BCMR Statement we referenced the EMR estimates produced by Europe Economics in their report for us. They used three variants of the DGM, which implied a real (CPI-based) EMR of 6.4% to 6.7%.[887] We used this as part of the evidence base to inform our overall judgement on the range and point estimate of the EMR.

A20.72 For this Statement, we have not produced updated estimates of the EMR using the DGM. A review of recent DGM evidence is presented in CMA's PR19 PFs. For example, the CMA generally finds Ofwat estimates of the EMR using a DGM to be more robust than estimates from other sources. The Ofwat analysis estimates a real EMR of 6% to 7% (CPI-based)[888] suggesting that the upper end of the historical *ex post* EMR range is likely to be overstating

[883] Another source of evidence frequently cited for this type of analysis is the Barclays Equity Gilt Study (ESG). The 2018 edition (which covers data from 1900 to 2017) calculates an average dividend yield of 4.5% for the UK market with a real growth rate of 1.2%. Since the Barclays dataset uses RPI rather than CPI to deflate nominal series, we prefer to focus on the DMS dataset.
[884] This is because dividend growth is used as a proxy for capital growth in such *ex ante* models.
[885] 2020 Yearbook, page 46.
[886] A treasury bill is a short-term government debt obligation with a maturity of less than one year.
[887] The three DGM models considered by Europe Economics make different assumptions for short-term and long-term dividend growth rates. See section 2.5.2 and Table 2.3 of Europe Economics' October 2018 report.
[888] PR19 PFs, paragraph 9.211.

future returns. While the outputs of DGM models are sensitive to the underlying assumptions, they can still provide a cross-check on other evidence.

A20.73 Another source of evidence is investor and practitioner surveys. We have not typically placed much weight on such evidence, but we note that the review of such evidence has led the CMA to conclude that "experienced investors are expecting returns towards the lower end, or even below, the ranges estimated using historic data." [889]

A20.74 Finally, we note that the 2020 Yearbook examines the empirical relationship between real interest rates and subsequent real returns for equities and concludes that "when real interest rates are low, expected future returns on all risky assets are also lower"[890], consistent with there being a positive relationship between real interest rates and real returns on equity.[891] This evidence is also consistent with a view that returns at the upper end of the historical *ex-post* range are likely to overstate future returns in the current low interest rate environment.

Our decision

A20.75 We consider that the EMR is more stable than the ERP and we place most weight on historical *ex post* evidence. However, using historical evidence assumes the underlying return generating process has not changed. Placing weight on historical evidence does not imply the regulatory view of the EMR should remain static for all time, particularly as there is a range of values based on historical estimates.

A20.76 While gilt yields have fallen further since the 2019 BCMR Statement, bearing in mind our stability and consistency objectives, and in the context of an uncertain macroeconomic environment, we consider an EMR of 6.7% remains appropriate.

A20.77 BT suggests that understating the EMR (and hence the WACC) could chill investment at a time when we are trying to incentivise significant investment in FTTP, and that this is an argument to use an EMR of 7% (the top end of the UKRN range).

A20.78 While we have not revised our EMR range from the 2019 BCMR Statement, there is evidence that the upper end of this range is likely to be upwardly biased for the reasons explained above and as recently noted by the CMA.[892] Further, the choice of the point estimate for the EMR (and any possible implications for investment incentives) needs to be considered in the round, taking into account the approach for each of the parameters as well as the wider package of remedies intended to incentivise investment. We return to the issue of picking a point estimate for the WACC later in this annex, where we conclude that our WACC decisions are consistent with incentivising investment in this review.

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[889] PR19 PFs, paragraph 9.215.
[890] 2020 Yearbook, page 23.
[891] Similarly, the 2018 UKRN Report presents some evidence that expected returns on global markets have been weakening in recent years, and that valuation ratios (such the Shiller cyclically-adjusted P/E multiple) are currently at historical highs (which might imply lower future returns on equities compared to the historical average). Section 4.4.3 of the 2018 UKRN Report.
[892] In its latest working paper on cost of capital, the CMA notes that the approach adopted by the CMA and regulators, which assumes a broadly constant EMR over time, "may provide an upward biased [EMR] estimate in the current low RFR environment." CMA Water Redeterminations 2020, Choosing a point estimate - Working Paper, paragraph 74.

A20.79 Using our forecast of CPI inflation of 2.0%, a real (CPI-based) EMR of 6.7% implies a nominal TMR of 8.8%. Combined with our estimate of the RFR, the nominal ERP in this decision is 7.9%.

Cost of debt

Our proposals

A20.80 To estimate the cost of debt, we started from observed bond yields - similar to the approach adopted in the 2019 BCMR Statement. Our proposed cost of debt was a weighted average of current and historical yields on a benchmark BBB index:

- we derived a cost of new debt of 2.9% which was in line with the 12-month average yield on a BBB 10-year benchmark bond index;
- we estimated the cost of existing debt of 4.0% with reference to the ten-year average yields on the same BBB 10-year benchmark bond index. We noted that benchmark yields were broadly in line with BT's reported cost of existing debt, and proposed to use benchmark yields in the interests of transparency; and
- proposed a cost of debt of 3.5% which was around the midpoint of this range recognising an uplift from the midpoint to allow for issuance costs.

Stakeholder responses

A20.81 BT Group stated that we had not provided any evidence for the 50:50 weighting for new and embedded debt. Based on its review of BT's existing debt obligations and assuming any debt maturing during the review period would be refinanced, BT proposed a higher weighting for embedded debt, i.e. [✂] new to embedded debt.[893]

A20.82 BT's second concern was with our approach for calculating the cost of existing debt using a benchmark index, which could lead to BT either over or under-recovering its efficiently incurred historical debt costs. Therefore, BT believed that we should estimate the cost of embedded debt using BT's actual debt costs. BT said we could use its published annual report to do this as it sets out the weighted average effective fixed interest rate. This would address our concern about transparency for stakeholders.[894]

A20.83 TalkTalk tentatively agreed with calculating the cost of debt with reference to the costs of new and embedded debt, particularly given the RAB model proposed for Area 3. However, TalkTalk noted that, as the Bank of England's Quantitative Easing (QE) programme came into effect over a decade ago, an efficiently financed firm should have been able to largely reflect lower debt costs in its financing structure. Therefore, TalkTalk considered that the cost of debt should largely reflect the cost of new debt, with limited weight on the cost of debt before QE was put in place.[895]

A20.84 TalkTalk also considered that we should consult on whether to adopt a debt indexation approach. TalkTalk noted that our current approach was out of line with other UK regulators

[893] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.28-A6.32.
[894] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.33-A6.36.
[895] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 2.4.

which was particularly relevant in light of our proposal to move to a RAB approach in Area 3. TalkTalk stated in the event that we did not move to a debt indexation approach we should make it clear in our final decision that there are no circumstances under which we would envisage reopening the permitted cost of debt, even if the outturn is considerably different from our allowance.[896]

A20.85 TalkTalk also stated that we should consider using an index focussed on utilities as it offered significant advantages citing Ofgem's consultation that "this was a better match for network debt costs in times of financial distress than the use of an A/BBB index, exhibited a lower halo than an A/BBB index, and that it was a broad and representative index."[897]

Our reasoning and decisions

A20.86 We apply the same methodology as proposed in the January 2020 Consultation but in line with our approach to calculating the RFR we consider evidence on both ten-year and 15-year BBB benchmark bond indices. We conclude on a cost of debt of 3.6% for BT Group.

Debt indexation

A20.87 The main argument in favour of debt indexation is that it reduces forecast error. This assumes the chosen debt index is a reasonable match for debt costs efficiently incurred to finance the provision of the relevant regulated service.

A20.88 In our view, indexation makes sense for highly exogenous costs like general inflation. However, for endogenous costs the risks should sit with the regulated company. Debt costs are partly exogenous and partly endogenous. For example, the company can manage the timing of debt issuance, currency of issue, bond duration and to an extent its credit rating. As such debt costs are much less exogenous than general inflation. Further, given that inflation expectations influence the future cost of debt, inflation indexation of price caps provides some protection against the most obviously exogenous aspect of the cost of debt.

A20.89 We recognise that Ofwat and Ofgem have adopted debt indexation (and in the case of Ofgem indexation of some components of the cost of equity), although not all regulators use indexation.[898] However, for the reasons set out above and in light of our decision to set inflation-adjusted (from 2021 levels) charge controls on MPF and FTTC 40/10 rental services in Area 3, consistent with Area 2, updating prices within-period for changes in debt yields is not appropriate for this market review.

Cost of new debt

A20.90 As at 31 October 2020, we estimate that BT's rated listed debt (all currencies) had an average maturity at issuance of around 16 years and an average outstanding maturity of around ten

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[896] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 3.4-3.9.
[897] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.5.
[898] Recent publications from other regulators who have not indexed the cost of debt include CAA's RP3 final decisions in respect of NERL's monopoly activities, August 2019 (paragraphs E149 to E179) and its consultation on Economic regulation of Heathrow: policy update and consultation, June 2020 (paragraphs 4.36 to 4.44), UREGNI's SONI price control 2020-2025, December 2020 (paragraphs 7.25 to 7.29) and the ORR's 2018 periodic review final determination ,October 2018 (paragraphs 5.1 to 5.24)

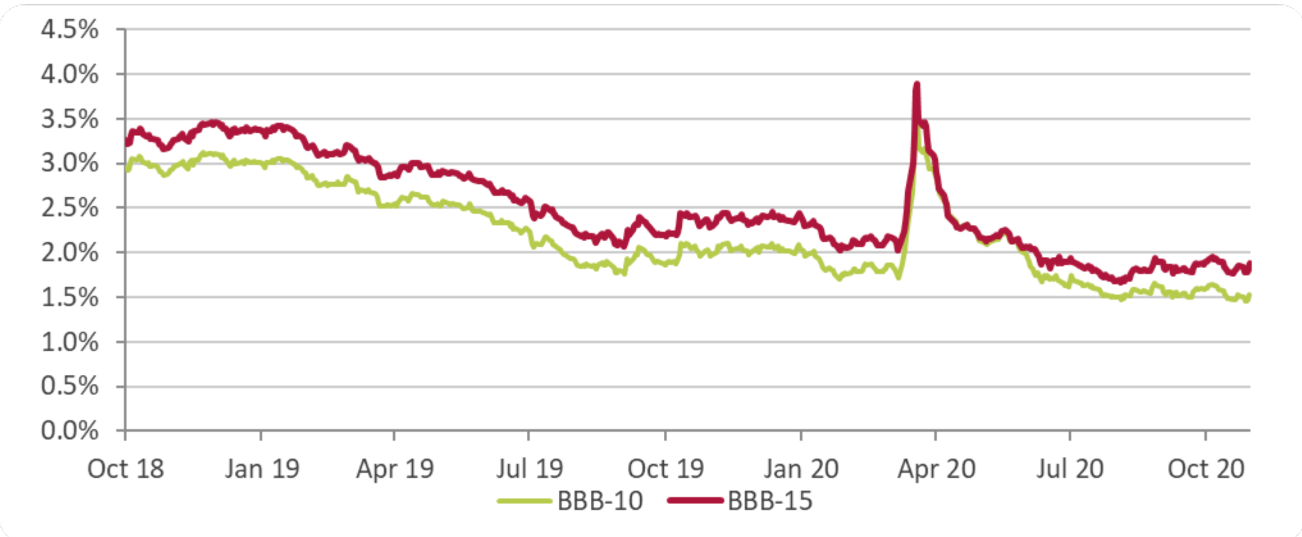
years.[899] Given this, we consider that recent yields on bonds with ten and 15-year maturities would give a reasonable estimate of the cost of new debt.

A20.91 We recognise TalkTalk's comment regarding the use of a utility specific debt index, however, given BT raises debt at the BT Group level, using such an index may underestimate the cost of debt for a telecoms company providing a range of services. Given that BT has been rated at least BBB- over the past 20 years, consistent with previous decisions we continue to rely on an index of BBB bonds.[900]

BBB yields

A20.92 Figure A20.4 shows spot yields for an index of BBB bonds with ten and 15-year maturities. In that period, BBB yields have trended down (briefly spiking in March/April 2020) with yields on both ten and 15-year bonds below 2% in the second half of 2020. The average yield over the last year was between 1.9% and 2.1%. Forward rates in October 2020 imply that at the end of the control period yields on ten and 15-year BBB bonds would be between 2.3% and 2.4%.[901]

Figure A20.4: Spot yields on an index of ten and 15-year BBB bonds



Source: Bloomberg, Ofcom analysis. Data to 31 October 2020.

A20.93 We want to use an up-to-date figure for the cost of new debt while also using an estimate that will smooth out the volatility in spot rates. We also recognise forward rates are higher than the 12-month average.

A20.94 We have decided on a cost of new debt of 2.1% which is the top end of the range for BBB yields in the last 12 months. We recognise that forward yields show an increase in the cost of new debt, however, given that the overall cost of debt allowance also gives weight to historical debt costs which are above spot rates (explained below) we consider that a point estimate of 2.1% for the cost of new debt is reasonable.

[899] Ofcom analysis of S&P Capital IQ data as at 31 October 2020.
[900] The index covers bonds that are BBB-, BBB and BBB+.
[901] The end of the charge control is 31 March 2026, which is in around 5 years time. These forward rates represent the expected yields on ten and 15-year BBB bonds five years from 31 October 2020.

Cost of existing debt

A20.95 Prior to the 2019 BCMR Statement, we estimated the cost of debt as the sum of the RFR and a forward-looking debt premium. Although with the RFR set above spot and short-term averages of benchmark gilts (see Figure A20.3 above), the effect was a cost of debt allowance somewhat above the cost of new debt. Starting from the 2016 BCMR Statement we cross-checked the resulting cost of debt against a weighted average cost of new and existing debt for BT.

A20.96 With the RFR being set closer to market rates in the 2019 BCMR Statement, we considered that a cost of debt allowance based on a RFR combined with an observed debt premium could result in a cost of debt allowance which might be inconsistent with providing the regulated firm an opportunity to recover efficiently incurred debt costs. This is because debt financing in telecoms tends to be of relatively long maturity (ten years or more, as explained above) and the extent to which interest rates fell following the global financial crisis may not have been anticipated even by an efficiently financed firm.

A20.97 While we recognise that unregulated firms do not benefit from this type of protection,[902] we think this is a reasonable approach when the WACC is used to set price caps for long-lived infrastructure assets (and there is limited prospect of infrastructure competition in the case of Area 3). With new debt costs lower compared to embedded debt costs, such an approach has the effect of producing an allowed regulatory return which is above a forward-looking WACC. This approach is in line with that used in the last review (2019 BCMR Statement) and broadly in line with that of preceding reviews and thus ensures a degree of stability and consistency in regulatory decisions over time.[903]

A20.98 In the January 2020 Consultation we proposed to calculate the cost of existing debt by reference to ten-year average yields on ten-year BBB bond index. Over the last ten years BT has been rated BBB- or BBB+ so we considered yields on a BBB index would provide a reasonable estimate of the cost of existing debt for an efficiently financed firm.[904] Using a ten-year average was broadly consistent with an average maturity on debt of ten years.

A20.99 We continue to apply the same methodology as in the January 2020 Consultation. As explained above, we have decided to consider an investment horizon of between ten and 15 years, in part recognising that recent debt issuances have been of longer maturities and the long lives of regulated infrastructure assets. On this basis, for consistency, we also consider evidence on the 15-year BBB index and the 15-year trailing averages. While we recognise this captures some data before QE was put into place, we are of the view that consistency with the chosen investment horizon is a relevant consideration.

A20.100 As at 31 October 2020, a simple ten-year average of yields is between 3.3% and 3.7% (for the ten and 15-year BBB index respectively), while a simple 15-year average is between 4.3 and 4.5% (for the ten and 15-year BBB index respectively). Overall, this gives a potential range for the cost of existing debt between 3.3% and 4.5%, with a midpoint of 3.9%.

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[902] As pointed out by some authors of the 2018 UKRN Report, Page 78.
[903] In the 2016 BCMR Statement and 2018 WLA Statement, we cross-checked our cost of debt estimate against the cost of BT's existing debt.
[904] Credit ratings per S&P Capital IQ.

A20.101 In BT's 2020 Annual report, BT reported a weighted average effective fixed interest rate of 3.9% for 2020.[905] Since 31 March 2020 BT has issued additional debt and some bonds are due to be repaid by 31 March 2021. As at 31 October 2020, we forecast BT's weighted average effective fixed interest rate to be 3.8% by the start of the charge control.[906]

A20.102 Given the evidence on benchmarks and the cross-check on BT's actual debt costs, we have decided to use 3.8% as the cost of existing debt.

Weighting of existing and new debt

A20.103 In the January 2020 Consultation we proposed that because the cost of debt would fall between the cost of new and existing debt during the charge control, we would take the midpoint of this range as the proposed cost of debt. This implied a weighting of 50:50 between new and existing debt.

A20.104 Given that the charge controls being set are a combination of costs at the start and at the end of the control (depending on the service in question), and given that we assume debt maturity of between ten and 15 years, we consider that a weighting higher than 50% on existing debt is appropriate. Assuming existing debt is gradually replaced with new debt over the five-year control, this supports a weighting on existing debt of around 80%.[907]

Our decision

A20.105 Taking into account the costs of new and existing debt, and our view on weighting above, the weighted average cost of debt is 3.5%.[908]

A20.106 As in previous decisions, we include an allowance for debt issuance costs since these costs are not included in operating costs within BT's RFS and so would not otherwise be included in charge controls based on BT's cost data.[909] We continue to allow a ten basis point uplift to the cost of debt for issuance and liquidity.

A20.107 Taken together, we use a pre-tax nominal cost of debt for BT Group of 3.6%.

Equity beta and asset beta – BT Group

Our proposals

A20.108 For the purposes of the January 2020 Consultation we used the 2019 BCMR Statement values of the BT Group asset beta of 0.68, a debt beta of 0.10 and a forward-looking gearing assumption of 40%. Combined, these implied a forward-looking equity beta for BT Group of 1.07.[910] We said we would review the evidence for these parameters for the next publication.

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[905] BT Annual Report 2020, Page 182.
[906] Ofcom analysis based on data from S&P Capital IQ and BT debt investor information.
[907] By the end of the five-year control the existing debt would account for 50% or 67% of total debt, depending on whether the debt is of 10 or 15 year maturity, and assuming existing debt is replaced with new debt. The average over the control would therefore be between 75% and 83%.
[908] Rounded to one decimal point.
[909] See paragraph A21.71 of the 2018 WLA Statement.
[910] 2019 BCMR Statement, Annex 21, Table A21.1. Equity beta = (asset beta – debt beta*gearing)/(1-gearing).

Stakeholder responses

A20.109 BT said that due to the current COVID-19 crisis there may be short-term changes in BT's share price and the market index as a result of a small number of data points having an unduly large effect on the beta. It said that short-term changes in market returns may not provide a reliable forward-looking estimate of BT's beta over a longer market review period of five years. It therefore believed that the estimation window would need to be reconsidered in light of the pandemic.[911]

A20.110 In a further submission, BT estimated that BT's 5-year asset beta had declined from 0.68 used in the 2019 BCMR to 0.62, although it did not explicitly revise its estimates of the BT Group WACC to reflect this evidence.[912]

A20.111 In relation to forward-looking gearing, BT made a similar point i.e. that we should not mechanistically update gearing based on short-term movements in equity valuations. BT emphasised that we should take account of longer-term trends in BT's gearing, rather than focusing on short-term market movements and used 40% in its own calculations.[913]

A20.112 In relation to BT Group's gearing, TalkTalk considered that we should use "optimal gearing" rather than actual gearing as this was in line with the approach of other regulators.[914]

Our reasoning and decisions

A20.113 Based on the updated evidence, we conclude on an asset beta for BT Group of 0.62, a forward-looking gearing of 45% and a debt beta of 0.10. Together these values translate into an implied forward-looking equity beta of 1.05 for BT Group.

