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for everyone

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

Annexes 1-23 of 24

Non-confidential version – redacted for publication [✂]

CONSULTATION:

Publication date: 8 January 2020 [Updated 28 February 2020]
Closing date for responses: 1 April 2020

Contents

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A1. Responding to this consultation

How to respond

A1.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 1 April 2020.

A1.2 You can download a response form from https://www.ofcom.org.uk/consultations-and-statements/category-1/2021-26-wholesale-fixed-telecoms-market-review. You can return this by email or post to the address provided in the response form.

A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to wftmr@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet. This email address is for this consultation only and will not be valid after 1 April 2020.

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:

Competition Group
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 We welcome responses in formats other than print, for example an audio recording or a British Sign Language video. To respond in BSL:

- Send us a recording of you signing your response. This should be no longer than 5 minutes. Suitable file formats are DVDs, wmv or QuickTime files. Or
- Upload a video of you signing your response directly to YouTube (or another hosting site) and send us the link.

A1.6 We will publish a transcript of any audio or video responses we receive (unless your response is confidential)

A1.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt if your response is submitted via the online web form, but not otherwise.

A1.8 You do not have to answer all the questions in the consultation if you do not have a view; a short response on just one point is fine. We also welcome joint responses.

A1.9 It would be helpful if your response could include direct answers to the questions asked in the consultation document. The questions are listed at Annex 4. It would also help if you could explain why you hold your views, and what you think the effect of Ofcom's proposals would be.

A1.10 If you want to discuss the issues and questions raised in this consultation, please contact Keith Hatfield by email at keith.hatfield@ofcom.org.uk.

Confidentiality

A1.11 Consultations are more effective if we publish the responses before the consultation period closes. In particular, this can help people and organisations with limited resources or familiarity with the issues to respond in a more informed way. So, in the interests of transparency and good regulatory practice, and because we believe it is important that everyone who is interested in an issue can see other respondents' views, we usually publish all responses on the Ofcom website as soon as we receive them.

A1.12 If you think your response should be kept confidential, please specify which part(s) this applies to, and explain why. Please send any confidential sections as a separate annex. If you want your name, address, other contact details or job title to remain confidential, please provide them only in the cover sheet, so that we don't have to edit your response.

A1.13 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.14 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

A1.15 Following this consultation, Ofcom plans to set out full details of our regulatory decisions in the wholesale fixed telecoms market in Q4 2020/21.

A1.16 If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

A1.17 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 2.

A1.18 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.

A1.19 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

Corporation Secretary
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
Email: corporationsecretary@ofcom.org.uk

A2. Ofcom's consultation principles

Ofcom has seven principles that it follows for every public written consultation:

Before the consultation

A2.1 Wherever possible, we will hold informal talks with people and organisations before announcing a big consultation, to find out whether we are thinking along the right lines. If we do not have enough time to do this, we will hold an open meeting to explain our proposals, shortly after announcing the consultation.

During the consultation

A2.2 We will be clear about whom we are consulting, why, on what questions and for how long.

A2.3 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible for people to give us a written response. If the consultation is complicated, we may provide a short Plain English / Cymraeg Clir guide, to help smaller organisations or individuals who would not otherwise be able to spare the time to share their views.

A2.4 We will consult for up to ten weeks, depending on the potential impact of our proposals.

A2.5 A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.

A2.6 If we are not able to follow any of these seven principles, we will explain why.

After the consultation

A2.7 We think it is important that everyone who is interested in an issue can see other people's views, so we usually publish all the responses on our website as soon as we receive them. After the consultation we will make our decisions and publish a statement explaining what we are going to do, and why, showing how respondents' views helped to shape these decisions.

A3. Consultation coversheet

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing ☐

Name/contact details/job title ☐

Whole response ☐

Organisation ☐

Part of the response ☐

If there is no separate annex, which parts? _____

_____

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name Signed (if hard copy)

A4. Consultation questions

A4.1 For the purpose of transparency and clarity, this annex contains an extract of the consultation questions which can be found in each of the sections of Volumes 2-4 of this consultation.

Volume 2

Question 2.1: Do you agree with our description of retail markets? Please set out your reasons and supporting evidence for your response.

Question 3.1: Do you agree with our provisional conclusion on physical infrastructure product market definition? Please set out your reasons and supporting evidence for your response.

Question 4.1: Do you agree with our provisional conclusion on physical infrastructure geographic market definition? Please set out your reasons and supporting evidence for your response.

Question 4.2: Do you agree with our provisional conclusion on the application of the three criteria test to the physical infrastructure market? Please set out your reasons and supporting evidence for your response.

Question 5.1: Do you agree with our provisional finding on SMP and resultant competition concerns in the physical infrastructure market? Please set out your reasons and supporting evidence for your response.

Question 6.1: Do you agree with our provisional conclusions on product market definition for wholesale networks? Please set out your reasons and supporting evidence for your response.

Question 7.1: Do you agree with our provisional conclusions on geographic market definition for wholesale networks? Please set out your reasons and supporting evidence for your response.

Question 7.2: Do you agree with our provisional conclusion on the application of the three criteria test to the wholesale inter-exchange connectivity market? Please set out your reasons and supporting evidence for your response.

Question 8.1: Do you agree with our provisional SMP findings and resultant competition concerns for wholesale networks? Please set out your reasons and supporting evidence for your response.

Question 9.1: Do you agree with our proposal not to regulate WFAEL, ISDN2 and ISDN30 markets on the basis that they no longer fulfil the three criteria test set out in the EC Recommendation? Please set out your reasons and supporting evidence for your response.

Question 10.1: Do you agree with our proposal not to regulate WBA market on the basis that it no longer fulfils the three criteria test set out in the EC Recommendation? Please set out your reasons and supporting evidence for your response.

Volume 3

Question 1.1: Do you agree with our proposed approach to remedies? Please set out your reasons and supporting evidence for your response.

Question 2.1: Do you agree with our proposed approach to Copper retirement? Please set out your reasons and supporting evidence for your response.

Question 3.1: Do you agree with our proposed general remedies? Please set out your reasons and supporting evidence for your response.

Question 4.1: Do you agree with our proposed specific PIA remedies? Please set out your reasons and supporting evidence for your response.

Question 5.1: Do you agree with our proposed specific remedies in the WLA, LL Access and IEC markets? Please set out your reasons and supporting evidence for your response.

Question 6.1: Do you agree with our proposed dark fibre access and dark fibre inter-exchange remedies? Please set out your reasons and supporting evidence for your response.

Question 7.1: Do you agree with our proposed approach to QoS? Please set out your reasons and supporting evidence for your response.

Volume 4

Question 1.1: Do you agree with our proposals for charge controlling WLA and LL access services in Area 2? Please set out your reasons and supporting evidence for your response.

Question 2.1: Do you agree that a RAB based control will achieve our objective in Area 3? Please set out your reasons and supporting evidence for your response.

Question 2.2: Do you agree that is appropriate to impose a post-build RAB charge control in Area 3? Please set out your reasons and supporting evidence for your response.

Question 2.3: Do you have any comments on our proposed design and method for calculating the proposed post-build RAB charge controls? Please set out your reasons and supporting evidence for your response.

Question 2.4: Do you agree with our proposals to charge control LL access services and dark fibre in Area 3? Please set out your reasons and supporting evidence for your response.

Question 3.1: Do you agree with our proposals in relation to charge control design and implementation? Please set out your reasons and supporting evidence for your response.

Question 4.1: Do you agree with our proposals for charge controlling in the IEC markets? Please set out your reasons and supporting evidence for your response.

Question 5.1: Do you agree with our proposals relating to calculating PIA rental charges? Please set out your reasons and supporting evidence for your response.

Question 5.2: Do you agree with the above proposal to introduce the PIA simplified underground lead-in service and the associated timings? Please set out your reasons and supporting evidence for your response.

Question 6.1: Do you agree with our proposed approach to charge controls for ancillaries? Please provide evidence to support your views. Please set out your reasons and supporting evidence for your response.

Question 6.2: Do you agree with our proposals for fair and reasonable obligations for ancillaries not covered by a charge control? Please set out your reasons and supporting evidence for your response.

A5. Regulatory framework

A5.1 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 5.

A5.2 Market review regulation is technical and complex; and requires us to apply legislation and to take into account 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 proposals for these markets.

Market review concept

A5.3 A market review is a process by which, at regular intervals, we identify relevant markets appropriate to national circumstances 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.

A5.4 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 Communications Act 2003 (the Act).[1] We exercise those functions within the framework harmonised across the European Union for the regulation of electronic communications by the Member States (known as the Common Regulatory Framework or CRF), as transposed by the Act. The currently applicable rules are contained in a package of five European Directives, of which two Directives are particularly relevant for present purposes, namely:

- Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services (the Framework Directive); and
- Directive 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities (the Access Directive).[2]

A5.5 The Directives require that National Regulatory Authorities (NRAs) such as Ofcom carry out reviews of competition in communications markets to ensure that SMP regulation remains appropriate and proportionate in the light of changing market conditions.

A5.6 Each market review normally involves three analytical stages, which are normally carried out together, namely:

- 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

[1] http://www.legislation.gov.uk/ukpga/2003/21/contents

[2] The Directives were subsequently amended on 19 December 2009. The amendments have been transposed into the national legislation and applied with effect from 26 May 2011 and any references in this document to the Act should be read accordingly.

- the assessment of appropriate regulatory obligations (the remedies stage).

A5.7 The European Electronic Communications Code (the EECC), established by Directive EU 2018/1972, entered into force on 20 December 2018. The EECC amends and replaces the current CRF, including the Framework Directive and the Access Directive. It maintains the requirements on NRAs to review markets on a periodic basis, although there are changes to some of the detail of the obligations. Member States have until 21 December 2020 to transpose the EECC into national law. The UK Government consulted in July 2019 on its proposed approach to implementing the EECC into national law.[3] Its consultation included proposals on the key legislative changes that will be required to implement the EECC in the UK. The deadline for transposition is 21 December 2020. There remains some uncertainty over the UK's future relationship with the European Union. Ofcom takes no view on the means or merits of Brexit. However, the requirement to transpose EU Directives may still apply to the UK by the time the deadline for transposing the EECC is reached. We therefore anticipate that the Act may be amended to reflect these provisions before we reach our final decisions on the matters set out in this consultation (our final statement is currently planned for early 2021).

Market definition

Relevant markets

A5.8 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" and analyse those markets.

A5.9 The Framework Directive requires that NRAs shall, taking the utmost account of the 2014 Recommendation on Relevant Markets (2014 EC Recommendation)[5] and EC SMP Guidelines[6] published by the European Commission (EC), define the relevant markets appropriate to national circumstances, in particular relevant geographic markets within their territory, in accordance with the principles of competition law.

A5.10 The 2014 EC Recommendation identifies a set of product and service markets within the electronic communications sector in which *ex ante* regulation may be warranted. Its purpose is twofold. First, it seeks to achieve harmonisation across the single market by ensuring that the same markets will be subject to a market analysis in all Member States. Second, the 2014 EC Recommendation seeks to provide legal certainty by making market players aware in advance of the markets to be analysed.

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[3] Department for Digital, Culture, Media and Sport, Implementing the European Electronic Communications Code, 16 July 2019: https://www.gov.uk/government/consultations/implementing-the-european-electronic-communications-code

[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] Commission Recommendation of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to *ex ante* regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services (2014/710/EU).

[6] 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).

A5.11 However, NRAs are able to regulate markets that differ from those identified in the 2014 EC Recommendation where this is justified by national circumstances by demonstrating that three criteria referred to in the 2014 EC Recommendation (the three-criteria test) are satisfied and where the EC does not raise any objections.

A5.12 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, 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). [7]

A5.13 The fact that an NRA identifies the product and service markets listed in the 2014 EC Recommendation or identifies other 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 a means of assessing effective competition.

A5.14 The relationship between the market definitions identified in this review and those listed in the 2014 EC Recommendation is discussed in relevant parts of this document.

Forward look

A5.15 The EC SMP Guidelines make clear that 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. As market analysis has to be forward-looking, the EC SMP Guidelines state that NRAs should determine whether the market is prospectively competitive, and thus whether any lack of effective competition is durable, by taking into account expected or foreseeable market developments over the course of a reasonable period. [8] The EC SMP Guidelines clarify that NRAs enjoy discretionary powers which reflect the complexity of all the relevant factors that must be assessed (economic, factual and legal) when identifying the relevant market and assessing whether an undertaking has SMP.

Modified Greenfield

A5.16 The EC SMP Guidelines state that the starting point for the identification of wholesale markets susceptible for *ex ante* regulation should always be the analysis of corresponding retail market(s). NRAs should determine whether the underlying retail market(s) is (are) prospectively competitive in absence of wholesale regulation based on a finding of SMP, and therefore whether any lack of effective competition is durable. However, the analysis should take into account the effects of other types of (sector-specific) regulation, decisions or

[7] The three-criteria test and the SMP assessment may make use of similar indicators – see 2014 EC Recommendation, paragraph 11.

[8] EC SMP Guidelines, paragraphs 15-18. The EC SMP Guidelines provide that the actual period used should reflect the specific characteristics of the market and the expected timing for the next review of the relevant market by the NRA.

legislation applicable to the relevant retail and related wholesale market(s) during the relevant period. This is known as a Modified Greenfield approach. [9]

A5.17 If the underlying retail market(s) is (are) prospectively competitive under the Modified Greenfield approach, the NRA should conclude that regulation is no longer needed at wholesale level. If the underlying retail market(s) is (are) not prospectively competitive, then the corresponding wholesale markets susceptible to regulation should be assessed. Where wholesale markets are vertically linked, the most upstream market should be analysed first. The NRA should conduct a gradual analysis of the markets that are downstream from a regulated input, to determine whether they would be effectively competitive in the presence of regulation upstream, until it reaches the final retail market. A downstream market should only be subject to *ex ante* regulation if competition on that market still exhibits SMP despite the presence of *ex ante* regulation on the related wholesale upstream market. [10]

Product and geographic dimensions

A5.18 The EC SMP Guidelines also describe how competition law methodologies may be used by NRAs in their 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.

A5.19 The boundaries between markets are determined by identifying competitive constraints on the price setting behaviour of firms. The EC SMP Guidelines set out that there are two main constraints to consider [11]:

- to what extent it is possible for a customer to substitute other services for those in question in response to a relative 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 relative price increase (supply-side substitution).

A5.20 The hypothetical monopolist test is a tool used to identify close 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. [12] 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.

[9] EC SMP Guidelines, paragraphs 15-18.
[10] 2014 EC Recommendation, Recitals 7, 10 18 and 21.
[11] See paragraph 27 of the EC SMP Guidelines, which also notes that potential competition also acts as a third source of competitive constraint on an operator's behaviour but is taken into account in the SMP assessment.
[12] See paragraph 29 of the EC SMP Guidelines.

A5.21 The starting point for the application of hypothetical monopolist test can be referred to as the 'focal product', [13] and typically starts from the narrowest potential market definition. [14]

A5.22 Having considered demand-side substitution we then, where relevant, assess supply-side substitution possibilities to consider whether they provide any additional constraints on the pricing behaviour of the hypothetical monopolist which have not been captured by the demand-side analysis. 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.

A5.23 Therefore, in identifying potential supply-side substitutes, it is important that providers of these services have not already been taken into consideration. There might be suppliers who provide other services but who might also be materially present in the provision of demand-side substitutes to the service for which the hypothetical monopolist has raised its price. Such suppliers are not relevant to supply-side substitution since they supply services already identified as demand-side substitutes. However, the impact of expansion by such suppliers can be taken into account in the assessment of market power.

A5.24 In relation to defining the relevant geographic markets, the EC SMP Guidelines explain 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. [15]

A5.25 Ofcom's approach to market definition follows that used by the UK competition authorities, is consistent with the EC SMP Guidelines and in line with the approach adopted by the EC.

Relationship with ex post competition law

A5.26 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 the markets identified *ex ante* are based on an overall forward-looking assessment of the structure and the functioning of 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

[13] This reflects the terminology used by the OFT (OFT, Market definition, December 2004, OFT403, www.oft.gov.uk/shared_oft/business_leaflets/ca98_guidelines/oft403.pdf).
[14] 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'.
[15] See paragraph 48 of the EC SMP Guidelines.
[16] http://www.legislation.gov.uk/ukpga/1998/41/contents

Chapter I or II prohibitions or Article 101 or 102 of the Treaty on the Functioning of the European Union) or the Enterprise Act 2002. [17]

Market analysis

Effective competition

A5.27 The Act requires that we carry out market analyses of identified markets for the purpose of making or reviewing market power determinations. Such analyses are normally to be carried out within two years from the adoption of a revised recommendation on markets, where that recommendation identifies a market not previously notified to the EC, or within three years from the publication of a previous market power determination relating to that market. Exceptionally, the three-year period may be extended for up to three additional years where the NRA notifies the EC, and it does not object.

A5.28 The EECC amends these time periods such that market power analyses should be carried out within three years from the adoption of a revised recommendation on markets, for markets not previously notified to the EC, or within five years from the adoption of a previous market power determination. Exceptionally, the five-year period may be extended for up to one additional year, where the NRA notifies the EC, and it does not object. [18]

A5.29 In carrying out a market analysis, the key issue for an NRA is to determine whether the market in question is effectively competitive. Recital 27 to the Framework Directive clarifies the meaning of that concept:

"It is essential that *ex ante* regulatory obligations should only be imposed where there is not effective competition, i.e. in markets where there are one or more undertakings with significant market power, and where national and Community competition law remedies are not sufficient to address the problem".

A5.30 The definition of SMP is equivalent to the concept of dominance as defined in competition law. 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. The Framework Directive requires that NRAs must carry out their market analysis taking utmost account of the EC SMP Guidelines, which emphasise that NRAs should undertake a thorough and overall analysis of the economic characteristics of the relevant market before coming to a conclusion as to the existence of SMP.

A5.31 In line with the EC SMP Guidelines we consider that market shares provide a useful first indication of competitive conditions in the market, and that they should however be interpreted in light of the relevant market conditions. [19]

[17] Enterprise Act 2002, Chapter 40
[18] Article 67(5), EECC
[19] EC SMP Guidelines, paragraph 54.

A5.32 In that regard, the EC SMP Guidelines set out, additionally to market shares, criteria that can be used by NRAs to measure the power of an undertaking to behave to an appreciable extent independently of its competitors, customers, and consumers, including:

- barriers to entry;
- barriers to expansion;
- 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. [20]

A5.33 A dominant position can derive from a combination of these criteria which when taken separately may not necessarily be determinative. However, according to established case law, a market share in excess of 50% is itself evidence of a dominant position, save in exceptional circumstances. [21]

Sufficiency of competition law

A5.34 As part of our overall forward-looking analysis, we also assess whether competition law by itself (without *ex ante* regulation) is sufficient, within the relevant markets we have defined, to address the competition problems we have identified. We consider this matter in our assessment of the appropriate remedies which, as explained below, are based on the nature of the specific competition problems we identify within the relevant markets as defined. We also note that the EC SMP Guidelines clarify that, if NRAs designate undertakings as having SMP, they must impose on them one or more regulatory obligations.

A5.35 In considering this matter, 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

[20] EC SMP Guidelines, paragraph 58.
[21] EC SMP Guidelines, paragraph 55.

possible to reduce such regulation over time as markets become more competitive, allowing greater reliance on *ex post* competition law.

A5.36 *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.

A5.37 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 may 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.

Remedies

Powers and legal tests

A5.38 The Framework Directive prescribes what regulatory action NRAs must take depending upon whether or not an identified relevant market has been found effectively competitive. Where a market has been found effectively competitive, NRAs are not allowed to impose SMP obligations and must withdraw such obligations where they already exist. On the other hand, where the market is found not effectively competitive, the NRAs must identify the undertakings with SMP in that market and then impose appropriate obligations.

A5.39 NRAs have a suite of regulatory tools at their disposal, as reflected in the Act and the Access Directive. Specifically, the Access Directive 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. When imposing a specific obligation, the NRA will need to demonstrate that the obligation in question is based on the nature of the problem identified, proportionate and justified in the light of the policy objectives as set out in Article 8 of the Framework Directive. [22]

A5.40 Specifically, for each and every SMP obligation, we will explain why it satisfies the requirement in section 47(2) of the Act that the obligation is:

- objectively justifiable in relation to the networks, services, facilities, apparatus or directories to which it relates;
- not such so as to discriminate unduly against particular persons or against a particular description of persons;
- proportionate to what the condition or modification is intended to achieve; and

[22] Article 8(4), Access Directive. The equivalent requirement in Article 68 of the EECC is that the obligation imposed is based on the nature of the problem identified, where appropriate taking into account the identification of transnational demand; proportionate, having regard, where possible, to the costs and benefits; justified in light of the objectives set out in Article 3 of the EECC; and imposed following consultation in accordance with Articles 23 and 32 of the EECC.

- transparent in relation to what is intended to be achieved.

A5.41 Additional legal requirements may also need to be satisfied depending on the SMP obligation in question. For example, NRAs are subject to additional requirements when imposing price controls and cost recovery obligations. [23]

A5.42 Specifically, we will explain why any such SMP obligation satisfies the requirements of section 88 of the Act. Namely:

- 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;
- we consider the setting of the obligation is appropriate for the purposes of promoting efficiency, promoting sustainable competition and conferring the greatest possible benefits on the end-users of public electronic communications services; and
- we have taken account of the extent of investment by the telecoms provider in the matters to which the SMP obligation relates.

A5.43 Where an obligation to provide third parties with network access is considered appropriate, NRAs must take into account factors including the feasibility of the network access, the technical and economic viability of creating networks that would make the network access unnecessary, the investment of the network operator who is required to provide access (taking account of any public investment made), and the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long term. [24]

A5.44 We demonstrate the application of these requirements to our proposed SMP obligations, to the extent relevant, in this consultation document. 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 proposed regulatory intervention, and that it is in accordance with the six European Community 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

A5.45 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.

[23] Article 13, Access Directive. The equivalent provisions in Article 74 of the EECC are broadly similar. However, in determining whether price controls would be appropriate, NRAs are required to take into account the need to promote competition and long-term end-user interests related to the deployment and take-up of next- generation networks, and in particular of very high capacity networks. When NRAs consider it appropriate to impose price controls on access to existing network elements, they are also required to take account of the benefits of predictable and stable wholesale prices in ensuring efficient market entry and sufficient incentives for all undertakings to deploy new and enhanced networks. In addition, any mandated cost recovery mechanism or pricing methodology must promote the deployment of new and enhanced networks (in addition to the existing requirements to promote efficiency and sustainable competition and maximise end-user benefits).

[24] Section 87 of the Act; Article 12, Access Directive. The equivalent provisions are in Article 73 of the EECC.

A5.46 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.

A5.47 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; and
- the desirability of encouraging the availability and use of high-speed data transfer services throughout the UK.

A5.48 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.

A5.49 However, Ofcom has a wide measure of discretion in balancing its 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.

European Community requirements for regulation – sections 4 and 4A of the Act, Article 3 of the BEREC Regulation and Article 3 of the EECC

A5.50 As noted above, our functions exercised in this review fall under the CRF. As such, section 4 of the Act requires us to act in accordance with the six Community requirements for regulation, which are derived from Article 8 of the Framework Directive.[25] In summary, these six requirements are:

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

b) to contribute to the development of the European internal market;

c) to promote the interests of all persons who are citizens of the EU;

d) 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);

e) to encourage, to such extent as Ofcom considers appropriate for certain prescribed purposes: the provision of network access and service interoperability; securing efficient and sustainable competition; efficient investment and innovation; and the maximum benefit for customers of telecoms providers; and

[25] The UK is due to leave the European Union on 31 January 2020. A consequence of this is that some of our functions under the Act, including certain functions relevant to this review, will be amended. We consider that the proposals set out in this consultation would continue to fall within the scope of our powers and meet our duties post-Brexit.

f) to encourage compliance with certain standards in order to facilitate service interoperability and secure freedom of choice for the customers of telecoms providers.

A5.51 We consider that the first, third, fourth, and fifth 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.

A5.52 Article 3 of the EECC amends and replaces Article 8 of the Framework Directive. NRAs' general obligations in Article 3 of the EECC mirror to a large extent the Community requirements currently in section 4 the Act. However, Article 3 of the EECC introduces a new objective for NRAs to promote connectivity, access to, and take-up of, very high capacity networks, including fixed, mobile and wireless networks, by all citizens and businesses of the Union ("the connectivity objective"). The objective to promote competition also includes an explicit reference to promoting efficient infrastructure-based competition. Another change from the current framework is that Article 3 of the EECC specifies that the promotion of citizens' interests includes ensuring connectivity and the widespread availability and take-up of very high capacity networks. Recital 24 of the EECC explains that work towards securing the connectivity objective should be assessed by, amongst other things, the availability to all households of networks which are capable of providing connection speeds of at least 100 Mbps, and which are promptly upgradeable to gigabit speeds.

A5.53 Section 4A of the Act requires Ofcom, in carrying out certain of its functions (including, among others, Ofcom's functions in relation to market reviews under the CRF), to take due account of applicable recommendations issued by the EC under Article 19(1) of the Framework Directive. Where we decide not to follow such a recommendation, we must notify the EC of that decision and the reasons for it.

A5.54 Further, Article 3(3) of the Regulation establishing BEREC [26] requires NRAs to take utmost account of any opinion, recommendation, guidelines, advice or regulatory best practice adopted by BEREC.

Impact assessment – section 7 of the Act

A5.55 The analysis presented in this document represents an impact assessment, as defined in section 7 of the Act.

A5.56 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 Ofcom has 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 Ofcom's activities. However, as a matter of policy,

[26] Regulation (EC) No 1211/2009 of the European Parliament and of the Council of 25 November 2009 establishing the Body of European Regulators of Electronic Communications (BEREC) and the Office (the BEREC Regulation) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0001:0010:EN:PDF [accessed 20 June 2019].

Ofcom is committed to carrying out and publishing impact assessments in relation to the majority of its policy decisions. [27]

A5.57 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.

A5.58 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects, and practices on equality. [28] This assessment is set out in Annex 10.

Regulated entity

A5.59 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").

A5.60 The Framework Directive requires that, where an NRA determines that a relevant market is not effectively competitive, it shall identify "undertakings" with SMP in that market and impose appropriate specific regulatory obligations. For the purposes of EU competition law, "undertaking" includes companies within the same corporate group (for example, where a company within that group is not independent in its decision making). [29]

A5.61 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.

A5.62 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".

[27] For further information about Ofcom's approach to impact assessments, see the guidelines, Better Policy Making: Ofcom's approach to Impact Assessment.
[28] 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.
[29] *Viho v Commission*, Case C-73/95 P [1996] ECR I-5447, Judgment of the court.