Equity beta estimates

A20.114 In the 2019 BCMR Statement we estimated the BT equity beta using 5-year daily data as a stable basis for projecting future systematic risk. This is because we observed significant volatility in shorter-term beta estimates. For example, the 2-year equity beta fell by 36% compared to the 2018 WLA Statement, due to the European referendum in June 2016 falling out of the two-year estimation window (the 'referendum effect'), [915] and the standard errors on 2-year betas had increased. We therefore concluded that using 5-year betas resulted in a better trade-off between our objectives of sending efficient price signals and regulatory stability than shorter-term betas.

A20.115 Brattle has updated the evidence on 1-year, 2-year and 5-year daily betas for BT Group and relevant comparators. The use of a daily sampling frequency ensures that there are sufficient observations for the beta estimate to be statistically robust and Brattle has performed liquidity checks on all of the comparators.

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[911] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.39-A6.40.

[912] BT supplementary report to Ofcom's consultation on promoting competition and investment in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26 – The WACC for FTTP, January 2021, (BT's 2nd Submission) paragraph 5.5.

[913] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.41-A6.44 and Table A6.4.

[914] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.18.

[915] See NERA 2018, Cost of capital: Beta and Gearing for the 2019 BCMR (NERA's October 2018 report), Appendix A.

A20.116 Brattle notes that using an estimation window longer than 5 years may not be appropriate in telecoms because the telecoms sector has been characterised by rapid technological innovation, significant levels of investment, and substantial M&A activity. [916]

A20.117 Further, as shown by Brattle, BT's 5-year equity beta has remained broadly stable over the last decade (with central estimates close to or a bit below 1).[917] We also note that Indepen estimated BT and utility equity betas using longer estimation periods and alternative methods (such as GARCH), and found that most central estimates of the BT equity beta were similar (and reasonably close to 1).[918] Therefore, while a case could be made for using data longer than 5 years in the case of BT, we do not think it adds significant new information on the appropriate level of BT's equity beta.

A20.118 Moreover, our preference is for a consistent estimation window when comparing BT to benchmark companies. We consider benchmark betas from a wide selection of comparators in Annex 21 and agree with Brattle that using an estimation window longer than 5 years may not be appropriate for many of these telecoms companies.[919]

A20.119 Figure V-1 of the 2020 Brattle Report shows the recent evolution of BT's 1-year, 2-year and 5-year equity betas against the FTSE All Share. The 5-year equity beta has been relatively stable over the last few years, while 1-year and 2-year equity betas for BT Group have recently realigned with the 5-year equity beta.

Table A20.5: BT equity betas at 31 October 2020 measured against the FTSE All Share

	Equity beta	95% confidence interval
1-year	0.96	0.74-1.18
2-year	0.94	0.74-1.14
5-year	0.94	0.80-1.09

Source: Brattle[920]

Asset beta estimates

A20.120 The asset beta is calculated by un-levering the equity beta for the effect of gearing. Taking account of systematic risk present in debt (i.e. the debt beta), we can derive the asset beta from the equity beta using the following equation: $\beta a = \beta e * (1 - gearing) + gearing * \beta d$, where βa is the asset beta, βe is the equity beta, gearing is the gross value of short-term debt and long-term debt as a proportion of enterprise value, and βd is the debt beta.

A20.121 Brattle has used the same methodology for calculating gearing as we used in previous reviews and has used a debt beta of 0.10 to un-lever the equity beta for BT.[921]

[916] See Annex 22: Cost of Capital: Beta and Gearing for WFTMR 2021, Brattle, February 2020 (2020 Brattle Report), paragraph 19.
[917] 2020 Brattle Report, Figure V-6.
[918] Ofgem Beta Study RIIO-2, Indepen, December 2018, Figure E2.
[919] 2020 Brattle Report, paragraph 31.
[920] 2020 Brattle Report Table V-1.
[921] 2020 Brattle Report, Page 15.

A20.122 From the 1 April 2019 BT adopted a new accounting standard, IFRS 16, which concerns the reporting of leases in its financial statements. Under IFRS 16 companies are required to treat operating leases in the same way they would treat a finance lease i.e. capitalise them. This led to the creation of right to use assets and equivalent lease liabilities on BT Group's Statement of Financial Position when it reported its interim financial results for the half year ended 31 September 2019. It was not required to restate prior periods.

A20.123 The impact of adopting IFRS 16 caused debt on the balance sheet to increase by c.£7bn in October 2019. The reason for the significant impact was due to the 2001 sale and leaseback transaction with Telereal Trillium whereby the majority of BT's property portfolio was sold to Telereal Trillium and BT entered into 30-year leases for the properties sold.

A20.124 The debt and enterprise value data series, sourced from Bloomberg by Brattle, therefore have a step change in reported statistics due to the adoption of IFRS 16 at some point in 2019 by all comparators considered by Brattle, including BT.

A20.125 Table A20.6 shows the impact of the reporting change on the gearing statistics and the implied asset beta for BT, at different estimation frequencies. The overall impact of the reporting change is relatively small on 5-year gearing and asset beta but is more pronounced at shorter frequencies.

Table A20.6: BT Group asset betas including and excluding IFRS 16

	Equity beta	Gearing including IFRS 16	Asset beta including IFRS 16	Gearing excluding IFRS 16	Asset beta excluding IFRS 16
1-year	0.96	65%	0.40	58%	0.46
2-year	0.94	55%	0.48	51%	0.51
5-year	0.94	40%	0.60	39%	0.62

Source: Brattle[922]

Choice of asset beta

A20.126 We agree with BT that short-term changes in market returns may not provide a reliable forward-looking estimate of BT's beta. While the equity betas are broadly similar across different estimation windows (as discussed above), the trends in gearing and asset beta show greater divergence, with recent changes in market valuations having a more significant impact. In the context of a longer market review period and continued uncertainty, we prefer to place most weight on 5-year betas.[923]

[922] 2020 Brattle Report, Table V-1.
[923] As noted above, the 5-year equity beta for BT is also consistent with longer-run beta evidence.

Treatment of IFRS 16

A20.127 There is a case for treating all lease liabilities as debt, regardless of their accounting treatment.[924] Rating agencies also typically adjust their debt ratios to include operating leases as debt (although we note that the size of the adjustment does not necessarily correspond to the adjustment adopted by companies under IFRS 16).[925] Therefore, in future, it would seem appropriate to take gearing statistics as reported under IFRS 16, with all lease liabilities capitalised.

A20.128 In this review, given that the accounting change has only been introduced in 2019 and our decision to use 5-year betas (which means the accounting change affects about one year's data out of the 5 year estimation window) we have decided to place most weight on gearing and asset beta estimates which exclude the impact of IFRS 16 to inform our judgement on betas. This is because excluding the impact of IFRS 16 ensures we have a consistent gearing dataset for each comparator. [926]

A20.129 An alternative approach could be to attempt to retrospectively adjust all the debt statistics, assuming all operating leases had been capitalised in prior years. [927] The difficulty with this approach is that it requires several subjective assumptions. Further, indicative analysis by Brattle suggests that the impact of adopting IFRS 16 is most material for BT but is relatively less material for other comparators. Therefore, IFRS 16 has much less of an impact when it comes to our judgements on comparator benchmarks in Annex 21.

A20.130 BT's 5-year equity beta as at 31 October 2020 was 0.94 and the average gearing over the same period was 39% (with the impact of IFRS 16 excluded). This results in an asset beta of 0.62, and this is the value we use in this decision.

Forward-looking gearing

A20.131 To inform our forward-looking gearing assumption, we start by considering recent trends in BT's gearing. Our view of forward-looking gearing for BT Group then informs our notional gearing assumptions for the disaggregated parts of BT, used to derive the appropriate WACCs for the different regulated services.

A20.132 Figure A20.7 shows the evolution of BT's market capitalisation, book value of gross debt and gearing. In recent years there have been several step changes in BT's gross debt i.e. in January 2016 following its acquisition of EE and in October 2019 when IFRS 16 was first adopted. Recent levels of gearing are relatively high. As shown in Table A20.6 above, at 31 October 2020 BT's one-year gearing is just under 60% after excluding the impact of IFRS 16. The increase in gearing can be largely explained by significant falls in market capitalisation.

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[924] See Leases, Debt and Value, Damodaran July 2009 and Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization, Brattle July 2016, ('2016 Brattle Report'), Footnote 87, Pages 81-82.

[925] Prior to the adoption of IFRS 16 in FY 2019/20 Standard and Poor's increased debt by £4.5bn to reflect the incorporation of the present value of operating leases.

[926] The approach to IFRS 16 in the cost modelling is outlined in Annex 14.

[927] Brattle has suggested a possible approach to do this and presented the results in the 2020 Brattle Report - Appendix B.

Figure A20.7: BT Group gearing, market capitalisation and total debt (including operating leases)[928]

Source: Bloomberg (debt = short-term + long-term debt; gearing = debt/(Market cap + debt)), data to 31 October 2020.

A20.133 Prior to the pandemic and the adoption of IFRS 16, gearing tended to be between 20% and 45%. The last time gearing was above 50% was around the global financial crisis when BT's equity value reduced significantly. The latest 5-year average gearing is 39% excluding the impact of IFRS 16.

A20.134 The steady increase in gearing explains the fall in the implied asset beta, while the overall equity risk (as measured by the equity beta) appears to have stayed fairly stable over the last 5 years (as shown in Table A20.6 above).[929]

A20.135 Considering the gearing evidence (excluding the impact of IFRS 16, for consistency) for other comparators, we note the following.

- For TalkTalk and Vodafone, the 1-year average gearing is 44% and 61% respectively, compared to 5-year averages of 36% and 48% respectively.
- For European telecoms, the 1-year average gearing is between 12% and 76%, and the average is around 36%. The 5-year average gearing is between 16% and 71%, with an average 34%. Within this large sample of European telecoms, only two companies have gearing above 50% (Telefonica and Telecom Italia),[930] when averaged over the last 5 years, and three companies when averaged over the past year.
- The 1-year average gearing for UK utilities is 48%, compared to a 5-year average of 51%.[931]

[928] The gearing presented in the chart is not the same as the gearing used to de-lever the equity beta in this decision because as explained earlier we use gearing excluding the impact of operating leases for consistency over time because IFRS 16 only impacted BT's gearing from October 2019.
[929] This assumes that the systematic risk taken by debtholders (as measured by the debt beta) has stayed constant.
[930] Moreover, one of these, Telecom Italia is just below investment grade at BB+. 2020 Brattle Report, Table V-6.
[931] Including IFRS 16 increases 1-year gearing from 44% to 49% for TalkTalk, from 61% to 65% for Vodafone, from 36% to 42% for European telecoms and from 48% to 51% for UK utilities.

A20.136 We conclude that a reasonable forward-looking gearing level for BT Group, consistent with our view of its systematic risk, would lie between 35% to 50%. The lower end of this range approximately reflects the average gearing for European telecoms, both recently and over the last five years. The upper end of the range is around the average gearing for UK listed utilities and close to the maximum level proposed in the 2016 Brattle Report.[932]

A20.137 We agree with TalkTalk regarding a notional approach to gearing, and it is the approach we used in previous reviews. We also broadly agree with BT that it is important to consider long-term trends, and not just short-term market movements (especially if there are significant movements in the market value of equity due to the ongoing pandemic).

A20.138 It is unclear at this stage if the recent increases in gearing for BT are reflective of future long-term trends. Given the overall upward trajectory, we consider it reasonable to increase our forward-looking gearing assumption but do not propose going outside the benchmarks for comparator companies, recognising the gearing assumption is used in identifying the cost of capital for relevant regulated services (see Annex 21). On this basis, we have decided to use a forward-looking gearing for BT Group of 45%.[933]

Debt beta

A20.139 No stakeholders commented on our proposal to use a debt beta of 0.10. We have decided to use a debt beta of 0.10 consistent with the January 2020 Consultation approach. This is appropriate given regulatory precedent and Brattle's approach, as outlined in the 2016 Brattle Report and the 2020 Brattle Report.[934]

[932] In the 2016 Brattle Report, Brattle recommends a maximum forward-looking gearing rate for telecoms providers of 50% to 55% (Page 83).

[933] If we were to adopt a materially higher forward-looking gearing (e.g. at 60%, which is around the latest 1-year average for BT), we would need to consider if the debt beta assumption remains appropriate (moderating the increase in the cost of equity), and whether BT could sustain its current credit rating. As we noted, most telecoms companies operate at lower gearing compared to BT's current gearing.

[934] 2020 Brattle Report, Page 16.

Forward-looking equity beta

A20.140 Combining an asset beta of 0.62, a notional forward-looking gearing of 45% and a debt beta of 0.10, we derive a forward-looking equity beta for BT Group of 1.05. An equity beta around one is consistent with long-run market evidence on BT's equity beta.[935]

Corporate tax rate

A20.141 In the January 2020 Consultation we proposed a forward-looking corporate tax rate of 17% based on HMRC published guidance from March 2016. The cut to corporation tax was announced as part of the March 2016 budget.[936]

A20.142 In its response to the January 2020 Consultation, BT noted that the Government decided to freeze the corporation tax rate at 19% in the March 2020 budget and therefore we should use 19%.[937]

A20.143 Just before the publication of this statement, the Government announced in the March 2021 budget that the corporate tax rate would remain at 19% for 2021/22 and 2022/23 before increasing to 25% from 2023/24.[938] In addition, the Government announced that from 1 April 2021 until 31 March 2023, companies investing in qualifying new plant and machinery assets would benefit from a 130% first-year capital allowance. It stated that this upfront super-deduction would allow companies to cut their tax bill by up to 25p for every £1 they invest and investing companies would also benefit from a 50% first-year allowance for qualifying special rate (including long life) assets.[939]

A20.144 Typically, we would expect the statutory tax rate (used in the WACC) to be a reasonable approximation of the average effective tax rate faced by BT Group over the market review period. Other things equal, a higher statutory tax rate points to a higher pre-tax WACC. However we expect the tax relief benefit on qualifying capital expenditure to be significant for a company like BT Group, such that the overall implications of the later planned increase in the corporate tax rate together with the tax relief measures are unclear at this stage.[940] Further, in this review, only the DFA, DFX and PIA prices are subject to price caps which are directly linked to the WACC. Therefore, we have decided to use the current corporate tax rate of 19%.

Our decision on the WACC for BT Group

A20.145 Based on our decisions above the resultant pre-tax nominal WACC is 7.8% for BT Group.

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[935] 2020 Brattle Report, Figure V-6. Ofgem Beta Study RIIO-2, Indepen, December 2018, Figure E2.
[936] Corporation Tax to 17% in 2020 – Policy paper, HMRC, 16 March 2016.
[937] BT Group's response to the January 2020 Consultation, Annex 6, paragraph A6.45. Further, in BT's 2nd submission, BT argues for a different tax rate assumption specifically for FTTP. We discuss this in Annex 20.
[938] Copy of the Budget Report – March 2021 as laid before the House of Commons by the Chancellor of the Exchequer when opening the Budget (Budget 2021), paragraph 2.81
[939] Budget 2021, paragraph 2.111.
[940] Various news outlets quoted a statement from a BT spokesman: "We are expecting to invest significant amounts of capex in plant and machinery over the next several years, and to the extent this proves to be eligible for the super-deduction it could result in a significant reduction in our corporation tax bill for our 2021/22 and 2022/23 financial years. This would be offset in later years by the subsequent increase in the corporation tax rate to 25% from April 2023." (link to Reuters article).

A20.146 There is debate whether there is an asymmetric cost from over- or under-estimating the true WACC in a regulatory setting. If the benefits of promoting investment outweigh the costs, then there is an argument for choosing a point estimate that is above the best (unbiased) point estimate of the WACC.[941] BT references this argument with respect to our choice of the EMR (as discussed above). This reasoning assumes that the regulator's judgement on the allowed return directly influences the regulated firm's investment decisions, and that there is an asymmetric cost to customers from underinvestment.

A20.147 We recognise that the regulator's estimate of the WACC may have some impact on the attractiveness of investing in the sector. Taken in the round, our estimate is consistent with supporting investment in the sector, which we consider appropriate in the context of this review. For example, while our choice of the EMR is around the mid-point of the 6.0% to 7.3% range we noted reasons why estimates at the top end of this range are likely to be upwardly biased. We also noted earlier that giving weight to historical debt costs has the effect of setting a regulatory allowed return above the forward-looking WACC.

A20.148 More generally, the overall approach to regulation in this review reflects our objective to promote investment in gigabit-capable networks by Openreach and other telecoms providers in order to promote network-based competition. Within this wider context, we consider that our estimate of the cost of capital for BT Group as the basis for deriving allowed returns for different regulated services (see Annex 21), in particular those subject to cost-based charge controls, is consistent with this objective, and no further adjustments to the regulatory allowed return are necessary.

[941] For example, see the discussion in 2018 UKRN Report (page 15) and PR19 PFs (paragraphs 9.663 to 9.673).

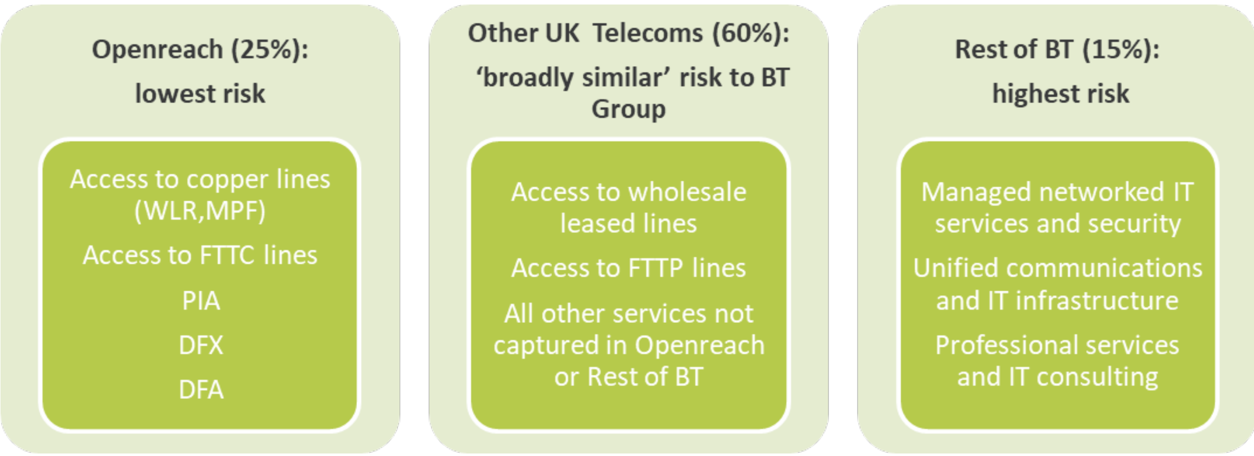
A21. Cost of capital for the relevant services

A21.1 In this annex we explain our approach to disaggregating the BT Group cost of capital, to estimate the appropriate rate of return for the services of interest in this review.

A21.2 In recent reviews we disaggregated the BT Group asset beta and cost of debt into three parts, based on our assessment of the relative risk of different services provided by BT.

A21.3 In the January 2020 Consultation, we proposed to keep the three parts of the BT Group disaggregation but proposed some revisions to the services included in each and the weightings. The three broad categories are summarised in Figure A21.1.

Figure A21.1: Disaggregation approach[942]



Note: numbers in brackets were proposed weights.

A21.4 For the purposes of the January 2020 Consultation, we used similar asset beta values as in the 2019 BCMR Statement for the disaggregated lines of business.

A21.5 Following consideration of the latest market evidence and stakeholder responses, we have adopted our proposed split of BT Group but updated the asset beta values and weights, as summarised below. We apply this split to our revised estimate of the BT Group cost of capital (see Annex 20).

Openreach

A21.6 We continue to associate the Openreach category with services which are lower risk compared to BT Group. This category largely reflects risks associated with core connectivity to broadband networks, which are increasingly seen as a necessity by customers. Consistent with our January 2020 Consultation proposals, we include access to copper only (i.e. MPF and WLR) and FTTC lines, PIA, DFA and DFX services in this category.[943] We consider that these services are

[942] We have previously referred to this part of BT as 'Openreach copper access', but since the 2019 BCMR Statement we use 'Openreach' for brevity and reflecting the fact that this part of BT includes services other than wholesale access to copper lines.
[943] When we refer to "copper" services in this annex we typically refer to the services provided over copper only lines i.e. excluding FTTC and G.fast. Elsewhere in this statement, copper may be defined to include FTTC and G.fast.

sufficiently similar in risk to be put into the same category, with an asset beta and WACC lower than BT Group.

A21.7 We use the Openreach WACC for setting cost-based charge controls for dark fibre services (Annex 17) and for PIA services (Annex 18). We also use the Openreach WACC for the creation of the RAB in Area 3 and in some of our cross-checks in Area 2 (Annexes 14 and 16).

Rest of BT (RoBT)

A21.8 We continue to treat BT's ICT activities as sufficiently distinct from other telecoms services provided by BT, with an asset beta and WACC higher than BT Group. The RoBT WACC is not used for any of the regulated services but provides a sense check on the other parts of our disaggregation.

Other UK Telecoms (OUKT) and FTTP

A21.9 All the remaining services, including FTTP, remain in OUKT, with an asset beta and WACC equal to BT Group. We recognise that the range of activities captured within the OUKT category is quite broad, and that the asset beta (and WACC) for FTTP could be higher than for OUKT. However, for the purposes of this review, we have decided not to disaggregate further.

A21.10 We use the OUKT WACC for the creation of the RAB in Area 3, and in some of our cross-checks in Area 2 (Annexes 14, 15 and 16).

A21.11 Table A21.2 summarises our WACC decisions for each category.

Table A21.2: Summary of WACC and component parameters

WACC component	Openreach	OUKT (same as BT Group)	RoBT	Source
Real (RPI-based) RFR	-2.0%	-2.0%	-2.0%	See A20.28
RPI inflation forecast	3.0%	3.0%	3.0%	See A20.24
Nominal RFR	0.9%	0.9%	0.9%	= (1+ real (RPI-based) RFR)*(1+RPI inflation)-1
Real (CPI-based) expected market return (EMR)	6.7%	6.7%	6.7%	See A20.56
CPI inflation forecast	2.0%	2.0%	2.0%	See A20.24
Nominal EMR	8.8%	8.8%	8.8%	= (1+real EMR)*(1+CPI inflation)-1
Nominal ERP	7.9%	7.9%	7.9%	= Nominal TMR – Nominal RFR
Debt beta (βd)	0.1	0.1	0.1	See A20.139
Asset beta (βa)	0.53	0.62	0.85	See A21.99, A21.106, A21.111
Weighting	25%	65%	10%	See A21.85, A21.87, A21.86
Gearing (forward looking) (g)	45%	45%	45%	See A21.123
Implied equity beta (βe)	0.88	1.05	1.45	= (βa - βd*g)/(1-g)
Cost of equity (post-tax) (Ke)	7.9%	9.2%	12.4%	= Nominal RFR + ERP *βe
Cost of equity (pre-tax)	9.8%	11.3%	15.3%	= Ke / (1-t)
Corporate tax rate (t)	19%	19%	19%	See A20.144
Cost of debt (pre-tax) (Kd)	3.5%	3.6%	3.9%	See A21.135
WACC (pre-tax nominal)	**7.0%**	**7.8%**	**10.2%**	=(Ke*(1-g))/(1-t)+(Kd*g)
January 2020 Consultation	*7.1%*	*7.9%*	*10.9%*	

Source: Ofcom[944][945]

Framework for assessing relative risk

A21.12 We did not receive material comments on our overall framework and therefore adopt the principles set out in the January 2020 Consultation. We explain the key elements of this framework in this section.

A21.13 We disaggregate the BT Group asset beta, cost of debt and WACC to reflect differences in the systematic risk of the different activities within BT Group.

[944] Note: Intermediate calculations in general are unrounded, however we round the pre-tax cost of equity, pre-tax cost of debt and pre-tax nominal WACC to one decimal point.

[945] For comparison purposes, the UKRN annual update has previously reported real vanilla WACCs used by UK regulators (where the vanilla WACC represents a weighted average of the post-tax cost of equity and the pre-tax cost of debt) with respect to CPI. The real vanilla WACC (with respect to CPI inflation of 2.0%) is 3.8%, 4.6%, and 6.5% for Openreach, Other UK Telecoms and RoBT respectively.

A21.14 The original evaluation framework for disaggregating the BT Group asset beta was established in 2005. [946] The two key aspects of this framework were:

- there were a priori reasons for why the systematic risk faced by the business in question would be different from that of the overall company (e.g. different income elasticities of demand and/or stability of cash flows); and
- there was evidence available to assess variations in risk.[947]

A21.15 Based on this framework we first split the BT Group beta in 2005 between Openreach's copper access network and the rest of BT (including in the latter voice call services, broadband and leased lines).[948] In the 2016 BCMR Statement, we further separated out services provided primarily by BT's Global Services division into a new 'Rest of BT' category, with all other services falling into 'Other UK Telecoms'.[949]

A21.16 The original decision to separate out only copper access was appropriate in a world where voice and internet access (dial-up or copper broadband) were sold as an "add-on" to basic copper line rental. In order to make calls or use an internet access service, customers needed to rent a copper line – which was separately charged for. We also reasoned (from historical demand estimation) that access services tended to have lower income elasticities of demand than call services which would imply a lower asset beta.[950]

A21.17 Given the decline in fixed voice usage and the integration of broadband with the line rental service (i.e. not sold as an overlay to fixed lines) the previous access and usage distinction is less relevant today.[951]

A21.18 Based on the evidence around broadband usage, we noted in the January 2020 Consultation that: i) broadband was becoming the 'basic building block' for communications services consumed at a fixed location, ii) customers were consuming ever more data (and hence required services capable of delivering that growing data usage) and iii) customers rarely downgraded their broadband service. Against this backdrop, we considered that systematic risk associated with overall broadband demand was likely to be relatively low and it is within this context that we assess the relative risk of different services below.

A21.19 As in previous reviews we have determined where services sit in the disaggregation with respect to two main characteristics of the services:

[946] Ofcom's approach to risk in the assessment of the cost of capital, August 2005 (August 2005 Statement), paragraph 5.24.
[947] Examples included: a) it was possible to identify benchmark firms that were close to 'pure play' comparators in terms of having similar risk characteristics to individual projects within BT; b) it was possible to use other quantitative analysis (such as quantified risk assessments or the analysis carried out by PwC at the time on behalf of Ofcom to assess variations in risk); and c) data was available at a disaggregated level (e.g. via separated accounts).
[948] August 2005 Statement, paragraph 1.22.
[949] In the 2018 WLA Statement and the 2019 BCMR Statement we also expanded 'Openreach copper access' to include PIA and DFX respectively, and we now simply refer to this category as 'Openreach'.
[950] Ofcom's approach to risk in the assessment of the cost of capital - first consultation, January, paragraph 5.39 to 5.40.
[951] Evidence of this includes: a) In November 2017, the Advertising Standards Agency ruled that when targeting businesses Plusnet plc must ensure they make clear the overall monthly cost of their broadband packages, for instance by merging the monthly cost and line rental into one all-inclusive price. This ruling applies to all broadband providers; and b) In 2005 there were 7.5m homes with broadband whereas at the end of 2019 there were 26.8m broadband connections.(2005 Communications Market Review and 2020 Communications Market Review).

- **Systematic demand risk:** services that exhibit more demand risk (greater income elasticity of demand) would be expected to have higher asset betas while services that have less demand risk (i.e. services that are 'necessities') would have lower asset betas; and
- **Operating leverage:** services that have greater operating leverage (i.e. require significant upfront investments or have a higher proportion of fixed costs) are more exposed to systematic risk and thus would have higher asset betas.

A21.20 Based on this framework, we first present our assessment of the relative risk of the different regulated services to inform our disaggregation, and then we discuss our decisions on the appropriate weights and asset betas for each disaggregated part of BT.

Relative risk: FTTC and copper

Our proposals

A21.21 We proposed that FTTC should sit with copper access line services within Openreach, reflecting our view that the systematic demand risk for services over FTTC was likely to have converged with risks previously associated with basic copper lines.[952] However, we thought there was an argument for a slightly higher asset beta than that used in 2019 BCMR Statement to reflect, for example, potential operating leverage risks during the transition to full-fibre.

Stakeholder responses

A21.22 BT disagreed with our proposal to shift FTTC services from OUKT to Openreach, only two years after Ofcom first decided to impose price regulation on the FTTC 40/10 service in the 2018 WLA Statement. Specifically, BT stated that no new evidence had been provided by Ofcom to support the move, and that the decline in the level of the assumed OUKT beta from 2018 WLA Statement already captured the effect of FTTC maturing as a service.[953]

A21.23 BT's other argument was that demand risk for superfast broadband (SFBB) remained higher than for standard copper broadband (SBB). In BT's opinion this was because demand for SFBB is more discretionary compared to standard copper broadband, implying that it is more sensitive to the economic cycle. BT cited the following evidence:

- 36% of the market continues to be unwilling to pay the price premium for SFBB (based on the number of copper only lines as of 2018);
- There is a positive relationship between the broadband speed and the advertised price, most notably between standard broadband (up to 30 Mbps) and superfast broadband (between 30Mbps and up to 100Mbps);
- Less than half (42%) of households with a broadband connection take a service provided over FTTC, with a similar proportion (36%) still taking a standard broadband service over MPF; and

[952] Previously FTTC was included in OUKT.
[953] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.50-A6.51.

- Only 40% of all households take a superfast broadband service provided over FTTC. The same proportion (40%) take a standard broadband service provided over MPF or do not take a broadband service at all.

A21.24 BT argued that SFBB provided over FTTC was clearly not a basic entry-level connectivity service, nor had it gained mass-market status. BT further suggested that upgrades and downgrades in response to macroeconomic events were more likely than for standard broadband.[954]

A21.25 To support this further, BT provided additional evidence that take-up of FTTC was higher in 'high affluence' areas relative to 'low affluence' areas; whereas take-up of SBB did not vary between low, medium and high affluence areas, suggesting that the demand for SBB was relatively insensitive to income. BT also noted that that evidence showed that the gap in FTTC take-up between high and low affluence households showed no sign of declining. BT concluded that there was therefore no evidence to show that demand risk between FTTC and standard copper broadband was likely to converge, given that the past five years showed no convergence.[955]

A21.26 TalkTalk agreed with Ofcom that copper only services on their own no longer represented core connectivity. TalkTalk noted that [✂%] of its residential customer base currently take an FTTx service, a proportion which continues to increase sharply. TalkTalk further considered the risk associated with customers downgrading from 80/20 to 40/10 FTTC services to be limited, not least because many retail customers were not even aware of the service that they were on, and where the price charged by the ISP was a blended rate across 40/10 and 80/20 wholesale services. TalkTalk also noted that Openreach was starting to issue MPF/FTTC stop sell notices at exchanges where ultrafast coverage has reached 75%, in time removing the option to downgrade from FTTC to copper only. [956]

A21.27 TalkTalk also stated that the operating leverage for FTTC was likely to be lower than for the copper network. TalkTalk noted that duct and poles would have already been in place (which was not the case at the time of the initial roll-out of the copper network), and that fibre optic cable was cheaper to purchase than copper cable. This would imply lower operating leverage for FTTC compared to copper. TalkTalk therefore agreed it was appropriate to include FTTC within Openreach but without any asset beta uplift to reflect this change in approach.[957]

Our reasoning and decisions

A21.28 We consider that the evidence continues to support our January 2020 Consultation position that FTTC is increasingly becoming the reason that demand for copper access lines remains, i.e. as it allows consumers to obtain SFBB. We have concluded that the beta risks of FTTC and copper lines have converged to the point where it is now appropriate to include both FTTC and copper lines in Openreach within our disaggregation.

[954] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.50-A6.60.
[955] BT supplementary report to Ofcom's consultation on promoting competition and investment in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26 – The WACC for FTTP, January 2021 (BT Group's 2nd Submission), paragraphs 4.4 to 4.6.
[956] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 3.22 to 3.27.
[957] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 3.22 to 3.27.

Demand risk

A21.29 In Annex 14, we show that at the end of 2019/20 standard broadband and voice only lines accounted for 45% of total Openreach lines (11.2m lines out of 24.9m).[958] By the end of the review period, we forecast this will drop to 19% of total Openreach lines (4.2m out of 21.9m). If we consider the broadband market only, we forecast that the proportion of Openreach broadband lines that use fibre (i.e. FTTC, G.Fast and FTTP) will reach 93% by 2025/26, with 54% being FTTC lines.[959] This shows how the market for broadband is now centred on FTTC and this will become even stronger over the review period.

A21.30 We also consider that the risk of customers downgrading from higher bandwidths to lower bandwidths, in response to macroeconomic shocks, is limited. Downgrading from FTTC services to standard copper broadband will be increasingly unlikely as demand for reasonable speeds grows, and as retail providers seek to migrate customers from standard copper broadband (e.g. by offering free or automatic upgrades). Volumes of 80/20 FTTC lines are also growing, largely facilitated by the low price differentials between FTTC 40/10- and 80/20-based services in order to encourage mass market customer upgrades to the faster speed service.[960] It may be that attempts to raise 80/20 prices are defeated by the potential for downgrading, but Openreach can respond to that risk by setting suitable prices.

A21.31 The evidence taken together points to FTTC increasingly becoming the main reason for continued demand for copper access. We do not think the evidence supports BT’s assertion that demand risk for FTTC is higher than for copper on a forward-looking basis.

A21.32 We also note that the latest submission from BT is consistent our conclusion. BT presents some analysis to quantify the income elasticities of demand and the associated beta uplifts between copper, FTTC and FTTP. While this analysis relies on several strong assumptions, BT’s own submission implies that the asset beta for FTTC might only be [✂] higher than for copper.[961]

A21.33 We disagree with BT that any potential reduction in risk of FTTC has already been captured in the reduction in the OUKT beta from 0.73 used in the 2018 WLA Statement to 0.65 used in the 2019 BCMR Statement and the January 2020 Consultation. The reduction was driven by a reduction in the BT Group asset beta (0.78 to 0.68) and a reduction in benchmark betas which are used to estimate the OUKT beta. As such, it is not appropriate to interpret the decline in the assumed OUKT beta since 2018 WLA Statement as a reflection of FTTC maturing as a service.

A21.34 Finally, we also stated in 2018 WLA Statement that as fibre access services became more widely used, they would likely exhibit more stable demand. At that time we did not consider we were at the point where the systematic demand risk for fibre access was equivalent to that of copper access.[962] However, fibre access services are now very widely used and their use is expected to increase over the control period.

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[958] Annex 14, Tables A14.2 and A14.3.
[959] Annex 14, paragraph A14.69 and Table A14.3.
[960] See Volume 2, Section 2 and Volume 4, Section 1.
[961] Ofcom calculation based on a report submitted by Oxera on behalf of BT. Quantifying the relative risk differences between FTTP and FTTC, Oxera, January 2021.
[962] 2018 WLA Statement Annexes, Paragraph A21.231.

A21.35 We conclude that putting FTTC and copper access into the same risk category is appropriate.

Operating leverage

A21.36 There is not one single measure of operating leverage, but the principle is that projects with a relatively higher ratio of fixed costs to project value would be associated with higher operating leverage and higher asset betas.[963]

A21.37 The incremental capital expenditure required to roll out FTTC was relatively low (as FTTC was an overlay to the copper network). For example, to 2017/18 we estimate FTTC capex totalled [✂] to pass and connect 26m premises, equivalent to around [✂].[964] This is similar to the average capex spend of [✂] on the copper network. Given that commercial FTTC roll out is now complete, we consider that going forward FTTC services are unlikely to be associated with higher operating leverage compared to copper only services.

A21.38 A simple metric which gives some indication of the relative level of operating leverage is profit margin.[965] The proportion of the cost stack which accounts for 'allowed profit' is one such measure (it is effectively a proxy for the EBIT margin on each service), assuming prices are broadly at cost. Using our base year costs for MPF and FTTC 40/10, the allowed return accounts for [✂%] of the cost stack for FTTC and [✂%] for MPF, suggesting that operating leverage is unlikely to be a significant differentiating risk factor between the two services.[966]

A21.39 As FTTP is rolled out and the copper/FTTC network continues to operate in parallel, there might be an argument that keeping the Openreach copper network running for a declining customer base might lead to relatively more fixed costs compared to a network operating more in steady state. This might be a relevant factor in choosing a point estimate for the asset beta for Openreach, but it is not an argument for keeping FTTC and copper in separate categories.

A21.40 Reflecting the converged risk of copper and FTTC, we have maintained our proposal to move FTTC services into Openreach.

Relative risk: Openreach copper network (copper/FTTC) and FTTP

Our proposals

A21.41 Given that speeds delivered over FTTP currently attract a retail premium, and to the extent these services are perceived as discretionary (meaning they might have a higher income elasticity of demand), we said the systematic risk for FTTP was likely to be greater than for FTTC and copper lines.

[963] Brealey and Myers, Principles of Corporate Finance. Chapter 10, 9th Edition, page 250.
[964] Ofcom analysis based on capex information from Openreach response dated 19 November 2019 to s135. dated 5 November 2019 and Openreach response dated 2 October 2017 to question 8 of the 36th WLA s135 notice dated 18 September 2017. Premises passed taken from BT Q4 2018/19 financial results, page 8. Note: FTTC capex estimated includes BDUK spend up to 2017/18.
[965] For example, In its March 2020 NATS (En Route) Plc /CAA Regulatory Appeal (Paragraph 12.47), the CMA considered EBIT and EBITDA margins to qualitatively compare the relative exposure to systematic risk of NERL compared to airports.
[966] Based on Ofcom modelling. [✂]. BT Group's response to the January 2020 Consultation, Table A6.7 shows several measures of operating leverage for FTTC only and for FTTC and copper combined. [✂].

A21.42 FTTP is currently in the build phase, with relatively low revenues but significant fixed cash outflows required over the next few years (implying relatively high operating leverage). This might point to greater sensitivity of cash flows and returns to macroeconomic shocks compared to FTTC and copper, and hence greater systematic risk.

A21.43 However, we also noted that once FTTP was rolled out and the copper network decommissioned, we would expect the systematic risk of FTTP to reduce, since it would be the primary means of consuming broadband.

A21.44 We proposed to include FTTP services within OUKT.

Stakeholder responses

A21.45 Although BT agreed with Ofcom's reasoning in relation to FTTP services being riskier than FTTC services, it disagreed with the implied WACC for FTTP services as it believed Ofcom had underestimated the risk of FTTC services. Given BT's view that FTTC services should remain in OUKT (rather than be moved to Openreach), BT argued that the WACC and the asset beta for FTTP services should be higher than for OUKT.[967] Within our disaggregation framework, BT suggested that FTTP should either sit in a separate category or be included in RoBT.[968]

A21.46 TalkTalk agreed with Ofcom that there would be higher systematic risk and operating leverage associated with FTTP services than copper and FTTC services during the next control period. TalkTalk also agreed that this higher relative risk was likely to reduce over time, as both demand risk and operating leverage for FTTP would fall over time.[969]

Our reasoning and decisions

A21.47 We agree with BT and TalkTalk that FTTP is higher risk than copper and FTTC (which we refer to as 'copper-based' services in this annex).

A21.48 Once the FTTP network is rolled out, over time, the FTTP network would become the only means of providing fixed connectivity to most premises in that exchange area (given our decisions to support gradual withdrawal of copper-based services). This means that over the long-run there is likely to be stable and enduring demand for core connectivity to broadband networks, and this demand will be increasingly met via FTTP networks (either built by Openreach or altnets).