A6. Overview of telecoms networks

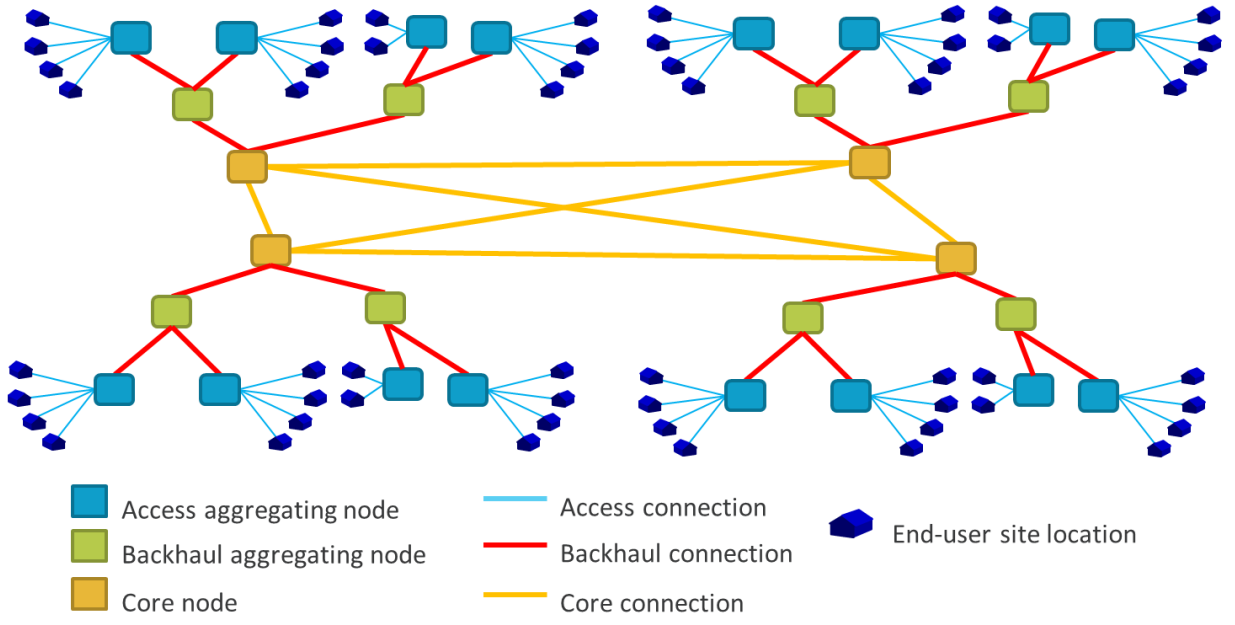
General overview

A6.1 A communications network provides the services that enable end-users to exchange information. A network is comprised of a number of elements:

- Access connections;
- Backhaul and core connections; and
- Network nodes which house equipment.

A6.2 Figure A6.1 sets out a high-level view of how networks are structured.

Figure A6.1: Illustration of logical arrangement of a communications network



Source: Ofcom.

A6.3 Each end-user site is connected to one of the network's access aggregating nodes.[30] 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[31] using a backhaul connection.[32]

[30] Access aggregating nodes aggregate the traffic from access connections and may also be referred to as access nodes. The access connection may be transmitted over radio, fibre, or copper. They may also be known as an access aggregation node, or simply, an access node.
[31] Backhaul aggregating nodes may also be referred to as backhaul, aggregating, or metro nodes. A backhaul aggregating node multiplexes the backhaul connections (or data traffic flows) onto a common bearer in a way that maintains the individual identity of each aggregated backhaul connection.
[32] Access or aggregating (backhaul) nodes may be connected to two or more core nodes to create a resilient network by providing alternative routing in the event of failure of a core node or backhaul connection.

Core nodes are typically connected to each other to form a core network.[33] In general, there are more access nodes than backhaul nodes and more backhaul nodes than core nodes.

A6.4 This structure is common to the 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 or more than one) and the structure of the core.

A6.5 Access aggregating 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 customer access connections to the network.

A6.6 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.

A6.7 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 typically located in a city of significant population within the geographic area covered by the network. Core nodes typically route (or switch) traffic from backhaul connections onto the core network, or between backhaul nodes or other core nodes.

A6.8 Most locations or sites housing core nodes also contain backhaul and access aggregating nodes, the latter for serving the area immediately surrounding the site.[34] 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.

A6.9 To enable communication between different networks[35], networks are interconnected between designated 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 or a data centre, or via a dedicated point-to-point connection between two network sites where the interconnection or handovers takes place.[36]

[33] Core nodes are used to route or switch traffic between other core nodes. They are sometimes further divided into a hierarchy of outer core edge nodes and inner core nodes. Most core nodes have duplicate connections between them to provide resilience in the event of a failure in the network equipment or connection.
[34] 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.
[35] For example, between two different business users, or between a business user and a serving computer such as a web server in a data centre, or simply between two network operators.
[36] Openreach provides products to connect between nodes within a BT exchange (Internal Cablelink) and to connect to other networks nearby (External Cablelink).

Access networks

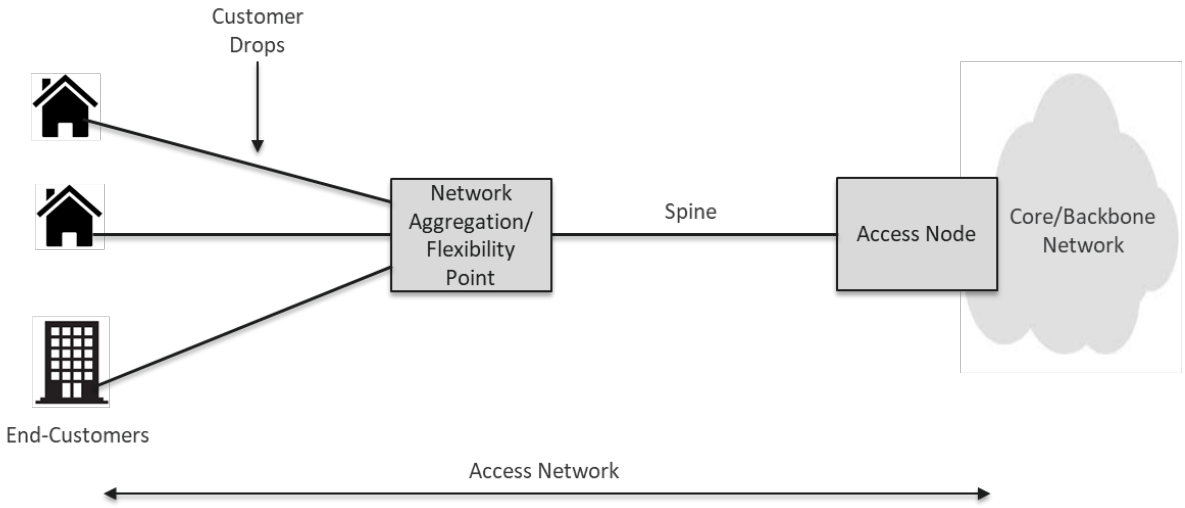
Access network overview

A6.10 Access networks provide the connection to the end customer. The connection to the customer from the access node may be realised all, or in part, using fixed connectivity (fibre, copper, coaxial cables) or using wireless connectivity.

A6.11 While there are a number of different types of access network, all share certain common attributes which make up the access connection between end user sites and an access aggregating node, such as customer drops, aggregation/flexibility points, spine links and access nodes.

A6.12 Figure A6.2 below illustrates how the constituent elements typically relate to one another.

Figure A6.2: Generic fixed access network



Source: Ofcom.

A6.13 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)) or mobile terminals, to the network.

A6.14 Aggregation nodes or flexibility points terminate a number of customer drops and either aggregate traffic or consolidate multiple transmission bearers into a smaller number for backhaul purposes. [37]

A6.15 Spine links are transmission bearers that carry aggregated customer traffic from an aggregation node or flexibility point to an access node. Access nodes host the technology-specific equipment that controls the access network.

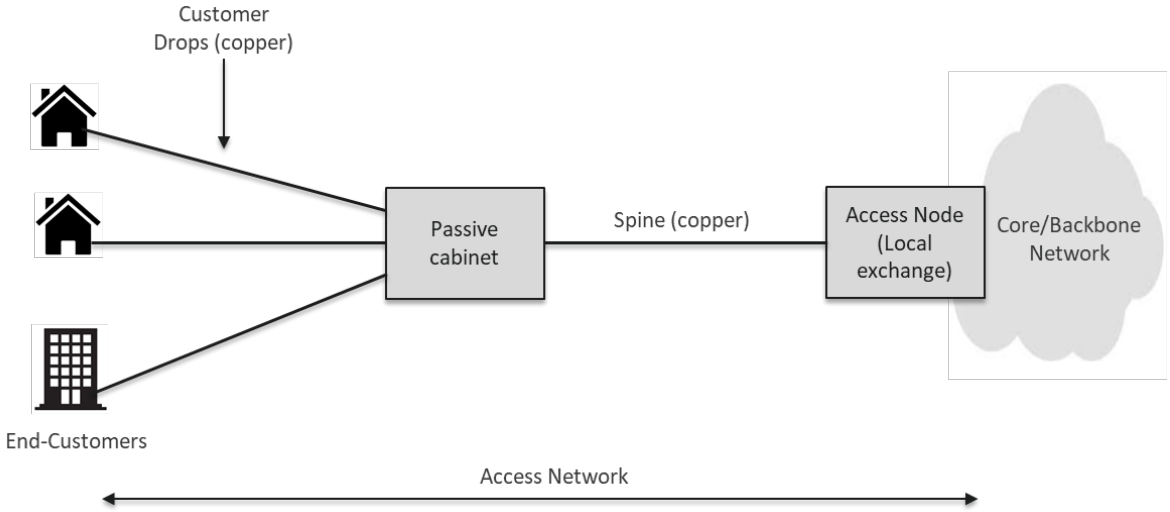
[37] In some access networks, the aggregation node can also perform some of the functions of the access node (e.g. DSL-based FTTC).

Fixed broadband and telephony for residential/SME customers

A6.16 Networks that supply broadband and telephony services to residential 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. The timescales and costs for connections should be broadly similar so that a standard connection can be offered. This means that these networks need to be deployed to have access points very close to prospective customers ahead of accepting offers from customers.

A6.17 Networks were initially deployed using copper connections to the customer premises as shown in Figure A6.3 below.

Figure A6.3: Copper access network

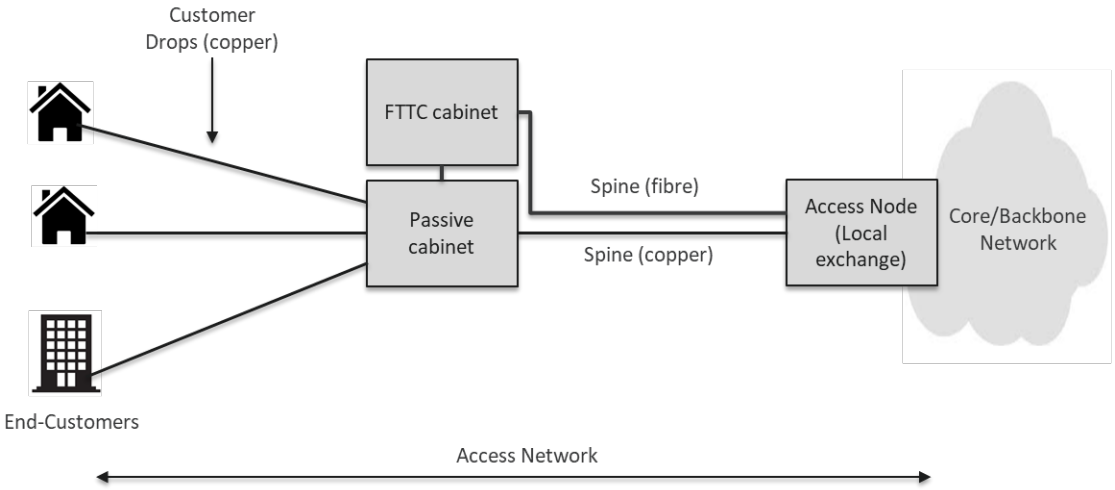


Source: Ofcom.

A6.18 Copper networks were initially deployed to provide telephony services. Broadband services were added by providing broadband equipment at the local exchange. The characteristics of this equipment and the copper line limited the speed available on the network, initially up to 8Mbit/s and, ultimately, to less than 30Mbit/s (with the highest speed theoretically being around 24Mbit/s but customers experiencing less than this, based on the length of the copper connection, quality of connection, etc.).

A6.19 This network could be upgraded to support higher speeds by deploying broadband equipment at the cabinet location, as shown in Figure A6.4.

Figure A6.4: Fibre to the Cabinet access network



Source: Ofcom.

A6.20 This network can provide broadband services with speeds up to 80Mbit/s downstream, depending on the length of the remaining copper line from the customer to the cabinet.

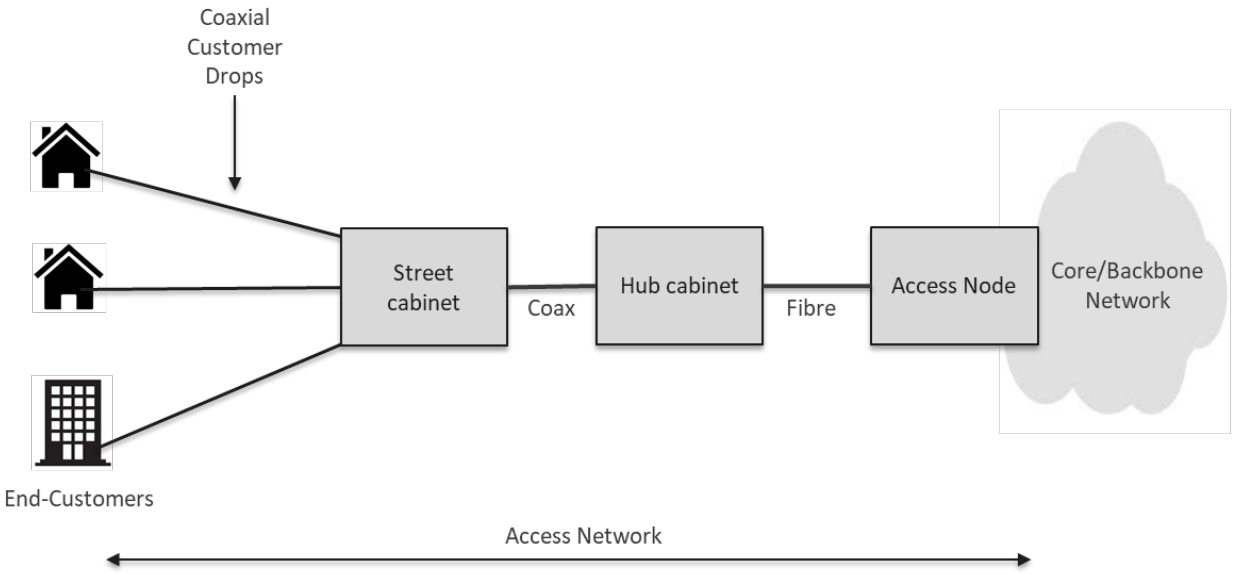
A6.21 To achieve speeds above this, the potential technologies include:

- G.fast;
- Coaxial cable; and/or
- Fibre To The Premises (FTTP).

A6.22 G.fast is a technology that relies on the existing copper connection to the end customer. The G.fast equipment can be placed close to the customer (for example near the final distribution point) to attain very high speeds. Openreach has deployed G.fast equipment at selected cabinets and offers services at up to 330Mbit/s.

A6.23 Virgin Media operates a cable network. This utilises coaxial cable in some parts of the access network as shown in Figure A6.5.

Figure A6.5: Cable access network



Source: Ofcom.

A6.24 The cable network was originally deployed to provide TV services. However, broadband is supported with the addition of broadband equipment supporting Data Over Cable Service Interface Specification (DOCSIS). DOCSIS equipment is located at the access node.

A6.25 The speed supported over the connection depends on the version of DOCSIS being used. The cable network is in the process of being upgraded to DOCSIS3.1. This will support speeds up to 1Gbit/s. Before this is complete, areas that have not yet been upgraded will still have ultrafast services available. [38]

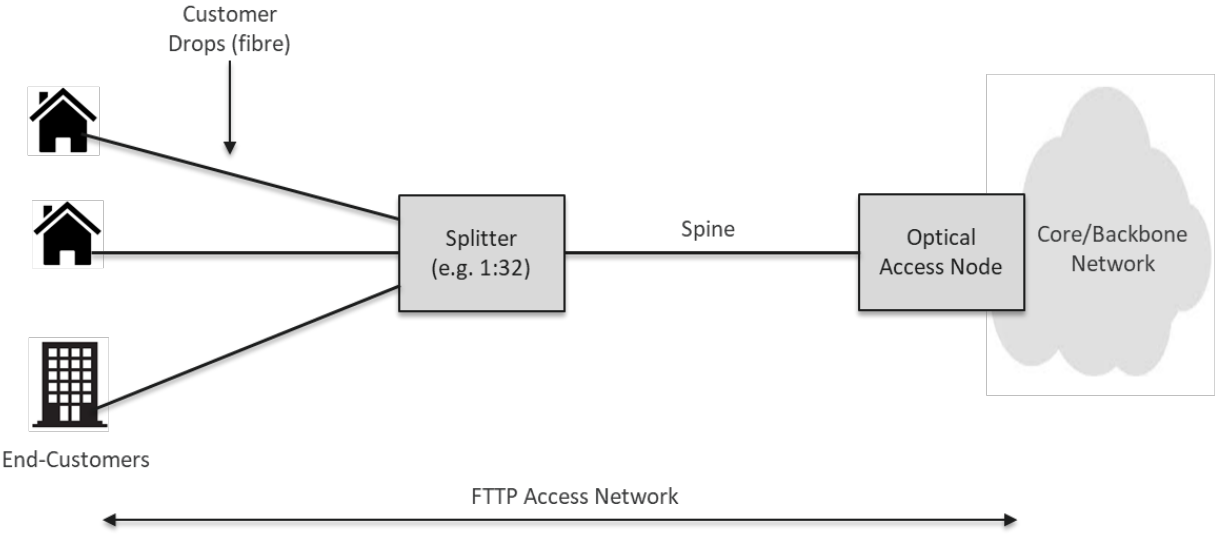
A6.26 FTTP networks can be provided in two main ways:

- Gigabit Passive Optical Network (GPON); or
- Point to point fibres (PtP).

A6.27 A GPON is a shared fibre network, as shown in Figure A6.6.

[38] Customers taking the highest specification of package include TV and telephony services can get a 516Mbit/s service, broadband customers can get services with speeds up to an average of 362Mbit/s.

Figure A6.6: Fibre to the Premises access network



Source: Ofcom.

A6.28 In the GPON, each customer has a dedicated fibre connecting it to a splitter. Between the splitter and the optical access node, the traffic of a number of customers (typically up to 32) are combined on a single fibre, so that the GPON's capacity is shared between multiple users. Initial GPON deployments typically have 2.5Gbit/s downstream and 1Gbit/s upstream, but with an expectation this can be upgraded fairly straightforwardly. Speeds of up to 10Gbit/s symmetric, and the use of wavelength division multiplexing (WDM) on the GPON are future developments to allow the GPON to continue to be used as demand grows.

A6.29 Whilst the GPON capacity is shared so that theoretically customers could experience congestion, telecoms providers deploying GPONs can generally offer customers up to 1Gbit/s symmetric services, on the basis that customers will not usually demand the full speed.

A6.30 The majority of FTTP deployments are GPONs.

A6.31 Alternatively, an FTTP network can be deployed as a PtP infrastructure. In this case, each customer has their own fibre all the way to the optical access node. This means customers do not suffer congestion due to other customer's demands in the access network, but means there needs to be much more equipment at the access node to terminate and light every fibre.

Leased Lines connectivity

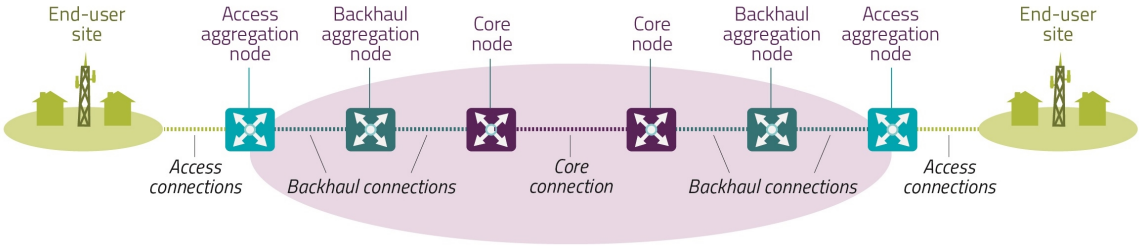
A6.32 When considering leased lines services, access, backhaul, and core connections have different functions and are illustrated in the Figure A6.7 below:

- access connections are typically between end-user sites and an access aggregation node or, in some cases, between customer sites; [39]

[39] Some networks have small access aggregation nodes between the end-user site and the access aggregation site (such as cabinets with FTTC DSLAMs or a mobile base station with a fixed connection which then uses microwave to connect to additional base stations) or as part of a 'daisy chain' (such as cabinets as part of a ring within the cable access network). We have treated these examples as a part of the access network and not inter-exchange backhaul connections.

- backhaul connections are between access and backhaul nodes, between backhaul nodes (not shown), and from a backhaul aggregation node to a core node;[40] and
- core connections are between core nodes.

Figure A6.7: Access, backhaul, and core connectivity

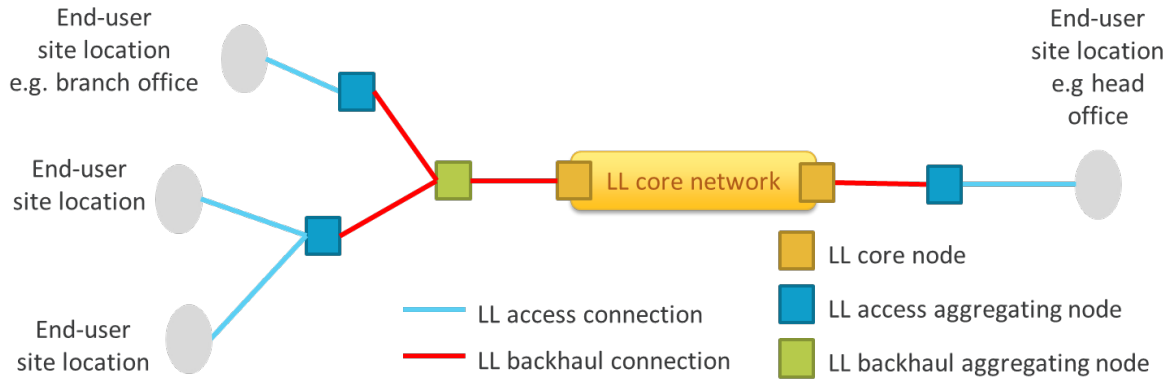


Source: Ofcom.

A6.33 Demand for access services comes from end-users, with a dedicated connection to each end-user site. These can also be referred to as terminating segments.[41]

A6.34 Traditionally, businesses have used leased lines to connect their sites, and sometimes to connect with other businesses, using dedicated connections. A typical end-to-end connectivity arrangement is illustrated in Figure A6.8.

Figure A6.8: Business end-to-end connectivity

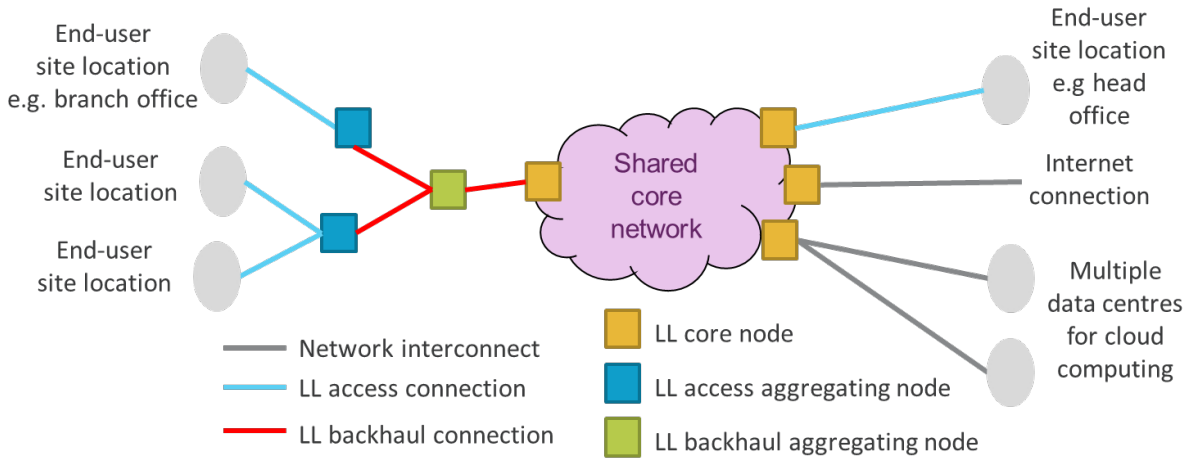


Source: Ofcom.

[40] Note that in our SMP Conditions we use the term "Backhaul Segment" which is defined as "connecting one operational building of the Dominant Provider to another operational building of the Dominant Provider" and which may include both backhaul and core connections as described in this section. We use this term in the course of defining the scope of our specific active remedies and reflecting our decisions (Section 13). See also Annex 26, Schedule 1, Part 2 and Part 3, Condition 2.
[41] Terminating and trunk segments are covered in more detail in Section 7 of Volume 2.

A6.35 This model is becoming less common as it is superseded by VPNs[42] which include connectivity to internet-based services and to outsourced cloud computing services.[43] This is illustrated in Figure A6.9.

Figure A6.9: Business access connectivity (VPN, internet & cloud computing)



Source: Ofcom.

A6.36 Demand for backhaul and core services comes from telecoms providers that need to carry aggregated traffic between BT exchanges, data centres and telecoms provider network nodes. These connections can also be referred to as trunk segments.

A6.37 Data centres are secure buildings that house computing facilities for cloud-based services such as data storage, application hosting, and data processing. Data centres typically house network nodes which can include core and backhaul aggregation and traffic routing functionality as well as being used for interconnection to other networks. They can have multiple tenants and may be owned and operated by telecoms providers or run by third-party providers, in the latter case they are known as 'carrier neutral data centres'.

A6.38 Most data centres require reliable high-capacity connections, often to a number of different telecoms providers, to support a large number of telecoms services and to support multiple end customers across multiple end user sites.

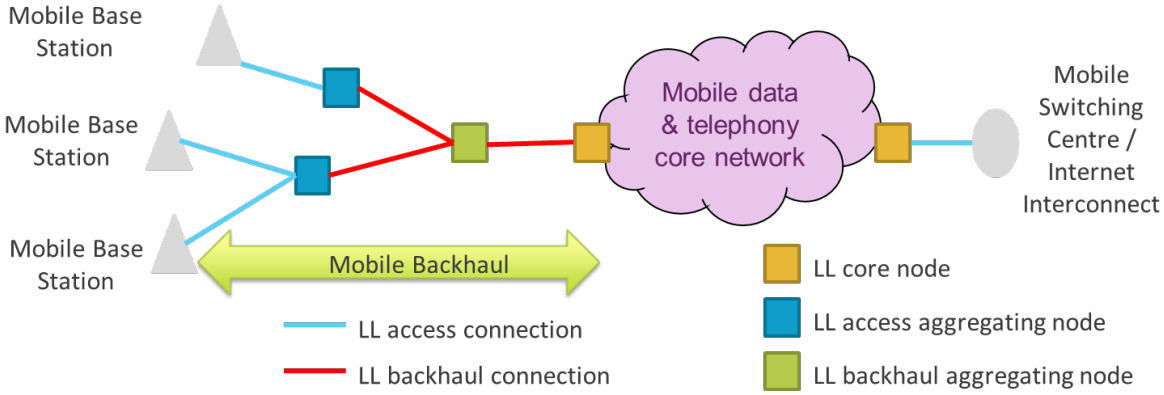
A6.39 Some data centres may be owned by a single customer, such as a large enterprise, providing services over a virtual private network at their own customer site rather than in a network operator's operational building.

A6.40 Leased lines may also be used by mobile network operators (MNOs) to connect their base stations[44], using access and backhaul connections, to their core network nodes. The term

[42] Virtual private networks (VPNs) are networks that provide any-to-any connection between multiple sites (not just point-to-point). They are private to the customer, unlike the internet which is public. They are provided using communications equipment that is shared between a number of business customers and normally located in a telecoms provider's or systems integrator's premises or a data centre.
[43] Cloud computing is computing capacity, distributed across a number of data centres, that is connected by either a business VPN or networks provided by the data centre operators.
[44] These are the radio masts that provide the communications between the mobile handset and the fixed mobile network.

'mobile backhaul' is often used to refer to the combination of access and backhaul connections between the mobile base station and the mobile core node. MNOs may also use leased lines to provide connectivity between their core sites to construct the networks used to support mobile services including access to the internet and other networks. This is illustrated in Figure A6.10.