A21.49 There is, however, uncertainty around the pricing FTTP providers will be able to secure. On the whole we find that consumers tend to have a low willingness to pay for higher speeds, given that most remain price sensitive, but there are some people who would be prepared to pay a substantial premium for 1Gbit/s services (which can only be delivered by FTTP networks).[970] To the extent that some customers are prepared to pay more for FTTP, this could be linked to

[967] BT Group's response to the January 2020 Consultation, Annex 6, paragraph A6.62.

[968] In its initial submission, BT stated that FTTP could have its own WACC and beta, without needing to be reconciled back to BT Group (given the low capital employed associated with FTTP). In its 2nd submission, BT showed how its view of the FTTP asset beta could be reconciled back to its updated view of the BT Group asset beta. Alternatively, BT suggested it could be achieved by placing FTTP within Ofcom's existing 'Rest of BT' category. BT's 2nd submission, paragraph 1.5.

[969] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 3.28-3.29.

[970] See Volume 2, Section 2, paragraph 2.3.

levels of household income, suggesting some of the higher demand risk of FTTP compared to copper-based services could be systematic in nature.[971]

A21.50 Rolling out new FTTP networks also requires significant upfront cost. For example, BT has indicated that it could cost up to £12bn to roll-out FTTP to 20m homes over the next decade,[972] which is significant in the context of the value of the existing copper-based network (with an MCE of around £12bn).[973] As we noted earlier, projects with a relatively higher proportion of fixed costs to overall project value would be expected to have higher betas. Yet translating this into an asset beta differential between copper-based and FTTP services is not straight forward and would require several assumptions, including taking a view on which costs are fixed or variable.[974]

A21.51 These factors taken together do point to FTTP being higher risk than copper-based services, however, the extent to which the risk is higher is difficult to quantify. Comparing the systematic risk of FTTP to other services provided by BT Group is even more difficult.

A21.52 Within our current disaggregation framework, the OUKT category captures ‘average risk’ activities of telecoms companies, with the OUKT beta benchmarked to a wide sample of UK and European telecoms companies. FTTP networks are the future of fixed broadband connectivity, with incumbents in Europe at different stages of upgrading their fixed networks to FTTP and many altnets investing in new FTTP networks.

A21.53 Identifying an explicit beta for FTTP is difficult because of the absence of listed pure play FTTP comparator companies. Any separate modelling to derive an explicit beta for FTTP requires significant assumptions (as we explain above). Using market evidence on betas for telecoms companies including BT is a reasonable starting point. Therefore, for the purposes of this review, we have retained FTTP within OUKT.

Relative risk: PIA

Our proposals

A21.54 We proposed that PIA services should remain within Openreach since these services represent the basic building blocks supporting multiple downstream services.

Stakeholder responses

A21.55 CityFibre stated that we had overestimated the PIA WACC as it considered the risk profile for PIA was likely to differ significantly from that of services such as copper access and FTTC. It

[971] BT has attempted to quantify the higher systematic demand risk of FTTP compared to FTTC. BT estimates that the asset beta for FTTP could be [✂] higher compared to FTTC, to account for higher demand risk. BT Group’s 2nd Submission, paragraph 4.2.
[972] On 7 May 2020, BT announced a plan to invest £12 billion on FTTP Broadband (see “BT Invest £12bn on FTTP Broadband for 20 Million UK Premises”, 7 May 2020).
[973] Based on BT Regulatory Financial Statements 2020, Note: Sum of MCE for PIA, WLA and WFAEL markets and therefore includes all fibre investment up to 19/20.
[974] BT estimates that the higher operating leverage of FTTP would be consistent with an asset beta which is [✂] higher compared to copper/FTTC products (this is separate to the higher demand risk impact discussed in A21.49). The differential is based on a combined beta for FTTC/copper of [✂] and the resulting asset beta for FTTP of [[✂]. See BT’s 2nd submission, paragraph 4.10.

suggested that Openreach should be separated into PIA and non-PIA with the PIA WACC being more closely aligned to other utility sectors such as water and electricity. In particular, CityFibre stated that an infrastructure network with long term expected usage and limited competition could sustain a much higher percentage of debt funding than the 40% assumed by Ofcom, and noted that a higher assumed gearing ratio was one of the main differences between our proposed WACC of 7.1% of Openreach and the cost of capital estimated by Ofwat and Ofgem.[975]

Our reasoning and decisions

A21.56 PIA remains an essential input regardless of the medium of connection (copper or fibre) and regardless of the bandwidth consumed. Most of the PIA network is a sunk asset and we would expect it to have stable demand from BT's downstream operations and those of other retail providers.

A21.57 However, there is no listed pure play PIA provider which we could use as a benchmark to identify a separate beta for PIA.[976] The demand for PIA is also intrinsically linked to the demand for telecoms services which are riskier than products provided by pure network utility operators (such as water and electricity networks). The Openreach asset beta reflects this as we choose an estimate between utility benchmarks and BT Group. We therefore do not agree with CityFibre that Openreach should be further disaggregated into PIA and non-PIA services.

A21.58 CityFibre has also compared our pre-tax nominal WACC with Ofwat and Ofgem's vanilla WACCs.[977] Calculated on the same basis the Openreach nominal vanilla WACC calculated in this decision is 5.9%. This is somewhat higher than the allowances in water and energy, which reflects the higher risk of telecoms.[978]

A21.59 As such we have decided to keep PIA services within Openreach.

A21.60 We discuss our gearing and cost of debt assumption for Openreach later in this annex.

Relative risk: leased lines (active and dark fibre)

Our proposals

A21.61 Consistent with previous decisions, we proposed that active leased lines sat within OUKT and DFX sat within Openreach.

A21.62 For DFA, we noted that demand risk for passive leased lines in general was likely to be lower than for active leased lines, given that charges for dark fibre do not vary with bandwidth requirements. We also considered that some of the uses of DFA were likely to be relatively low risk (i.e. mobile backhaul). We also anticipated that the operating leverage for DFA might be

[975] CityFibre further response to the WFTMR Consultation: PIA Remedies, 27 August 2020, Annex 1
[976] i.e. there is no listed company that provides only PIA services.
[977] The vanilla WACC is a weighted average of the post-tax cost of equity and the pre-tax cost of debt.
[978] For reference Ofwat's decision on the nominal vanilla WACC was 5.0% (Table 1.1) and Ofgem's decision is below 5% as the real CPIH WACCs are around 2.69% - 2.81% (Table 13)

lower than for active leased lines, as no electronics were required to deliver dark fibre. Therefore, we proposed DFA should sit within Openreach.

Stakeholder responses

A21.63 TalkTalk partly agreed with our proposals but said that we should split active leased lines between the access layer and inter-exchange circuits (IEC), i.e. between circuits in our LL Access and IEC product markets. TalkTalk agreed that demand in the access layer would in part be driven by demand for business circuits which may show some cyclical volatility. However, TalkTalk stated that demand for IEC active circuits would not show meaningful cyclical volatility, as the demand would be primarily driven by the demand for consumer broadband and for consumer mobile phone services. It said that it was unlikely that telecoms providers would trade down to lower bandwidths in response to cyclical events as consumer demand for data was growing rapidly, and most backhaul circuits are on multi-year contracts which cannot easily be broken.[979] TalkTalk concluded that the cyclicality of IEC active circuits would be similar to that of dark fibre circuits. TalkTalk further agreed with our proposal to include all dark fibre circuits (i.e. both DFA and DFX) in Openreach, as demand for dark fibre would not be related to bandwidth; and suggested IEC active circuits should also sit in Openreach.

A21.64 BT disagreed with our proposal to include DFA in Openreach. BT disagreed with the impact of the bandwidth gradient on risk, highlighting that the bandwidth gradient for active leased lines has been reducing rapidly, and is likely to reduce further following the introduction of the DFA remedy. BT also disagreed that DFA would principally be used for mobile backhaul. BT asserted that Openreach considered that most of the demand for DFA would be in substitution for active leased lines used by business customers. BT also disagreed that operating leverage for DFA would be lower than for active leased lines. It noted that active services included a significantly higher proportion of on-going variable costs as part of their end to end cost stack, resulting in lower operating leverage for active services as compared to DFA.[980]

Our reasoning and decisions

A21.65 For active leased lines, we are not setting a cost-based control. The decision where to capture active leased lines in the disaggregation therefore only has some (minor) impact on the disaggregation weightings in this review.

A21.66 For DFX and DFA, which are important (but nascent) services, we are setting cost-based charges, which require a point estimate for the cost of capital.

Active leased lines and DFX

A21.67 In the 2019 and 2016 BCMR Statements we included active leased lines in OUKT on the basis that some of the demand was driven by business customers, which might be more cyclical than demand from residential customers. We have decided to retain this classification for this review and have kept active leased lines in OUKT.

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[979] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.33.
[980] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.72-A6.78.

A21.68 With respect to the distinction between IEC and access active circuits, we recognise that demand drivers for IEC circuits might be slightly different to those for access circuits. If demand is largely driven by backhaul requirements of other telecoms providers aggregating consumer and mobile data traffic, the overall demand risk could be lower compared to the demand for access leased lines.

A21.69 However, we are not setting cost-based charges on either IEC or access active circuits in this review. The IEC circuits also account for a small percentage of total revenues and MCE (c.3% of Openreach SMP revenues and 1% Openreach SMP MCE), which means our decision on IEC circuits will not materially affect the weightings.[981] Therefore, we have decided to keep IEC active circuits in OUKT, together with access leased lines. Even if this slightly overstates the risk (and hence the WACC) for IEC circuits, this does not affect our approach to price regulation for these services.

A21.70 As no stakeholder commented on our approach to DFX, we adopt our January 2020 Consultation position (reflecting our conclusions in the 2019 BCMR Statement) and include DFX in Openreach.

DFA

A21.71 Overall, there are three broad factors to consider in deciding where DFA sits on the spectrum of risk relative to other services.

A21.72 First, dark fibre services are agnostic to bandwidth, i.e. a single fibre can provide unlimited capacity, with dark fibre charges invariant to bandwidth. This means there is likely to be relatively limited revenue volatility due to changes in end user bandwidth requirements, compared to active circuits which are specified by bandwidth. BT notes that the bandwidth gradient is reducing rapidly on active circuits. However, this would suggest that the demand risk on active leased lines is likely to be reducing over time, rather than an argument that dark fibre is higher risk than we suggested in the January 2020 Consultation. Further, the bandwidth gradient, albeit small, is not zero, so there is still likely to be some difference in revenue volatility between dark fibre and active circuits.

A21.73 Second, with respect to usage, in Annex 9 we recognise that it is difficult to predict all of the ways in which dark fibre could be used. Active leased lines are used by enterprise customers, and by telecoms providers for mobile and fixed access backhaul connections, and DFA may be used in similar or other ways. On the basis of usage alone, without any revenue data to analyse yet, it is difficult to judge how dark fibre compares to active leased lines.

A21.74 Finally, with respect to cost structure, as we stated in the January 2020 Consultation, provision of a dark fibre circuit will not require fixed expenditure on electronics. However, the associated revenue stream from a dark fibre circuit will also be lower since the charges will not include a contribution to the recovery of the cost of the electronic equipment.

A21.75 DFA is only being introduced in Area 3 (i.e. areas with little or no competition to Openreach) and with relatively little new investment likely to be required to satisfy requests to provide dark fibre. Further, a simple analysis of the cost stack for EAD LA 1Gbs rental and DFA rental charges

[981] BT Regulatory Financial Statements 2019/20.

suggests that operating margins on DFA are expected to be higher (i.e. 'allowed profit' accounts for a greater share of the cost stack on the DFA rental compared to EAD LA 1Gbs ([✂%] compared to[✂%]).[982] These factors would point to DFA being less risky than active leased lines.

A21.76 Taken together, we conclude that DFA is likely to be relatively low risk (i.e. below the average risk of BT Group). Therefore, we have included DFA within Openreach.

Overall split of services

A21.77 Table A21.3 summarises our decision on the categorisation of the wholesale services subject to ex ante regulation in this review.

Table A21.3: Split of regulated wholesale services

Openreach	OUKT*	RoBT
Copper access lines, FTTC, DFA, DFX, PIA	LL Access, IEC active circuits, FTTP	N/A

**Note that the summary here excludes other wholesale and retail services (including mobile and pay-TV)*

Asset beta weights

Our proposals

A21.78 To estimate the relevant weightings for our three-way disaggregation, we:

- Reviewed the last 5 years' average Openreach EBITDA share of BT Group and net replacement cost of copper and FTTC services as a proportion of total enterprise value. From this we proposed a 25% weighting for Openreach (up from 20% in the 2019 BCMR Statement, reflecting the inclusion of FTTC services);
- Reviewed the last 5 years' average share of ICT and managed network (ICT). From this we proposed a 15% weighting to RoBT which captured BT's ICT operations; and
- used the remainder (60%) for the OUKT weighting (including FTTP services).

Stakeholder responses

A21.79 TalkTalk stated, based on the evidence presented, the weighting of Openreach appeared to be broadly appropriate, but it was not able to comment on the RoBT weighting as information related to BT's IT operations was redacted.[983]

A21.80 BT stated given the mean capital employed and earnings from FTTP were currently small relative to BT Group, there would be minimal impact on Ofcom's disaggregation approach if we were to estimate a separate FTTP WACC.[984] In a further submission, BT assigned a low weight of [✂%] to FTTP in its proposed disaggregation of the BT Group asset beta (based on end FY20 share of FTTP MCE relative to Group's MCE), with a corresponding reduction in the weight

[982] Based on Ofcom modelling.
[983] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 3.37.
[984] BT Group's response to the January 2020 Consultation, Annex 6, paragraph A6.79.

assigned to OUKT. BT further noted that the asset beta of BT today (based on historical data) reflects very little of the risk associated with future FTTP fibre investment.[985]

Our reasoning and decisions

A21.81 Table A21.4 below reports weightings based on EBITDA and the ratio of net replacement cost to enterprise value (NRC/EV) for Openreach (as defined for the purposes of our disaggregation) as a proportion of BT Group.

Table A21.4: Estimated share of Openreach (per Table A21.3) within BT Group

	2015/16	2016/17	2017/18	2018/19	2019/20[986]	5Y Average
EBITDA	34%	35%	34%	31%	31%	33%
Regulatory NRC/EV	20%	18%	24%	26%	30%	23%

Source: Ofcom analysis of BT Regulatory Financial Statements

A21.82 In estimating the relevant weightings, we have considered the relative size of Openreach in relation to BT Group. On average over the five-year period the NRC/EV metric would imply slightly below a one-quarter weighting for Openreach and the EBITDA metric around one-third. Over the past three years, the EBITDA and Regulatory NRC/EV metrics have converged and the midpoint of the 5-year average for EBITDA and Regulatory NRC/EV is 28%.

A21.83 For a steady state network, historical data may be a reasonable proxy for the future. However, we are concerned with forward-looking risks and weights of the various activities provided by BT.

A21.84 We expect changes in the mix of broadband lines offered by Openreach in the future, with the overall proportion of copper only and FTTC lines falling over the review period from 98% to 73%,[987] while the share of FTTP lines is expected to increase.[988] This effect would point to selecting a lower value from the average of historical metrics in Table A21.4. However, more recent historical data could support a weight for Openreach higher than the January 2020 Consultation proposal of 25% (also accounting for potential growth in volumes of DFX and DFA).[989]

A21.85 Taken in the round, and in line with our January 2020 Consultation proposal, we have decided to attribute a 25% weighting to Openreach.

A21.86 BT's ICT operations (which are captured in our RoBT disaggregated asset beta) are spread across its Global Services and other divisions. To estimate the weightings of RoBT, we asked BT to provide EBITDA figures for the relevant ICT services. Our analysis suggests that over the past five years, EBITDA for BT's ICT services represented between [✂% and %] of BT Group

[985] BT's 2nd submission, paragraph 5.13
[986] In 2019/20, EBITDA, regulatory NRC and EV take account of IFRS16.
[987] See Annex 14, Tables 14.2 and 14.3.
[988] While we have decided not to disaggregate OUKT further into FTTP and non-FTTP, this does suggest that a forward-looking weight for FTTP would certainly be higher than the most recent historical weighting of [✂%].
[989] Note: Even if all customers moved to DFA in Area 3, we do not think our overall weightings would be significantly impacted.

EBITDA[990]. As such we propose to apply a weighting of 10% to the RoBT, which captures BT's ICT operations. This is a reduction from the January 2020 Consultation, recognising ICT's reducing contribution over time and the fact that BT has been selling parts of Global Services over the past couple of years.[991]

A21.87 Given our weights for Openreach and RoBT, the implied weight for OUKT is 65%.

Market evidence on comparator betas

A21.88 We commissioned Brattle to estimate asset betas for comparator companies (as above). Consistent with our approach to the BT Group beta, we have decided to place most weight on five-year asset betas excluding the impact of IFRS 16 on gearing.[992]

A21.89 Brattle estimated each comparator's equity and asset beta against a home index and a world index (FTSE All World). For the home index, Brattle used the FTSE All Share for the UK listed companies and the FTSE All Europe for European telecoms companies. For ICT comparators the home betas were estimated against either the S&P 500 or the FTSE All Europe depending on where the company was listed.

A21.90 Table A21.5 and A21.6 summarise the various estimates produced by Brattle.

Table A21.5 Five-year daily equity beta averages and 95% confidence intervals for comparator groups[993]

	Home index		World index	
	Average	95% CI	Average	95% CI
UK Utilities	0.60	0.50 – 0.70	0.68	0.54 – 0.82
Vodafone	0.96	0.84 – 1.08	0.97	0.82 - 1.12
TalkTalk	0.80	0.68 – 0.92	1.32	1.02 – 1.62
European telecoms	0.78	0.68 – 0.89	0.78	0.59 – 0.98
Incumbent	0.80	0.69 - 0.90	0.78	0.59 – 0.98
Alternative	0.80	0.69 - 0.92	0.81	0.64 – 0.99
ICT	1.02	0.90 – 1.14	1.26	1.06 - 1.46
BT Group	**0.94**	**0.80 - 1.09**	**0.97**	**0.72 – 1.22**

Source: Brattle.

[990] 2018 WLA Statement, paragraph A21.163 (for 2015/16 to 2016/17); Openreach response dated 20 June 2018 to question 3 of the 6th LLCC s.135 notice (for 2017/18); BT Group response dated 10 September 2019 to question 1 of the s.135 notice dated 27 August 2019 (for 2018/19); and BT Group response dated 18 December 2020 to question 1 of the s.135 notice dated 4 December 2020 (for 2019/20) .
[991] Sale of BT Business units in Italy, Spain and Latin America.
[992] See Annex 22 for Brattle's full report.
[993] Incumbent operators include BT and alternative operators include Vodafone but exclude TalkTalk

Table A21.6: Five-year daily asset beta ranges, gearing and averages for comparator groups [994]

	Home index		World index		Gearing	
	Range	Average	Range	Average	Range	Average
UK Utilities	0.32 - 0.36	0.34	0.36 - 0.39	0.38	47% - 57%	51%
Vodafone	0.55		0.56		48%	
TalkTalk	0.55		0.88		36%	
European telecoms	0.41 - 0.81	0.53	0.38 - 0.75	0.53	16% - 71%	34%
Incumbent	0.41 - 0.64	0.50	0.38 - 0.64	0.50	16% - 71%	39%
Alternative	0.46 - 0.81	0.61	0.53 - 0.75	0.62	18% - 48%	26%
ICT	0.66 - 1.11	0.87	0.89 - 1.38	1.07	0% - 44%	15%
BT Group	**0.62**		**0.63**		**39%**	

Source: Brattle.