Figure A6.10: Mobile network connectivity

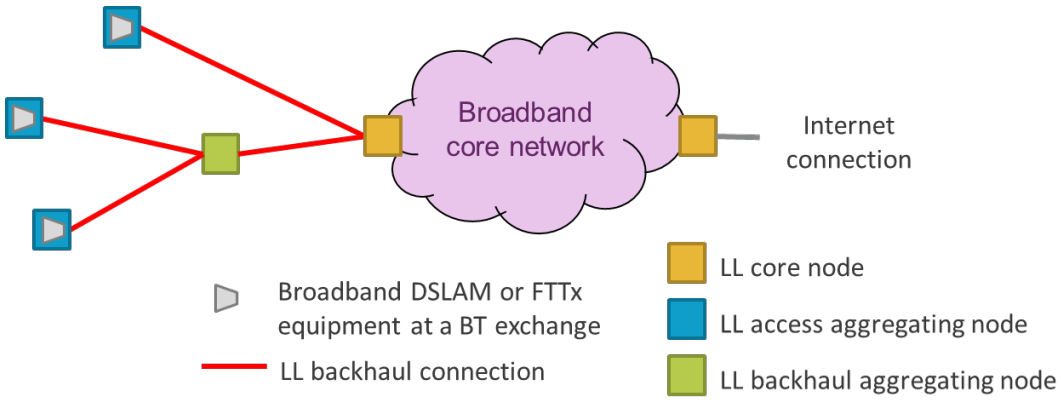


Source: Ofcom.

A6.41 Fixed broadband operators can build their own broadband networks using leased lines for backhaul and core connectivity, together with access connections owned and operated by BT. In this case, they will site their equipment to connect to BT's access network (i.e. their access aggregating node) at a BT local exchange. Alternatively, an operator may choose to build their own access connections (for example Virgin Media's network).

A6.42 Fixed broadband operators use leased lines to connect from their access nodes within BT local exchanges to their backhaul and core network nodes. These network connections are referred to as 'fixed broadband backhaul'. Fixed broadband operators will also connect to the internet at suitable locations to provide an end-to-end broadband service. This is illustrated in Figure A6.11.

Figure A6.11: Broadband network connectivity



Source: Ofcom.

Access, trunk and inter-exchange connectivity

A6.43 In Volume 2 we separate leased lines access and inter-exchange connectivity into separate markets. This is based on the difference between access (terminating) and trunk connectivity. In general terms, access connectivity connects to a customer location, whereas trunk connectivity connects between telecoms provider nodes and, importantly, aggregates traffic from multiple access connections or services.

A6.44 In some cases, an access circuit may include a segment that runs between telecoms provider nodes. For example, in Figure A6.8 above, we explain end to end business connectivity. The connection between the two end customer locations may be provided through aggregating nodes. But, where this is a single dedicated connection, we consider that the segments between these aggregating nodes should still be considered as part of the access service since these segments are required to provide the service.

A6.45 Where access circuits are provided at the wholesale level, these may run from a retail customer's end location to an aggregation node of the network operator where the telecoms provider purchasing the wholesale service has located its own equipment. This aggregation node may not be the node closest to the retail customer's end location and so the circuit may run through several aggregating nodes. Again, the segments connecting between aggregating nodes needed to provide the single connection form the retail customer's location to the wholesaler's equipment would constitute the access circuit.

A6.46 In terms of other leased lines, we consider mobile backhaul (i.e. connections where one end is the mobile cell site, as per Figure A6.10) has the characteristics of an access circuit. Broadband connectivity (see Figure A6.11), should be considered as a trunk circuit.

A6.47 Trunk circuits can then be characterised based on the specific nodes that are connected, as shown in Table A6.12 below.

Table A6.12: Clarification of alignment of trunk connectivity and inter-exchange connectivity market

Type of route	In the Inter-exchange connectivity services markets	Trunk segments
BT exchange to BT exchange	Yes	Yes
BT exchange to telecoms provider network node	No	Yes
BT exchange to data centre [45]	No	Yes
Telecoms provider network node to telecoms provider network node	No	Yes
Telecoms provider network node to data centre	No	Yes

[45] We note that this excludes data centres that are not used for aggregation and onward routing purposes. Those data centres sit in CI Access services.

Data centre to data centre	No	Yes

Source: Ofcom.

Wireless technologies

A6.48 The discussion above relates to networks that provide services at a fixed location using a wired (either copper, coaxial cable or fibre) connection all the way.

A6.49 Services can also be provided using wireless technology: satellite, mobile and fixed wireless access (FWA).

Satellite

A6.50 Satellite coverage is available almost everywhere in the UK, offering an alternative for customers that receive poor broadband, typically those in remote rural areas.

A6.51 Satellite broadband can be offered by either a GEO (geostationary) 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 distance from the Earth, being able to cover large areas. This results in large response times and slow speeds.

A6.52 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 coverage. In order to track and connect to the best satellite as they move overhead, user terminals require very expensive antennas.

A6.53 Satellite services tend to offer services with lower bandwidth than fixed broadband services. In addition, traditional GEO satellite services have higher latency than fixed broadband services. This could affect some users who have requirements for low latency, e.g. gamers or consumers wishing to make VoIP calls.

A6.54 Performance could be improved with the use of LEO (low earth orbit) satellites. Although not available yet, companies like SpaceX, OneWeb and Telesat plan to launch LEO constellations for commercial broadband as early as 2020. In theory, LEO satellites will offer low latency and higher speeds, ranging from 100Mbit/s to gigabits per second.

A6.55 Upfront charges for equipment could be even higher for LEO services, for which affordable user terminals have not been yet produced.

A6.56 Even if the new LEO satellites will be able to deliver increased performance compared to traditional satellite broadband, it is not yet clear whether the price packages will be attractive enough to win customers over from fibre.

Internet access over a mobile network

A6.57 Use of mobile data services is another 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.

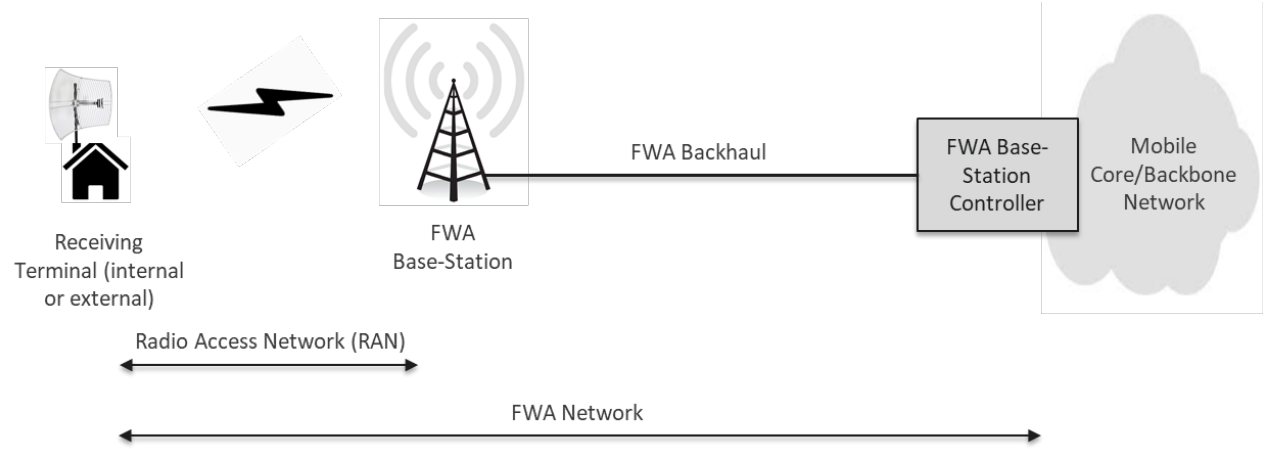
A6.58 Whilst very high speeds can be obtained, due to the shared nature of the network and the fact that speed will depend on the quality of signal being received, speeds are likely to be much lower in many cases. On a 4G network, these could typically be around 20Mbit/s on average. On a 5G network, the latest mobile technology that was introduced to the UK earlier in 2019, users may be able to receive higher average speeds of 150Mbit/s.

A6.59 Mobile coverage is another factor that needs to be considered. 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, it currently has very limited reach, with operators making it available in select areas of the biggest cities in the UK.

Fixed Wireless Access

A6.60 Fixed Wireless Access (FWA) networks use a wireless link for the final connection to an end user premise, avoiding the installation of a cable to the building. The link is between the mobile mast and a customer premise equipment placed in the customer's premise. Depending on the customer's location, an external antenna might need to be installed to achieve connection (Figure A6.13).

Figure A6.13: Typical Fixed Wireless Access network topology



Source: Ofcom.

A6.61 Fixed wireless access services can be grouped into two broad categories depending on the frequencies used:

- services using light-licensed and license-exempt spectrum in the 5GHz band;[46] and
- services using licensed 4G and 5G mobile bands.[47]

A6.62 The first category is mainly present in rural and suburban areas. Speeds vary, with basic packages offering speeds from 2Mbit/s, sometimes up to30 Mbit/s. Most packages have data caps, although more expensive packages offer higher or unlimited data. These FWA services usually come with substantial setup fees (typically around £100-200). As this service operates on licence-exempt and light-licensed frequencies, interference from nearby services operating

[46] There are no restrictions on the use of unlicensed spectrum which means that the quality of the connection cannot be guaranteed, due to interference from neighbouring services.
[47] Generally, licensed spectrum bands are allowed to be used only by organisation licensed by Ofcom.

on the same frequencies is common. This, along with capacity constraints and line-of-sight issues make it difficult to scale these services.

A6.63 The second type of FWA uses access to 4G and the newer 5G networks. This service shares many of the characteristics of mobile broadband, but is optimised for home usage by, for example, locating customer modems in optimal locations in customer premises. As discussed for mobile, depending on traffic and capacity in the network, speeds can vary and are around 20Mbit/s for 4G and 150Mbit/s for 5G for an average user experience.

A7. Network build and the use of PIA

A7.1 This annex sets out our assessment of the prospects of network build (including the potential use of PIA over the period of this market review (i.e. to 2026). We set out our assessment in the following order:

- Approaches to building networks to provide services at fixed locations;
- Types of fixed networks;
- Impact of PIA on cost and time of network build; and
- Evidence on planned build and use of PIA for WLA, LL Access and IEC markets.

A7.2 In summary, the evidence we have gathered suggests that:

- PIA has the potential to significantly reduce the cost and time of network build;
- there are high prospects of commercial build by rival network providers by 2026, facilitated by PIA; however, there are uncertainties around where and when it will be deployed;
- there are prospects of material network build, including that based on PIA, for WLA services in Area 2 and LL Access services in the CLA, HNR areas and Area 2; and
- there are limited prospects of potential build and use of PIA for the IEC services.

Approaches to building networks to provide services at fixed locations

A7.3 When a telecoms provider decides to build a network, it might build the network to provide:

- Only broadband services (a broadband only network);
- only leased lines (a leased lines only network); or
- both broadband and leased lines (a multi-service network (MSN)).

A7.4 There are three key differences between broadband only and leased lines only networks:

- Areas covered: broadband only networks are deployed in largely residential areas whereas leased lines only networks will be deployed in areas with a density of businesses, such as city centre business districts and business parks.
- Network access/flexibility points: broadband only networks are usually built with flexibility points very close to each potential customer's premises. This allows new customers to be connected to the network quickly at a relatively low cost. This 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). Leased lines only networks deploy flexibility points close to groups of potential customers (i.e. business locations). However, connections to new customer sites are generally provided on a case by case basis. The costs and timescales can be significant and vary by site.
- Capacity for expansion: in a broadband only network, as there is a flexibility point close to every customer and each customer only requires a single connection, the capacity of the network in terms of fibre (or space to provide fibre on demand) is relatively stable over time. In a leased lines only network, demand can vary as new customers are connected and existing customer demand changes and this means space to expand capacity is

necessary (either through having spare fibres or space available in ducts to deploy additional fibres).

A7.5 A broadband only network may not be able to easily start providing leased lines. To provide a leased line, it would need to have a flexibility point close to the business location (otherwise the costs of providing the connection to the customer site would be high due to the dig cost). Even if a flexibility point was located close to the business, the fibre broadband-only networks are often GPONs as explained in Annex 6. This means there is a shared fibre up to the point of the optical splitter, with dedicated customer connections from there to the customer. This network could not be used to provide a leased line where a dedicated connection end to end is required. Therefore, the network operator would need spare fibres in its existing cables or spare capacity in existing ducts in which new fibres could be deployed in order to provide a dedicated connection. As above, because spare fibres and/or spare capacity are not necessary to support broadband services, these may not be available, particularly from the splitter location out to the customer premises.

A7.6 A leased lines only network is unlikely to easily be able to start to provide residential services. This is because a leased lines only network will not have material coverage in an area with residential premises and would not have access/flexibility points located very close to residential premises.

A7.7 MSNs supply both broadband and leased lines services and so:

- cover areas with residential and business customers;
- have flexibility points close to all residential customers, and close to groups of business premises; and
- have spare fibre, or capacity to deploy additional fibre.

Types of fixed networks

MSNs

A7.8 BT and Virgin Media are the main operators currently operating MSNs.

A7.9 BT's network coverage is ubiquitous. Traditionally, it has provided leased lines over dedicated fibre infrastructure 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. When BT upgraded its network to offer superfast broadband services using FTTC it deployed new fibre cables to connect to the cabinets. In its deployment of FTTP, we understand BT is now installing fibre cables with spare fibres so that leased lines can use these new cables. This is particularly relevant in the spine connections (i.e. those parts of the network closer to the exchange).

A7.10 Virgin Media’s network currently covers approximately 50% of UK premises. Broadband services are provided over either a cable network (originally provided to support cable TV) or an FTTP network (the majority over cable). The cable network (i.e. the specific coaxial cables used to connect to end customers) cannot be used to provide leased lines. However, Virgin Media can use spare fibres from the POP to the cabinet for leased lines. To connect to businesses, it then must run a cable from the cabinet to the business premises. To the extent

possible it can re-use the ducts carrying coaxial cables to also carry fibre leased lines to businesses. In areas where Virgin Media has installed fibre to the premises as part of Project Lightning, these fibres cannot be used for leased lines without reconfiguration as it is configured in the same way as a GPON and so the points raised above for broadband only networks would apply.[48] Virgin Media also supplies leased lines outside its residential network footprint, for example in central business districts such as the CLA. Virgin Media currently offers retail and wholesale leased lines, and retail broadband services.

A7.11 New networks are now being deployed. Some of these are MSNs, such as CityFibre and FibreNation.

A7.12 CityFibre commences build in a town/city based on securing an anchor tenant such as the local authority. This phase of build provides leased lines to the anchor tenant and generates revenue to contribute to covering capital cost of the initial build.[49] This build will focus on deploying to the anchor tenant's locations, but will also build a central spine network. Within these towns, CityFibre may then build out an FTTP network to serve broadband. This involves extending the network from the spine into residential areas, providing flexibility points at each potential customer premises that is passed. Selection of towns to build out in is based on several factors, and is driven by discussion with an anchor tenant for broadband. Other factors include the overall number of premises, and the density of premises, as well as the extent to which the build can use BT's infrastructure (for example, areas with a high proportion of residential customer connections provided from poles are attractive using PIA). The ability to get permission to carry out civil works will also determine if, and when, build in a town takes place (i.e. build may be cancelled or delayed in towns where it is difficult to get access to undertake street works, or where street works have recently been undertaken and so there is an embargo on new works). The existing footprint of Virgin Media and any published rollout by BT may also impact the decision. When extending its network to provide residential broadband, its design provides capability to provide leased lines services (i.e. by including access points and spare capacity near potential customers such as business parks and mobile mast sites).

A7.13 TalkTalk has established FibreNation as a separate wholesale fibre network company. It is currently building in York and has aspirations to deploy a network covering up to 3 million premises. As for CityFibre, it is likely that the build will provide the capability to connect leased lines within its footprint.

A7.14 New networks that are currently being planned and commencing build may be deployed as MSNs to support a range of services (for example, Axione).

[48] 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 DOCSIS.
[49] [✂].

Broadband only networks

A7.15 There are a number of networks focused on providing broadband services. These include:

- **Hyperoptic:** Hyperoptic largely targets multi dwelling units (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. This also allows it to address some targeted single dwelling units (SDUs).
- **Gigaclear:** 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 a sufficient number of customers committed, it built its network. It has since also won State Aid funding to build network. It has largely built its own infrastructure, with limited use of PIA.
- **B4RN:** 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.
- **Community Fibre:** Community Fibre has deployed to council-owned MDUs in parts of London.
- **Other entrants:** There are a number of other providers deploying networks. These include Zzoomm, Toob, Trooli and Jurassic Fibre.

Leased lines only networks

A7.16 There are also leased lines only networks, including Colt, Verizon, Zayo, CenturyLink and Vodafone.[50]

A7.17 In terms of leased lines only network deployment, these deployments are generally focused on areas where there is a higher density of large business premises (for example city centres and business parks), though on a case by case basis these networks have also built out to other locations. Increasingly, they are also looking to expand their footprints to connect to data centres as these become more important to the support of business critical applications.

Impact of PIA on cost and time of network build

PIA significantly reduces cost and time of network deployment

A7.18 PIA has the potential to increase the strength of competition in the WLA, LL Access and IEC markets over time by supporting the expansion of network competition. PIA has the potential to significantly reduce the cost and time involved in rolling out networks. BT may still have a cost and time advantage in some areas where it has network presence at, or close to, customer

[50] A number of these suppliers have over time acquired other telecoms providers with leased lines networks. For example, Vodafone purchased C&W which as well as providing leased lines had itself also acquired networks providing leased lines, including Thus, Energis and Your Communications. This means Vodafone has coverage in areas with high density of business premises, similar to other leased lines networks, but also has greater presence outside of the city centres and business parks than other leased lines only providers.

sites while other operators are not present and need to roll out new networks to connect customers.

A7.19 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:

a) BT estimated a cost per premise of [✂]. [51]

b) Virgin Media also estimated that PIA saves approximately [✂]. [52]

c) We understand that network build times could be significantly reduced using PIA. [53]

A7.20 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 a network provider undertaking civil infrastructure work to deploy its own network: [54]

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. [55] 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. [56]

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. [57] Longer extensions are typically associated with more significant costs and a longer time to provide, as outlined above. [58]

[51] [✂].
[52] [✂].
[53] Meeting between Ofcom and [✂].
[54] 2019 BCMR Statement, paragraphs A6.28-A6.34.
[55] 2019 BCMR Statement, paragraphs A6.20, A6.28-A6.32.
[56] 2019 BCMR Statement, paragraphs A6.21, A6.30.
[57] 2019 BCMR Statement, paragraphs A6.33.
[58] Also see 2019 BCMR Statement, paragraph A6.26 for evidence related to IEC services.

Types of network expansions and potential for using PIA

A7.21 Network operators can use PIA for three main types of network expansion. [59]

Extend coverage to completely new areas (new area rollout)

A7.22 Where a network provider seeks to provide its own network in a new town or city, PIA could be used to help build the network in the town/city (including to provide spine and customer connections and for providing a higher density of flexibility points). Rollouts in new towns or cities will then require core connections from the existing network to the new town; PIA could be used to supply these links as well. We note that PIA may often be used in combination with some own build, depending for example on the ability to use PIA (i.e. whether the existing duct and pole infrastructure can be used, or is full or unusable for other reasons).

To extend coverage within current network footprint (infill)

A7.23 PIA could reduce the time and costs of deploying new network within the existing footprint to "densify" the network. PIA could be used from the BT exchange or the network provider could build its network to a convenient access point in the Openreach duct network and use PIA from there.

Customer-specific connections

A7.24 PIA could reduce the time and cost of deploying new network to connect a single customer site in response to a customer's order.

A7.25 For the provision of WLA services, access to PIA could be important to allow quick deployment at scale. Both duct lead-ins and poles could be used to deploy networks using PIA. In particular, we understand that using BT's poles to provide coverage where these are available will mean deployment can be achieved quicker and at lower initial cost. The access seeker can pre-build its network to the top of each pole (perhaps by using an overhead connection from pole-top to pole-top to quickly pass all premises covered by a number of poles) as part of new rollout or infill as discussed above. Individual customers can then be connected in response to a specific order by installing a fibre from the top of the pole to the customer premises.

A7.26 For leased lines, installing new duct to provide connections to customer premises can be costly and time-consuming, depending on the distance and type of public highway that needs to be dug up to lay the new connection. Therefore, as set out in Volume 2, Section 7, customer-specific network extensions by networks are generally for short distances as it is more expensive and takes longer to connect customers for longer distances.

A7.27 While PIA can reduce the time and cost for longer customer-specific extensions, it will still be more challenging and resource intensive where the network is being extended to serve a single customer with leased lines compared to infills and rolling out to a new area. [60] This is because – unlike infills and rolling out to a new area - the cost of the network extension and the

[59] PIA may also provide a new option for providing resilience.
[60] 2019 BCMR Statement, paragraphs A6.37-A6.50.

opportunity cost of using resources to plan using PIA for a customer specific network extensions will not be shared among multiple users. [61]

A7.28 Therefore, we consider that PIA is less likely to be used on a material scale for customer specific extensions than for infill of existing networks or building networks in new areas. To the extent PIA will be used for customer-specific extensions it is most likely to be targeted at shorter circuits (which are more likely to be in areas where rival networks already have substantial existing network, especially HNR areas and the CLA) and for higher value VHB services.

A7.29 Vodafone and BT Group have previously told us in response to the 2019 BCMR Consultation that PIA is more likely to be used for mass rollout and network infill than for single site installations. [62] Our understanding based on meetings with stakeholders since the 2019 BCMR Statement is that they also expect PIA to be most useful for infill. [63]

Evidence on planned build and use of PIA

A7.30 We asked providers for their views and data on planned build and use of PIA until 2026, in meetings and using our statutory information gathering powers. [64] This included MSNs, broadband only operators and leased lines only operators.

A7.31 Overall, evidence suggests that there are prospects of commercial build by rival network providers by 2026, facilitated by PIA. This is likely to be:

a) by MSNs and some broadband only operators for WLA services;

b) by MSNs and some leased lines only operators for LL Access services; and

c) limited prospects for IEC services.

A7.32 However, at this stage it is difficult to identify exactly where rollout (including using PIA) will be deployed, as plans will develop and may change and develop during the period. [65]

A7.33 Below we present the evidence we have gathered on planned build and usage of PIA during the review period.

There are prospects of rival build for WLA

A7.34 Based on our assessment of the evidence in Volume 2 Section 7 we consider there are prospects for material build by both MSNs and broadband only networks in Area 2. Table A7.1

[61] Using our statutory information gathering powers we also asked leased lines only network operators for copies of internal documents including an assessment of the usage of PIA for each of the types of network extension discussed above, but did not receive any documents.

[62] Vodafone stated in its PIMR response "the economics of [unrestricted PIA] for single site installations are challenging" and although we would expect some usage of PIA for this purpose, this is likely to be limited as operators prioritise mass network rollout/infill- 2019 BCMR, paragraph A6.13. BT Group mentioned that the impact of PIA could be greater where it is used to provide multiple circuits (BT Group's response to the 2018 PIMR and 2018 BCMR Consultations (Alix Partners report), paragraph 14).

[63] Meeting between Ofcom and [✂].

[64] Responses from B4RN, CityFibre, Community Fibre, Gigaclear, Hyperoptic, TalkTalk, Virgin Media and Zzoomm to the s.135 notice dated [✂], [✂], [✂], [✂], [✂], [✂], [✂] and [✂].

[65] We understand that a number of operators are currently trialling the use of PIA, and therefore do not have formal plans. [✂].

below presents publicly available evidence on planned build by MSNs and broadband only networks, which shows networks' plans to increase coverage by 2025.

Table A7.1: Planned build by MSNs and broadband only networks

	Current coverage	Planned coverage at 2025
Virgin Media	14.7 million [66]	17 million [67]
CityFibre	0.1 million	5 million
Hyperoptic	0.3 million	5 million
FibreNation	0.04 million	3 million
Gigaclear	0.09 million	0.5 million (2022)
Jurassic Fibre	0	300,000+
Other	0.6 million	3.5 million

Source:https://www.thinkbroadband.com/news/8578-cityfibre-fttp-footprint-passes-100-000-premises-mark (CityFibre - current coverage); https://www.cityfibre.com/network/ (planned); https://www.hyperoptic.com/press/posts/kkr-acquires-majority-stake-in-hyperoptic/ (Hyperoptic – current); https://www.hyperoptic.com/press/posts/hyperoptic-raises-record-250m/ (planned); https://fibrenation.co.uk/news/fibrenation-and-makehappen-forge-multi-million-pound-partnership-for-uk-wide-fibre-rollout (FibreNation – current); https://fibrenation.co.uk/about-us/ (planned); https://www.ispreview.co.uk/index.php/2019/06/rural-isp-gigaclear-ends-2018-with-93000-full-fibre-uk-premises.html (Gigaclear – current); https://www.gigaclear.com/news/gigaclear-appoints-james-lowther-chief-marketing-officer (planned); https://jurassic-fibre.com/about (Jurassic Fibre – planned) and Ofcom analysis based on stakeholder responses to the s.135 notice titled Promoting investment and competition in fibre networks.

Note: 'Other' includes Zzoomm, Community Fibre, and Toob.

A7.35 Evidence also shows that some of the network providers building these networks are planning to use PIA. Tables A7.2 and A7.3 below shows the current view on the use of PIA by MSNs and broadband only networks.

[66] Virgin Media reports 15.7m premises passed in UK and Ireland, and c. 1m premises passed in Ireland. Virgin Media website: https://www.virginmedia.com/corporate/investors-overview, Liberty Global Ireland website: https://www.libertyglobal.com/operation/ireland/. [Both accessed 21/11/19].

[67] Initial Project Lightning announcement of build to 2020. 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 04/12/19].

Table A7.2: Planned usage of PIA by MSNs

	Proportion of new network route length deployed in third party infrastructure, as at March 2026 [68]	Use of PIA
Virgin Media	[✂%]	[✂]
CityFibre	[✂%]	[✂]
FibreNation	[✂%]	[✂]

Source: data on route length deployed in third party infrastructure is based on stakeholder responses to the s.135 notice titled *Promoting investment and competition in fibre networks.*
Note: CityFibre estimate given in terms of premises passed rather than network route length. Forecasts are incremental to network as at June 2019.

[68] Includes route length deployed to the premise i.e. excluding in-building wiring.

Table A7.3: Planned usage of PIA by broadband only networks

	Proportion of new network route length deployed in third party infrastructure, as at March 2026	Use of PIA
Community Fibre	[✂%]	[✂]
Gigaclear	[✂%]	[✂]
Hyperoptic	[✂%]	[✂]
Zzoomm	[✂%]	[✂]
Toob	[✂%]	[✂]
B4RN	[✂%]	[✂]

Source: data on route length deployed in third party infrastructure is based on stakeholder responses to the s.135 notice titled *Promoting investment and competition in fibre networks.*
Note: Forecasts are incremental to network as at June 2019.

There are prospects of rival build in some areas for leased line access

A7.36 We expect that there are prospects for rival build, facilitated by PIA, because:

- new network rollout could begin in this review period, facilitated by PIA, where MSNs rollout generally to new locations, and where leased lines-only operators networks expand their footprint.
- at least some existing networks may use PIA for network infill extensions during the review period in the area where they already have at least some coverage. While customer specific extensions may still be challenging, to the extent used they are more likely to be in higher density areas.

A7.37 Therefore, we expect prospects of material build in areas with high density of existing rival infrastructure (i.e. HNR areas and the CLA) by MSNs and leased line-only networks. We also expect prospects of material build in Area 2 (as set out in Volume 2 Section 7) by MSNs.

A7.38 This is consistent with evidence from MSNs, leased line-only networks. In particular, evidence gathered using our statutory information gathering powers on planned build by leased lines-only networks suggests that some roll-out is expected in urban areas including those where there is already significant leased lines coverage.[69] In particular, [✂] plans to rollout to 8 sites, and [✂] plans to rollout to four towns/cities.[70]

[69] Responses from CenturyLink, Colt, Verizon, Vodafone and Zayo to the s.135 notice dated [✂], [✂], [✂] and [✂].
[70] [✂].

A7.39 As outlined above, MSNs currently intend to make some use of PIA within the review period. We expect some of this rollout will include the provision of LL Access. In Table A7.4 below we also present current views on the use of PIA by leased lines-only networks. [71]

Table A7.4: **Planned usage of PIA by leased lines only networks**

Access	Proportion of new network route length deployed in third party infrastructure, as at March 2026	Use of PIA
Colt	[✂%]	[✂]
Zayo	[✂%]	[✂]
CenturyLink	[✂%]	[✂]
Vodafone	[✂]	[✂]

Source: data on route length deployed in third party infrastructure is based on stakeholder responses to the s.135 notice titled Promoting investment and competition in fibre networks.

Note: Forecasts are for incremental build to network as at June 2019.

A7.40 One stakeholder ([✂]) told us that they have plans to roll out in London. [72]

A7.41 Evidence also suggests the use of PIA for investment in network deployments to support the rollout of 5G networks by MNOs. For example, Three noted that PIA could be attractive for the supply of mobile backhaul and told us "the access tails of the [mobile] backhaul network are more attractive to infrastructure providers using a PIA remedy than inter-exchange lines, as there is a larger market for these lines (they are more numerous than inter-exchange lines) and access tail line lengths are much shorter, reducing the costs to operators of deploying their own fibre." [73] We expect future demand from MNOs to be increasingly for VHB services:

a) [✂]. [74]

b) [✂]. [75]

Potential build and use of PIA for IEC

A7.42 In Table A7.5 below we present evidence gathered using our statutory information gathering powers on planned build by leased lines-only networks for the period to 2026 for IEC. This data suggests that there are limited prospects of commercial build in IEC, although some build may be facilitated by the use of PIA.

Table A7.5: Planned build to exchanges, for the period to 2026

Provider	BT + 1	BT + 2	BT + 3

[71] [✂].
[72] Meeting between Ofcom and [✂].
[73] 2019 BCMR Statement, paragraphs A9.102.
[74] [✂].
[75] [✂]. See also 2019 BCMR Statement, paragraphs A9.48 and A9.61.

[✂]	1	23	52

Source: data on planned build to exchanges is based on our estimation and [✂].

Note: It was not possible to match 16 exchanges to their relevant status as they are not included in Ofcom's list of exchanges from the 2019 BCMR.

A7.43 We note that [✂] is also targeting exchanges in big cities in North East England and Scotland. However, there are uncertainties around the scale and location of this build as data was provided at city-level and it was not possible to predict the exact location of the exchanges. [76]

A7.44 We expect PIA to be more useful for IEC where distances are shorter and demand is higher, which is more likely to be at BT+1 or BT+2 exchanges:

a) Connecting a network node to a BT exchange is likely to have many of the challenges of customer-specific extension, as it is likely to involve a network which does not 'pass' an exchange [77] using PIA for a single extension to connect to its network. Although customer-specific build for IEC is possible, it is costly and involves delay compared to where a network has existing duct.

b) Additionally, some build is likely to be required even with PIA, as some work will be needed to join the two networks together. [78]

c) We recognise that extensions to connect existing network to exchanges could in some circumstances form part of infill/rolling out to new area planning (reducing some of the time and cost disadvantages discussed above). However, based on responses from operators the extent and location of this build is unclear.

A7.45 Table A7.6 below shows current views on the use of PIA for core and backhaul (of which leased lines IEC is a component). Our understanding of the evidence is that leased lines-only networks are interested in using PIA for customer connections and infill and deployments into new towns/cities, but view it as less likely to be used significantly to provide new backhaul/core routes.

Table A7.6: Planned usage of PIA for core and backhaul

	Proportion of new network route length deployed in third party infrastructure, as at March 2026
Colt	[✂]%
Zayo	[✂]%
CenturyLink	[✂]%

Source: Ofcom analysis based on stakeholder responses to the s.135 notice titled Promoting investment and competition in fibre networks.

Note: Forecasts are incremental to network as at June 2019.

[76] [✂].
[77] For example, is not close to the point where it could connect to an External Cablelink product.
[78] 2019 BCMR Statement, paragraphs A6.78.

A8. Geographic assessment

A8.1 In this annex we explain the modelling steps and results of our proposed geographic assessment in relation to WLA and LL Access. We consulted on our initial views on the approach we should take to geographic markets in our December 2018 Consultation. We have revised some aspects of our approach in light of stakeholder views and our further thinking.

A8.2 We first discuss the model assumptions and data we have used to assess existing and planned network operator presence. In doing so, we discuss stakeholder responses to the December 2018 Consultation. We then present the results of our geographic assessment of the presence of MSNs and service-specific networks across the UK. We also provide further sensitivity analysis of the impact of different modelling assumptions.

Modelling assumptions and data

A8.3 In this part of the annex we cover the following:

a) the geographic unit used to assess network presence;

b) the threshold that we use to consider whether a network covers sufficient premises within the geographic unit to be considered as present;

c) the data sources on existing network coverage and planned network build;

d) the processes undertaken to map the geographic extent of existing MSN and broadband only network coverage and planned network build; and

e) analysis of leased lines network presence.

A8.4 As discussed in Volume 2, Section 7, in the December 2018 Consultation, we proposed to use a cluster analysis to identify geographic areas of potential build. We proposed to identify areas of sufficient size and density of premises to determine where there was potential for material commercial deployment. We have reconsidered this approach and decided not to include our modelling of areas of potential build to inform our assessment of geographic markets. Hence, our assessment now only includes existing and planned coverage. However, we have used the cluster analysis in mapping network operator planned build, so we explain this analysis and its use in our planned build assessment below.

Choice of geographic units

A8.5 In our December 2018 Consultation, we discussed the choice of geographic unit. As a building block for our analysis, we explained that we need to choose a geographic unit that strikes the right balance between granularity and practicality. We considered various geographic units, including:

- individual premises (c.30 million);
- postal system units (postcodes (c.1.6 million) or postcode sectors (c.10,000); or
- a network-based approach, such as Openreach's exchange footprints (c. 5,600 copper exchanges and c.1,000 fibre exchanges).

A8.6 We proposed to reject the use of individual UK premises as our geographic unit based on practicality considerations, but also due to the way rivals deploy networks.

A8.7 We remain of the view that individual premises would not be the correct unit because:

a) We do not consider it would be practical to conduct analysis at an individual premises level because locations are being added to and removed on a frequent basis, and operators do not always hold build plans down to individual premises even at quite an advanced stage in their planning processes.

b) We also consider that the significant fixed costs associated with network deployment mean that operators need to build networks to cover a sufficiently large number of premises within an area and, therefore, that premises in close proximity are likely to face similar levels of rival network presence.

A8.8 In the December 2018 Consultation, we considered a more aggregated level of analysis to be appropriate. We explained why we thought that either postcode sectors or BT's exchange footprint might be the most appropriate candidates.

A8.9 No stakeholders considered that BT exchanges would be a good geographic unit for analysis as the deployment of rival networks will not necessarily correspond closely to BT's exchange footprints. Furthermore, we recognise that analysis based on exchange units would be complicated, as BT exchange footprints differ for its copper local access services (with c.5,600 exchange areas) compared to fibre-based services (c.1,000 exchange areas). Premises in the same copper exchange footprint can be served from different fibre exchanges, and fibre exchanges can cover wide areas including dense urban areas and rural areas, so that conditions of competition can differ across the area.

A8.10 BT submitted that we should generate a square grid map of 500m^2 areas across the UK (fewer than 1 million geographic units [79]). However, we do not agree. This would be a new system used only for our analysis which would need to be defined, and it would not necessarily map to the features that drive network build.

A8.11 We think that there are benefits to be had from using the postal system boundaries. It is a well-established and familiar unit. The boundaries of postcodes tend to follow streets and other geographical features such rivers and railways. Such features are often important to where operators build their networks. We also have access to information on the geographic size of each postcode, the number of premises in each postcode and the demographics of people living in each postcode.

A8.12 We also consider that postcode sectors are a more practical unit for analysis than postcodes, given the total number of postcodes; and the fact that postcodes are somewhat more variable over time as the address system is regularly updated for new buildings. We note that Ofcom has used postcode sectors for a number of other reviews.

[79] This is an approximation based on there being four 500m^2 units per km^2 out of a total of 244,820 UK km^2 (Source: https://www.nationsencyclopedia.com/economies/Europe/United-Kingdom.html).

Coverage threshold for considering a network to be present

A8.13 As network operators' existing and planned deployments do not map exactly onto the boundaries of postcode sectors, we need to determine an appropriate 'coverage threshold' i.e. how many of the premises within a postcode sector need to be covered by a network before we count that network as being present. [80]

A8.14 In our December 2018 Consultation, for the purposes of illustrating our proposed approach we used a 65% threshold (i.e. 65% of premises in a postcode sector would need to be covered by an existing network or by a planned network rollout before considering that the network is present). We selected 65% at that time largely because it had been used in other reviews.

A8.15 We invited stakeholders' views and evidence on the choice of threshold we should adopt in this review.

Responses to the December 2018 Consultation

A8.16 BT Group's view was that Ofcom should err on the side of being inclusive at the geographic market definition phase, so as not to exclude prematurely areas that could be potentially effectively competitive. It considered that this approach was appropriate as Ofcom had indicated that it would conduct further competition analysis based on a range of metrics and not only rely on operator presence.

A8.17 Openreach also noted that if a high coverage threshold were used, Ofcom would need to be clear about the scale and direction of likely errors between category 2 and 3 areas, particularly given Virgin Media's network footprint. It argued that even though an operator may have plans to cover initially less than 65% of premises, future build could be viable in that area. It considered that the application of a 65% coverage threshold to planned and potential build appeared to contradict Ofcom's statement that it '*would consider [a higher level] plan [as covering] all premises in that town/city and include all geographic units that have a sufficient proportion of its premises within the boundary of the town/city*'. The implication was that Ofcom should select a somewhat lower threshold for existing and planned coverage, as presence could be expanded in future within and across an urban area.

A8.18 Virgin Media did not consider that we needed to establish very significant coverage in order for a competitive constraint to be present, but it submitted that there was no "right" answer on the threshold. On balance, however, it was broadly supportive of 65% threshold given its use in previous Ofcom market reviews to assess operator presence.

A8.19 Other stakeholders (CityFibre, Gigaclear, Hyperoptic, TalkTalk, UKCTA, Vodafone) did not consider past use of 65% in previous Ofcom market reviews was informative of the appropriate threshold for this review.

A8.20 They expressed concerns that the 65% threshold could result in a postcode sector being identified as an (potentially) effectively competitive area where Openreach faced no

[80] We note that there may be less than complete alignment of network rollouts and build plans if we were to use any geographic unit that is larger than individual premises.

competition in up to 35% of the area and retained a majority share despite the presence of two rivals. TalkTalk saw a risk of Openreach price discriminating across such areas.

A8.21 Hyperoptic believed, as Ofcom had found in its PIA market review, that ubiquity of coverage was a basic requirement for competitor networks and noted that the BCMR had previously used a much higher threshold and had only moved to using 65% in the BCMR 2019.

A8.22 Some stakeholders also considered the choice of threshold resulted in a larger Area 2, and that the choice of threshold had been determined by Ofcom's preference for a lower threshold as this is 'more likely to identify an area as potentially competitive'. These stakeholders considered that Ofcom's strategy to promote network competition should not be a relevant consideration in the geographic market definition, which should be an evidence-based assessment of differences in competition.

Proposed approach

A8.23 As explained in Volume 2, Section 7 we propose to apply a 50% threshold.[81]

A8.24 We note that where a postcode sector falls within an urban deployment, the count of network presence will not be that sensitive to the choice of threshold. Most current or planned rival network deployments will target more densely populated areas. Within these areas, we understand that networks will typically aim to cover the majority of premises. This means that many postcode sectors that fall within an individual deployment will see very high coverage, apart from a few 'not-spots' within a deployment and areas at the edge of an urban deployment, where postcode sectors spanning urban/rural areas may not see complete coverage as premises density thins out. When analysing areas with existing and planned MSN presence, we have carried out some sensitivity analysis based on using a 65% threshold, rather than the 50% threshold we are proposing (see below).

Data on existing network presence and planned build

A8.25 Our analysis of existing network presence is based on Connected Nations data. This includes information on existing network coverage from MSNs (CityFibre, Virgin Media and FibreNation) and broadband only networks (i.e. B4RN; Gigaclear; Hyperoptic; ITS and IFNL).[82]

A8.26 Our analysis of planned build is based on information provided by network operators in response to a formal information request. We received details of planned build from: CityFibre, FibreNation, Virgin Media, Community Fibre, Gigaclear, Hyperoptic, Toob and Zzoomm.[83]

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[81] In our leased lines analysis, we also propose to use a threshold to determine network reach for each postcode sector to inform rival network presence. For the purpose of this consultation, we have relied on the analysis in the BCMR 2019, which applied a threshold of 65% (i.e. the number of sites with rival networks with presence to assess network reach for each postcode sector).

[82] Responses to question 2 of our Connected Nations s.135 information request, referenced CN1905-F01 and dated 30 April 2019. Responses to this information request were received in June 2019. The Connected Nations dataset also includes data from other providers such as BT Group; Sky; and Vodafone, which we have used when we assess take-up. We have excluded KCOM from our analysis as its presence relates to the Hull Area.

[83] CityFibre's response of [✂] to question 1 of the s.135 notice dated [✂]. TalkTalk's response of [✂] to question 1 of the s.135 notice dated [✂]. Virgin Media's response of [✂] to question 1 of the s.135 notice dated [✂]. Community Fibre's response dated [✂] to question 1 of the s.135 notice dated [✂]. Gigaclear's response dated [✂] to question 1 of the s.135 notice dated

A8.27 In compiling data on existing coverage, we were aware that some smaller fibre networks were not included in the Connection Nations data collected in June 2019. Therefore, as part of our formal information request that asked about planned build, we asked some smaller operators about their existing coverage. We limited this request to those operators not already included in our Connection Nations dataset; and to networks that had successfully applied for Code Powers and were likely to have completed some actual build as of July 2019, this included Community Fibre, Toob and ZZoomm.

Use of Connected Nations data

A8.28 The Connected Nations dataset provides information on the UK premises passed and connected by each operator. [84]

A8.29 For this consultation we used Connected Nations data collected in June 2019 for the Summer 2019 report. This will be consistent with the data that we asked operators to provide on planned build over the period until 2026. [85]

A8.30 Since we issued our information request to gather data on planned build, some further network operators with plans to deploy fibre networks have applied to Ofcom for Code Powers. However, as none of these have yet deployed fibre networks, they do not feature in our analysis of existing coverage. [86]

Network operators' planned build

A8.31 We asked network operators to provide as granular data as possible on the location of all their planned deployments up to 2026, and the target number of residential and business premises they planned to pass for each location.

A8.32 We also asked operators what their own records indicated about the status of those roll-out plans and about the planned start and end dates for network deployments in each location.

A8.33 Responses to these requests differed in format and the level of detail provided on the location, coverage and status of build. We therefore needed to apply a number of rules to be able map these plans to postcode sectors (see below for further details).

Approach to assessment of existing MSN and broadband only network coverage

A8.34 We start by assessing existing MSN coverage (and we also use the same approach for broadband only networks).

[✂]. Hyperoptic's response dated [✂] to question 1 of the s.135 notice dated [✂]. Toob's response dated [✂] to question 1 of the s.135 notice dated [✂]. Zzoomm's response dated [✂] to question 1 of the s.135 notice dated [✂].

[84] The information requests for the Connected Nations report asked operators to provide network coverage information down to individual premises in the UK, including individual apartments in blocks of flats, based on its Unique Premises Reference Number (UPRN).

[85] We have not used the more recent Connected Nations data collected for the Winter 2019 report as this would make it more difficult to process the planned build data we collected in the separate formal information request in July 2019. The most recent Connected Nations' dataset also does not include details of take-up on different operators' networks.

[86] For example, a number of Code Power applications have been made to Ofcom that we will need to consider (e.g. [✂]).

A8.35 We define existing network coverage as any network deployments that have already been built and are ready for service. We have not included any networks in the process of build for our assessment of existing coverage.

A8.36 We classify MSNs as networks that offer, or intend to offer, both WLA (broadband) and LL Access services on their networks. For this consultation we identify Openreach, Virgin Media, CityFibre and FibreNation as MSNs.[87] We identify broadband only networks as any provider whose network has been rolled out only to supply residential and business broadband services and that has no current capability or intention to develop support leased lines services on that network.[88]

A8.37 As explained above, we treat an operator as 'present' within a postcode sector if its network covers at least 50% of premises within the postcode sector.

A8.38 We used the Connected Nations datasets (which rely on Ordinance Survey's (OS) Unique Property Reference Number (UPRN) system with an address and postcode as provided from the OS's *AddressBase Premium* product).[89] From this total base of UPRNs, for the Connected Nations report, we applied various filters to determine the total number of 'broadband delivery points'[90] per postcode sector and the number passed by each network by:

- Identifying locations within the UK (i.e. excluding locations included in Connected Nations data that are not in the UK such as the Isle of Man);
- Removing non-postal addresses and other premises unlikely to receive telecoms services (e.g. street furniture, garages and other non-addressable locations);
- Removing parent shell-addresses, for example where a UPRN relates to an entire building (i.e. the name of the block of flats), as we only want to count the individual premises within the block;
- Removing any 'child' addresses (e.g. a house boat, annex or other ancilliary buildings outside of the main residential delivery address); and
- Identifying unique records for each operator to avoid double-counting presence.[91]

A8.39 In some instances, the Connected Nations data on existing coverage for a particular operator could not be matched to the OS address information. This was either because the UPRN provided by the operator did not match to a corresponding postcode in the *AddressBase Premium* dataset; or where there was missing UPRN data. Where this was the case, we

[87] References to rival MSNs to BT relates to Virgin Media, CityFibre and FibreNation.
[88] We identified broadband only networks based on their responses to formal information requests on operator forecasts that they do not support any leased lines connections on their own networks.
[89] The Connection Nations report used *AddressBase Premium* epoch 67.
[90] These data processing steps are essentially the same as the ones Ofcom applied when assessing the USO broadband obligation. For that analysis, we also had to consider the correct count of premises we should treat as broadband delivery locations in the UK. See https://www.ofcom.org.uk/__data/assets/pdf_file/0019/151354/statement-delivering-the-broadband-universal-service.pdf.
[91] In some cases, an individual property may include more than one premises that can take a broadband line due for example to a house being converted into separate apartments. In some cases, the UPRN records may not have been updated to identify separate premises. However, in the most part, individual apartments in a multi-dwelling unit will be identified in the records as separate premises and each apartment will be counted as a separate premises in our analysis.

dropped these records from the analysis unless we could match at a higher level (i.e. to a postcode sector).

Approach to assessment of planned MSN and broadband only build

Assumptions used to map operator plans to postcode sectors

A8.40 We received plans at various levels of detail. Our approach to mapping was:

a) Where data was provided at the level of postcode sector or below, we mapped the data directly to matching postcode sectors using the Connected Nations address data (based on *OS AddressBase Premium*). As noted above, where the listed postcode did not match our records, the related plans were included in 'planned build' only where we could match the information provided to the Connected Nations dataset of postcode sectors.[92]

b) Where data was provided at a higher level of aggregation, i.e. postcode areas or specific towns/cities, we mapped these to postcode sectors using our urban 'clusters'. We discuss this approach further below.[93]

c) Where networks did not identify a specific town or city, these are not included in our assessment of 'planned build'.

A8.41 Similar to our assessment of current build, we only count a network as 'present' in a postcode sector where, taking account of both existing and planned build, coverage would extend to at least 50% of premises in a postcode sector. For example, Virgin Media's Project Lightning deployment often relates to infill of coverage gaps in towns and cities where it already has some presence. This planned build, when added to its existing coverage, may result in Virgin Media being counted present in postcode sectors where its existing coverage of premises is relatively low.

Status and timing of operators' plans

A8.42 As explained above, we also asked operators to explain the status of their build plans, including the planned start and end dates of any planned build. We asked operators to provide their own description of the status of their plans to different areas.

A8.43 We found that planned build ranges from very advanced to quite preliminary including where:

a) Build is on-going but not yet ready for service;

b) Plans where funding and senior management approval are in place and the necessary permissions have been undertaken to commence build;

[92] For some operators e.g. [✂] our Connected Nations dataset indicated build was already complete for some postcodes as the operator had existing coverage, but the operator's dataset on planned build sometimes indicated lower implied planned coverage for the postcode sector. We have relied on Connected Nations data on existing coverage, unless planned build exceeds existing coverage, in which case we use existing and planned coverage combined.

[93] Some operators [✂] provided high-level data on premises passed to certain towns [e.g. [✂] but also detailed information on premises passed per postcode for each town. We have relied only on postcode data for planned premises passed.

c) Higher level planning has been complete but without a final sign-off or funding commitment; and where

d) Planning is only indicative or very preliminary, for example, a list of target areas, based on higher-level research.

A8.44 We grouped plans into the following four categories: [94]

a) **Build phase:** including where network is currently under construction or build is about to commence;

b) **Committed/More Certain plans:** including where planning is at an advanced stage;

c) **Less certain plans:** including where indicative analysis of potential towns, cities or areas has been carried out.

d) **Cancelled plans:** where plans for build have been cancelled, for example for commercial reasons or due to difficulty of the build in that area.

A8.45 As noted above our proposed approach is to include all plans in categories apart from cancelled plans for our assessment of areas of planned build. [95]

A8.46 At the end of this annex, we include a supplementary table with details of our mapping of individual operator statuses to one of the above four Ofcom classifications.

Approach to identification of urban clusters

A8.47 As discussed above, some operators provided data on a planned deployment to a town or city and the number of target premises, but not details of the precise postcodes or postcode sectors to be covered. To overcome this issue, we have identified a set of urban clusters that can help identify the postcodes and postcode sectors that might be targeted when an operator plans to roll-out to a town or city but has not yet identified precisely where this will be in the town or city.

A8.48 The steps to identify urban clusters were as follows, we:

a) identified 'urban' postcodes where there is a reasonable density of premises;

b) grouped any adjacent postcodes into clusters;

c) for relevant selected clusters, mapped these onto postcode sectors; and

d) selected postcode sectors where 50% or more of the premises are included in our clusters.

A8.49 We discuss these steps below.

A8.50 We note that in our December 2018 Consultation another purpose of our urban cluster analysis was to identify areas of potential build. In particular, we selected urban clusters where there were no existing or planned networks but which were of sufficient scale (i.e. those clusters

[94] As there were a significant number of status classifications, we provide more detailed mapping assumptions for each operator in Table A8.14 at the end of this Annex.

[95] In some cases, operators indicated that they had considered an area or location for build, but they had subsequently decided not to proceed due to difficulties encountered either at the planning, permissions or build stage. We have therefore not included planned build by an operator where it has explicitly ruled out such build.

containing more than 20,000 premises) for build to be potentially economic. Stakeholders in response to the December 2018 Consultation made a range of comments on what factors we might include when determining areas with the potential for build. However, as set out in Volume 2, Section 7, we propose to rely on existing and planned coverage to inform our geographic market analysis. We have therefore not discussed stakeholder comments on areas of potential build in this consultation.

Identify all postcodes where there is a reasonable density of premises

A8.51 As noted above, the first step is to identify those postcodes where there is a reasonable density of premises that reflects urban areas. To do so, we exploit a feature of the postal system whereby the area covered by an individual postcode will scale in proportion to letter volumes delivered within that postcode. This is useful as a measure of premises density as, in general, the smaller a postcode (in metres squared) the larger the number of premises within a postcode.

A8.52 For this analysis, we used Connected Nations premises data combined with OS postcode data (*OS CodePoint with polygons data*) that gives details of the physical footprint of postcodes.

A8.53 In the December 2018 Consultation, we observed that the footprint of postcodes in urban areas typically does not exceed 100,000m². We have used this threshold to identify postcodes which map to dense residential and business locations. At the postcode footprint level, this technique filters out large green spaces in urban areas (such as large parks; golf courses; and airports) as well as rural areas of low population density.[96]

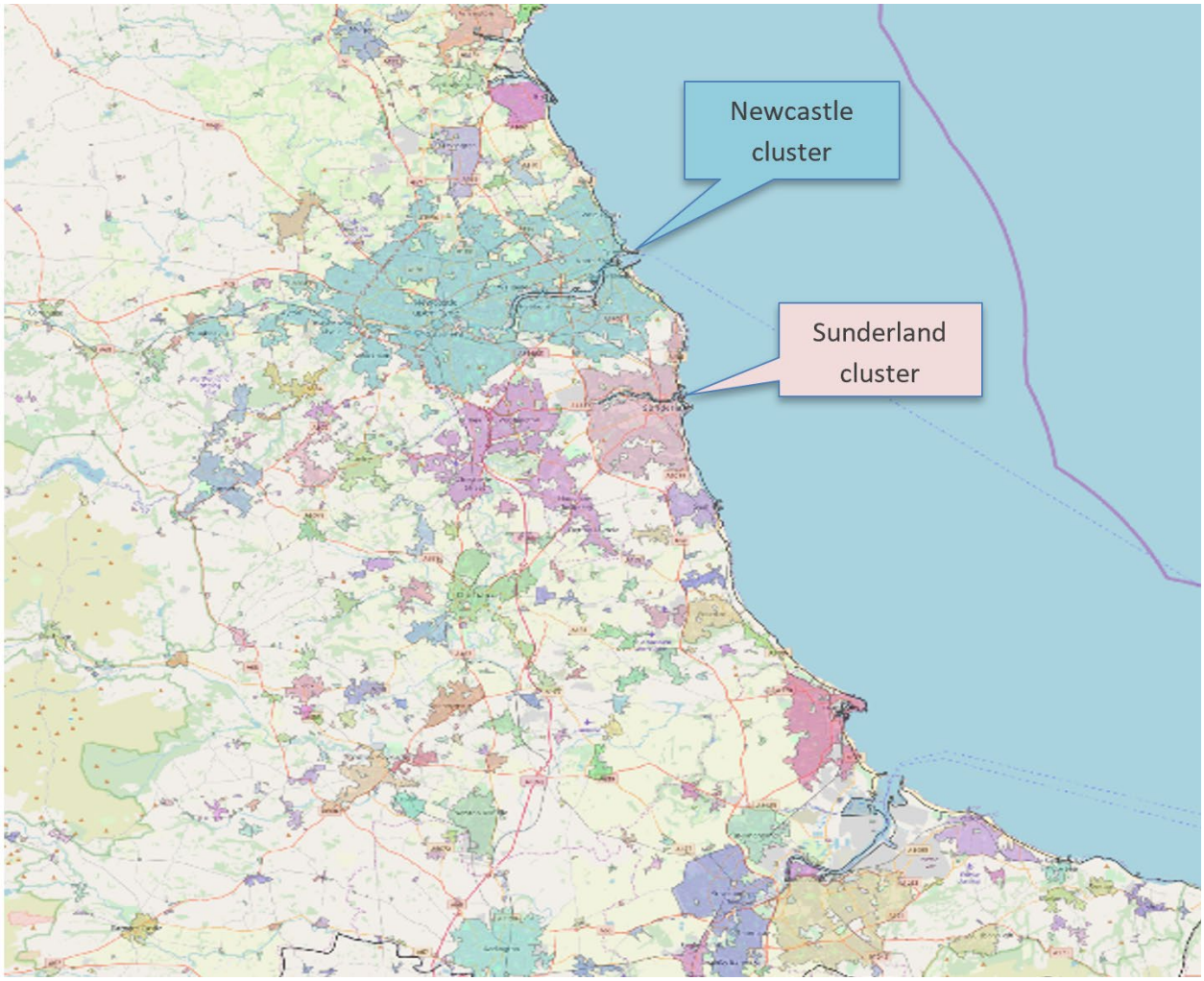
Grouping these postcodes into clusters

A8.54 Our next step is to group together urban postcodes into clusters.