Asset beta for Openreach

Our proposals

A21.91 In the 2019 BCMR Statement we used an Openreach asset beta of 0.55. This was broadly at the midpoint of asset betas for BT Group (then 0.68) and listed UK network utility asset betas (then 0.39).[995] In the January 2020 Consultation, because of the changes to the services included within Openreach, we proposed to use an Openreach asset beta slightly above the midpoint. Based on otherwise unchanged benchmark company asset betas we used a value of 0.57 for the purposes of the January 2020 Consultation. This was because:

- running two access networks (i.e. copper + FTTC and FTTP during the transition period) would tend to increase the operating leverage of each; and yet,
- we would expect the Openreach asset beta to be below the average asset beta of UK retail telecoms providers (then 0.63) as these companies offer services over access lines (which tend to face greater demand risk).[996]

Stakeholder comments

A21.92 TalkTalk disagreed with our proposal that the asset beta for Openreach should be above the midpoint of the range implied by utilities and BT Group. TalkTalk said that the increased operating leverage impact was likely to be small since there was no real sense in which the networks competed since they were both controlled by Openreach and that systematic demand volatility for Openreach services was likely to have reduced as the current Covid-19

[994] Incumbent operators include BT and alternative operators include Vodafone but exclude TalkTalk. Gearing adjusted to exclude the impact of IFRS16

[995] 2019 BCMR Statement, paragraphs, A21.206 to A21.208.

[996] January 2020 Consultation, paragraph A21.74.

pandemic had demonstrated the importance of home connectivity to residential customers. TalkTalk stated that this had led to demand for broadband services becoming ever more utility-like, with very little demand risk and no meaningful customer willingness to migrate down to lower speeds. Therefore, Ofcom should set the Openreach asset beta at or below the midpoint of the range of other listed UK Utilities and BT Group.[997]

A21.93 BT provided extensive submissions on why it was inappropriate to include FTTC in Openreach (discussed above) but did not specifically comment on the proposed asset beta value for Openreach.

Our reasoning and decisions

A21.94 As we explained above, the Openreach category is meant to capture the lowest risk services provided by BT Group, which increasingly include most of the wholesale regulated services offered over existing network infrastructure. Specifically, we are now including FTTC and DFA in this category, in addition to copper access, PIA and DFX.

A21.95 Our starting point is that the appropriate asset beta would be below the beta for BT Group, but above that for UK utilities. The telecoms industry is characterised by greater technological innovation, and while the overall demand risk associated with core connectivity is likely to be low, we do not consider it would be as low as for a water or an energy network. The average asset beta for UK utilities is 0.34 (against the home index), compared to the asset beta for BT Group of 0.62 – the midpoint between the two is 0.48.

A21.96 We would also expect the asset beta for Openreach to be below that of other UK telecoms providers, although we recognise that there is increasingly limited evidence on asset betas for other UK telecoms companies. Vodafone derives a relatively small proportion of overall revenue from the UK, and does not wholesale copper networks in any of the countries it operates.[998] TalkTalk is a retail provider, and has also been the subject of takeover negotiations, finally being taken private with a deal agreed in December 2020 and an expected delisting from the stock market on 15 March 2021.[999]

A21.97 Vodafone's latest asset beta is 0.55 (against the home index); as is TalkTalk's asset beta. It is therefore likely that an appropriate asset beta for Openreach is below 0.55.

A21.98 We also draw on the much larger sample of European telecoms companies. While UK telecoms providers appear to have somewhat higher asset betas than their European counterparts, we think it unlikely that the asset beta for BT's least risky services (i.e. those in Openreach) would be above that of an average European telecoms company (0.53 on the home or world index).

A21.99 We recognise that Openreach includes more services in this review period, specifically we have added FTTC and DFA into Openreach. The risks of these services may not be identical to that of copper access and PIA but as explained earlier they are sufficiently close to be in the same category, given the overall uncertainty in estimating the beta for individual services. To reflect

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[997] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 3.38 - 3.41.
[998] For revenue analysis see Vodafone Annual Report 2020, page 157. Further, in the 2020 Brattle Report, Brattle, classifies Vodafone as an alternative operator i.e. does not own a copper network.
[999] 2020 Brattle Report, page IV-21.

this, we have decided to use an asset beta slightly above the mid-point of the BT Group to network utility range, but no higher than that of an average telecoms provider. Taking this evidence in the round, we have used an asset beta of 0.53.

Asset beta for OUKT

Our proposals

A21.100 We proposed an asset beta of 0.65, consistent with 2019 BCMR Statement. In the 2019 BCMR Statement, we decided to use an OUKT asset beta of 0.65, based on the midpoint of the 0.55 to 0.75 range we had previously identified as capturing the range of plausible beta values for services included in OUKT.[1000]

Stakeholder comments

A21.101 BT disagreed with our proposal to include FTTP within OUKT, and by implication to use an asset beta of 0.65 for FTTP services.[1001]

Our reasoning and decisions

A21.102 In recent market reviews (2018 WLA and 2019 BCMR Statements) we considered that an appropriate asset beta for OUKT was likely to be in the range of 0.55 to 0.75. The average 5-year asset beta (against the home index) for European telecoms comparators has been broadly flat at just below 0.60 up until early 2020, and has since decreased to 0.53 (see 2020 Brattle Report, Figure V-24).[1002] Against the global index, the average 5-year asset beta is showing a more pronounced downward trend (albeit starting from a higher level), with the latest average also at 0.53.[1003] These averages are similar to the latest asset beta estimates for UK telecoms comparators (Vodafone and TalkTalk).

A21.103 Table A21.6 above further shows that the range for the asset betas of European telecoms is relatively wide: 0.41 to 0.81 (home index) and 0.38 to 0.75 (global index). However, only one company has an asset beta above 0.75 (against the home index), and there is a reasonably large number of companies with betas less than 0.55 (against both indices).[1004] Overall, the evidence suggests that the asset betas of telecoms companies have been declining, a trend we also observed for BT Group (see Annex 20).

A21.104 Based on the five-year average, the asset beta for BT Group is 0.62 (see Annex 20). Combined with slightly higher average gearing compared to the European average, this explains why the equity beta for BT Group is close to one, whereas equity betas for European telecoms companies tend to be below one (see 2020 Brattle Report Table V-5).

[1000] 2019 BCMR Statement, paragraphs A21.220 to A21.223.
[1001] BT Group's response to the January 2020 Consultation, Annex 6, paragraphs A6.68-A6.70. BT Group's 2nd submission, paragraph 1.4.
[1002] The average is 0.52, unadjusted (i.e. not removing the impact of IFRS 16 on gearing). See Brattle report, Table V-7.
[1003] 2020 Brattle report, Figure V-25.
[1004] 2020 Brattle report, Figures V-21 and V-22.

A21.105 We also note that BT's asset beta is at the top end of the range of betas for incumbent telecoms operators (0.41 to 0.64 against the home index) but towards the middle of the range of the betas when compared with alternative operators (0.46 to 0.81 against the home index), see Table A21.6.[1005]

A21.106 Taken all the evidence together, we have decided on an asset beta for OUKT of 0.62, equal to that of BT Group. This reflects the downward trend in benchmark betas since the 2019 BCMR Statement (suggesting that a decrease in the asset beta from 0.65 is appropriate). Our decision also reflects the fact that OUKT captures most of the BT Group's activities. With the BT Group asset beta within the range we observe for other European telecoms, we see no reason to choose an asset beta for OUKT that is different to that of BT Group.

A21.107 The implication of our asset beta decisions for Openreach and OUKT means that the 'average risk' activity within OUKT has an asset beta that is 0.09 higher than the copper-based services included within Openreach.[1006] We noted earlier that the systematic risk of FTTP could be higher than the average activity within OUKT, which would imply a bigger difference in the relative betas of copper-based and FTTP services (for example, BT quantifies the differential at around [✂]).[1007]

A21.108 As explained previously in this annex, it is difficult to further separate out the risk of FTTP from the rest of the activities captured in OUKT, and we have not disaggregated further.

Asset beta for RoBT

Our proposals

A21.109 The January 2020 Consultation estimate of an Openreach asset beta of 0.57 combined with the proposed weightings and the Other UK Telecoms asset beta of 0.65 meant that the RoBT asset beta was 0.98. This was the same as that used in the 2019 BCMR Statement.[1008]

Stakeholder comments

A21.110 No stakeholders specifically commented on our asset beta proposal for the RoBT.

Our reasoning and decision

A21.111 Given our decisions on the relative weights and the asset betas for Openreach and OUKT, the resulting asset beta for RoBT is 0.85. The overall ranges for the 5-year asset beta of ICT

[1005] We note that average equity betas are similar between incumbents and alternative operators. If alternative operators are indeed exposed to higher systematic risk, they appear to be taking on less financial risk as a result (as evidenced by lower average gearing).
[1006] Directionally, the evidence on average asset betas produced by Brattle suggests that the average asset beta for alternative operators is about 0.10 higher compared to incumbents. As these comparators are all diversified operators, this evidence is indicative only. However, we note that average equity betas are similar between incumbents and alternative operators. If alternative operators are indeed exposed to higher systematic risk, they appear to be taking on less financial risk as a result (as evidenced by lower average gearing).
[1007] BT 2nd submission, paragraph 4.2.
[1008] 2019 BCMR Statement, paragraph A21.219.

comparators are 0.66 to 1.11 (home index) and 0.89 to 1.38 (global index), with an average of 0.87 (home index) and 1.07 (global index).

A21.112 However, we note that the gearing of ICT comparators is lower than that of BT Group and average telecoms companies. Because we do not disaggregate gearing for the different lines of business within BT (see below), using the BT Group gearing for RoBT will yield a particularly high equity beta if the asset beta for RoBT were around the middle of the ICT comparator range. Therefore, an asset beta of 0.85 for RoBT, which happens to be in the lower part of the benchmark range, is reasonable in our view.

Gearing for the constituent parts of BT Group

Our proposals

A21.113 In line with previous reviews we proposed to use our view of the BT Group forward-looking gearing for all constituent parts of BT (i.e. Openreach, OUKT and RoBT).

Stakeholder responses

A21.114 TalkTalk disagreed with this approach and stated that Ofcom should disaggregate gearing, with Openreach having the highest gearing, OUKT somewhat lower gearing and RoBT with gearing close to zero. TalkTalk further noted that Openreach's gearing should be informed by utilities companies and OUKT could have optimal gearing in the 40%-50% range.[1009]

A21.115 Cityfibre also stated that an infrastructure network with long term expected usage and limited competition could sustain a much higher percentage of debt funding than the 40% assumed by Ofcom.[1010]

A21.116 BT did not propose to disaggregate BT Group gearing. In its submission to us, it used 40% gearing for all parts of BT Group. See Annex 20 for BT Group's response on gearing.

Our reasoning and decisions

A21.117 We recognise that lines of business with different levels of systematic risk could have different optimal gearing levels. However, estimating different levels of gearing for different parts of BT introduces further judgement into the WACC estimation, which needs to be balanced against the likely materiality of assuming different levels of gearing on the overall WACC.

A21.118 We consider the systematic risk of Openreach to be between that of a utility company and a telecoms provider. We note that the average five-year gearing of listed utilities is 51%, with current gearing around 48%. We recognise that notional gearing levels adopted by Ofwat and Ofgem are higher (at 60% for the latest round of price control decisions) but these notional gearing levels in part reflect a mix of ownership structures within the sectors and the ability of

[1009] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraphs 3.15 - 3.18.
[1010] CityFibre further response to the WFTMR Consultation: PIA Remedies, 27 August 2020, Annex 1, paragraph A1.9.

the companies to maintain investment grade credit ratings with sustained gearing at such levels.[1011]

A21.119 Given that we consider the systematic risk of activities captured within Openreach to be higher than that of utility networks, it is not clear if a notional gearing for Openreach above 50% would be appropriate. Further, in the 2016 Brattle Report, Brattle recommends maximum forward-looking gearing for a legacy telecoms network of 50% to 55%.[1012]

A21.120 In any case, for relatively modest differences in gearing between different parts of BT (e.g. using 50% gearing for Openreach rather than 45% across the three units), the overall impact on the regulatory allowed return would not be significant.[1013]

A21.121 Previously we have set the gearing for OUKT the same as for BT Group. Particularly with the OUKT beta now determined at the same level as BT Group and OUKT having 65% weighting, we see no reason to use a different gearing assumption to that used for Group.

A21.122 Finally, we consider RoBT. While the average gearing of ICT comparators is lower than for telecoms companies, there is a wide range with 45% just outside the top end of this range. As noted above, we have had regard to this in our choice of asset beta for RoBT (in that the resulting point estimate is deliberately below the average of ICT asset beta benchmarks).

A21.123 Therefore, we consider that adopting a uniform assumption of 45% across the different parts of BT is reasonable and appropriate.

Summary of asset beta disaggregation

A21.124 Table A21.7 summarises our decisions on asset betas, weights and gearing for different parts of BT Group.

[1011] Average gearing of privately held utilities (which is the predominant form of ownership) tends to be higher than for the remaining listed utilities. For example, for water companies see Figure 2.2 of Ofwat's PR19 draft determinations: Cost of capital technical appendix.

[1012] 2016 Brattle Report, Page 83.

[1013] For example, increasing the Openreach gearing to 50% does not change the Openreach pre-tax nominal WACC (to one decimal point).

Table A21.7: Summary of asset betas and gearing for the different parts of BT

	BT Group	Openreach	OUKT	RoBT
Asset beta	0.62	0.53	0.62	0.85
Debt beta	0.10	0.10	0.10	0.10
Weighting	100%	25%	65%	10%
Gearing (forward looking)	45%	45%	45%	45%
Implied equity beta	1.05	0.88	1.05	1.45

Source: Ofcom analysis.

Disaggregation of BT Group cost of debt

Our proposals

A21.125 Consistent with previous market reviews, we considered that a firm facing lower systematic risk could attract a higher credit rating for a given level of gearing than a firm facing higher systematic risk. This implies that BT's services with lower systematic risk (i.e. those included within Openreach) would face a lower cost of debt than OUKT or RoBT (at the same level of gearing).

A21.126 BT Group's credit rating was BBB. In the 2019 BCMR Statement we assumed a one notch uplift to the credit rating for Openreach (assuming its rating would be closer to the average listed utility credit rating of BBB+) which we estimated would decrease the cost of debt by c.0.1%. We also concluded that OUKT would likely share the same credit rating of BBB as BT Group (and therefore have the same cost of debt).

A21.127 Based on a proposed cost of debt for BT Group of 3.5%, we proposed a cost of debt of 3.4% for Openreach and 3.5% for OUKT. Based on the proposed disaggregation weightings, this implied a cost of debt of 3.7% for RoBT.

Stakeholder responses

A21.128 TalkTalk agreed that Ofcom should disaggregate BT's cost of debt and that it was appropriate to assume a one notch higher rating for Openreach than BT Group.[1014]

Our reasoning and decision

A21.129 The credit ratings of UK utilities currently range from BBB to A- compared to BT Group at BBB.[1015] While BT Group's rating (BBB) sits within the range of UK utilities, the utilities are

[1014] TalkTalk's response to the January 2020 Consultation, Addendum 1, paragraph 4.1 – 4.2.
[1015] This excludes recent data, where changes in gearing have been driven largely by falls in market capitalisation of BT, as discussed earlier. Long-term credit ratings from S&P: Severn Trent (BBB), United Utilities (BBB) and National Grid (A-).

typically more highly geared than BT Group.[1016] Consistent with previous reviews, we assume a one notch uplift for Openreach compared to BT Group.

A21.130 To estimate the cost of debt for Openreach, we have compared the spreads between BBB-rated debt and A-rated debt with maturities of ten and 15 years (as at 31 October 2020), shown in Table A21.8 below.[1017] This suggests that the spread between yields on A-rated debt and BBB-rated debt is between 0.16% and 0.45%; the lower spread reflecting a comparison of UK utilities' indices and the higher spread reflecting a comparison of BBB and A-rated companies in general.

A21.131 Assuming a one notch uplift to Openreach from the BT Group rating, Openreach might be able to reduce its cost of debt by around 0.05% to 0.15% relative to BT Group.[1018]

Table A21.8: Spread between BBB and A-rated benchmark indices (10 years and 15 years)

	One-year average	Two-year average
BBB vs A ratings	0.41% to 0.43%	0.40% to 0.45%
UK Utilities BBB vs A ratings	0.16% to 0.22%	0.16% to 0.22%

Source: Bloomberg, Ofcom analysis using data to 31 October 2020. BBB indices are the BVCSGU10 and BVCSGU15 indices from Bloomberg. A indices are the BVCSGK10 and BVCSGK15 indices from Bloomberg. UK Utilities BBB indices are the BVGBUB10 and BVGBUB15 indices from Bloomberg. UK Utilities A indices are the BVGBUA10 and BVGBUA15 indices from Bloomberg.

A21.132 Any adjustment based on this approach is approximate as it depends on the extent to which Openreach is perceived as utility-like and the assumed level of gearing, among many factors. In Annex 20 we estimated the cost of debt for BT Group at 3.6%. An adjustment between the utility range and that for other companies would imply a cost of debt for Openreach around 0.1% point lower than for BT Group, i.e. around 3.5% compared to BT Group's 3.6%.

A21.133 We assume that the systematic risk of OUKT is the same as that of BT Group. Therefore, we use the same cost of debt as for BT Group, i.e. the 3.6% cost of debt estimated above.[1019]

A21.134 To estimate the cost of debt for the RoBT, we use the weightings from the asset beta disaggregation. On this basis, the weightings imply a RoBT cost of debt of 3.9%.[1020]

A21.135 In summary, we have decided on a cost of debt of 3.5% for Openreach and 3.6% for OUKT. For completeness (since we do not regulate services supplied within what we describe as RoBT), we present a WACC for RoBT using a cost of debt of 3.9%.[1021]

[1016] On a shorter averaging basis, the BT Group gearing is higher – e.g. 1-year average gearing (excluding the impact of IFRS 16) is 58% and the utilities average is 48% - however, on a 5-year average basis BT Group's average is 39% against a utilities average of 51%.
[1017] There are effectively three ratings notches between BBB rated debt and A rated debt.
[1018] One-notch estimates have been derived by dividing the figures in the paragraph above by three.
[1019] From Brattle's report of the sample of 19 European telecoms companies, Illiad SA and United Internet AG do not have credit ratings, 4 have BBB, 6 have BBB+, 2 have BBB-, 1 BB+ and 3 have A ratings.
[1020] 3.5% x 25% [Openreach] + 3.6% x 65% [Other UK Telecoms] + 3.9% x 10% [RoBT] = 3.6% [BT Group].
[1021] Rounded to one decimal point.

Our decision on the disaggregated WACC

A21.136 Table A21.9 summarises the pre-tax nominal WACC for each constituent part of BT Group.

Table A21.9: Pre-tax nominal WACC for disaggregated lines of business

	Openreach	OUKT (same as BT Group)	RoBT
Pre-tax nominal WACC	7.0%	7.8%	10.2%

Source: Ofcom.

A22. Brattle report

A22.1 This annex has been published separately on the Ofcom website.

A23. Equality impact assessment

A23.1 Section 149 of the Equality Act 2010 (the "2010 Act") imposes a duty on Ofcom, when carrying out its functions, to have due regard to the need to eliminate discrimination, harassment, victimisation and other prohibited conduct related to the following protected characteristics: age; disability; gender reassignment; marriage and civil partnership; pregnancy and maternity; race; religion or belief; sex and sexual orientation. The 2010 Act also requires Ofcom to have due regard to the need to advance equality of opportunity and foster good relations between persons who share specified protected characteristics and persons who do not.

A23.2 Section 75 of the Northern Ireland Act 1998 (the "1998 Act") also imposes a duty on Ofcom, when carrying out its functions relating to Northern Ireland, to have due regard to the need to promote equality of opportunity and regard to the desirability of promoting good relations across a range of categories outlined in the 1998 Act. Ofcom's Revised Northern Ireland Equality Scheme explains how we comply with our statutory duties under the 1998 Act.

A23.3 To help us comply with our duties under the 2010 Act and the 1998 Act, we assess the potential impact of all our decisions on persons sharing protected characteristics and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations. An equality impact assessment (EIA) also assists us in making sure that we are meeting our principal duty of furthering the interests of citizens and consumers.

A23.4 In our January 2020 Consultation our view was that our proposed remedies would not have a differential impact on any equality group or equality implications under the 2010 Act or the 1998 Act. Further, we did not consider it necessary to carry out separate EIAs in relation to race or sex equality, or under our Revised Northern Ireland Equality Scheme because we did not anticipate that our proposals would have a differential impact on people of different sexes or ethnicities, consumers with protected characteristics in Northern Ireland[1022] or disabled consumers compared to consumers in general.

Stakeholder comments

A23.5 TalkTalk disagreed that our proposed regulations in the WLA market would not have a differential impact on any equality group. TalkTalk said that our pricing proposals would lead to higher WLA prices, which could disproportionately affect some groups with protected characteristics. This is because some groups are more likely to have lower average earnings, and so may be more likely to remain on FTTC or ADSL services, rather than take FTTP and benefit from Ofcom's policy.[1023]

A23.6 Which? also commented that consideration must be given to the price of fibre services and how quickly copper services are removed, because of the impact on vulnerable groups reliant on existing copper services, or unable to easily switch.[1024]

[1022] In addition to the characteristics outlined in the 2010 Equality Act, in Northern Ireland consumers who have dependents or hold a particular political opinion are also protected.
[1023] TalkTalk response to the January 2020 Consultation, paragraphs 9.1-9.22.
[1024] Which? response to the January 2020 Consultation, paragraph 26.

A23.7 No stakeholder raised equality impact concerns about our proposed regulations covering physical infrastructure, LL Access and IEC services.

Our Equality Impact Assessment

A23.8 We have considered whether our proposals are likely to have an adverse impact on promoting equality. In particular, we have considered whether they are likely to have a different or adverse effect on UK consumers and citizens with respect to the following equality groups: age, disability, gender reassignment, marriage and civil partnership, pregnancy and maternity, race, religion or belief, sex, and sexual orientation. We have also considered the same in relation to the additional protected characteristics for Northern Ireland consumers under Northern Ireland's equality legislation.

WLA services

A23.9 The intention behind our approach to regulation in this review is to promote competition and investment in gigabit-capable networks, which will benefit all consumers that rely on the relevant fixed telecoms markets, including broadband services.

A23.10 To understand how our decisions may affect equality groups, we have considered how different groups in society engage with communications services. In particular, we have conducted market research that enabled us to assess the potential impact of future regulation on certain equality groups, particularly older consumers.[1025] While our research identifies differences in take-up and use of fixed line services by different groups within society, we do not consider that our wholesale regulation is likely to have a disproportionate impact on any of the equality groups, as our regulation is aimed at promoting competition and investment across the range of services that rely on WLA. Therefore, we consider that our regulatory interventions will further the aim of advancing equality of opportunity between different groups in society by furthering the interests of all consumers that use retail services reliant on WLA.

A23.11 In relation to TalkTalk and Which?'s comments, we consider that all equality groups will ultimately benefit from the move to full fibre. Our regulations include measures to protect all consumers, including vulnerable consumers during the transition to fibre. These include:

- Maintaining price caps on copper-based services at their current levels (adjusted for inflation) until full fibre is available.[1026]
- A progressive approach to transitioning regulation from copper to fibre.[1027]

Leased Lines and PIA Services

A23.12 We do not have detailed sectoral information on the businesses that purchase wholesale leased lines services or physical infrastructure services. However, given the nature of the services – network services which support a variety of retail services – we also do not have any

[1025] Ofcom, 2020. *Affordability of Communication Services.*
[1026] As outlined in Volume 4, Section 1 and 2.
[1027] As outlined in Volume 3, Section 2.

reason to suspect that there will be a disproportionate impact on any of the above defined equality groups through modification of the regulation on these services.

A24. Sources of evidence

A24.1 We have noted throughout this consultation the evidence we have relied upon in relation to our decisions and how we have relied upon that evidence. This annex lists the main sources of evidence used, including responses to our consultations and to our formal s.135 notices requesting information.

A24.2 While this annex lists the main evidence we have relied upon, the list is for convenience only and is not intended to be exhaustive.

Consultation responses

Responses to the December 2018 Consultation on approach to geographic markets

A24.3 On 11 December 2018, we published a consultation (December 2018 Consultation), setting out our initial views on how to define geographic markets from 2021 and seeking stakeholders views.

A24.4 19 stakeholders provided written responses to this consultation:

- G Adam
- BT Group
- CityFibre
- Gamma
- Gigaclear
- Hyperoptic
- D Meadmore
- Openreach
- Passive Access Group
- Sky
- TalkTalk
- UKCTA
- Virgin Media
- Vodafone
- 5 respondents requested their names be withheld

A24.5 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the March 2019 Consultation on approach to remedies

A24.6 On 29 March 2019, we also published a consultation (March 2019 Consultation), setting out our initial views on regulatory measures for wholesale fixed telecoms markets from 2021. which we considered will, in combination with duct and pole access, best achieve our strategy to secure investment by promoting network-based competition.

A24.7 33 stakeholders provided written responses to this consultation:

- Advisory Committee for Northern Ireland (ACNI)
- Advisory Committee for Wales (ACW)
- BNP Paribas Asset Management
- BT Group
- BUUK Infrastructure/GTC
- CityFibre
- CMS and Intercai Mondiale
- Consumer Council for Northern Ireland
- Gamma Telecom Holdings Ltd
- Gigaclear
- Independent Network Communications Association (INCA)
- Invesco
- Openreach
- Passive Access Group (PAG)
- P Scott
- Scottish Government
- Sky
- SSE Telecommunications Ltd
- TalkTalk
- Three
- UK Competitive Telecommunications Ltd
- Virgin Media
- Vodafone
- 10 respondents requested their names be withheld.

A24.8 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the June 2019 Consultation on the approach to modelling the costs of a fibre network

A24.9 On 21 June 2019, we published a consultation (June 2019 Consultation), to gather stakeholders' views on our initial proposals on our approach to modelling the costs of services provided over a fibre network. Specifically, our proposal to use a bottom-up modelling approach, our proposed design of the modelled fibre network and our proposed design of the cost model.

A24.10 10 stakeholders provided written responses to this consultation:

- BT Group
- CityFibre
- Infrastructure Investors Group (IIG)
- Independent Networks Cooperative Association (INCA)
- North Skye Broadband
- Openreach
- Passive Access Group (PAG)
- TalkTalk

- Virgin Media
- Vodafone

A24.11 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the January 2020 Consultation on the Wholesale Fixed Telecoms Market Review 2021-26

A24.12 On 8 January 2020, we published a consultation (January 2020 Consultation), setting out our proposals for the regulation of several markets from 1 April 2021 to 31 March 2026.

A24.13 46 stakeholders provided written responses to this consultation:

- G Adam
- Ofcom Advisory Committee for Northern Ireland (ACNI)
- Ofcom Advisory Committee for Scotland (ACS)
- Axione
- BT Group
- BUUK Infrastructure/GTC
- CityFibre
- Connect Fibre
- County Broadband Ltd
- Cumbria County Council
- Communications Workers Union (CWU)
- euNetworks Fibre UK Ltd
- Federation of Communication Services (FCS)
- Fern Trading Ltd
- Gamma Telecom Holdings Ltd
- Gigaclear
- Glide
- Hyperoptic Ltd
- Independent Networks Cooperative Association (INCA)
- ITS Technology Group
- Internet Telephony Services Providers' Association (ITSPA)
- Jurassic Fibre Ltd
- KCOM Group Ltd
- D MacDonald
- NextGenAccess
- Openreach
- Passive Access Group (PAG)
- Scottish Government
- Sky
- SSE Telecommunications Ltd
- Swish Fibre Ltd
- TalkTalk plc
- Telefonica UK Ltd

- Three
- TowerHouse LLP
- Truespeed Communications Ltd
- UK Competitive Telecommunications Association (UKCTA)
- Virgin Media
- Vodafone
- Welsh Government
- Which?
- 5 respondents requested their names be withheld

A24.14 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the February 2020 Consultation on BT regulatory financial reporting

A24.15 On 6 February 2020, we published a consultation (February 2020 Consultation), setting out our proposed regulatory financial reporting requirements on BT in relation to several markets from 1 April 2021-31 March 2026.

A24.16 Six stakeholders provided written responses to this consultation:

- BT Group
- CityFibre
- Competition Finance Ltd (a report for UKCTA)
- Frontier Economics (a report for Vodafone)
- TalkTalk plc
- Vodafone

A24.17 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website

Responses to the June 2020 Consultation on copper retirement

A24.18 On 25 June 2020, we published a consultation (June 2020 Consultation), setting out our proposals in relation to copper retirement.

A24.19 16 stakeholders provided written responses to this consultation:

- G Adam
- Advisory Committee for Scotland (ACS)
- BT Group
- BUUK Infrastructure/GTC
- Communications Management Association (CMA)
- Federation of Communication Services (FCS)
- Gamma Telecoms Holdings Ltd
- Internet Telephony Service Provers' Association (ITSPA)
- Joint Radio Company (JRC)
- Openreach

- Scotland 5G Centre
- TalkTalk
- TAUWI
- Telint Ltd
- Vodafone
- 1 respondent requested its name be withheld

A24.20 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the July 2020 Consultation on BT offer in Area 3

A24.21 On 29 July 2020, we published a consultation (July 2020 Consultation), in relation to an offer from BT to deploy FTTP in Area 3.

A24.22 21 stakeholders provided written responses to this consultation:

- G Adam
- Axione
- BT Group
- BUUK Infrastructure/GTC
- CityFibre
- County Broadband Ltd
- Fern Trading Ltd
- Gigaclear
- Independent Networks Cooperative Association (INCA)
- KCOM Group Ltd
- M Kiely
- Lothian Broadband Networks Limited
- Openreach
- SPC Network
- TalkTalk plc
- Truespeed Communications Ltd
- UK Competitive Telecommunications Association (UKCTA)
- Virgin Media
- Vodafone
- Zen Internet
- Zzoomm

A24.23 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the October 2020 Consultation on Copper Retirement

A24.24 On 15 October 2020, we published a consultation (October 2020 Consultation Copper Retirement), in relation to copper retirement.

A24.25 22 stakeholders provided written responses to this consultation:

- G Adam
- Atos IT Services Limited
- BT Group
- BUUK Infrastructure/GTC
- Citizens Advice Scotland
- CityFibre
- Colt
- Communication Management Association (CMA)
- County Broadband Ltd
- Federation of Communication Services (FCS)
- Fern Trading Ltd
- Gamma Telecoms Holdings Ltd
- Independent Networks Cooperative Association (INCA)
- Internet Telephony Services Providers' Association (ITSPA)
- Joint Radio Company (JRC)
- Ombudsman Services
- Openreach
- TalkTalk
- TAUWI
- Vodafone
- Zzoomm
- 1 respondent requested its name be withheld
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A24.26 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the October 2020 Consultation on Quality of Service

A24.27 On 23 October 2020, we published a consultation (October 2020 Consultation Quality of Service), in setting out proposals on Openreach Quality of Service.

A24.28 6 stakeholders provided written responses to this consultation:

- Communications Workers Union (CWU)
- Openreach
- Sky
- TalkTalk plc
- Verastar
- Vodafone

A24.29 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Responses to the November 2020 Consultation on changes to proposed remedies

A24.30 On 6 November 2020, we published a reconsultation (November 2020 Consultation), in relation to certain proposed remedies.

A24.31 15 stakeholders provided written responses to this consultation:

- BUUK Infrastructure/GTC
- CityFibre
- Community Fibre
- County Broadband Ltd
- Hyperoptic Ltd
- Joint INCA and Altnet Response submitted by GOS Consulting
- KCOM Group Ltd
- Openreach
- Passive Access Group (PAG)
- SSE Telecommunications Ltd
- TalkTalk plc
- Truespeed Communications Ltd
- Virgin Media
- Vodafone
- 1 respondent requested its name be withheld

A24.32 Where available, we have published non-confidential versions of the responses from the stakeholders listed above. These can be found on our website.

Information gathered using statutory powers

A24.33 During this market review, we have issued a series of notices under section 135 of the Communications Act 2003 requiring various telecoms providers to provide specified information as set out in the notice. We have set out the information requests below by stakeholder.

Notices addressed to and responses received from Airband Community Internet Limited

A24.34 Our Ref 00950662 Notice of 8 September 2020 regarding broadband connections. Responses received on 29 September 2020 and 14 October 2020.

Notices addressed to and responses received from AT&T Global Network Services (UK) BV

A24.35 Our Ref 01089000 Notice of 19 January 2021 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 1 February 2021.

Notices addressed to and responses received from Axione UK Limited

A24.36 Our Ref 00951204 Notice of 20 August 2020 regarding broadband connections. Response received on 21 September 2020.

A24.37 Our Ref 01137212 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 8 March 2021.

Notices addressed to and responses received from British Telecommunications plc

A24.38 Our Ref 00916189 Notice of 6 May 2020 regarding pricing remedies. Response received on 15 May 2020 and 22 May 2020.

A24.39 Our Ref 00918501 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020 and 29 July 2020.

A24.40 Our Ref 00945678 Notice of 14 August 2020 regarding broadband connections. Response received on 11 September 2020, 14 September 2020, 23 September 2020, 25 September 2020, 30 September 2020, 5 October 2020, 9 October 2020, 7 December 2020, 9 December 2020, 14 December 2020.

A24.41 Our Ref 00961390 Notice of 10 September 2020 regarding Fixed Wireless Access (FWA) broadband. Response received on 8 October 2020.

A24.42 Our Ref 00921775 Notice of 11 September 2020 regarding Regulatory Financial Statements (RFS). Response received on 15 September 2020, 16 September 2020, 8 October 2020, 21 October 2020 and 11 November 2020.

A24.43 Our Ref 00989201 Notice of 1 October 2020 regarding Weighted Average Cost of Capital (WACC). Response received on 15 October 2020.

A24.44 Our Ref 00924854 Notice of 12 October 2020 regarding mobile backhaul. Response received 9 November 2020, 23 November 2020 and 3 December 2020.

A24.45 Our Ref 01010849 Notice of 19 October 2020 regarding the provision of leased lines and dark fibre volumes. Response received on 2 December 2020.

A24.46 Our Ref 01035472 Notice of 18 November 2020 regarding regulatory financial statements (RFS). Response received on 2 December 2020, 9 December 2020, 11 December 2020, 17 December, 18 December 2020 and 18 January 2021.

A24.47 Our Ref 00924522 Notice of 19 November 2020 regarding the use of inter-exchange connectivity (IEC) services. Response received on 17 December 2020.

A24.48 Our Ref 01078935 Notice of 4 December 2020 regarding an update on estimate of revenue and EBITDA for ICT and managed networks activities for 2018/19. Response received 18 December 2020.

A24.49 Our Ref 01098764 Notice of 14 January 2021 regarding consent to use information previously gathered under s135 dated 5 December 2019 entitled “Helping Consumer Get Better Deals” for the Wholesale Fixed Telecoms Market Review. Response received on 25 January 2021.

A24.50 Our Ref 01093246 Notice of 18 January 2021 regarding network component data. Response received on 26 January 2021

A24.51 Our Ref 01128099 Notice of 16 February 2021 regarding the confirmation of information previously submitted. Responses received on 23 February 2021, 25 February 2021, and 26 February 2021.

A24.52 Our Ref 01137214 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 4 March 2021.

A24.53 Our Ref 01135583 Notice of 24 February 2021 regarding the confirmation of information previously submitted. Response received on 2 March 2021.

Notices addressed to and responses received from Broadband for the Rural North (B4RN)

A24.54 Our Ref 00950671 Notice of 14 August 2020 regarding broadband connections. Response received on 4 September 2020.

Notices addressed to and responses received from Cancom Managed Services Ltd

A24.55 Our Ref 00924521 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 27 November 2020.

Notices addressed to and responses received from CenturyLink Communications UK Limited

A24.56 Our Ref 00915497 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 21 April 2020, 1 May 2020, 20 May 2020, 29 May 2020, 13 June 2020, 15 June 2020, 18 June 2020, 16 July 2020, 24 July 2020, 30 July 2020, 28 September 2020, 29 September 2020 and 7 October 2020.

A24.57 Our Ref 00918398 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 25 September 2020, 2 October 2020, 5 October 2020, 7 October 2020, and 6 November 2020.

A24.58 Our Ref 00924473 Notice of 27 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 14 and 15 January 2021.

Notices addressed to and responses received from CityFibre Infrastructure Holdings Limited

A24.59 Our Ref 00915502 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 29 May 2020, 12 June 2020, 7 July 2020, 15 July 2020, 27 July 2020 and 7 August 2020.

A24.60 Our Ref 00918401 Notice of 12 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 21 August 2020, 3 November 2020, 5 November 2020, 8 December 2020, 10 December 2020, 22 January 2021 and 29 January 2021.

A24.61 Our Ref 00924337 Notice of 21 July 2020 regarding broadband connections. Response received on 1 September 2020 and 28 September 2020.

A24.62 Our Ref 00945659 Notice of 10 September 2020 regarding Business plan and network cost information. Response received on 29 October 2020.

A24.63 Our Ref 01019314 Notice of 15 October 2020 regarding confirmation of current network build and investment plans. Response received on 21 October 2020

A24.64 Our Ref 00924487 Notice of 24 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 18 December 2020, 14 January 2021 and 27 January 2021.

A24.65 Our Ref 01068602 Notice of 25 November 2020 regarding analysis from consultation response. Response received on 25 November 2020.

A24.66 Our Ref 01077966 Notice of 30 November 2020 regarding the follow up on planned investment in fibre networks. Response received on 4 and 8 December 2020.

A24.67 Our Ref 01128101 Notice of 16 February 2021 regarding the confirmation of information previously submitted. Response received on 22 February 2021.

A24.68 Our Ref 01137215 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 5 March 2021.

Notices addressed to and responses received from Colt Technology Services Group Limited

A24.69 Our Ref 00915503 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 29 May 2020, 2 July 2020, 6 July 2020, 18 December 2020, 22 December 2020 and 4 January 2021.

A24.70 Our Ref 00918449 Notice of 12 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 23 July 2020, 26 August2020, 23 October 2020 and 23 November 2020.

A24.71 Our Ref 00924491 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 16 December 2020.

Notices addressed to and responses received from Commsworld Limited

A24.72 Our Ref 00924532 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 23 December 2020 and 12 January 2021.

Notices addressed to and responses received from Community Fibre

A24.73 Our Ref 00950663 Notice of 20 August 2020 regarding broadband connections. Response received on 10 September 2020 and 21 September 2020.

Notices addressed to and responses received from County Broadband Ltd

A24.74 Our Ref 00950664 Notice of 4 September 2020 regarding broadband connections. Response received on 25 September 2020.

Notices addressed to and responses received from Daisy Group Holdings Limited

A24.75 Our Ref 00924533 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 21 December 2020.

Notices addressed to and responses received from Eircom (UK) Limited

A24.76 Our Ref 00915504 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 28 May 2020, 12 June 2020, 15 June 2020 and 16 July 2020.

A24.77 Our Ref 00918456 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020, 24 August 2020, 16 October 2020 and 3 November 2020.

A24.78 Our Ref 00924907 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 20 August 2020.

A24.79 Our Ref 00924493 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 9 December 2020 and 14 December 2020.

Notices addressed to and responses received from Entanet International Ltd

A24.80 Our Ref 00924497 Notice of 24 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 18 December 2020 and 14 January 2021.

Notices addressed to and responses received from euNetworks Fiber UK Limited

A24.81 Our Ref 00915507 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 29 May 2020 and 12 June 2020

A24.82 Our Ref 00918458 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020 and 19 October 2020.

A24.83 Our Ref 00924908 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 18 August 2020.

Notices addressed to and responses received from Exponential-e Limited

A24.84 Our Ref 00924534 Notice of 24 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 24 November 2020.

Notices addressed to and responses received from Fern Trading Limited

A24.85 Our Ref 01137224 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 4 March 2021.

Notices addressed to and responses received from Fibrespeed Limited

A24.86 Our Ref 00915508 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 26 May 2020, 22 June 2020, 8 July 2020 and 15 July 2020.