A8.55 To identify clusters that form contiguous areas of interest, we identified adjacent 'urban' postcodes. We repeated this exercise iteratively until we identified all groups of adjacent 'urban' postcodes that form contiguous clusters.[97] Using this process, we identified 54,928 unique clusters.

[96]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.
[97] Due to the nature of postcode geography, some areas (polygons) representing some postcode units are unavoidably split across more than one polygon. In special cases of postcodes allocated to premises far apart, i.e. in case a postcode is mapped to more than one polygon, each polygon was examined separately to preserve the contiguity of the corresponding cluster(s).

Figure A8.1: Ofcom identified urban clusters in Northeast England



Source: Ofcom, December 2018 Consultation.

A8.56 The figure above shows that the cluster analysis can identify quite large urban areas associated with specific towns or cities such as Newcastle and Sunderland. It will also pick up smaller surrounding villages or towns.

Mapping clusters where there is planned build to our selected geographic unit

A8.57 As noted above, the purpose of identifying urban clusters is to map planned build to a town or city more precisely, where the network operator did not provide further detail of the individual postcodes and postcode sectors to which it planned to roll-out.

A8.58 Where the operator provided a named town or other location details such as higher level postcode data, we looked to identify the main urban cluster associated with the town and the number of premises within it. We then tested whether the number of premises that the operator planned to pass in the town was at least 50% of the premises within the cluster. If the

operator's planned coverage was to 50% or more of premises, we counted it as present across the whole cluster. If it was less than 50% of premises we did not count it as present. [98]

A8.59 We then have a number of clusters identified with planned presence by MSN. The next step is to map the selected urban cluster onto postcode sectors. [99] In some cases, particularly at the boundary of a cluster, a postcode sector may consist of premises some of which are within the cluster and some of which that fall outside. We have identified all postcode sectors that are wholly or in part within a cluster. We then include only those postcode sectors where at least 50% of the postcode sector's premises are within the area of the cluster. [100]

Approach for leased lines networks

A8.60 In our BCMR 2019, we assessed the extent of leased line network presence in different areas for large business and mobile sites. This analysis looked at whether those sites had existing leased lines networks nearby able to supply leased lines services competitively (based on existing network build as at December 2017).

A8.61 As explained in Volume 2, Section 7, we consider that the data gathered for the 2019 BCMR remains a reasonable basis for analysing existing leased lines network presence for the purposes of this consultation. In particular, we have had discussions with stakeholders and sent formal information requests. This information shows that:

a) there has not been material new leased lines only network build since December 2017; and

b) there are prospects for new build, including opportunities for using PIA to increase the density of existing network coverage, but it is difficult to reflect this in the data analysis as operators' build plans are still developing.

Summary of network reach analysis

A8.62 In the BCMR 2019, we explained that in order to supply business and mobile site customers with leased lines services, network operators must build a physical network connection (most commonly using optical fibre) to a customer site.

A8.63 To determine how many networks are close enough to businesses and mobile sites to be able to supply them competitively, we need to know the location of businesses and mobile sites, and the location of networks.

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[98] One operator [✂], stated it had plans to deploy to a number of premises within a postcode area of a town or city, e.g. [✂] postcode area of Brighton. As above, we would assess the coverage associated with that planned roll out, but only to those postcode sectors that would be counted as: (a) part of the urban cluster; and (b) that fall in the relevant postcode area. For example, Brighton consists of BN1, BN2 and BN3 postcode areas and we would only include postcode sectors starting with BN[✂] and were part of the urban cluster for Brighton we identify.

[99] Similar to our analysis of existing coverage, we have used the Connected Nations list of postcode sectors based on OS *AddressBase Premium* for this purpose.

[100] In a few cases a postcode sector may have premises located in more than one large urban cluster. For the purpose of assessing whether a postcode sector overlaps sufficiently with an area of potential build, we have counted all the premises in all urban clusters with which the postcode sector overlaps.

A8.64 In order to assess this, as explained above, we propose to use the network reach analysis applied in 2019 BCMR. This analysis was conducted as follows:

- Collect information from major leased lines operators on the precise location of their duct and leased-lines capable fibre networks across the UK. [101]
- Map as precisely as possible the location of large business sites and other site locations likely to make use of leased lines (absent further information on business sites, the BCMR used the postcode of a business site to map its location). [102]
- Assess the proximity of rival networks to BT to the business site by measuring the radial distance of each rival network to the assumed location of each business site.
- Apply a buffer-distance assumption to determine which operators are within 'network reach' and hence counted as a rival network 'present' at that site. [103]
- Calculate an aggregate view of 'network presence' for each postcode sector:
  - Find the proportion of large business and other sites within that area that have 'n' competitor networks (i.e. zero, one, two, etc) within the assumed buffer distance. [104]
  - Calculate a network presence score depending on whether the majority of premises (in the BCMR 2019 we chose a number of at least 65%) had a choice of zero, one or two or more rival networks.

A8.65 In the BCMR 2019, we grouped together postcode sectors with similar competitive conditions into separate geographic markets for the purpose of assessing SMP within each market. For those areas where at least 65% of large business sites within an area had a choice of BT plus two or more rivals, we classified these as High Network Reach Areas (HNRs) and separately to HNRs we also identified the CLA as an area with particularly high levels of network presence.

Use of BCMR postcode sectors

A8.66 As noted in Volume 2, Section 7, our BCMR 2019 analysis relies on a different data source for postcode sector information than we used for our assessment of MSNs and broadband only

[101] In the BCMR 2019, we asked the following providers: CityFibre, Colt, Eir, EU Networks, Fibrespeed, Interoute, KCOM, CenturyLink, MS3, Openreach, Sky, SSE, Surf, TalkTalk Verizon, Virgin Media, Vodafone and Zayo.
[102] In the BCMR 2019, we relied *Market Location* as our source of UK business information and used the locations of c.140,000 businesses which employed 250 or more employees on the postcodes as representative of large business sites in the UK. We added the locations of the circa 26,000 mobile sites to those of large businesses for our access network reach analysis. For large business sites, we used the centre of the postcode (postcode centroid) to give us the Easting and Northing locations coordinates of all large business sites in the UK. We then compared generated Easting and Northing coordinates that followed the precise routes each operator's access network.
[103] We did not have reliable information on the extent to which operators had existing fibre or duct connections into specific business sites for most of the UK. Furthermore, as noted above, we had to approximate the location of customer sites based on postcode centroids, which introduced a degree of error. Taking these factors into account, we considered that we should count rival networks presence for operators with network within a 'buffer distance' of 50 metres of the geographic centroid of post code where the business is located. We thought that this buffer distance would be a reasonable indicator of the number of rival operators' networks that were much closer than 50m to the actual location of businesses. This is because we considered that - due to measurement errors – the distances measured by our model will overstate the actual distances between networks and business sites. As such, the 50m buffer distance in practice captures networks with existing connections or which need very short network extensions.
[104] For postcode sectors without any large business or MNO sites located within their boundaries, we would assign each postcode within the postcode sector a large business/mobile site for the purposes of our geographic market classification. This ensures that rival telecoms providers' network infrastructure in areas where we do not identify the presence of leased line consumers is taken into consideration in our geographic assessment.

networks. The BCMR 2019 used postcode data from Miso [105] as of September 2018, whereas the MSN and broadband only analysis used postcode sectors from Connected Nations, based on OS from May 2019. The net result is that, for this consultation, there is a total of 9,632 postcode sectors identified in our proposed LL Access geographic markets and 9,558 postcode sectors in our WLA analysis. We explain the source of those differences below. When we conduct analysis for our statement, we will review any mismatches in underlying data for the statement to ensure a comprehensive list across the WLA and LL Access analysis.

A8.67 As discussed in Volume 2, Section 7, for our LL Access markets we identify geographic markets for the CLA and HNR, which relies on the geographic analysis and postcode sectors used in the BCMR 2019. For the remaining LL Access postcode sectors, we otherwise rely on the postcode sectors designated as Area 2 or 3 based on the list of postcode sectors identified by our WLA analysis using the Connected Nations dataset from May 2019.

A8.68 There was a total of 9,974 postcode sectors in the BCMR 2019 analysis (excluding the Hull Area). Out of these, in the BCMR 2019 we identified 579 postcode sectors as part of the CLA and HNR areas. Only 505 of these 579 postcode sectors could be matched to our Connected Nations dataset from May 2019. We have included the complete set of 579 postcode sectors in our analysis and listed those postcode sectors as part of the CLA and HNR LL Access geographic markets.

A8.69 We identify 9,053 postcode sectors for LL Access geographic markets based on Area 2 and 3 postcode sectors from our WLA analysis and excluding any already allocated to the CLA and HNR. However, not all postcode sectors for Areas 2 and 3 are common with the BCMR 2019 postcode sectors. [106] There are: six postcode sectors in our WLA analysis (new postcode sectors) that did not exist when the BCMR 2019 analysis was conducted; and 342 postcode sectors used in the BCMR 2019 analysis which no longer exist in the list of postcode sectors in the WLA analysis.

A8.70 Hence, when we report analysis on network reach below for Areas 2 and 3, our analysis relies on the 9,047 postcode sectors in Area 2 or 3 with postcode sectors common to our WLA and BCMR datasets. But, for the avoidance of doubt, the total number of postcode sectors in LL Access geographic markets for Areas 2 and 3 is 9,053 (i.e. we include the six new postcode sectors in our WLA dataset, which we assign to Area 2 or 3 based on MSN analysis alone). [107] If we add to this the 579 postcode sectors in the CLA and HNR areas, we get to the total of 9,632

[105] Miso is a division of Dotted Eyes Ltd offering mapping data and software.

[106] There was a total of 9,974 postcode sectors in the UK excluding the Hull Area in the BCMR 2019. Out of these, 9,395 postcode sectors were identified outside of CLA and HNR in the BCMR 2019 (i.e. postcode sectors with BT plus one rival or BT only).

[107] We are proposing to assign these to markets based on our MSN analysis alone (i.e. either Area 2 or Area 3), but we will consider ahead of the statement whether there is additional competition from leased lines only networks in these postcode sectors such that they should be in a different market. We conducted an initial assessment of these six postcode sectors and only one of them has the potential to be near either the CLA or HNR areas. The remaining postcode sectors were not found to be close to city centres that might see two or more rivals to BT.

postcode sectors for the LL Access geographic markets. We do not include the 342 postcode sectors in the BCMR 2019 list that do not appear in the WLA dataset. [108]

Results of our geographic markets analyses

A8.71 In this part we present the outputs of our analysis based on the approach set out above. We start by presenting existing network roll-out and then overlay that with areas of planned build.

Existing MSN network roll-out

A8.72 The table below shows existing coverage by rival MSNs to BT, including the count of postcode sectors and the corresponding number of premises in those postcode sectors.

Table A8.2: Summary of results of geographic market analysis based on existing MSN presence

Number of rival MSNs to BT present	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Two or more rival networks	15	0.05 million	0.2%	0.2%
One rival network	4,425	16.8 million	46.3%	55.1%
No rival network	5,118	13.7 million	53.5%	44.8%
Total	9,558	30.5 million	100%	100%

Source: Ofcom, December 2019 based on operator data.

A8.73 The figures in Table A8.2 suggest MSN existing coverage to 46% of UK postcode sectors covering 55% of UK premises.

A8.74 We can compare existing MSN coverage estimated above to data from our December 2018 Consultation. To do so, we need to adjust the December 2018 analysis so it considers MSNs only and a 50% coverage threshold. [109] The December 2018 data suggests, at that time, that at least one rival MSN had presence in UK postcode sectors covering 53% of UK premises. This suggests a slight increase of around two percentage points in premises covered by existing MSNs networks.

A8.75 As a sensitivity, based on the most recent data in Table A8.2 above, we have considered the impact of using a 65% threshold rather than 50%. This would lead to the percentage of UK premises in postcode sectors with existing MSNs reducing to 48%.

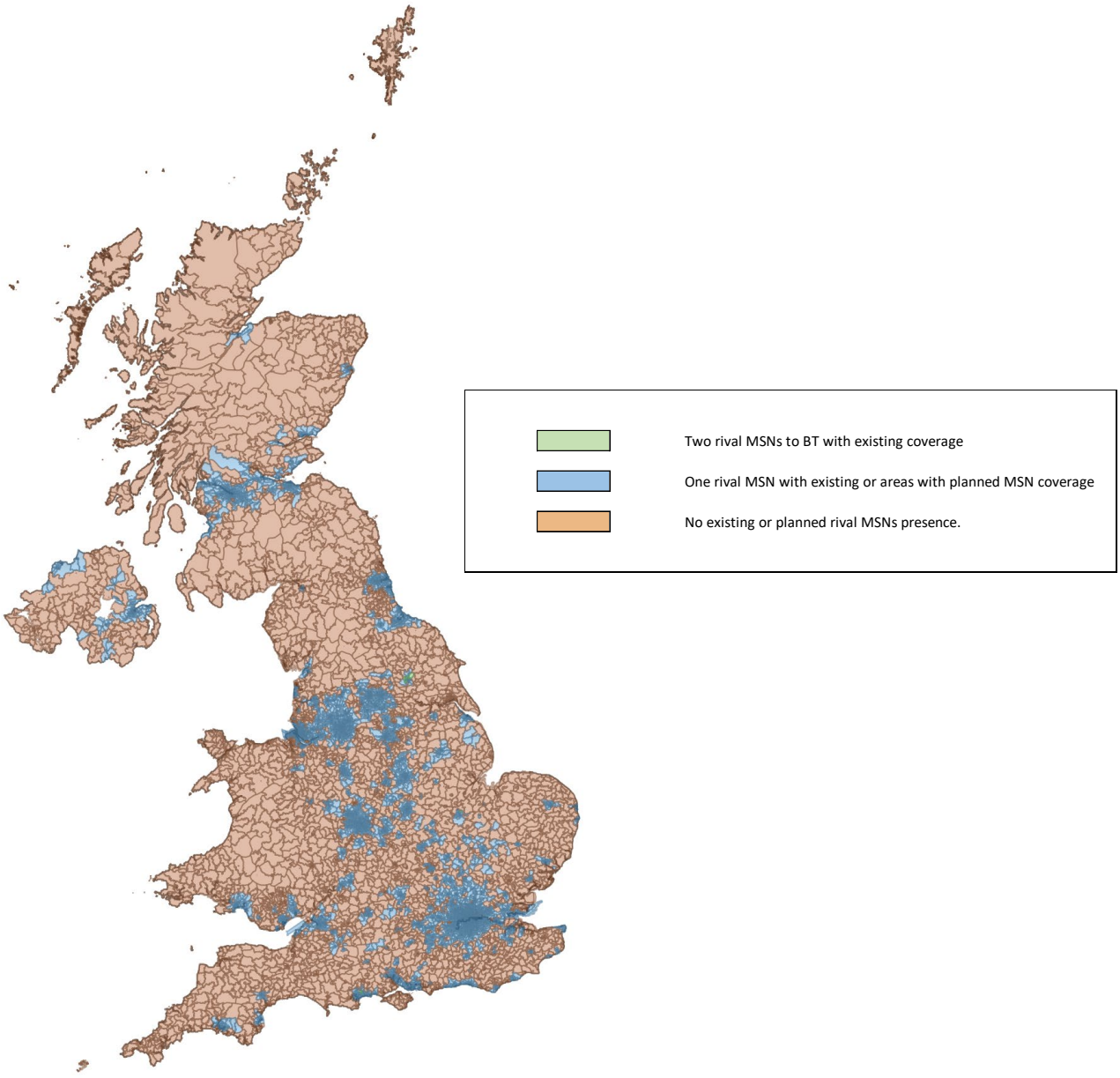
[108] Where a postcode sector appears to not be listed, such as the 342 postcode sectors that were in the list of BCMR 2019, then a stakeholder can check relevant the OS's *AddressBase Premium* product (Epoch 67) as used in our Connected Nations dataset: https://www.ordnancesurvey.co.uk/business-government/tools-support/addressbase-epoch-dates. This will allow a stakeholder to match specific premises locations to a new postcode and postcode sector location.

[109] This calculation differs from the existing network coverage reported in the December 2018 Consultation in Table 4.9 where we estimated that 46% of UK premises were in postcode sectors with existing network presence. However, to calculate existing coverage in Table 4.9, we used a 65% coverage threshold and included both MSN and broadband only networks.

Existing and planned MSN network build

A8.76 The map below shows network coverage by rival MSNs to BT by postcode sector when planned build is also included. We indicate on our map, based on existing and planned deployments, postcode sectors with either no rival MSNs (brown), areas with one rival MSN with existing coverage or planned coverage (blue); and areas with two rival MSNs with existing coverage (green).

Figure A8.3: Number of existing and planned MSNs



Source: Ofcom.

Table A8.4: Summary of results of geographic market analysis based on existing and planned MSN network presence

Number of rival operators present	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Two or more existing MSN operators	15	0.05 million	0.2%	0.2%
One rival MSN present and/or planned MSN build	6,022	21.3 million	63.0%	69.6%
No rival MSN present or planned	3,521	9.2 million	36.8%	30.2%

Source: Ofcom, based on operator data.

A8.77 Based on the above analysis, we find 63.0% of UK postcode sectors (covering 69.6% of UK premises) have one existing rival MSN or planned coverage of rival MSNs. Including postcode sectors with two existing rival MSNs, there would be 63.2% of postcode sectors and 69.8% of UK premises with at least one existing or planned rival MSN present.

A8.78 Planned MSN deployments would increase by 16.7 percentage points the proportion of postcode sectors covered by at least one rival MSN to 63.2% of the UK. This is equivalent to an increase of 14.4 percentage points in the proportion of UK premises covered by at least one rival MSN (69.8% of UK premises).

A8.79 The above calculations of existing and planned MSN coverage are based on a 50% coverage threshold. If we were to apply a 65% threshold, the percentage of UK premises in postcode sectors with at least one existing rival MSN or planned coverage of rival MSNs would be 67.9%.

A8.80 In our December 2018 Consultation, Table 4.9, we estimated that 58% of UK premises were in postcode sectors with existing or planned network presence (based on a 65% coverage threshold and all networks at that time). [110] We can repeat this calculation with the December 2018 data, but with a 50% coverage threshold and for MSNs only. This suggests estimated existing and planned coverage in December 2018 for MSNs was to 63% of UK premises. This suggests that since December 2018, MSNs have expanded their plans for build to 70% of UK premises (a seven percentage point increase).

A8.81 As explained above, we mapped operator internal status for planned build onto one of four categories: 1. Build phase; 2. Committed/More Certain plans; 3. Less certain plans; and 4. Cancelled plans. The above modelling includes all plans in categories 1 to 3. In Table A8.4 above we included all plans in categories 1 to 3. We have applied a sensitivity for MSNs planned build based on categories 1 and 2 only.

A8.82 This sensitivity reduces the number of postcode sectors and premises with existing or planned presence to 62% of UK postcode sectors representing 68% of UK premises. This is a two

[110] The analysis reported in the December 2018 Consultation on existing and planned build included all network plans including MSN and broadband only networks such as Gigaclear.

percentage point difference compared to presence based on all plans, i.e. 70% of UK premises based on all plans in categories 1 to 3.

A8.83 This difference reflects the status of different MSN plans. For example, [✂]. Nevertheless, as set out in Volume 2, Section 7, we consider it appropriate to include all operator plans, as it indicates those areas where operators think build could be economic.

Assessment of broadband only specific networks

A8.84 In terms of broadband only rival networks, we set out current and planned build in Table A8.5 below.

Table A8.5: Summary of results of geographic market analysis based on existing broadband only network presence

Number of rival operators present	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises	% of postcode sectors in Area 2 or 3 (as defined by MSN analysis):	
					Area 2	Area 3
One rival operator	84	0.1 million	0.9%	0.5%	61%	39%
No rival operators	9,474	30.4 million	99.1%	99.5%	63%	37%

Source: Ofcom, December 2019 based on operator data.

A8.85 Existing broadband only network presence is limited (fewer than 0.1 million UK premises) and most of this presence (61%) is in postcode sectors identified as Area 2 (based on our MSN analysis). There are no postcode sectors with two or more rival broadband only networks.

A8.86 Hyperoptic, Gigaclear and IFNL have existing coverage in the largest numbers of postcode sectors in the 84 postcode sectors with one rival broadband only operator. In these 84 postcode sectors, ([✂]), with the remaining postcode sectors covered by a tail of other operators each covering five or fewer postcode sectors. Hyperoptic's network is [✂] while [✂ [111]].

A8.87 Below in Table A8.6 we set out existing and planned build by broadband only networks.

Table A8.6: Summary of results of geographic market analysis based on existing and planned broadband only network presence

Number of rival operators present	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises	% of postcode sectors in Area 2 or 3 (as defined by MSN analysis):	
					Area 2	Area 3

[111] Based on Gigaclear's coverage of premises in postcode sectors where it is counted as present.

One or more rival operators	2,701	8.7 million	28.3%	28.6%	72%	28%
No rival operators	6,857	21.8 million	71.7%	71.4%	60%	40%

Source: Ofcom, December 2019 based on operator data.

A8.88 The above results suggest that if all broadband only network plans were fulfilled then broadband only networks would be present in 28.3% of UK postcode sectors (28.6% of UK premises) compared to existing presence of 0.9% of UK postcode sectors (0.5% of UK premises) today.

A8.89 Much of this planned and existing build (72%) would be in postcode sectors identified as Area 2 (based on our MSN analysis). However, broadband only networks' plans also include some 768 postcode sectors identified as Area 3 (based on MSN analysis). Those postcode sectors in Area 3 would cover around 2.4 million premises.

A8.90 Table A8.7 below shows the break-down by different operators.

Table A8.7: Summary of results by broadband only operators

Rival broadband only network	Count of postcode sectors	Count of UK premises	% of UK premises operator plans to pass that fall in Area 2 or 3 (as defined by MSN analysis)	
			Area 2	Area 3
[✂]	[✂]	[✂]	[✂]%	[✂]%
[✂]	[✂]	[✂]	[✂]%	[✂]%
[✂]	[✂]	[✂]	[✂]%	[✂]%
[✂]	[✂]	[✂]	[✂]%	[✂]%
[✂]	[✂]	[✂]	[✂]%	[✂]%
[✂]	[✂]	[✂]	[✂]%	[✂]%

A8.91 Overall, across all of the operators there is a mix in the proportion of broadband only planned build that would fall in Area 2 or 3 (as defined based on MSN analysis). Nevertheless, some operators such as B4RN and Community Fibre are more focused on rural build. Based on the existing plans, [✂] would account for the majority of planned build, which would be almost exclusively in [✂].

Assessment of leased lines specific networks

A8.92 Based on the outputs of the BCMR 2019, we present below the number of UK postcode sectors with similar levels of rival network coverage. As explained in Volume 2, Section 7, the analysis in the BCMR included rival networks such as Virgin Media, CityFibre as well as leased lines only networks such as Colt, Verizon, Zayo. We identified the CLA as a separate market, and below

we refer to other areas with BT plus two rival networks as HNR. Therefore, our definition of HNR excluded the CLA.

Table A8.8: Postcode sectors with similar levels of rival network coverage

Number of rival leased lines networks	Average number of rival networks with presence	Number (% share) of postcode sectors	Number (% share) of customer ends connected in 2017
BT only	0.3	5,723 (57%)	30,755 (48%)
BT plus one rival network	1.0	3,324 (33%)	21,075 (33%)
HNR	2.4	304 (3%)	3,978 (6%)
CLA	4.3	275 (3%)	7,988 (13%)
Total UK excl. the Hull Area	0.8	9,974 [112]	63,828 (100%)

Source: BCMR 2019 analysis. Note that the sum of percentages may not exactly equal 100% due to rounding. Additionally, some invalid or missing postcodes have been excluded.

A8.93 In Volume 2, Section 7, we propose to identify four geographic markets. We propose to identify HNR areas using the network reach analysis from the 2019 BCMR, and to split these between the CLA (which we refer to as LL Access CLA) and other postcode sectors where there are two or more rival networks to BT in the provision of leased lines (referred to as LL Access HNR areas).

A8.94 For the remaining postcode sectors (i.e. postcode sectors with BT and no other network providing leased lines or BT and one rival network), we propose to rely on our MSN analysis to determine relevant markets. Hence, these postcode sectors would fall in either Area 2 or 3. We report the key metrics for rival networks in Table A8.9 below.

[112] BCMR 2019 postcode sectors in the UK (excluding the Hull Area).

Table A8.9: Network analysis for leased lines only networks [113]

	CLA	HNR	Area 2	Area 3
Number of postcode sectors	275 (3%)	304 (3%)	5,536 (58%)	3,511 (36%)
Number of connections in 2017	7,988 (13%)	3,978 (6%)	38,866 (61%)	12,964 (20%)
Average network reach (50 metre buffer distance)	4.3	2.4	0.8	0.1
Proportion of businesses with N rival networks within 50m				
N=0	4%	4%	35%	89%
N=1	6%	12%	53%	10%
N=2	9%	44%	9%	1%
N=3	17%	26%	2%	0%
N=4	18%	9%	0%	0%
N=5	17%	4%	0%	0%
N=6+	29%	1%	0%	0%

Source: BMCR 2019 data and Ofcom further analysis.

A8.95 The evidence suggests that the CLA is a particularly distinct geographic area with significant density of large businesses and a significant number of operators present. Across the CLA, on average large business and mobile sites have a choice of 4 rival networks with presence. 90% of customer sites have a choice of at least two rivals; and 81% have a choice of at least three rivals and 64% with a choice of four or more.

A8.96 For other HNRs postcode sectors, while competition is not as strong as in the CLA, on average sites have 2.4 rival networks with presence. 84% of customer sites have a choice of at least two rivals; and 40% have a choice of at least three rivals and 14% with a choice of four or more.

A8.97 For the remaining postcode sectors, we have calculated the network reach metrics separately for Area 2 and Area 3 (which are based on the areas identified using our MSN analysis excluding the CLA and HNRs [114]). For the remaining postcode sectors that fall in Area 2, there are on average 0.8 rival networks with presence. 11% of customer sites have a choice of at least two rivals; and 2% have a choice of at least three rivals and with no sites with a choice of four or more. For the remaining postcode sectors that fall in Area 3, there are on average only 0.1 rival networks with presence. 1% of customer sites have a choice of at least two rivals; and no sites have a choice of three or more rivals.

Further evidence in HNRs (excluding the CLA)

A8.98 Below we present network presence metrics for HNRs in the top-ten metro areas, as well as the remaining HNRs (outside of the top-ten metro areas).

[113] For analytical purposes, we use 9,626 postcode sectors, based on the 579 postcode sectors in the CLA and HNR, and 9,047 BCMR 2019 postcode sectors that could be matched to Area 2 or 3 postcode sectors.
[114] As explained above, the analysis relies on those Area 2 and 3 postcode sectors that we could match to postcode sectors used in our BCMR 2019 analysis (9,047 postcode sectors).

Table A8.10: Overall statistics for HNRs

HNR sub-area	Number of postcode sectors	Number of connections in 2017	Average network presence
HNR (all)	304	3,978	2.4
Birmingham	10	283	2.7
Bristol	10	280	2.9
Edinburgh	21	466	2.2
Glasgow	20	424	2.6
Leeds	14	327	2.7
Liverpool	28	189	1.9
Manchester	34	481	2.8
Nottingham	7	139	2.2
Sheffield	7	133	2.5
South East London	5	184	2.6
HNR outside metros	148	1,073	2.1

Source: BCMR 2019 data.

A8.99 Across these HNR sub-areas, the average network reach in each area is broadly similar (which range from on average 1.9 in Liverpool [115] to 2.9 in Bristol).

A8.100 As shown in Table A8.11 below, in the HNR postcode sectors, most businesses see two or more operators present.