A24.87 Our Ref 00918459 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020, 27 August 2020, ,22 October 2020 and 5 November 2020.

Notices addressed to and responses received from Gamma Telecom Ltd

A24.88 Our Ref 00924538 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 16 December 2020.

Notices addressed to and responses received from Gigaclear Limited

A24.89 Our Ref 00924343 Notice of 24 August 2020 regarding broadband connections. Response received on 8 October 2020.

A24.90 Our Ref 00945662 Notice of 10 September 2020 regarding Business plan and network cost information. Response received on 22 October 2020 and 28 October 2020.

Notices addressed to and responses received from Glide Business Limited

A24.91 Our Ref 00924502 Notice of 24 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 10 and 15 December 2020.

Notices addressed to and responses received from GTT-EMEA Ltd

A24.92 Our Ref 00915509 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 29 May 2020, 12 June 2020, 10 July 2020, 20 July 2020, 14 September 2020, 18 September 2020, 28 September 2020 and 7 October 2020.

A24.93 Our Ref 00918460 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020, 8 September 2020, 23 October 2020 and 6 November 2020.

A24.94 Our Ref 00924505 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 21 December 2020.

Notices addressed to and responses received from Hutchison 3G UK Limited (Three)

A24.95 Our Ref 00924874 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 20 August 2020.

A24.96 Our Ref 00961397 Notice of 10 September 2020 regarding Business plan and network cost information. Response received on 22 October 2020.

A24.97 Our Ref 00924855 Notice of 1 October 2020 regarding mobile backhaul. Response received on 12 November 2020, 18 November 2020, 22 January 2021 and 27 January 2021.

A24.98 Our Ref 01128104 Notice of 16 February 2021 regarding the confirmation of information previously submitted. Response received on 23 February 2021.

A24.99 Our Ref 01137633 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 5 March 2021.

Notices addressed to and responses received from Hyperoptic Limited

A24.100 Our Ref 00924342 Notice of 19 August 2020 regarding broadband connections. Response received on 22 September 2020, 25 September 2020, 30 September and 13 October 2020.

A24.101 Our Ref 00945661 Notice of 10 September 2020 regarding Business plan and network cost information. Response received on 22 October 2020 and 26 October 2020.

A24.102 Our Ref 00924525 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 17 December 2020 and 7 January 2021.

Notices addressed to and responses received from Independent Networks Cooperative Association Limited

A24.103 Our Ref 01137273 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 5 March 2021.

Notices addressed to and responses received from Jurassic Fibre Limited

A24.104 Our Ref 00951235 Notice of 18 August 2020 regarding broadband connections. Response received on 29 September 2020, 7 October 2020 and 12 October 2020.

Notices addressed to and responses received from KCOM Group Limited

A24.105 Our Ref 00915511 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 29 May 2020, 25 June 2020, 3 July 2020 and 17 July 2020.

A24.106 Our Ref 00918461 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020, 14 August 2020 and 23 October 202.

A24.107 Our Ref 00935134 Notice of 22 June 2020 regarding confirming information on KCOM's operations in the Hull Area. Response received on 30 June 2020.

A24.108 Our Ref 00965242 Notice of 18 September 2020 regarding broadband connections. Response received on 9 October 2020, 15 October 2020 and 22 January 2021.

A24.109 Our Ref 00924506 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 17 December 2020 and 14 January 2021.

Notices addressed to and responses received from Liberty Networks Limited

A24.110 Our Ref 01006907 Notice of 29 September 2020 regarding broadband connections. Response received on 9 October 2020.

Notices addressed to and responses received from MLL Telecom Ltd

A24.111 Our Ref 00924536 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 21 December 2020 and 11 January 2021.

Notices addresses to and responses received from Mobile Broadband Network Limited

A24.112 Our Ref 00924877 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 30 July 2020.

A24.113 Our Ref 00924861 Notice of 12 October 2020 regarding mobile backhaul. Response received on 10 November 2020, 20 November 2020, 1 December 2020 and 15 December 2020.

Notices addressed to and responses received from MS3 Networks Limited

A24.114 Our Ref 00915513 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 30 April 2020, 26 May 2020 and 22 October 2020.

A24.115 Our Ref 00918464 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 23 July 2020 and 16 October 2020.

Notices addressed to and responses received from Net Support UK Ltd

A24.116 Our Ref 00924520 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 17 December 2020 and 19 January 2020.

Notices addressed to and responses received from Openreach Limited

A24.117 Our Ref 00915514 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 1 May 2020.

A24.118 Our Ref 00916169 Notice of 6 May 2020 regarding pricing remedies. Response received on 26 May 2020 and 5 June 2020.

A24.119 Our Ref 00918471 Notice of 11 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 23 July 2020.

A24.120 Our Ref 00930423 Notice of 12 June 2020 regarding the leased lines forecasts and planning, Non-PIA. Response received on 1 July 2020.

A24.121 Our Ref 00941660 Notice of 18 August 2020 regarding PIA Simplified Lead-In Price - Verification of Derivation. Response received on 9 and 16 September 2020.

A24.122 Our Ref 00924339 Notice of 20 August 2020 regarding broadband connections. Response received on 10 September 2020 and 1 October 2020.

A24.123 Our Ref 00945658 Notice of 10 September 2020 regarding Business plan and network cost information. Response received on 8 October 2020 and 15 October 2020.

A24.124 Our Ref 00921724 Notice of 11 September 2020 regarding PIA model update, efficiency and dark fibre. Response received on 1 and 29 October 2020.

A24.125 Our Ref 01009050 Notice of 23 September 2020 regarding Broadband, leased lines and dark fibre service volumes. Response received on 30 September 2020.

A24.126 Our Ref 01011000 Notice of 28 September 2020 regarding outputs from the NGA cost models (follow-up question taken out from previous information request: 00945658). Response received on 9 November 2020.

A24.127 Our Ref 00999915 Notice of 7 October 2020 regarding Local Access Offer. Response received on 21 October 2020.

A24.128 Our Ref 01024616 Notice of 15 October 2020 regarding cablelink circuits. Response received on 22 October 2020.

A24.129 Our Ref 01035413 Notice of 5 November 2020 regarding Follow-up question on response to information request - Verification of Derivation. Response received on 12 November 2020.

A24.130 Our Ref 00989209 Notice of 12 November 2020 regarding volume forecast information. Response received on 2 December 2020.

A24.131 Our Ref 01074951 Notice of 7 December 2020 regarding FTTP connection costs. Response received on 21 December 2020.

A24.132 Our Ref 01068617 Notice of 8 December 2020 regarding cost modelling and WBA. Response received on 11 December 2020 and 13 January 2021.

A24.133 Our Ref 01085533 Notice of 21 December 2020 regarding PIA Simplified Lead-In volumes and assumptions. Response received on 12 November 2020.

A24.134 Our Ref 01071592 Notice of 22 December 2020 regarding Postal addresses of customer sites with leased line fibre connections. Response received on 14 January 2021.

A24.135 Our Ref 01083538 Notice of 6 January 2021 regarding FTTP forecast numbers. Response received on 13 and 20 January 2021.

A24.136 Our Ref 01088817 Notice of 14 January 2021 regarding information on Very High Bandwidth (VHB). Response received on 28 January 2021.

A24.137 Our Ref 01095503 Notice of 12 February 2021 regarding the mapping of Network Instruction Management systems (NIMs) to BTs Fixed Asset Register. Response received on 26 February 2021.

A24.138 Our Ref 01111524 Notice of 3 February 2021 regarding Fibre to the cabinet (FTTC) revenue and volume data. Response received on 10 February 2020.

A24.139 Our Ref 01107505 Notice of 8 February 2021 regarding Physical Infrastructure Access (PIA) model update, efficiency and dark fibre. Response due on 19 February 2020.

A24.140 Our Ref 01128100 Notice of 16 February 2021 regarding the confirmation of information previously submitted. Response received on 26 February 2021.

A24.141 Our Ref 01137227 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 5 March 2021.

A24.142 Our Ref 01142445 Notice of 3 March 2021 regarding the confirmation of information previously submitted. Response received on 9 March 2021.

A24.143 Our Ref 01144291 Notice of 5 March 2021 regarding the confirmation of information previously submitted. Response received on 9 March 2021.

Notices addressed to and responses received from Origin Broadband Services Ltd

A24.144 Our Ref 00924539 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 21 December 2020 and 8 January 2021.

Notices addressed to and responses received from Services Direct Newco Limited

A24.145 Our Ref 00924508 Notice of 20 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 18 December 2020 and 20 January 2021.

Notices addressed to and responses received from Six Degrees Holdings Limited

A24.146 Our Ref 00924516 Notice of 24 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 10 December 2020.

Notices addressed to and responses received from Sky UK Limited

A24.147 Our Ref 00918499 Notice of 12 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 23 July 2020.

A24.148 Our Ref 00924344 Notice of 18 August 2020 regarding broadband connections. Response received on 11 September 2020.

A24.149 Our Ref 01010851 Notice of 9 October 2020 regarding broadband, leased lines and dark fibre service volumes. Response received on 30 October 2020.

A24.150 Our Ref 00934387 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 17 December 2020.

A24.151 Our Ref 01038058 Notice of 20 November 2020 regarding SPC report. Response received on 23 November 2020.

A24.152 Our Ref 01088356 Notice of 6 January 2021 regarding Information about broadband volumes. Response received on 14 January 2021.

A24.153 Our Ref 01098765 Notice of 14 January 2021 regarding consent to use information previously gathered under s135 dated 6 December 2019 entitled "Helping Consumer Get Better Deals" for the Wholesale Fixed Telecoms Market Review. Response received on 25 January 2021.

A24.154 Our Ref 01137228 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 2 March 2021.

A24.155 Our Ref 01135585 Notice of 24 February 2021 regarding the confirmation of information previously submitted. Response received on 25 February 2021.

Notices addressed to and responses received from SSE Telecommunications Limited

A24.156 Our Ref 00915515 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 16 May 2020 and 12 June 2020.

A24.157 Our Ref 00918474 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 7 September 2020.

A24.158 Our Ref 00924911 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 6 October 2020.

A24.159 Our Ref 00924509 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 18 December 2020 and 15 January 2021.

A24.160 Our Ref 01137230 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 5 March 2021.

Notices addressed to and responses received from SPC Network Ltd

A24.161 Our Ref 01032496 Notice of 30 October 2020 regarding underlying data supporting econometric analysis. Response received on 3 November 2020.

A24.162 Our Ref 01037546 Notice of 9 November 2020 regarding the modelling code used to undertake analysis. Response received on 10 November 2020.

Notices addressed to and responses received from Swish Fibre Limited

A24.163 Our Ref 00951236 Notice of 17 August 2020 regarding broadband connections. Response received on 28 September 2020.

Notices addressed to and responses received from TalkTalk Telecom Group PLC

A24.164 Our Ref 00918495 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 27 July 2020.

A24.165 Our Ref 00924347 Notice of 23 July 2020 regarding broadband connections. Response received on 3 September 2020.

A24.166 Our Ref 00997451 Notice of 25 September 2020 regarding an update of information for the fibre premium work. Response received on 12 October 2020.

A24.167 Our Ref 01010853 Notice of 13 October 2020 regarding broadband, leased lines and dark fibre service volumes. Response received on 3 November 2020 and 14 December 2020.

A24.168 Our Ref 00924540 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 18 December 2020.

A24.169 Our Ref 01098767 Notice of 14 January 2021 regarding consent to use information, previously gathered under s135 dated 5 December 2019 entitled "Helping Consumer Get Better Deals", for the Wholesale Fixed Telecoms Market Review. Response received on 25 January 2021.

A24.170 Our Ref 01137232 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 2 March 2021.

A24.171 Our Ref 01135586 Notice of 24 February 2021 regarding the confirmation of information previously submitted. Response received on 10 March 2021.

Notices addressed to and responses received from Telefónica UK Ltd

A24.172 Our Ref 00924904 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 19 August 2020.

A24.173 Our Ref 00961394 Notice of 10 September 2020 regarding Business plan and network cost information. Response received on 14 September 2020.

A24.174 Our Ref 00924857 Notice of 12 October 2020 regarding mobile backhaul. Response received on 9 November 2020.

Notices addressed to and responses received from The Networking People Limited (TNP)

A24.175 Our Ref 01036125 Notice of 23 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 21 December 2020 and 6 January 2021.

Notices addressed to and responses received from Toob Limited

A24.176 Our Ref 00951237 Notice of 1 September 2020 regarding broadband connections. Response received on 20 September 2020.

Notices addressed to and responses received from Truespeed Communications Ltd

A24.177 Our Ref 00950668 Notice of 19 August 2020 regarding broadband connections. Response received on 30 October 2020.

Notices addressed to and responses received from Updata Infrastructure (UK) Limited

A24.178 Our Ref 01036123 Notice of 4 December 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 22 December 2020 and 8 January 2021.

Notices addressed to and responses received from Venus Business Communications Limited

A24.179 Our Ref 01036119 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 14 December 2020, 22 January 2021 and 02 February 2021.

Notices addressed to and responses received from Verizon UK Limited

A24.180 Our Ref 00915518 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 1 and 12 June 2020, 30 July 2020 and 10 December 2020.

A24.181 Our Ref 00918475 Notice of 12 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 20 July 2020.

A24.182 Our Ref 00924914 Notice of 30 July 2020 regarding Dark Fibre access. Response received on 3 August 2020.

A24.183 Our Ref 00924511 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 17 December 2020.

Notices addressed to and responses received from Virgin Media Limited

A24.184 Our Ref 00915521 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 29 May 2020 and 12 June 2020.

A24.185 Our Ref 00918489 Notice of 12 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 24 July 2020 and 7 August 2020.

A24.186 Our Ref 00924330 Notice of 22 July 2020 regarding broadband connections. Response received on 8 September 2020.

A24.187 Our Ref 00956210 Notice of 20 August 2020 regarding additional questions on network investment plans. Response received on 10 September 2020.

A24.188 Our Ref 00945663 Notice of 10 September 2020 regarding business plan and network cost information. Response received on 29 October 2020 and 5 November 2020

A24.189 Our Ref 01006905 Notice of 25 September 2020 regarding broadband connections. Response received on 9 October 2020.

A24.190 Our Ref 00924514 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 22 December 2020.

A24.191 Our Ref 01128102 Notice of 16 February 2021 regarding the confirmation of information previously submitted. Response received on 23 February 2021.

A24.192 Our Ref 01137233 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 5 March 2021.

Notices addressed to and responses received from Virtual1 Limited

A24.193 Our Ref 00924541 Notice of 20 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 18 December 2020.

Notices addressed to and responses received from Vodafone Limited

A24.194 Our Ref 00915526 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 15 May 2020 and 12 June 2020.

A24.195 Our Ref 00918490 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 24 July 2020.

A24.196 Our Ref 00924348 Notice of 24 July 2020 regarding broadband connections. Response received on 28 August 2020 and 30 September 2020.

A24.197 Our Ref 00961400 Notice of 10 September 2020 regarding business plan and network cost information. Response received on 8 October 2020.

A24.198 Our Ref 00924859 Notice of 12 October 2020 regarding mobile backhaul. Response received on 9 November 2020.

A24.199 Our Ref 01038074 Notice of 20 November 2020 regarding the SPC Network report. Response received on 20 November 2020.

A24.200 Our Ref 00924515 Notice of 27 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 6 January 2021 and 13 January 2021.

A24.201 Our Ref 01088974 Notice of 22 December 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 6 January 2021.

A24.202 Our Ref 01128103 Notice of 16 February 2021 regarding the confirmation of information previously submitted. Response received on 23 February 2021.

A24.203 Our Ref 01137234 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 4 March 2021.

Notices addressed to and responses received from WPD Telecoms Limited

A24.204 Our Ref 00915530 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 12 June 2020.

A24.205 Our Ref 00918492 Notice of 15 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 24 July 2020 and 28 August 2020.

Notices addressed to and responses received from Zayo Group UK Limited

A24.206 Our Ref 00915532 Notice of 1 May 2020 regarding new connections and network extensions, network flexibility points and network sites. Response received on 8 and 19 June 2020.

A24.207 Our Ref 00918494 Notice of 12 June 2020 regarding the wholesale leased lines markets and the locations of data centres. Response received on 19 and 26 August 2020.

A24.208 Our Ref 00924519 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 11 and 16 December 2020.

Notices addressed to and responses received from Zen Internet Ltd

A24.209 Our Ref 00924542 Notice of 19 November 2020 regarding the use of Inter-exchange connectivity (IEC) services. Response received on 17 December 2020 and 7 January 2021.

Notices addressed to and responses received from Zzoomm

A24.210 Our Ref 00950669 Notice of 17 August 2020 regarding broadband connections. Response received on 28 September 2020.

A24.211 Our Ref 01137235 Notice of 26 February 2021 regarding the confirmation of information previously submitted. Response received on 26 February 2021.

Consultations to the Wholesale Fixed Telecoms Market Review

A24.212 Ofcom, December 2018 Approach to geographic markets consultation.

A24.213 Ofcom, March 2019 Approach to remedies consultation.

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A25. Glossary

Term	Description
2014 EC Recommendation	The 2014 EC Recommendation on relevant product and service markets.
5G	The term used to describe the next generation of wireless networks beyond 4G LTE mobile networks. 5G is expected to deliver faster data rates and better user experience.
Access Change Notice (ACN)	A notice issued by Openreach of any amendment to the charges, terms and conditions on which it provides network access, or in relation to any charges for new network access.
Active leased line	A communications link between two sites provided with active electronics at either end of the connection. These services tend to be symmetric (the capacity is the same in both directions), uncontended (the capacity is guaranteed and not subject to reduction by the presence of other telecoms services), and typically, dedicated to the customer's exclusive use.
AFI (Additional Financial Information)	Detailed financial information provided in confidence to Ofcom as part of BT's Regulatory Financial Statements.
AMD (Accounting Methodology Document)	A document prepared by BT which sets out the methodologies used to attribute its costs to prepare the Regulatory Financial Statements.
Anchor pricing	An approach that sets the upper bound for charges of existing services by reference to the cost of providing those services using existing technology. This ensures that the introduction of new technology which is intended to provide a greater range of services does not inappropriately lead to an increase in the cost of the existing services.
AVE (Asset Volume Elasticity)	The percentage increase in capital costs required for a 1% increase in volume.
Backhaul	Connections between access and backhaul aggregating nodes, and from access or backhaul aggregating nodes to core aggregating nodes.
Bandwidth	The rate at which data can be transmitted. Usually expressed in bits per second (bit/s).
Basket	A term used in relation to the structure of charge controls, where the charge control is applied to the total revenue from a group of services in a given year, subject to a specified compliance formula.
Bearer	A transmission link that carries one or more multiplexed smaller capacity connections.

BEREC	Body of European Regulators for Electronic Communications.
BES (Backhaul Ethernet Services)	A legacy Openreach Ethernet service providing high bandwidth inter-exchange connectivity, superseded, for example, by Openreach's EBD and EAD products.
BT	British Telecommunications plc.
BT CCN (Change Control Notification)	BT's annual publication of methodology changes affecting the Regulatory Financial Statements.
BT Enterprise	The downstream part of BT which provides wholesale services to telecoms providers as well as retail services to enterprise customers.
Broadband	Broadband commonly refers to high-speed internet access that is always on and faster than legacy (narrowband) dial-up access.
CAPM	Capital Asset Pricing Model.
Capex (Capital Expenditure)	The firm's investment in fixed assets.
CBDs (Central Business Districts)	The main business and commercial area of a town or city.
CCA (Current Cost Accounting)	An accounting convention, where assets are valued and depreciated according to their current replacement cost while maintaining the operating or financial capital of the business entity.
CCA adjustments	The accounting convention where the value of assets is adjusted and depreciated according to their current replacement cost while maintaining the operating or financial capital of the business entity.
CDD (Contractual Delivery Date)	A date provided by Openreach to a telecoms provider on which Openreach contracts for an order to become a completed order.
Certainty	A QoS standard based on the percentage of orders completed on or before initial Contractual Delivery Date (iCDD).
CI (Contemporary Interface)	A set of modern technologies used for delivery of leased line services (e.g. Ethernet or wavelength-division multiplexing).
CLA (Central London Area)	A geographic market in central London.
CNI (Critical national infrastructure)	Infrastructure supporting essential services such as water or electricity provision, or access to emergency services.
Common costs	Costs which are shared by multiple services supplied by a firm.
Co-location	The provision of space and associated facilities at a BT exchange for telecom provider equipment.
CP (Communications Provider)	An organisation that provides electronic communications services. We often refer to them as telecoms providers or network operators.