Table A8.11: Availability of rival networks to businesses within HNRs

HNR sub-area	Proportion of businesses with 'N' rival networks present						
	N=0	N=1	N=2	N=3	N=4	N=5	N=6+
HNR (all)	4%	12%	44%	26%	9%	4%	1%
Birmingham	8%	10%	25%	27%	22%	6%	2%
Bristol	3%	7%	24%	44%	8%	12%	2%
Edinburgh	4%	14%	49%	26%	6%	0%	0%
Glasgow	2%	7%	46%	28%	10%	4%	2%
Leeds	3%	7%	32%	40%	13%	4%	0%
Liverpool	5%	6%	80%	9%	0%	0%	0%
Manchester	4%	5%	40%	19%	18%	10%	3%
Nottingham	2%	15%	44%	37%	1%	0%	0%
Sheffield	1%	11%	37%	40%	11%	0%	0%
South East London	12%	16%	23%	28%	5%	8%	9%
HNR outside metros	5%	17%	51%	19%	4%	3%	0%

[115] Although Liverpool has average network presence of 1.9 across all sites in the area (as shown in Table A8.10), 89% of customer sites have a choice of 2 or more networks present that are rivals to BT.

Source: BCMR 2019 data.

A8.101 Table A8.11 shows that across HNR sub-areas there are two or more operators present at 89% of sites in Liverpool and 90% in Bristol, 91% in Glasgow and Manchester, 82% in Edinburgh and Birmingham and 78% in HNR areas within the rest of the UK.

Our proposed geographic markets based on existing and planned build

A8.102 In Volume 2, Section 7, we set out our proposed geographic markets based on the combined results of our analysis of existing and planned build and service- specific networks.

Table A8.12: Summary of results of geographic market analysis for wholesale local access markets

Geographic Market	Description	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Area 1	Postcode sectors where there are at least two established rival MSNs to BT.	0	0	0.0%	0.0%
Area 2	Postcode sectors where there is already some material commercial deployment by rival MSNs to BT or where this could be economic.	6,037	21.3 million	63.2%	69.8%
Area 3	Postcode sectors where there is unlikely to be material commercial deployment by rival MSNs to BT	3,521	9.2 million	36.8%	30.2%

Source: BCMR 2019 data.

A8.103 Based on the analysis of existing and planned build, we identified an Area 2 for around 63% of postcode sectors, which is 70% of UK premises, with existing coverage by MSNs to just 46% of postcodes sectors, which is 55% of UK premises. Area 3 would be just over 30% of UK premises.

Table A8.13: Summary of results of geographic market analysis for LL Access markets

Geographic Market	Count of postcode sectors	Number of connections in 2017 [116]	% of UK postcode sectors	% of UK premises
CLA	275	7,988	3%	12.5%

[116] The total number of postcode sectors included in RoUK (Area 2) and RoUK (Area 3) is 9,053, however, for the purpose of reporting leased lines connections for RoUK (Area 2) and RoUK (Area 3), we have this based on 9,047 postcode sectors for which we have data from the BCMR 2019 analysis that we could match to Area 2 and Area 3.

HNR	304	3,978	3%	6.2%
Area 2	5,538	38,866	57%	60.9%
Area 3	3,515	12,964	36%	20.3%

Source: BCMR 2019 data

A8.104 Based on the network reach analysis from the BCMR 2019, we identify CLA and HNR geographic markets, which are together 5% of UK postcode sectors but a higher proportion of leased lines connections in 2017 (19%). The remaining postcode sectors are classified based on Area 2 or 3 definitions from the MSN analysis, with: 57% of UK postcode sectors in Area 2, which accounted for 61% of leased lines connections in 2017; and 36% of UK postcode sectors in Area 3 (20% of leased lines connections in 2017).

Supporting table on Ofcom classification of operators' planned status

A8.105 The table below shows how we have classified different operator plans based on the different internal planning status they provided.

Table 8.14: Ofcom mapping of operator internal planning status to Ofcom classifications

Operator with planned build	All internal classifications and descriptions of planned build	Ofcom classifications: 1=Build in progress; 2= Advanced plans; 3= Uncertain/uncommitted plans; 4=Cancelled by operator/not included			
		1	2	3	4
[✂]	*"Under build now"*	x			
[✂]	*"Service activation phase" "Build phase"*	x			
	"Detailed Planning Phase" "Planning Phase" "Core Design Phase" "High-Level design" "Design Phase - Planned" "Design Phase – under consideration"		x		
	"City-selection phase"			x	
	"Deemed not viable"				x
[✂]	*"All funded and with wayleave"*		x		
[✂]	*"Pipeline"* [if the date when build was forecast to be completed was after August 2019 we included it as planned build, otherwise we treated as completed build]		x		
	"Future"			x	

[✂]	*"Very likely by 2026"* [If planned start date listed]		x	
	"Very likely by 2026" [If no start date was included, but the plans were among the operator's next planned tranche to [✂]		x	
	"Very likely by 2026" [If no start date was included, but the plans were among the operator's later planned tranche of build to [✂]			x
[✂]	*"High level planning and funded"*		x	
	"Planned and funded"		x	
	"Planned but Unfunded"			x
[✂]	*"Built"*	x		
	"Forecasted"		x	
[✂]	*"With contractor" "In Progress – Straight to release"*	x		
	"Planning Completed" "In Planning" "Pending Tickets Being Raised" "ODG Approved" "In Progress", "Pending Developer's Acceptance", "Awaiting Contribution", "Pending Approval", "Costs Complete", "Pending Costs", "Pending PC", "Design Costs Complete", "Pending PO",		x	
	"Not yet approved to plan" "Future New development"			x
	"Infrastructure" (removed from dataset) "Job on Hold"			x
[✂]	*"CU – Committed"*	x		
	"PLA – Committed"		x	
	"PLC – Proposed"			x
	"PR1-4 – Proposed by priority level"			x

Source: Ofcom.

A9. Supporting evidence for SMP analysis

A9.1 In our SMP analysis in Volume 2, Section 8, we present data on shares of WLA and LL Access connections, split, for example, by speed and geography. We also present data for leased lines access on the presence of rival infrastructure, and other infrastructure indicators.

A9.2 This annex sets out:

- how we gathered the data underlying our calculations;
- the basis on which we calculated the estimates presented;
- our detailed current and forecast shares of WLA connections, by speed and geography; and
- additional evidence related to the LL Access markets including shares of the VHB and mobile backhaul segments of the LL Access markets.

Wholesale local access

Source of the data

A9.3 In carrying out our analysis of shares of active WLA connections we have relied on two datasets. We collected UK-level data using our formal information gathering powers as part of this review, and geographic data from the Connected Nations dataset. [117]

A9.4 We collected UK-level data using our formal information gathering powers from network providers and telecoms providers. Specifically, we asked both networks (excluding Openreach) [118] and telecoms providers (excluding BT) [119] for a breakdown of connections in June 2019 by broadband speeds (which we refer to as 'actual'). We also asked for six monthly forecasts of these volumes to December 2025. In addition, we asked telecoms providers to provide volumes by network used to deliver services. These forecasts reflect the perspectives at the time of our information requests and are likely to continue to evolve with suppliers' plans.

A9.5 Further information requests were sent to Openreach [120] and BT [121] for the equivalent information.

A9.6 When calculating shares in areas of Virgin Media presence, and shares in our proposed geographic markets (Area 2 and Area 3), we have used Connected Nations data based on the information request sent in May 2019. The dataset includes data on the take-up of broadband, split by network provider.

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[117] The Connected Nations dataset supports Ofcom's periodic Connected Nations reports. The dataset is updated by Ofcom several times a year using our statutory information gathering powers. We have used the dataset resulting from responses to question 2 of our Connected Nations s.135 information request, referenced CN1905-F01 and dated 30 April 2019.
[118] Responses from B4RN, CityFibre, Community Fibre, Gigaclear, Hyperoptic, TalkTalk, Virgin Media and Zzoomm to the s.135 notices dated [✂], [✂], [✂], [✂], [✂], [✂], [✂] and [✂] respectively.
[119] Responses from B4RN, Community Fibre, Gigaclear, Hyperoptic, Sky, TalkTalk, Virgin Media, Zzoomm and Vodafone to the s.135 notice dated [✂], [✂], [✂], [✂], [✂], [✂], [✂], [✂] and [✂] respectively.
[120] Response from Openreach to the s.135 notice dated [✂].
[121] Response from BT to the s.135 notice dated [✂].

Calculating shares

Calculating shares of connections

A9.7 Using data gathered from telecoms providers and network providers we calculated current shares of UK active broadband connections for BT, Virgin Media, and other network providers. Specifically, we:

a) Aggregated data on the total number of connections in June 2019 provided by the network providers excluding Openreach (i.e. B4RN, CityFibre, Community Fibre, Gigaclear, Hyperoptic, FibreNation, Virgin Media and Zzoomm); and

b) Estimated the number of connections in June 2019 delivered using Openreach's network using both:

   i) data provided by Openreach on 2018/19 SMPF volumes, and SFBB and UFBB volumes; and

   ii) data provided by Sky, TalkTalk and Vodafone on SBB connections provided over Openreach's network.

A9.8 We also estimated indicative forecasts of connections by broadband speeds, to the end of the review period (2025), by aggregating network providers' own forecasts. We consider these forecasts to be illustrative only for a number of reasons:

a) There is significant uncertainty as to the extent of network build in practice, and its take-up by telecoms providers.

b) The forecasts provided may reflect different assumptions about future scenarios considered by network providers.

c) We note that there are some inconsistencies in forecasts provided by different parties. For example, [✂] have forecasted a significant increase in the total active broadband connections provided over their network within the review period, which is not consistent with telecoms providers' forecasts (of volumes provided over the [✂] network).

d) Openreach's data from 2019/20 onwards relates to Great Britain (i.e. excluding Northern Ireland), rather than the UK (which includes Northern Ireland), which means that we underestimate BT's current and forecasted share of active connections. [122]

[122] Based on the Connected Nations dataset, there are approximately 1 million premises in Northern Ireland (out of approximately 31 million in the UK), with Virgin Media having [✂].

e) We recognise there is significant uncertainty in forecasting these volumes and have therefore not attempted to supplement these forecasts with our own assessment of how the market might evolve over the period of the review. We needed, however, to make some adjustments to account for missing data. For example, [✂] did not have a forecast for their total broadband connections further than December 2023. In this case, we assumed that the change in total connections between December 2022 and December 2023 to be the same as the change in total connections from December 2023 to December 2024, and from December 2024 to December 2025. We also tested the sensitivity of our results to this assumption by considering the average yearly change across all periods, and the results are not sensitive to this assumption. We have applied a similar approach to other missing data.

A9.9 We therefore consider these forecasts to provide some indication of how BT's share might evolve in the future, but this indication is uncertain and subject to how market developments evolve in practice.

A9.10 In addition, we have also estimated current and indicative forecasted shares by standard, superfast and ultrafast broadband speeds by aggregating networks' and telecoms providers' own forecasts of these different categories of service.[123] These forecasts are also illustrative only, since actual developments will depend on the speed of roll out of new networks by Openreach and its rivals, on telecoms providers' strategies for upgrading their subscriber bases and otherwise pricing the various products, and on how competition in retail and wholesale markets evolves.

Areas of Virgin Media presence

A9.11 Currently, Virgin Media's network covers [✂%] (40-50%) of UK premises and serves just over 15 million premises nationally. In order to analyse the extent to which BT's share of active broadband connections varies within the Virgin Media footprint, we needed to define the geographic extent of the Virgin Media network.

A9.12 Consistent with our approach to assessing shares in Areas 2 and 3, and as outlined in Volume 2, Section 7, we have defined the postcode sector as the relevant geographic unit.

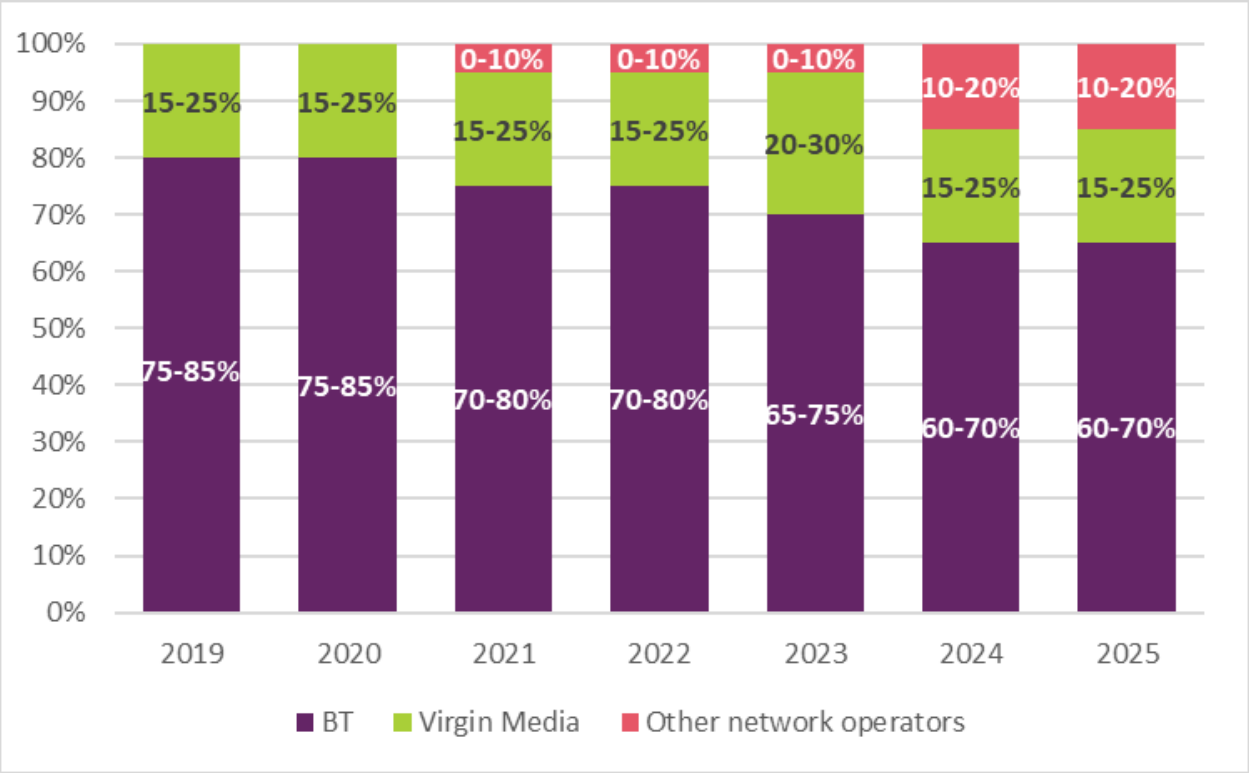
A9.13 Consistent with our approach in Volume 2, Section 7, we have also defined Virgin Media as 'present' in postcode sectors in which Virgin Media has passed 50% of premises.

Results of our analysis

A9.14 We have calculated shares of active broadband connections in the UK, including indicative forecasts to December 2025, using network providers' current projections. As discussed in Volume 2, Section 8, the results do not include standalone landline connections. Given BT accounts for the large majority of these connections, if they were included in our estimates BT's share would be higher.

[123] As above, we have made some adjustments to the data to account for missing data.

Figure A9.1: Indicative forecast of shares of active connections in the UK

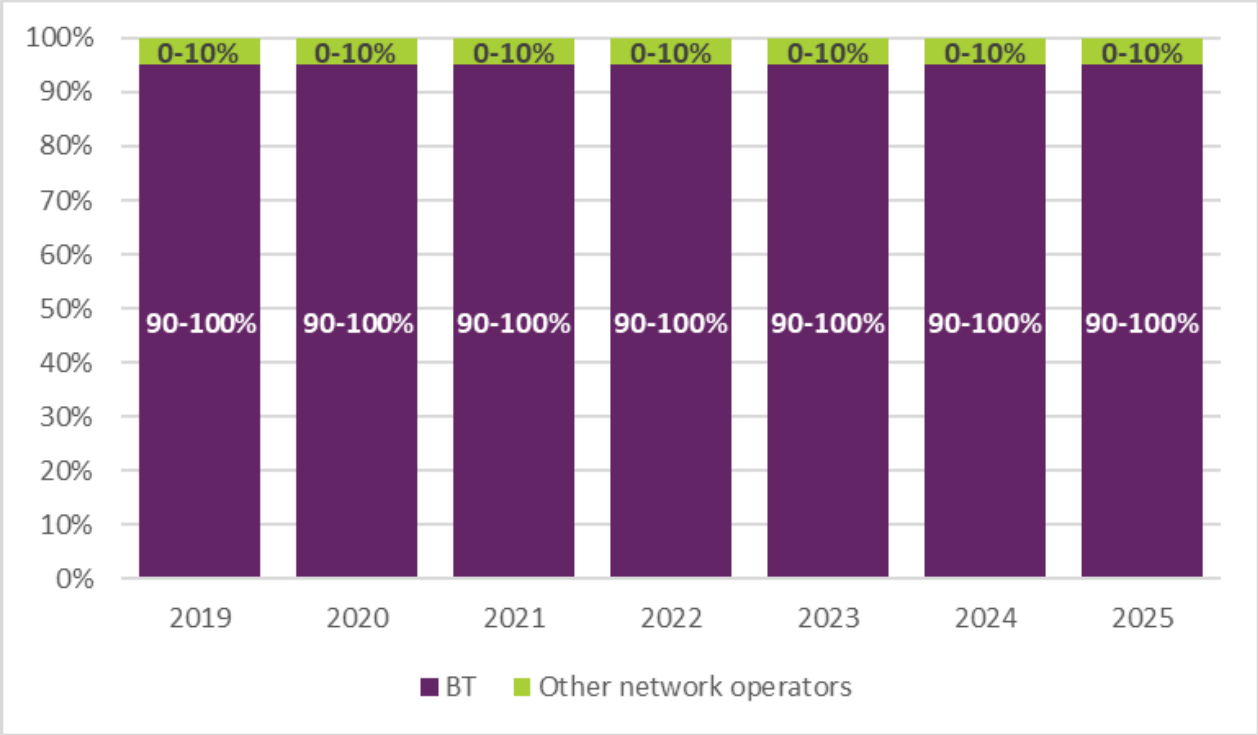


Source: Ofcom forecast based on provider customer connection data (including forecasts). Forecasts are for the end of each calendar year.

Note: BT have provided numbers for GB only from 2019/20 onwards. Shares for BT may therefore be slight underestimates due to the exclusion of Northern Ireland connections data for some lines.

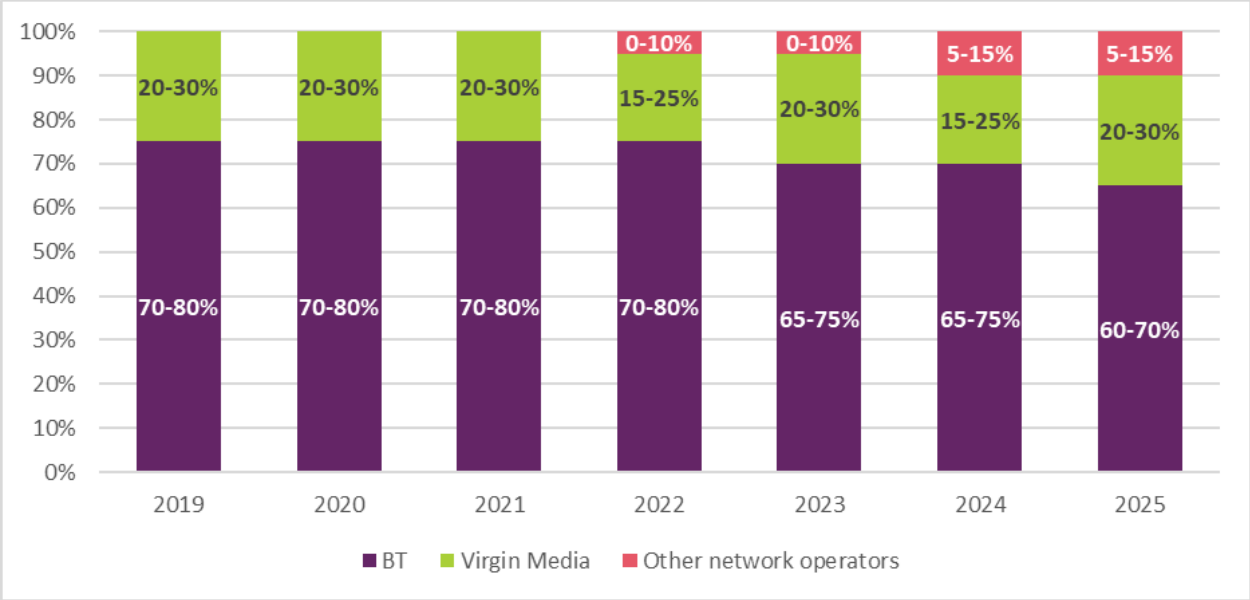
A9.15 As explained in our market definition assessment (Volume 2, Section 6), we consider that for this review period there is strong evidence for including all broadband services in a single market. For completeness, however, we have also analysed shares of active broadband connections by SBB, SFBB, and UFBB services.

Figure A9.2: Network shares for Standard Broadband



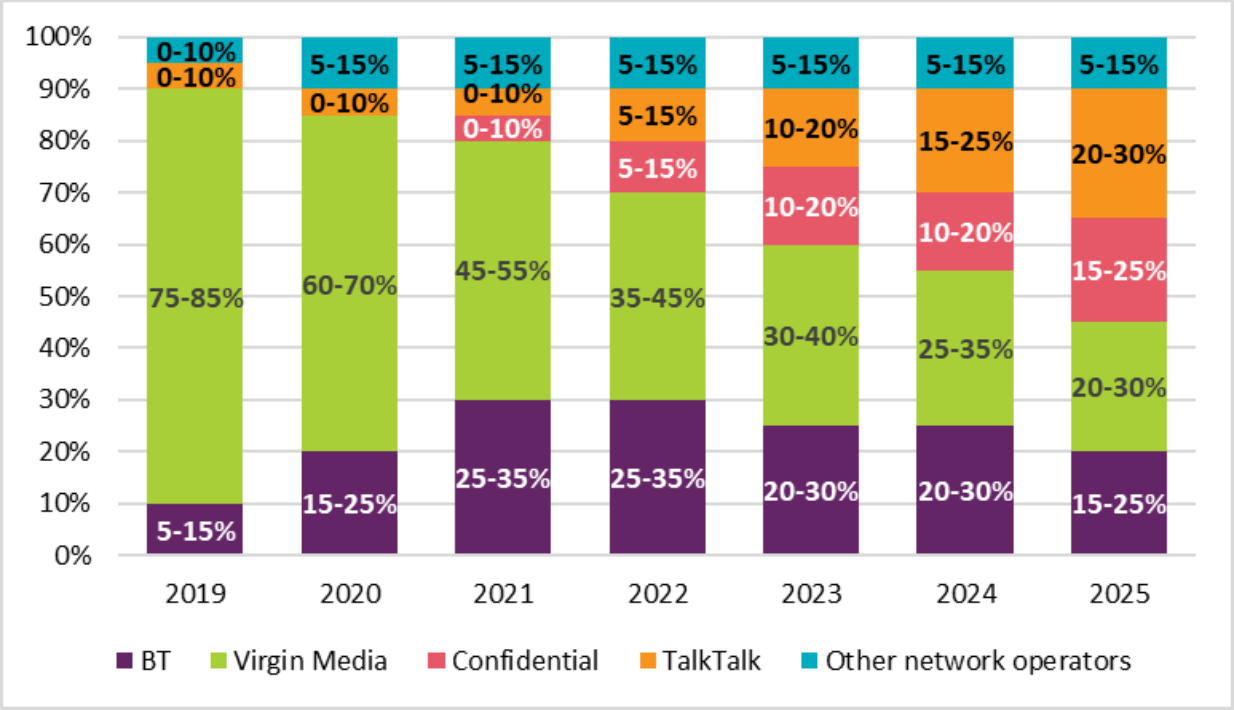
Source: Ofcom forecast based on provider customer connection data (including forecasts). Forecasts are for the end of each calendar year.

Figure A9.3: Network shares for Superfast Broadband



Source: Ofcom forecast based on provider customer connection data (including forecasts). Forecasts are for the end of each calendar year.

Figure A9.4: Network shares for Ultrafast Broadband



Source: Ofcom forecast based on provider customer connection data (including forecasts). Forecasts are for the end of each calendar year.

A9.16 Using the methodology outlined above, we have estimated BT's share in areas of Virgin Media presence as approximately 60% (across both Area 2 and Area 3).

Leased lines access services

Source of data

A9.17 Our analysis of market shares and presence of rival infrastructure is based on the same underlying data collected as part of the 2019 BCMR Statement and uses the same methodology.[124] This data was collected from network operators using our formal information gathering powers, which we will consider updating for our final Statement.

Results of our analysis

A9.18 We have calculated additional evidence for leased lines access markets, presented in Table A9.5. This supports our proposed SMP findings in Volume 2, Section 8. The indicators we have considered are:

- **Proportion of businesses with X rival networks present:** this is based on the 2019 BCMR Statement network reach analysis and captures the degree of choice across an area. For example, 18% of businesses in the CLA have 4 rival networks either connected or very

[124] This is based on the same data processing and analysis set out in the 2019 BCMR Statement. Ofcom, June 2019. *Promoting competition and investment in fibre networks: review of the physical infrastructure and business connectivity markets*, Annex 12.

close to the customer site such that it only requires a very short network extension to connect a customer.

- **Rivals' build vs buy:** in choosing how to supply new customer ends in 2017, where rivals were not connected, they chose to dig for 20% of the new connections in HNR areas.
- **Median radial distance dug:** this gives an indication of how far rival networks dug in an area.

Table A9.5: Additional evidence for LL Access markets

	X	CLA	HNR areas	Area 2	Area 3
Proportion of businesses with X rival networks present [125]	X=0	4%	4%	35%	89%
	X=1	6%	12%	53%	10%
	X=2	9%	44%	9%	1%
	X=3	17%	26%	2%	
	X=4	18%	9%		
	X=5	17%	4%		
	X=6	14%	1%		
	X=7	10%	0%		
	X=8	3%	0%		
	X=9	1%	0%		
Rivals' build vs buy in 2017 [126]		9%	20%	9%	2%
Median radial distance dug in 2017 (m) (non-BT)		9.8	10.5	15.1	17.4

Source: Ofcom analysis based on stakeholder responses to the 2019 BCMR s.135 notices.

A9.19 As explained in our market definition assessment (Volume 2, Section 6), we consider that for this review period there is strong evidence for including LL Access services of all speeds in a single market. For completeness, however, we have also analysed shares of VHB and mobile backhaul leased lines access.

A9.20 The table below presents the number of VHB Access connections and BT's service shares based on new customer ends connected in 2017.

[125] Percentage values may not add up to 100% due to rounding.
[126] We determine rivals 'build' as a percentage of rivals 'build' plus rivals 'buy' in relation to the supply of a leased line to a customer's site outside their existing network reach.

Table A9.6: BT's share of VHB and mobile backhaul

	CLA	HNR areas	Area 2	Area 3
Number of access customer ends in 2017	7,988	3,978	38,866	12,964
Number of VHB access customer ends in 2017	344	118	975	177
BT service share access customer ends	[✂%] 60-70%	[✂%] 60-70%	[✂%] 70-80%	[✂%] 90-100%
BT service share VHB customer ends (based on new connections)	[✂%] 30-40%	[✂%] 60-70%	[✂%] 60-70%	[✂%] 70-80%
Share of BT's largest rival in VHB customer ends	[✂%] 40-50%	[✂%] 20-30%	[✂%] 20-30%	[✂%] 0-10%
BT's share of supply to MNOs (based on MNO inventory)	[✂%] 80-90%	[✂%] 80-90%	[✂%] 80-90%	[✂%] 90-100%

Source: Ofcom analysis based on stakeholder responses to the 1st and 5th 2019 BCMR s.135 notices.

A10. Equality impact assessment

A10.1 Ofcom is required by statute to assess the potential impact of all our functions, policies, projects and practices on equality. 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 regardless of their background or identity.