CPE (Customer Premises Equipment)	Sometimes referred to as customer apparatus or consumer equipment. Equipment on consumers' premises which is not part of the public telecommunications network but is directly or indirectly attached to it via network terminating equipment (NTE).
CPI (Consumer Price Index)	An official measure of inflation of consumer prices in the UK.
CSH (Customer Sited Handover)	CSH is an interconnection between BT and another telecoms provider which involves BT providing a point of handover (POH) at the site of the interconnecting telecoms provider e.g. at an operational building.
Cumulo rates	The phrase we use to describe the non-domestic rates (effectively a property tax) that BT pays on its rateable network assets in the UK. These assets include BT's passive infrastructure such as its duct, poles, fibre and copper cables and exchange buildings. It is called a cumulo assessment because the rates on these assets are assessed together.
CVE (Cost Volume Elasticity)	The percentage increase in operating costs required for a 1% increase in volume.
CVR (Cost Volume Relationship)	The relationship of how cost and volumes move in relation to one another.
CWU (Communication Workers Union)	A union for the communications industry which represents members in postal, telecom, mobile, administrative and financial companies.
Data centre	Premises whose main purpose is to house computing, data and application hosting, and communications equipment. They tend to have multiple tenants and may be owned and operated by carriers and/or run by third party providers that are carrier neutral.
Deemed consent	A contractual provision allowing Openreach to deem the consent of its customers to a change of the CDD in a range of circumstances as provided for in its contract.
Dark fibre	A service which allows telecoms providers to lease only the fibre element of leased lines from a supplier, allowing them to attach equipment of their own choosing at either end to 'light' the fibre and use it as the basis for offering a range of leased lines products.
Dark Fibre Access (DFA)	A requirement on Openreach to provide access to dark fibre in certain geographic areas of the LL Access product market.
Dark Fibre Inter-exchange (DFX)	A requirement on Openreach to provide access to dark fibre in the IEC market from BT exchanges with no rival networks within 100m.
Disposals	The assets that the firm disposes of (e.g. an asset that becomes fully depreciated or an asset that the firm sells) over the course of the financial year.

DLRIC (Distributed Long Run Incremental Cost)	The long-run incremental cost of the individual service with a share of costs which are common to other services over BT's core network.
DOCSIS (Data Over Cable Service Interface Specification)	A telecommunications standard that enables cable TV networks to support broadband internet access services.
DP (Distribution Point)	A flexibility point in BT's access network to which final connections to customer premises are connected. Usually either an underground joint or a connection point on a pole where dropwires are terminated.
DPA (Duct and Pole Access)	A wholesale access service allowing a telecoms provider to make use of the underground duct network and the poles of another telecoms provider.
Dropwire	An overhead cable, connecting BT's access network to a customer's premises.
DSAC (Distributed Stand Alone Cost)	An accounting approach estimated by adding a proportionate share of the inter-increment common costs to the DLRIC. Rather than all common costs shared by a service being allocated to the service under consideration, the common costs are instead allocated amongst all the services that share the network increment.
DSL (Digital Subscriber Line)	A family of technologies generically referred to as DSL or xDSL that enable the transmission of broadband signals over ordinary copper telephone lines.
EAD (Ethernet Access Direct)	An Ethernet product offered by Openreach providing high bandwidth, point-to-point connections.
EAD Local Access (EAD LA)	This refers to an Openreach leased line variant of an EAD (Ethernet Access Direct) product which only runs between an end-user site and the local access serving exchange. An LA leased line has no main fibre link between exchanges.
EBD (Ethernet Backhaul Direct)	An Ethernet backhaul product offered by Openreach providing high bandwidth, inter-exchange connectivity between designated BT exchanges.
EBITDA	Earnings before interest, tax, depreciation and amortisation.
EC	The European Commission.
ECCs (Excess Construction Charges)	A charge levied by Openreach where additional construction of duct and fibre or copper is required to provide service to customer site. Provided either directly by Openreach or by a contractor.
EFM (Ethernet in the First Mile)	A network technology for the delivery of Ethernet services over access networks. Although the technology also encompasses fibre access networks, in common usage, EFM refers to the provision of Ethernet services over copper access networks.

EMP (Equivalence Management Platform)	A set of operational support systems and associated processes put in place by Openreach.
ERP	Equity Risk Premium.
Ethernet	A packet-based technology originally developed for use in Local Area Networks (LANs) but now also widely used in telecoms providers' networks for the transmission of data services.
EV	Enterprise Value. A measure of a company's value, equal to its market capitalisation plus the value of debt.
FAC (Fully Allocated Cost)	An accounting approach under which all the costs of the company are distributed between its various products and services. The fully allocated cost of a product or service may therefore include some common costs that are not directly attributable to the service.
Fibre channel	Standardised storage area network protocol operating at bandwidths between 1 Gbit/s and 16 Gbit/s.
FTTC (Fibre-to-the-Cabinet)	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.
FTTP (Fibre-to-the-Premises)	An access network structure in which the optical fibre network runs from the local exchange to the end-user's house or business premises. The optical fibre may be point-to-point (there is one dedicated fibre connection for each home) or may use a shared infrastructure such as a GPON. Sometimes also referred to as Fibre-to-the-home (FTTH), Fibre-to-the-Business (FTTB) or full-fibre.
Gbit/s	Gigabits per second (1 Gigabit = 1,000,000,000 bits). A measure of bandwidth in a digital system.
GEA (Generic Ethernet Access)	Openreach's wholesale service providing telecoms providers with access to its FTTC and FTTP networks to supply higher speed broadband services. The GEA service meets BT's obligation to provide VULA.
Gigabit capable networks/broadband	Gigabit broadband is a network connection to a customer's premises capable of delivering download speeds of 1 Gbit/s or more. These may be referred to as gigabit capable broadband for shared network connections to residential customers.
GPON (Gigabit Passive Optical Network)	A shared FTTP network architecture that can be used for NGA.

GRC (Gross Replacement Cost)	The cost of replacing an existing tangible fixed asset with an identical or substantially similar new asset having a similar production or service capacity.
G.fast	GEA over Fibre-to-the-Distribution-point uses a fibre connection between the serving exchange and the distribution point, with a copper connection between the distribution point and the premise. It provides higher broadband speeds than FTTC. Over short copper connections, G.fast is capable of delivering ultrafast speeds. As with FTTC, it is necessary to purchase both the G.fast access product and the copper bearer.
HCA (Historic Cost Accounting)	The measure of the cost in terms of its original purchase price of the economic benefits of tangible fixed assets that have been consumed during a period. Consumption includes the wearing out, using up or other reduction in the useful economic life of a tangible fixed asset whether arising from use, effluxion of time or obsolescence through either changes in technology or demand for the goods and services produced by the asset.
HGL (Holding Gains and Losses)	The change in the value of the underlying assets used by the company over the course of the financial year.
HNR (High Network Reach) Area	Geographic areas with at least two rival leased lines providers within a specific distance from a business site, as defined in Volume 2, Section 7.
Hull Area	The area defined as the 'Licensed Area' in the licence granted on 30 November 1987 by the Secretary of State under section 7 of the Telecommunications Act 1984 to Kingston upon Hull City Council and Kingston Communications (Hull) plc (KCOM).
iCDD (initial Contractual Delivery Date)	The iCDD is the first date provided to Openreach's customers by Openreach advising of the anticipated circuit completion date.
ISDN (Integrated Services Digital Network)	A digital telephone service that supports telephone and switched data services.
ISP (Internet Service Provider)	A company that provides end-users with access to the internet and other related services such as data storage, email, and other cloud services.

Jitter	A measure of the variation of delay in transmission over a transmission path.
kbit/s	Kilobits per second (1 kilobit = 1,000 bits). A measure of bandwidth in a digital system.

KPIs (Key Performance Indicators)	Specified information to be provided for the purposes of assessing performance and providing transparency of service provision by a dominant provider.
Latency	A measure of delay in transmission over a transmission path.
Lead-in	The final section of a physical infrastructure network, housing the connection between the distribution point and the customer premises equipment.
Leased line	A communications link between two sites provided with active electronics at either end of the connection which can be provided either by the customer or by the supplier. Leased line services tend to be symmetric (the capacity is the same in both directions), uncontended (the capacity is guaranteed and not subject to reduction by the presence of other telecoms services), and typically, dedicated to the customer's exclusive use.
LLCC	Leased line charge control.
LLU (Local Loop Unbundling)	A process by which a dominant provider's local loops are physically disconnected from its network and connected to competing providers' networks. This enables operators other than the incumbent to use the local loop to provide services directly to customers.
LRIC (Long Run Incremental Cost)	A measure of the change in the long-run total costs of the firm that arises from the provision of a discrete increment of output.
Mbit/s	Megabits per second (1 Megabit = 1 million bits). A measure of bandwidth in a digital system.
MBORC (Matters Beyond Our Reasonable Control)	MBORCs are usually raised when Openreach's network has experienced serious damage caused by extreme weather, or as a result of criminal or negligent damage caused by third parties.
MCE (Mean Capital Employed)	BT's definition of Mean Capital Employed is total assets less current liabilities, excluding corporate taxes and dividends payable, and provisions other than those for deferred taxation. The mean is computed from the start and end values for the period.
MDF (Main Distribution Frame)	A wiring flexibility frame where copper local loops are terminated and interconnected.
MDF Site	A BT operational building containing an MDF. Also referred to as a Local Serving Exchange.
MEA (Modern Equivalent Asset)	The approach to set charges by basing costs and asset values on what is believed to be the most efficient available technology that performs the same function as the current technology.
MEAS (Mobile Ethernet Access Service)	This is a service provided by BT Enterprise to provide connectivity from multiple mobile base station sites back to a mobile core network.

MNO (Mobile Network Operator)	A provider which owns a cellular mobile network.
Modified greenfield Approach	An approach to analysing markets, where we consider a hypothetical scenario in which there are no ex ante SMP remedies in the market being considered or in any markets downstream of it.
MPF (Metallic Path Facility)	The provision of access to the copper wires from the customer site to a BT MDF that covers the full available frequency range, including both narrowband and broadband channels, allowing a competing provider to provide the customer with both voice and/or data services over such copper wires.
MSAN (Multi Service Access Node)	A network access device associated with an IP-based network that provides network interfaces for telephony, broadband and other services. MSANs are typically installed in a telephone exchange or a roadside cabinet.
MTTP (Mean Time To Provide)	A QoS standard measuring the average time to provide an Ethernet circuit excluding customer caused delays.
NDRs (Non-Domestic Rates)	A form of property tax paid by organisations and businesses to contribute towards the cost of local services.
NICC	A technical forum for the UK communications sector that develops interoperability standards for public communications networks and services in the UK. It is an independent organisation owned and run by its members. Ofcom participates in NICC as an observer.
NMR	Narrowband Market Review.
NRA	National Regulatory Authority.
NRC (Net Replacement Cost)	Gross replacement cost less accumulated depreciation based on gross replacement cost.
OTDR (Optimal Time Domain Reflectometer)	An instrument used to test the performance of fibre links and detect problems, in particular, used to identify the location of a broken fibre.
OHP (Openreach Handover Point)	Network nodes in BT's network at which certain Openreach backhaul services are terminated.
Openreach	The line of business of BT which comprises BT's access and backhaul network assets and the products and services provided using those assets and which Openreach Limited, a wholly owned subsidiary of BT plc, has responsibility for operating and managing on behalf of BT.
Opex (operating expenditure)	Costs reflected in the profit and loss account excluding depreciation and financing costs such as interest charges.

OSA (Optical Spectrum Access)	An Openreach WDM service.
OSEA (Optical Spectrum Extended Access)	Openreach WDM services supporting circuits over a longer distance than OSA.
OTA2 (Office of the Telecommunications Adjudicator)	An organisation independent of Ofcom and the industry, tasked with overseeing cooperation between telecoms providers.
OUKT	Other UK telecoms.
Patch panel	A patch panel is used to interconnect and manage fibre optic cables.
PCO (Principal Core Operator)	A telecoms provider with its own network infrastructure, has a substantial footprint, and offers a wholesale inter-exchange connectivity service to other telecoms providers.
PIA (Passive Infrastructure Access)	A remedy requiring BT to provide telecoms providers with access to its passive access network infrastructure (i.e. ducts and poles).
POH (Point of Handover)	A point (location) where one telecoms provider interconnects with another telecoms provider for the purposes of connecting their networks to 3rd party customers to provide services to those end customers. May also be referred to as point of connection (POC).
PON (Passive Optical Network)	A point to multipoint fibre-optic network architecture that uses passive optical splitters.
POP (Point of Presence)	A node in a telecoms provider's network (such as an exchange or other operational building), generally one used to serve customers in a particular locality.
PSTN (Public Switched Telephone Network)	The circuit-switched telephone network operated by BT and other electronic communications providers.
QoS (Quality of Service) standards	The level of performance standards that we have set Openreach to meet.
RAP (Regulatory Accounting Principles)	A set of guiding principles with which BT's Regulatory Financial Reporting must comply in order to preserve the integrity and consistency of BT's RFS.
RAB (Regulatory Asset Base	A RAB approach involves the assets used to provide all of the operator's services being entered into a common pool known as the regulatory asset base (or RAB) which is recovered across charges on all of the firm's services in a particular area. This differs from an approach where the costs of providing a particular service are recovered only from the charges on that service.
RAV (Regulatory Asset Value)	The value ascribed by Ofcom to an asset or capital employed in the relevant licensed business.

RBS (Radio Base Station) backhaul circuit	A TI circuit provided by BT that connects a mobile network operator's base station to the operator's mobile switching centre which is made up of leased line access and leased line backhaul segments.
RFR	Risk-free Rate.
RFS (Regulatory Financial Statements)	The financial statements that we require BT to prepare. They include the published RFS and AFIs provided to Ofcom in confidence.
RO (Reference Offer)	A document published by a telecoms provider setting out matters such as technical information, the terms and conditions for provisioning, SLAs and SLGs, and availability of other related services such as accommodation.
ROCE (Return on Capital Employed)	The ratio of accounting profit to capital employed.
RWT (Right When Tested)	When a line tests as 'OK' when tested remotely or tested by an onsite engineer visit.
SAC (Stand Alone Cost)	An accounting approach under which the total cost incurred in providing a product is allocated to that product.
SDH (Synchronous Digital Hierarchy)	A TI digital transmission standard that is widely used in communications networks and for leased lines. Although SDH systems are still widely used, they are being replaced increasingly by Ethernet services.
SDSL (Symmetric Digital Subscriber Line)	A DSL variant that allows broadband signals to be transmitted at the same rate from end-user to exchange (downstream) as from exchange to end-user (upstream).
SFP (Small Form-factor Pluggable)	The small form-factor pluggable is a compact, optical module transceiver (laser) used in network equipment for data transmission over a fibre connection.
SLA (Service Level Agreement)	A contractual commitment provided by Openreach to telecoms providers about service standards.
SLG (Service Level Guarantee)	A contractual commitment by Openreach to telecoms providers specifying the amount of compensation payable by Openreach to a telecoms provider for a failure to adhere to an SLA.
SME	Small and medium-sized enterprise
SMP (Significant Market Power)	Significant Market Power is equivalent to the concept of dominance as defined in competition law and is used to identify those telecoms providers which could act, to an appreciable extent, independently of the market in order to determine if additional obligations should be imposed on them to address this.
SOGEA	Single Order Generic Ethernet Access over FTTC is a standalone product variant that allows customers to buy a superfast broadband line without the need to buy the copper bearer separately.

SOG.fast	Single Order G.fast is a standalone product variant that allows customers to buy a broadband line without the need to buy the copper bearer separately.
SOR (Statement of Requirements)	A BT process for submission and processing of requests for product/service enhancements.
SPM (Sales Product Management)	A network cost component.
SSNIP (Small but Significant Non-transitory Increase in Price) Test	An element of the hypothetical monopolist test used in market definition analysis, in which the competitive constraints posed by potential substitutes for the service in question are tested by considering switching to the substitutes if the price of the service was increased by a small but significant non-transitory amount (often 5 to 10 per cent).
Sub-basket	A sub-basket refers to a control on a group of two or more charges.
Sub-cap	A sub-cap refers to a control on a single charge.
Supplementary depreciation	The additional depreciation charge to convert a HCA depreciation charge into a CCA depreciation charge.
TCO (Total Cost of Ownership)	The total price of a service, including all incurred charges, over a specified period.
TDM (Time Division Multiplexing)	A method of combining multiple data streams for transmission over a shared channel by means of time-sharing. The multiplexor shares the channel by repeatedly allowing each data stream in turn to transmit data for a short period. PDH and SDH are examples of systems that employ TDM.
Telecoms provider	An organisation which provides an electronic communications network or provides an electronic communications service.
The Act	The Communications Act 2003.
TMR (Total Market Return)	TMR includes interest, capital gains, dividends and distributions derived from an investment over a given period of time, as opposed to just capital gains.
TRC (Time-Related Charge)	A charge raised by Openreach to recover costs incurred when Openreach engineers perform work not covered under the terms of the Openreach standard service.
Tribunal	The Competition Appeal Tribunal.
TTP (Time To Provide)	How long it takes Openreach to deliver an Ethernet circuit following acceptance of a customer's order.
Ultrafast broadband	Broadband services capable of delivering a minimum of 300Mbit/s services.

UKRN	UK Regulators Network.
USO (Universal service obligation)	In 2018, the Government introduced legislation for a broadband USO, to give homes and businesses the right to request a decent and affordable broadband connection.
VHB (Very High Bandwidth)	Bandwidths above 1Gbit/s.
VOA (Valuation Office Agency)	An executive agency of HM Revenue & Customs (HMRC). Among other functions, it compiles and maintains the business rating and council tax valuation list for England and Wales.
VPN (Virtual Private Network)	A technology allowing users to make inter-site connections over a public telecommunications network that is software partitioned to emulate the service offered by a physically distinct private network.
VULA (Virtual Unbundled Local Access)	A regulatory obligation requiring BT to provide access to its FTTC and FTTP network deployments which allows telecoms providers to connect at a local aggregation point and are provided a virtual connection from this point to the customer premises.
WACC (Weighted Average Cost of Capital)	The rate that a company is expected to pay on average to all its security holders, both debt and equity, to finance its assets.
WAN (Wide Area Network)	A geographically dispersed telecommunications network, typically a corporate network linking multiple sites at different locations.
WBA (Wholesale Broadband Access) market	The WBA market concerns the wholesale broadband products that telecoms providers provide for themselves and sell to each other.
WES (Wholesale Extension Service)	A legacy Openreach Ethernet service that can be used to link customer site to a node in a communications network, superseded by Openreach's EAD product.
WEES (Wholesale end-to-end service)	A legacy Openreach Ethernet service that can be used to provide a point-to-point connection between two customer's sites, superseded by Openreach's EAD product.
WDM (Wavelength Division Multiplex)	An optical frequency division multiplexing transmission technology that enables multiple high capacity circuits, to share an optical fibre pair by modulating each on a different optical wavelength.
WiFi	A short range wireless access technology that allows devices to connect to the internet. These technologies allow an over-the-air connection between a wireless client and a base station or between two wireless clients.
WLR (Wholesale line rental)	The service offered by Openreach to other telecoms providers to enable them to offer retail line rental services.

A26. Cartesian report

A26.1 This annex has been published separately on the Ofcom website.