A10.2 It is not apparent to us that our remedies will have a differential impact on any equality group. Further, we have not considered it necessary to carry out separate EIAs in relation to race or sex equality, or under our Northern Ireland Equality Scheme. This is because we anticipate that our proposals will not have a differential impact on people of different sexes or ethnicities, consumers with protected characteristics in Northern Ireland [127] or disabled consumers compared to consumers in general.

A10.3 The intention behind our approach to regulating the WLA, PIA and leased line markets is to promote competition to the ultimate benefit of end consumers.

Equality impact assessment by Product Market

A10.4 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, sex, gender reassignment, pregnancy and maternity, race, religion or belief and sexual orientation. We also have complementary duties under Northern Ireland's equality legislation.

WLA services

A10.5 We regularly monitor the take-up and use of fixed line services by different groups within society. While this on-going research does show evidence of variation in consumption, we do not consider that the wholesale regulation proposed here is likely to have a disproportionate impact on any of the groups as our regulation is aimed at promoting competition across the range of services for all equality groups that rely on WLA.

Leased lines and PIA services

A10.6 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 – core network services which support a variety of retail services – we do not have any reason to suspect that there would be a disproportionate impact on any of the above defined equality groups through modification of the regulation on these services.

[127] 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.

A11. Potential adverse effects of the physical infrastructure access remedy

A11.1 In 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.

A11.2 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.

A11.3 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 collapse the bandwidth 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

A11.4 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

A11.5 An effective PIA remedy will reduce the absolute costs and time required to build ultrafast broadband 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.

A11.6 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 much 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 telecoms providers generally are supportive of the PIA remedy.

Impact on BT's incentives to invest

A11.7 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. [128]

A11.8 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

A11.9 By allowing telecoms providers to use PIA for business connectivity services, this should have the effect of increasing the competitive pressure on BT'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.

A11.10 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. [129] 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.

A11.11 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 do not consider that the pace of change in scale of competition will be so great that Openreach would not be able to readjust its capital investment to adjust to the new competitive conditions without significant unrecoverable investment costs. 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 our proposed charge control, we believe we have allowed sufficient flexibility for Openreach to recover some revenues to compensate for any reduced leased lines sales – see Annex 16.

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

A11.12 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 have already anticipated this in our charge control calculations and consider that our charge controls should ensure that Openreach will be in a position to recover its efficiently incurred costs over this review period– see Annex 16. 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

A11.13 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. The current pricing structure set by Openreach involves it recovering its common costs across different services, with a higher share of common costs recovered from higher bandwidth leased lines.[130] Higher pricing of higher bandwidth services is called the bandwidth gradient. We acknowledge that in theory a bandwidth gradient can allow a more efficient recovery of common costs relative to a flat pricing structure.

A11.14 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

A11.15 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 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.

A11.16 Moreover, a competitor using PIA to deploy a competing network will most likely deploy a full-fibre network. This is not a simple duplication of the existing network that still relies partly on a copper connection, it is a new means of offering broadband that offers a number of advantages, including much higher speeds and improved service quality.

A11.17 In the long-term we expect the existing copper network will anyway need to be supplemented with new technologies, such as full-fibre, and this process of network upgrade will involve

[130] 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.

simultaneous provision of the current copper network and full-fibre. There is therefore likely to be duplication of copper and full-fibre, whether PIA is used to provide the new technologies or not. 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

A11.18 In Section 8 of Volume 2, we propose to find that the CLA is competitive, and that BT has no SMP. One of the factors in our proposed SMP finding is the increased competitive constraint BT will face from competitors in the CLA as a result of competitors using PIA.

A11.19 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.

A11.20 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

A11.21 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.

A11.22 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

A11.23 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.

A11.24 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.

A11.25 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

A11.26 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. This is due to Openreach only being 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 asset to circumvent the unusable section of Openreach's infrastructure. Openreach can also suggest alternative, more efficient solutions to meet its obligation.

A11.27 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

A11.28 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.

A11.29 We have previously estimated that the costs for network adjustments to leased lines will be immaterial.[131] 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.

A11.30 These small increases in prices are unlikely to affect Openreach's ability to compete, particularly given its SMP. However, the impact of our proposal and objective of the PIA remedy is that other telecoms providers will be able to compete more effectively with Openreach.

Financial impact on Openreach

A11.31 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.

A11.32 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

A11.33 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.

A11.34 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.

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

A12. Guidance on PIA network adjustments and no undue discrimination compliance

A12.1 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 on BT in the physical infrastructure market.

A12.2 In this annex, we outline our guidance on what we constitute a network adjustment, and how we propose to monitor BT's compliance with our no undue discrimination remedy on BT in the physical infrastructure market.

Network adjustments

The requirement to make network adjustments is limited

A12.3 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.

A12.4 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) 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);

d) the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long-term.

A12.5 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 fourth 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.

A12.6 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 fourth factor set out in section 87(4) of the Act.

A12.7 With respect to the third 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.

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

A12.8 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:

a) 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. 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. 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.

b) 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.[132] 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.[133] 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.[134]

A12.9 Network adjustments on ducts or poles may involve requiring existing users of the infrastructure (including itself) to temporarily remove their equipment. We consider that it is reasonable for Openreach and telecoms providers in this instance to cover the costs incurred in removal and replacement of their equipment rather than recover such costs from the Network adjustments pool[135].

A12.10 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.

Is the requested adjustment necessary?

A12.11 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

[132] 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.
[133] The practical effect of this is that these ancillary activities are not subject to our proposals regarding the recovery of network adjustment costs.
[134] 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).
[135] We note that previously this approach had not been consistently applied and that included within the PIA pole charges was the costs of rewiring the poles for all users. This approach is set out in "network adjustments" within Section 4 of Volume 3, and Openreach network adjustment cost recovery set out in Volume 4.

is unlikely to be under an obligation to remedy the unusable section of the physical infrastructure. [136]

Is the requested adjustment feasible?

A12.12 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.

A12.13 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?

A12.14 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.

A12.15 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).

A12.16 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. [137]

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

[137] 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

A12.17 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).

A12.18 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. [138]

A12.19 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).

A12.20 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.

A12.21 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 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

A12.22 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.

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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).

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

A12.23 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.

A12.24 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). [139]

Breaking in and out of BT's network infrastructure

A12.25 Telecoms providers are likely to deploy hybrid networks, using a mixture of Openreach's infrastructure and their own infrastructure. 140 Therefore, to make effective use of Openreach's physical infrastructure, telecoms providers need to be able to break in and out of the infrastructure to interconnect with their own infrastructure. 141 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. [142]

A12.26 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

[139] As network adjustments are made to Openreach's physical infrastructure, Openreach will retain ownership of the relevant assets.
[140] We expect most deployments to be hybrid designs.
[141] 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.
[142] 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).

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

A12.27 In Section 3 we propose to 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.

A12.28 Although we expect Openreach to be able to justify any instances of non-equivalence, we do not consider it necessary for Openreach to set out the entire end-to-end process on how passive infrastructure is used (with differences being individually identified and justified). We are not proposing an upfront obligation on Openreach to justify all instances of non-equivalence, however, we are provisionally 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 telecoms providers to identify any differences in process.

A12.29 We also propose to extend the ongoing monitoring programme we established following the WLA review to ensure Openreach complies with the non-discrimination obligation. This programme 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, and through use of our investigatory powers.

A12.30 With respect to pricing, if Openreach undertakes network adjustments to support BT's own deployments, we propose that it should charge itself internal transfer charges which are consistent with the charges for network adjustments faced by competing telecoms providers using PIA (to the extent that a different approach cannot be justified). This means that costs of network adjustments above the financial limit which are incurred to support BT's own deployments should be attributed entirely to Openreach's downstream products, and not spread across all users of the physical infrastructure.

A12.31 In relation to other aspects of pricing (e.g. rental charges), we consider that the specific regulation we are proposing in relation to PIA pricing is sufficient to address our concerns over price discrimination with respect to third party charges in this review period.

A13. Benefits and risks of dark fibre

A13.1 In this section, we present our assessment of the benefits and risks of the proposed dark fibre remedies (for leased lines in Area 3 and for inter exchange connectivity). As the 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

A13.2 In this sub-section we set out our assessment of the potential benefits that could arise as a result of the introduction of dark fibre. We consider how the dark fibre remedy allows 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

A13.3 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.

A13.4 This provides scope for innovation in the functionality of the electronics used to deliver services (e.g. in equipment software management functionality features), even if innovation in the electronic equipment itself is unlikely given it is standardised globally.

A13.5 Having choice of electronic equipment could also allow telecoms providers to better differentiate their services. 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. [143]

A13.6 Changes to service features could also be implemented more quickly with dark fibre. With active services, any new service feature developed by Openreach (even if it is 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 BT's no undue discrimination obligation. 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

[143] For example, this could include differentiation based on speed, packages, latency, features, pricing structures and quality.

deploy service feature changes based on their assessment of 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

A13.7 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.

A13.8 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. The bandwidth gradient for circuits of 10 Mbit/s, 100 Mbit/s and 1Gbit/s has flattened over time (see below), however there is still a bandwidth gradient between 1 Gbit/s and 10Gbit/s circuits. For example, the unit FAC differential between an EAD 10 Gbit/s and 1 Gbit/s service is £1,768, but the unit price differential is £4,324. [144]

A13.9 Under our proposals, dark fibre pricing is independent of bandwidth, and telecoms providers will have access to the full capacity of their equipment connected to the fibre. Telecoms providers 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. In some cases this may be zero (or close to zero). This lowers the cost of upgrading bandwidth and ensures upgrade decisions based on true incremental costs. [145]

A13.10 As a result, telecoms providers using dark fibre, whether for access or interexchange 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 capacity and rollout 5G more quickly, compared to using Openreach's active leased line products, generating direct benefits for consumers.

A13.11 Whilst the benefits described above could also be achieved through regulating active services to an appropriate standard of cost, there are additional benefits to dark fibre, as set out in this annex, which could not be achieved through the regulation of active services.

[144] Ofcom analysis based on BT's 2017/18 (restated) RFS with Ofcom base-case adjusted costs and Openreach prices as at October 2019. 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 7.9% WACC. For main link costs we have assumed a 5km link distance.

[145] As a general principle, prices in line with costs expand output and therefore static efficiency.

Reducing equipment duplication increases efficiency

A13.12 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.

A13.13 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.[146] If buying inter-exchange services, telecoms providers are highly likely to have equipment in the exchanges at each end of the circuit to perform other functions, such as offering access services from those exchanges or the onward routing of traffic.

A13.14 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.

A13.15 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.[147]

A13.16 We acknowledge that telecoms providers may need to invest in additional equipment to replicate the Openreach's existing functionality and/or systems and process 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 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

A13.17 Openreach launched OSA Filter Connect in 2018. This WDM product provides flexibility for telecoms providers to add their own equipment to other wavelength channels and provides lower-cost bandwidth upgrades through the addition of additional channels. Openreach has

[146] For example, better monitoring capabilities, traffic and circuit aggregation functionality, downstream service features, and/or onward routing of the connection.

[147] 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 £583 of the costs allocated to an Openreach EAD 1 Gbit/s circuit (24%) and £583 of the costs allocated to an EAD LA 1 Gbit/s circuit (36%). BT Regulatory Financial Statement 2019 restated for 2017/18 with Ofcom base-case adjusted costs. 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).

previously argued that the OSA Filter Connect product it offers delivers the same benefits as dark fibre, rendering the dark fibre remedies unnecessary, however we consider that it is less flexible and more expensive than dark fibre.

A13.18 We recognise that OSA Filter Connect provides additional flexibility over other active services, 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.

A13.19 However, OSA Filter Connect does not replicate all the benefits of dark fibre:

a) The base product includes a 10 Gbit/s active Ethernet circuit which may limit the features that can be deployed on this circuit and may therefore not be required by the customer. There may also be equipment duplication for some customers.

b) The product is significantly more expensive than an equivalent active or dark fibre product for bandwidths of 10Gbit/s and below, and so would only be suitable for requirements which are higher than 10 Gbit/s. [148]

A13.20 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 OSA Filter Connect. Alternative telecoms providers could also use dark fibre to offer competing services to OSA Filter Connect, 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 interexchange

A13.21 As inter-exchange connectivity is an important component of downstream broadband, mobile and access leased line services, dark fibre inter-exchange will directly benefit consumers through improvements in the quality of their service and the potential for lower costs to be passed on.

A13.22 Furthermore, dark fibre inter-exchange may encourage investment in access areas by reducing the cost of inter-exchange connectivity. In particular, there may be some areas where access investment could be economic, but there is currently no competitive supply of backhaul and prospects for this to emerge in future are limited. [149] Dark fibre could relieve this bottleneck and enable greater investment in access networks, and so deliver benefits to end consumers.

[148] If a telecoms provider used a 10 Gbit/s active wavelength then they would not be able to benefit from flexibility in the active layer, whilst if they used a different channel to gain flexibility the equipment used to provide the active channel would be wasted.

[149] For example, certain parts of Area 2 (i.e. areas where there is potential for rival network build). In Area 3, access investment is unlikely to be economic even if lower cost backhaul is available.

Risks of dark fibre

A13.23 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 BT's opportunity to recover its costs; and
- result in an increase in faults or make it harder to detect and repair faults.

Impact on incentives to invest

A13.24 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 and services.

A13.25 We do not expect the dark fibre remedies we are imposing to materially weaken incentives to invest in rival networks. 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.

a) For dark fibre access, we limit the scope of the remedy to Area 3 only, where we do not expect there to be material commercial deployment by rival networks, irrespective of the dark fibre access remedy. The scope of any existing networks within Area 3 is also limited.

b) For dark fibre inter-exchange, we limit the scope of the remedy to routes from BT Only exchanges where the nearest rival PCO network is more than 100m away.

A13.26 We also believe that the design of the dark fibre inter-exchange 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 inter-exchange dark fibre, and allowing Openreach to take steps to address such concerns provided they do not unduly restrict circuit configurations and the limited scope of the remedy, deal with this issue. This reduces the risk that existing investments or future incentives to invest in competitive routes would be materially undermined.

Impact on economic efficiency

A13.27 BT 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.

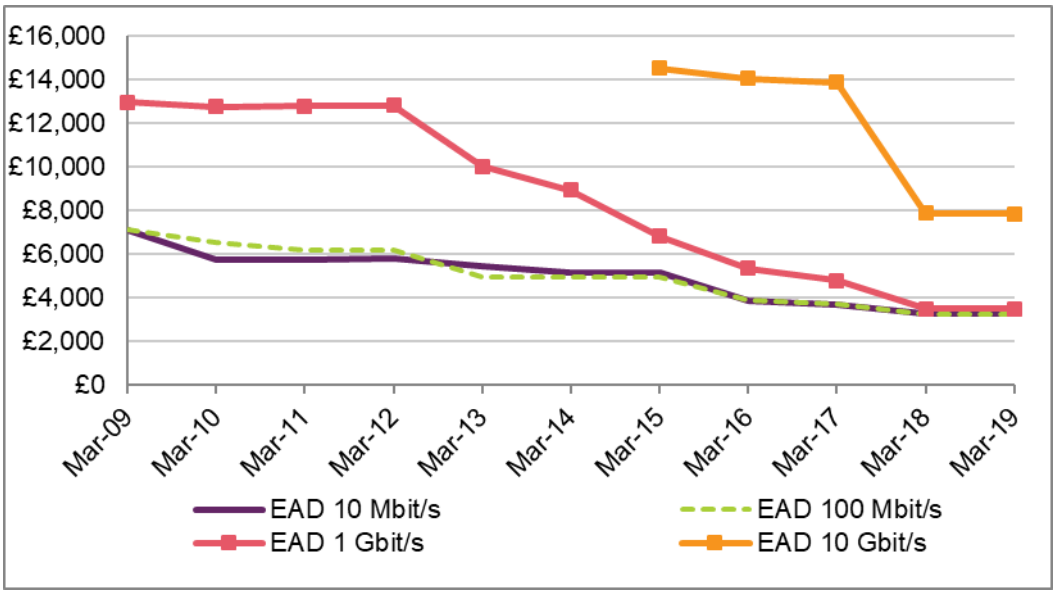
A13.28 The introduction of regulated dark fibre access and dark fibre inter-exchange products priced at cost is likely to reduce Openreach's ability to price its active services above cost, particularly for VHB services where dark fibre is available. As such, dark fibre access and dark fibre inter-exchange are 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 active services to dark fibre.

A13.29 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.

A13.30 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 A13.1 and A13.2 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 10 Mbit/s, 100 Mbit/s and 1 Gbit/s is almost non-existent. Openreach still maintains a bandwidth gradient between 1 Gbit/s and 10 Gbit/s, however it has flattened significantly since March 2018. We also note the evidence set out in the 2019 BCMR which suggested that the inter-exchange bandwidth gradient is already flattening. [150]

Figure A13.1: EAD Bandwidth gradient [151]

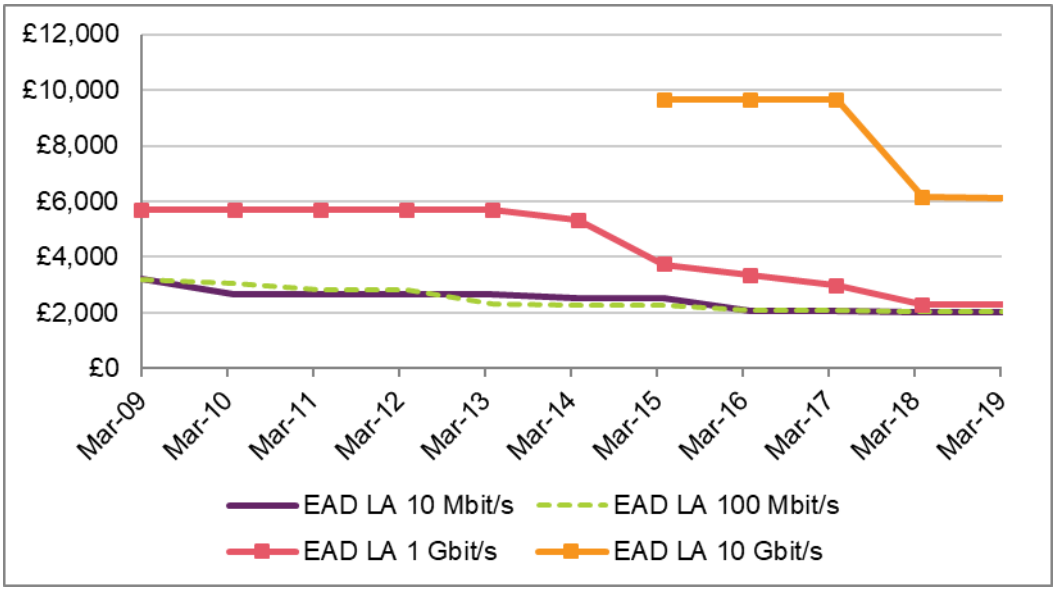


Source: Ofcom based on Openreach price list as at October 2019.

[150] 2019 BCMR Statement, Volume 2, paragraph 12.82.

[151] 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 A13.2, however a main link charge is not included.

Figure A13.2: EAD LA Bandwidth gradient



Source: Ofcom based on Openreach price list as at October 2019.

A13.31 Although a bandwidth gradient between 10 Gbit/s and lower bandwidth services still exists, BT has been able to recover its costs without the need for enhanced contributions from VHB services. Prior to the BCMR 2019 Statement, Openreach's prices for access and inter-exchange Ethernet circuits of 1 Gbit/s and below were subject to a charge control under the Temporary Conditions. That control was set with reference to projections of BT's costs, the base year for which included an attribution of fixed and common costs that had only a weak link to bandwidth costs.[152] Our analysis shows that Openreach has generally priced to the cap allowed within leased lines charge controls.[153]

A13.32 Therefore, VHB's high prices and margins are not facilitating materially lower prices or common cost recovery for lower bandwidth services, and BT'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 BT would still be able to recover its costs without an increase in prices for lower bandwidth services. As such, we do not consider that either of the dark fibre remedies we have proposed 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.

[152] The costs of passive components such as duct and fibre and some common costs such as Systems development, Ethernet Monitoring platform and accommodation costs do not vary by bandwidth. Some costs (Ofcom Admin Fee, Openreach Sales Product Management and Revenue Receivables) are allocated based on revenue and so could vary by bandwidth. However, these costs only account for a small proportion of total costs (less than 2% of the total costs allocated to an EAD 1Gbit/s circuit, for example). This means that even though VHB prices are higher than low bandwidth prices, this only has a small impact on the share of costs allocated to VHB circuits. 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].

[153] In 2016/17, BT priced to the cap for the CISBO basket. In the period December 2017-March 2018 (the first period of reporting under the Temporary Conditions), BT 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 100 Mbit/s circuits below cost. However, these offers are no longer operative.

A13.33 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 remedy 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.

A13.34 In summary, we do not consider that the access and inter-exchange dark fibre remedies will have adverse impacts on economic efficiency or BT'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 BT's cost recovery

A13.35 There is a risk that the availability of regulated dark fibre products in the access and inter-exchange markets will mean that investment in infrastructure that BT has made may become obsolete or cannot be used. If such stranded assets are not appropriately taken into account in setting the price for BT's other services, this could lead to perceived regulatory instability or uncertainty which could reduce BT's incentives to invest in infrastructure in the future.

A13.36 The risk of stranded assets arises in both the access and inter-exchange markets and comes from two sources:

- the active layer or electronics: as these will no longer be included in dark fibre services that replace active services; and
- fibre: to the extent that telecoms providers have a greater incentive to aggregate leading to reduced fibre utilisation on a given route.

A13.37 In general, we consider that the risk of stranded assets in both markets is low. The main passive infrastructure, such as existing ducts, would continue to be used in the provision of both the dark fibre access and dark fibre inter-exchange remedies.

A13.38 In relation to electronics, we expect BT to recover the majority of these costs across the contract period and therefore consider the risk of stranded electronics to be very low.

A13.39 In response to our March Consultation, Openreach commissioned a report by AlixPartners to consider the impact of a dark fibre access remedy in non-competitive areas. In this report, Alix Partners argued that the ability and incentives for telecoms providers to aggregate [154] under the dual dark fibre remedies proposed in the March Consultation, are likely to be material and greater than those for the 2019 BCMR dark fibre inter-exchange remedy. [155]

[154] 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).
[155] AlixPartners report, paragraph 70. AlixPartners considered that dark fibre access risks multiple forms of arbitrage in the form of single-circuit substitution, multiple-circuit substitution and multiple-service substitution. Paragraphs 27 and 31.

A13.40 Aggregation is already an option when purchasing active circuits. For example, rather than buying multiple 1 Gbit/s circuits, a customer can buy a 10 Gbit/s circuit instead. There are already incentives to aggregate BT'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 remedy might result in significant incremental stranded fibre. [156]

A13.41 Moreover, as set out above, aggregation is an important 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 dark fibre on Openreach's cost recovery, we do not view it as an intrinsic objection to the dark fibre remedy.

A13.42 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.

A13.43 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 dark fibre access 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. [157]

A13.44 In relation to dark fibre inter-exchange, we note that the scope for any aggregation is limited by the scope of the remedy. Notwithstanding this, any negative effect may be offset, at least partially, by demand for new inter-exchange dark fibre circuits which do not substitute for existing circuits. [158] 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. [159] We did not consider that this is a material risk and remain of this view. In summary:

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[156] For example, a telecoms provider requiring more than 10 Gbit/s already has 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 A13.1 and A13.2), 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.

[157] We estimate that it is only a minority ([✂%]) of total access circuit segments that are prone to aggregation in Area 3 (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 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.

[158] We discuss this in more detail in paragraphs A20.24-A20.28 of the 2019 BCMR.

[159] EBD circuits are Ethernet connections available mainly at 1Gbit/s and 10Gbit/s from BT's larger exchanges. We propose that the dark fibre inter-exchange remedy will be priced on a per kilometre basis, whereas Openreach's active EBD product is not priced on this basis. 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.

a) Our analysis suggests that the dark fibre remedy would almost always be more cost effective than an EBD 10 Gbit/s [160] service, so there is no incentive to arbitrage at current EBD 10 Gbit/s prices. Instead, telecoms providers will purchase dark fibre for all distances where it is available.

b) 1 Gbit/s EBD circuits currently account for a minority of inter-exchange circuits from BT Only exchanges. [161] If BT were to alter its pricing structure, 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.

A13.45 We have also considered whether there is a risk that telecoms providers may request dark fibre before ceasing their active circuits, which may result in Openreach laying down additional fibre which becomes redundant when the active service is ceased. We do not consider this to be a significant risk as it would only occur on routes with no spare fibre, [162] and we would expect Openreach to provide suitable cost-based migration products which should be more attractive to telecoms providers than requesting additional fibre.

A13.46 In any case, our proposed charge control 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. [163]

Fault frequency, detection and repair

A13.47 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.

A13.48 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 overall. Dark fibre will therefore provide more reliable services and potentially reduce costs, through associated reductions in required repairs.

A13.49 The fault detection and repair processes for dark fibre access and dark fibre inter-exchange 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

[160] For Band A, Band B and Band C circuits.
[161] BCMR 2019 Statement, paragraph 12.107.
[162] In relation to inter-exchange routes, Openreach previously indicated that the inter-exchange market there are currently just 130 routes with no spare fibre, out of all routes between 5,575 exchanges. 2019 BCMR Statement, Volume 2, paragraph 12.103.
[163] 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.

circuits. Repairs (except repairs to Openreach's fibre) would also be within the purchasing provider's control.

A13.50 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.

A13.51 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 our proposed Right When Tested (RWT) charge.

A13.52 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

A13.53 We expect telecoms providers will use dark fibre access and dark fibre inter-exchange, where they are able to realise the benefits discussed above – cost savings and/or increased flexibility and control. We consider take up of each remedy separately below.

Take-up of dark fibre access

A13.54 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.

A13.55 We consider Ethernet circuits are the most similar to the proposed dark fibre remedy 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 (i.e. areas where there is no expected rival network build). [164]

[164] 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 A13.3: Breakdown of Ethernet products at exchanges in Area 3 [165]

Product	Openreach circuits at exchanges in Area 3	
	Circuits	%
EAD LA 10 Mbit/s	[✂]	[✂]
EAD LA 100 Mbit/s	[✂]	[✂]
EAD LA 1 Gbit/s	[✂]	[✂]
EAD LA 10 Gbit/s	[✂]	[✂]
EAD 10 Mbit/s	[✂]	[✂]
EAD 100 Mbit/s	[✂]	[✂]
EAD 1 Gbit/s	[✂]	[✂]
EAD 10 Gbit/s	[✂]	[✂]

Source: Ofcom analysis of Openreach data

A13.56 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. [166] Dark fibre provides clear savings over EAD LA 10 Mbit/s, 100Mbit/s and 1 Gbit/s circuits and even more significant savings over EAD LA 10 Gbit/s circuits. It also provides clear savings for the vast majority of EAD 10 Mbit/s, 100 Mbit/s and 1 Gbit/s circuits and even more significant savings for the vast majority of EAD 10 Gbit/s circuits. [167] Given this, we would expect a significant proportion of new circuits that would have used these services to use dark fibre instead.

A13.57 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. 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). This may limit the speed of migration, even in the face of the saving offered by the remedy.

A13.58 Based on Openreach's current Ethernet product sales 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.

[165] 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.
[166] 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.
[167] Savings over both EAD and EAD LA circuits are likely to persist even where telecoms providers incur additional costs due to non-domestic rates.

Take up of dark fibre inter-exchange

A13.59 To understand the potential take-up of the dark fibre inter-exchange remedy, we have considered analysis previously carried out for the 2019 BCMR. This analysis considered current volumes of EAD circuits. These circuits account for the majority [✂%] of Openreach's total inter-exchange circuits at BT Only exchanges.[168]

A13.60 Other product types, such as OSA or EBD, make up a minority of current Openreach sales from BT Only exchanges. For these, the cost recover from migration to dark fibre are less certain due to the potential need for telecoms providers to add additional equipment to replicate the service provided by Openreach.

A13.61 We also note that in response to the 2019 BCMR Consultation, several stakeholders, including mobile network operators, highlighted their increasing demand for backhaul and the current constraints which they believe dark fibre inter-exchange could alleviate.[169] Further evidence of specific plans to use dark fibre within the scope of the inter-exchange remedy proposed in the 2019 BCMR Consultation was provided by TalkTalk, Vodafone, SSE, Three, Gigaclear and Sorrento.[170]

[168] 2019 BCMR Statement, Volume 2, paragraph 12.117.
[169] 2019 BCMR Statement, Volume 2, paragraph 12.65.
[170] 2019 BCMR Statement, Volume 2, paragraph 12.118.

A14. Quality of Service KPI reporting tables

A14.1 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.

Wholesale Local Access

Table A14.1: 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	x	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	YP	Y
(v)	Percentage of installation orders rejected		Y	Y	Y

(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	YP	Y
(viii)	Average installation time – non-appointed orders		Y P	YP	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
(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

A14.2 '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).

A14.3 'P' means that BT is required to publish this information on its website every three months.

A14.4 '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 in relation to the United Kingdom as a whole.

A14.5 'x' means the KPI does not apply to the service indicated.

A14.6 '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 A14.2: 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** [171]	**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 (P)	Y (P)			Y
e) Time to provide (upper percentile)	Y (P)	Y (P)	Y	Y	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				
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

[171] By NHR areas, we are referring to High Network Reach areas, as defined by our market definition.

Table A14.3: 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	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	
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

A14.7 "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:

e) EAD (including EAD LA);

f) EBD;

g) Cablelink;

h) WDM; and

i) Dark fibre.

j) "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).

A14.8 "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

A14.9 "(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.

A14.10 "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.

A15. Regulation of geographic discounts and other commercial terms

A15.1 We are concerned that BT, through Openreach, may adopt wholesale pricing structures which would deter alternative network rollout. In this Annex we set out our competition concerns in relation to geographic discounts and other commercial terms, and how we propose to use regulation to address these concerns.

A15.2 In relation to geographic discounts, we propose to restrict Openreach's ability to geographically target price reductions as follows:

- FTTC and G.fast – prohibit geographic discounts on rental charges in each of Area 2 and Area 3.
- FTTP – prohibit geographic discounts on rental charges in Area 2.
- Leased lines – prohibit geographic discounts on rental charges in Area 2. This prohibition would not apply in the CLA or HNR areas.

A15.3 There are other commercial terms that Openreach might deploy that could deter alternative network rollout e.g. loyalty inducing discounts. We recognise that such commercial terms may be beneficial. However, we are concerned that some could have the effect of deterring or undermining alternative network rollout.

A15.4 We expect to prohibit any commercial terms which pose a substantial threat to emerging competition without compensating benefits and set out two options for how we might do this. Under our preferred option, we plan to monitor commercial terms proposed by Openreach on an ongoing basis and, where necessary, intervene including through our direction powers under SMP conditions. However, if consultation responses, further analysis or future market developments indicate that this option does not provide sufficient certainty, we would prohibit specific commercial terms which in our view would deter alternative network rollout, except where we give explicit consent.

Competition concerns

A15.5 Over recent years the fibre investment case has improved, and significant scale deployment plans by Openreach and others have been announced (see Section 1 of Volume 2 and Annex 7). However, nascent alternative network deployment is relatively fragile while it establishes scale and reputation. In these early stages we consider that it is potentially vulnerable to conduct on the part of Openreach. Openreach faces a substantial erosion of its market share where new networks are built, and therefore it is likely to have incentives to deter new build.

A15.6 Openreach could use wholesale pricing structures to reduce the returns available to investors in new fibre networks and undermine their investment incentives. We have identified geographic discounts as a particular concern in the context of this review. We also consider that concerns may arise from other commercial terms.

Geographic discounts

A15.7 Our concern is that Openreach may use geographically targeted price reductions, which involve charging different prices for the same wholesale access, in order to deter rollout in areas where others are starting/planning to roll out new fibre networks. This could happen both where Openreach reduces prices ahead of build occurring (e.g. in response to an announcement of rollout) or where Openreach reduces prices after rollout has occurred.

A15.8 If Openreach lowers its prices in a selective geographic area where it faces competition, this may reduce the returns to Openreach in that area.[172] However, this strategy may benefit Openreach in the longer term. If its actions deter alternative network rollout then it will face reduced competition and benefit from a higher market share (and the ability to charge higher prices) in that area over the longer term. In addition, the benefits to Openreach from this strategy could be much larger if it curtails alternative network operators' rollout plans in other areas (as Openreach will face reduced competition across a much wider area). We also note that Openreach is currently proposing to rollout FTTP on a relatively large scale. Even if reducing local prices results in lower returns in local areas – this may not be significant in the context of the overall FTTP investment.

A15.9 We consider that the potential financial gains to Openreach from defending its market share in the face of competition from alternative networks are large. Openreach's own internal analysis [✂][173]

Other commercial terms

A15.10 In the March 2019 Consultation, we focused on geographic discounts. However, several stakeholders have argued that other commercial terms could raise concerns.[174] For example Vodafone noted, "We'd like to see Ofcom take steps to clarify upfront clear rules for discounting, setting out key principles that must be adhered to, ensuring selective CPs cannot be discriminated against and Openreach can't leverage sales in non-competitive areas to guarantee sales in more competitive parts of the country, to the detriment of other wholesale providers."[175]

A15.11 [✂[176]]

A15.12 We recognise that many commercial terms may have benefits e.g. providing for more efficient pricing structures that encourage take up of better quality products. However, we are concerned that Openreach could design commercial terms which undermine alternative network operator rollout. For example, a commercial arrangement which penalises access seekers from moving volumes from Openreach to an alternative network operator with the effect that the alternative network operator rollout is deterred. Openreach is the only operator with a national network footprint. In order to serve the national market access seekers must

[172] When facing competition in an area it may also be profit maximising to reduce prices in order to retain market share.
[173] BT's response dated 12 August 2019 to the s.135 notice titled Promoting investment and competition in fibre networks dated 29 July 2019. [✂]
[174] For example, CityFibre, Vodafone, [✂] and Three.
[175] Vodafone response to March 2019 consultation, paragraph 11.14.
[176] [✂]

purchase some wholesale services from Openreach (i.e. in areas where there is no alternative network). Openreach could design commercial terms which mean access seekers face a significantly higher average charge for services purchased from Openreach if they also purchase from an alternative network operator. This could undermine the business case for alternative network operators which operate on a wholesale business model as they need to attract access seekers to achieve scale and financial viability.

Rationale for *ex ante* regulation

A15.13 We have carefully considered whether *ex ante* regulation is warranted, or whether competition law or other remedies imposed as part of this review would allay our competition concerns.

A15.14 In response to the March 2019 consultation Openreach and BT argued that we have not demonstrated that competition law is insufficient to deal with our concerns around geographic discounts.[177] BT/Openreach argued that Openreach should be able to meet competition fairly and such competition could lower prices to the benefit of consumers.[178] BT and Openreach considered that the restrictions would mean Openreach is unable to be as responsive to customer needs,[179] and BT argued that they may harm the competitiveness of BT's downstream businesses.[180] BT said that we have not shown there are sufficient gains to Openreach from lowering prices where it faces alternative network competition to outweigh the lost profits.[181]

A15.15 Our proposed approach to remedies in this review aims to support investment in very high-speed networks through network competition where this is viable (see Section 1 of Volume 3). As explained below, our concern goes beyond Openreach setting potentially anti-competitive prices within the meaning of competition law and extends to the broader impact that commercial terms may have on alternative network operators' incentives to invest in FTTP.

We are seeking to support competitive build during the early phase of roll out

A15.16 Rivals building new networks will face considerable challenges in becoming established and overcoming the incumbency advantages of Openreach. For example, Openreach benefits from economies of scale meaning it has lower unit costs than an entrant. In relation to FTTP networks, a key advantage comes from it having higher customer volumes i.e. due to having BT Consumer as an 'anchor tenant'.

A15.17 In addition, Openreach has an established relationship with existing access seekers and some level of systems/process integration. Further, access seekers will have to purchase wholesale services from Openreach in some parts of the country. There is a cost to dealing with multiple network operators. Overall, this means alternative network operators are likely to need to offer terms that are at least as attractive as Openreach's to win business.

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[177] BT response to March 2019 consultation, paragraphs 4.24 to 4.26; Openreach response to March 2019 consultation paragraph 73.
[178] BT response to March 2019 consultation, paragraph 4.4; Openreach response to March 2019 consultation paragraph 75.
[179] BT response to March 2019 consultation paragraph 4.16; Openreach response to March 2019 consultation paragraph 75.
[180] BT response to March 2019 consultation paragraphs 1.30 and 4.17.
[181] BT response to March 2019 consultation, paragraph 4.14

A15.18 In Section 8 of Volume 2, we set out our analysis of the wholesale local access and leased line markets where we propose that BT has SMP. This proposed dominance finding means that Openreach's pricing flexibility is more restricted than an operator without SMP. However, we do not consider that the restrictions on Openreach's commercial terms resulting from competition law or other SMP obligations are sufficient to protect nascent entry. Therefore, while rival networks to Openreach are becoming established, we consider it appropriate to limit Openreach's commercial flexibility to a greater extent, including pricing arrangements that might normally be regarded as legitimate commercial reactions to competitive entry for operators with SMP.

A15.19 With no restrictions, Openreach may reduce prices where it faces local competition from alternative networks and some consumers may benefit for a period (assuming any discount in the wholesale price is passed through to the retail price). However, if these discounts ultimately undermine alternative network rollout (as we believe they could) then the longer-term benefits of network competition would be lost. We have a relatively small window of opportunity to encourage alternative network investment. In the context of our overall strategy we place greater weight on reducing the risk to rival network investment.

A15.20 Our emphasis on supporting competition does not extend to permanent protection of entrants or measures that risk eliminating price competition over the longer term with the consequential harm to consumers that would result.

A15.21 With respect to BT's challenge that *ex ante* regulation of Openreach could disadvantage its downstream businesses, we note that Openreach could reduce its FTTP prices uniformly or BT's downstream businesses could purchase wholesale services from alterative providers.

Ex ante regulation is clearer and more effective

A15.22 We do not consider that competition law, which would focus on considering whether Openreach has abused a dominant position, would be sufficient protection to address our concerns. *Ex ante* regulation can more effectively address the risk of specific types of conduct occurring in the market review period.

A15.23 We consider that *ex ante* regulation makes it clearer to Openreach and others what conduct is not permitted. This ensures transparency and promotes regulatory certainty. In contrast *ex post* enforcement, which may take longer to conclude in the event of enforcement activity, would not provide the same degree of regulatory certainty which is itself an important factor in any investment decision.

A15.24 In the context of emerging network investment, *ex post* enforcement action may be too late if competition is deterred in the interim. For example, Vodafone noted, "…we would like Ofcom to take steps to ensure discounting can't be used as an anti-competitive tool. The Competition Act is a poor defence in such circumstances, particularly given the timescales (4 years+), uncertainties and expense to pursue a case, with the complex nature of the issues making the cases difficult to pursue." [182]

[182] Vodafone response to March 2019 consultation, paragraph 11.13.

Insufficiency of other proposed remedies

A15.25 We have also considered whether the other remedies we are proposing in the access reviews would be sufficient to address our concerns. Where we are setting charge controls these apply a cap for charges, but not a floor. The charge controls do not prohibit geographic discounts or other commercial terms that may be a concern.

A15.26 The general requirements for network access to be on fair and reasonable terms, conditions and charges, and not to be unduly discriminatory, could be used to regulate geographic discounts and other commercial terms. We also have powers of direction both in relation to these requirements and on the reference offer.

A15.27 However, we consider that none of these provides the regulatory certainty that is necessary in the case of geographic discounts.

A15.28 In relation to other commercial terms, we are providing additional guidance on how we would interpret and use both our proposed and existing SMP remedies.

Form of *ex ante* regulation

Geographic discounts

A15.29 We have considered the appropriate form of *ex ante* regulation and propose to restrict Openreach's ability to make geographically targeted price reductions by imposing a specific provision in the SMP conditions providing that such conduct would amount to undue discrimination (we refer to this as the non-discrimination condition below). This makes it clear that Openreach is prohibited from discriminating by targeting geographic discounts except where we explicitly consent (see "Process for granting consent for geographic price variations").

A15.30 We consider that this non-discrimination condition is relatively simple to implement and monitor. It promotes transparency and regulatory certainty and will give a clear signal to potential entrants/investors. We already have a form of this non-discrimination condition in place in relation to FTTC and G.fast – so the measure is understood by market participants.

A15.31 We consider that it will directly address the potential harm we have identified and reduce the risks faced by potential entrants and therefore improve the prospects for competing network investments. We note that some stakeholders suggested additional/alternative regulation to address this issue in the form of a price floor - see "Price floor alternative" where this is discussed in further detail.

A15.32 We consider that our proposed non-discrimination condition is appropriate and proportionate in relation to BT's market power in each of the wholesale local access and leased lines access markets in which we are proposing it is imposed. In each case, we consider that the non-discrimination condition is the minimum required to address our competition concern.

Charges that the non-discrimination condition would apply to

A15.33 Our starting point is that the proposed non-discrimination condition should apply to rental charges. We consider the rental charge is the most important charge in terms of; i) the potential effect on competition and ii) alternative operators business models (as it is where they will recover the majority of their costs).

A15.34 We have considered whether the condition should also apply to other charges. CityFibre and INCA argued that the pricing restrictions should also apply to connection and installation charges.[183] [✂] was concerned about Openreach offers to waive connection fees.[184]

A15.35 We currently consider that it is sufficient to apply the remedy to the rental charge alone. We acknowledge that discounted connection charges may have some impact on competition. However, given the charge is a one-off and, in some cases (such as mass migration), will not apply, we do not currently consider that the impact on competition would be significant enough to justify it being subject to the prohibition on geographic discounts.

A15.36 [✂] was also concerned about Openreach offering 'migration' pricing.[185] We have interpreted this to mean promotions to incentivise take-up (e.g. of FTTP). We recognise that such promotions may reflect legitimate intentions e.g. Openreach encouraging access seekers to migrate customers from copper-based services to FTTP to facilitate copper network retirement. However, we would be concerned if promotional offers had the potential to undermine alternative network rollout. We consider that promotional offers on rental charges that have a geographic dimension (i.e. result in different geographic pricing, even on a temporary basis) are captured by our proposed regulation. Openreach should use the consent process if it wants to introduce such a promotional offer (see "Process for granting consent for geographic price variations").

A15.37 We discuss below how the proposed non-discrimination condition on rental charges would apply to the product and geographic markets covered by this review.

FTTC/G.fast

A15.38 In the 2018 WLA statement we imposed a non-discrimination condition which prohibited Openreach from using geographic discounting in relation to FTTC and G.fast across the UK excluding Hull.

A15.39 In this review we are proposing to define three geographic markets for wholesale local access (see Section 7 of Volume 2). We consider that there is significant scope for roll out of competing networks in Area 2. We consider that a prohibition on geographic discounts for FTTC/G.fast is necessary to prevent Openreach for deterring rollout in this area.[186]

A15.40 In Area 3 we do not expect large scale deployment by alternative network operators, but there are likely to be some smaller scale pockets of rollout. Discounting FTTC prices in local areas where alternative networks are starting/planning to deploy could be a very effective way for Openreach to undermine this rollout, particularly given that FTTC is already available to the

[183] CityFibre response to March 2019 consultation, paragraph 4.4.3; INCA response to March 2019 consultation, paragraph 40.
[184] [✂] response to March 2019 consultation, page 3.
[185] [✂] response to March 2019 consultation, page 3.
[186] Where we remove the charge control obligations on FTTC in support of copper retirement, we will also remove the prohibition on geographic discounting with respect to the provision on FTTC. See Section 3 of Volume 3.

vast majority of premises. We therefore consider that the prohibition on geographic discounts for FTTC/G.fast should also apply in Area 3. Openreach has not applied geographic discounts to FTTC or G.fast in the past and we consider that the main reason for doing so now is likely to be to undermine entry. We consider the cost associated with our proposals (in terms of reduced pricing flexibility for FTTC and G.fast) is low and benefits are potentially large because they could promote pockets of alternative network rollout in Area 3.

A15.41 We are currently proposing to have a different approach to regulating FTTC/FTTP prices in Area 2 compared to Area 3, therefore we consider that the uniform pricing requirements would apply within each geographic market (i.e. Openreach could apply a different uniform price in each area). That said, we consider that our proposals may be more effective if they require Openreach to apply uniform prices across both Areas 2 and 3. If we ultimately reach a position where we were proposing to apply the same price controls with respect to these services in both Areas 2 and 3, and we consider that the application of uniform prices across both areas would be more effective, then we may set the rule so prices are required to be uniform across both areas.

A15.42 The benefit of this provision could be undermined if Openreach were able to target price reductions on services currently used alongside these services, i.e. MPF. We therefore propose that the restriction will also apply to MPF when used in combination with FTTC and G.fast.

FTTP

A15.43 In the 2018 WLA statement we did not impose the non-discrimination provision on FTTP. At the time of the 2018 WLA statement we did not consider that Openreach's FTTP deployment was significant enough for it to be able to foreclose FTTP competition over that review period.

A15.44 Openreach has now rolled out FTTP to 1.8 million premises and its prospective rollout plans are significantly larger scale.[187] In May 2019 Openreach increased its FTTP targets to 4 million premises passed by March 2021, with an ambition to pass 15 million premises by the mid-2020s, subject to the right conditions.[188] We therefore consider that Openreach could use targeted FTTP pricing to deter alternative network rollout over the upcoming review period. Even if Openreach has not actually covered a particular area with FTTP, competing network builders will face the potential for Openreach to subsequently build in the area, and the potential impact of that build will be greater if Openreach were able to selectively offer lower prices. [✂]

A15.45 We recognise that FTTP (unlike FTTC) is a new service and there could be valid reasons for different geographic pricing e.g. as part of trialing. We need to balance the potential cost of preventing Openreach from using pricing flexibility for good reasons (e.g. innovative pricing) against the risk that pricing flexibility is used to deter entry.

A15.46 In Area 2, where we are expecting large scale alternative network rollout, we consider the risk that Openreach uses pricing flexibility to deter entry is significant. We consider that the benefits of restricting geographic discounts (to promote competitive entry) exceed the possible

[187] See https://www.openreach.com/fibre-broadband/fibre-first [accessed 19 November 2019]
[188] BT, 2019. *BT financial results for full year to 31 March 2019* [accessed 5 November 2019]

costs of limiting Openreach's pricing flexibility, therefore our view is that the non-discrimination condition should apply to FTTP in Area 2. As discussed in "Process for granting consent for geographic price variations", Openreach will be able to use the consent process to request use of discounts where they are objectively justified and consistent with our policy objectives. In Area 2 we consider that this strikes the right balance between promoting alternative network rollout while also allowing Openreach pricing flexibility where we judge that this is beneficial.

A15.47 In Area 3 we are not expecting large scale alternative rollout of FTTP, and the benefits of restricting Openreach's geographic pricing flexibility (to promote entry) are likely to be lower than Area 2. In light of this, on balance we are not minded to apply the non-discrimination condition for FTTP in Area 3.

Leased lines

A15.48 In the 2019 BCMR we decided not to impose regulation that would prevent Openreach from using geographic discounts for leased lines. We considered that the remedies imposed were sufficient to restrict Openreach's ability and incentives to engage in geographic pricing to deter alternative investment.[189] In particular, we imposed charge controls and did not allow geographic discounts to count towards compliance with these controls. This meant that Openreach could charge lower prices in more competitive areas, but its ability to recoup profits by increasing prices in other areas was constrained by the charge control caps.

A15.49 We are now reconsidering whether additional regulation is required to prevent geographic discounts for leased lines. This reflects our strategy to promote alternative networks and the nature of our 'combined' market review where we assess leased line and broadband markets at the same time.

A15.50 As explained in Annex 7, we see prospects for material network build including networks focused on leased lines and networks offering both broadband and leased lines.

A15.51 Allowing Openreach the ability to offer selective geographic discounts on leased lines to undercut alternative network rivals where they plan/start to rollout could undermine alternative network investment. We are therefore minded to apply the non-discrimination condition to leased lines given the importance of supporting new network entry. We propose to apply the rule in the leased lines access market in Area 2 only. As discussed above, this is the area where we are expecting significant alternative network deployment and therefore where the prohibition on geographic discounts is appropriate. We propose that the non-discrimination condition would not apply to rentals for leased line services in Area 3.

A15.52 In Section 7 of Volume 2 we propose separate leased lines geographic markets for the CLA and HNR areas. In the SMP assessment we are proposing that the CLA is effectively competitive, while in the HNR area there is greater rival infrastructure and a higher likelihood of having network-based competition in future. We are not imposing regulation in the CLA given that it is effectively competitive. In the HNR areas imposing a prohibition on geographic discounts could impede Openreach's ability to compete with established rivals and deprive consumers of the

[189] 2019 PIMR and BCMR Statement paragraphs 13.52 to 13.54.

benefits of that competition. Therefore, we propose that the non-discrimination condition would not apply to rentals for leased line services in the HNR areas.

Product variants

A15.53 We recognise that a number of different variants sit within the products above e.g. different speeds of broadband products (FTTC, G.fast, and FTTP) and those of the leased lines. We have considered whether it would be appropriate to apply the non-discrimination condition to all product variants or only a subset (potentially with different approaches for each of the different technologies and products). If we only applied the restriction to a subset of products, then Openreach would have greater pricing flexibility. However, only applying the condition to a subset of the products would undermine the effectiveness of the remedy because Openreach could use geographic discounts on the unrestricted products to deter alternative rollout. Therefore, our view is that the prohibition should apply to all product variants.

Process for granting consent for geographic price variations

A15.54 We recognise there may be circumstances where geographic discounts may be acceptable. For example, where it would not deter alternative investment and could be beneficial to consumers or where it can be objectively justified. Therefore, we are proposing a process whereby Openreach can request consent to vary prices geographically that would otherwise be prevented.

A15.55 We have proposed to include Condition 4.1 which enables Ofcom to consent in writing to geographic price differentiation. The purpose of the consent process is to provide Openreach with additional pricing flexibility (on a consent basis) where appropriate. In assessing whether to consent to differential geographic pricing we would consider:

- Whether Openreach had provided objective justification for the differential pricing; and
- Whether it is consistent with our overarching policy objectives (including our strategy to promote network competition).

A15.56 The onus is on Openreach to demonstrate that its proposed geographic pricing satisfies the criteria above. We would be happy to discuss with Openreach any specific initiatives that it is considering.

A15.57 In terms of process, the Act requires that we consult for one month where proposing to give a consent for the purposes of an SMP condition if the proposed consent would have a "significant impact" on the market (section 49A).[190] We would assess the need to consult on a case-by-case basis reflecting this statutory requirement and our ability to observe whether a pricing measure by Openreach targeted areas of competitive rollout. Input from relevant stakeholders may be necessary to understand this in some instances, but not others. Early engagement by Openreach will assist with the efficiency of this process. We would not generally expect to consult for any longer than a month and our decision would follow shortly

[190] And in certain circumstances it may be necessary to notify the European Commission where proposals are of "EU significance" as defined by section 150A of the Act.

after the consultation period closed (clearly this would depend on the nature and/or extent of responses from telecoms providers).

A15.58 The process for consenting, where appropriate, would therefore be relatively short. We do not expect it to place an onerous requirement on Openreach, on the basis that it would need to prepare materials that explain any proposed geographic based discount scheme for its own internal purposes and for telecoms providers. In addition, we are proposing that Openreach is required to give either 28 or 90 days' notice (depending on the type of pricing change) before introducing a price reduction under Condition 8 and so there is already transparency regarding its price changes. Again, timely engagement from Openreach will contribute to the efficiency of this process.

Other commercial terms

Our concern

A15.59 There are other ways that Openreach might structure its contracts that could have a significant impact on deterring entry, such as loyalty discounts or pricing contingent on large volume commitments from wholesale customers. An example of our concern is commercial terms which disincentivise access seekers from moving volumes from Openreach to an alternative operator and, in so doing, undermine investment in alternative networks.[191] A contract with a loyalty discount could mean access seekers face significantly higher average charges for services purchased from Openreach if they also purchase from an alternative network. This could create a barrier to using alternative network operators, undermining the business case for entry. Our concerns could apply to all the products and geographic markets where we have found that BT has SMP in this review excluding PIA and IEC (ie for all WLA and Lease line markets).

A15.60 We recognise that Openreach may want to consider different commercial terms as part of a strategy of migrating customers off its legacy copper network in areas where it invests in an FTTP network. In principle we support this objective, as recognised in our copper switchover arrangements. However, we would be particularly concerned about the impact of any commercial terms which incorporate an element of loyalty inducement as these could deter nascent alternative network rollout.

Analytical framework

A15.61 In considering such commercial terms, our starting point is that the creation of any barrier to using alternative network operators would only be justified where:

a) the impact on nascent network competitors is unlikely to be material; and

b) the arrangements will generate clear and demonstrable benefits, such as:

[191] Effectively Openreach is able to leverage its position as the only operator with a national footprint. An access seeker wishing to serve the national market must inevitably purchase some volumes from Openreach.

iii) the arrangements are essential to Openreach's business case for fibre roll-out. In considering what is essential, we would need to see evidence that the restrictive elements were necessary over and above the fact that to date BT Consumer has not sought wholesale services from other infrastructure providers, relying instead on Openreach as a sole supplier and thus should be reliable as an anchor customer, plus our proposed copper switchover arrangements already give BT very powerful levers to achieve migration quickly; or

iv) the arrangements are necessary to offer more efficient prices that would deliver benefits for consumers. For example, setting low incremental wholesale charges to customers for higher quality products. We would evaluate these benefits recognising that more efficient pricing structures of this type often can be achieved in a variety of ways that need not require large volume commitments on the part of wholesale customers.

A15.62 In our view, setting out now an approach to dealing with problematic commercial terms before they are introduced will support investment by providing more certainty to Openreach, alternative network operators, and purchasers of wholesale services.

Options to address our concern

A15.63 Following on from our concerns set out above, we would expect to prohibit any commercial terms which created a barrier to using alternative network operators which Openreach could not justify. We have considered two options for *ex ante* regulation to deal with our concerns:

- Option 1 – Prohibit upfront specific commercial terms which we consider would deter alternative network rollout, unless we explicitly consent.
- Option 2 – Rather than imposing an upfront prohibition, we would use our powers under SMP conditions to intervene to prohibit commercial terms which we consider would deter alternative network rollout where these might arise. To facilitate the effectiveness of this option, we would propose to adopt a 90-day notification period for changes to commercial terms where the price or other contractual conditions are conditional on the volume and/or range of services purchased.

A15.64 Under option 1, Openreach would notify to Ofcom certain specific commercial arrangements in advance of them entering into force. Following an assessment of the commercial arrangements notified to us, we would consult on our provisional view. Following consultation, we would reach a decision either permitting Openreach to proceed with the commercial arrangements or maintaining the prohibition. We would endeavour to reach a view on any such notification on an expedited timescale.

A15.65 Option 1 could provide greater reassurance for alternative network investors. However, we recognise that flexibility on commercial terms may have benefits. There would also be some difficulties with identifying in advance all of the structures that could deter competing investment and specifically prohibit these, with the potential for Openreach to game the rules (designing structures to get around any specific prohibition). This is because there are many possible variants/permutations. More clarity might be achieved with a very broad definition of

possible commercial terms but, the broader the definition, the more likely that an upfront prohibition would inadvertently impact on desirable commercial arrangements.

A15.66 Under option 2 we would monitor the commercial arrangements proposed by Openreach on an ongoing basis and use our powers to intervene to prohibit any pricing structures which we consider would deter alternative network rollout, including through our direction powers under SMP conditions. In considering whether to prohibit any particular commercial arrangements, we would apply the analytical framework set out earlier.

A15.67 The SMP conditions currently require BT to provide at least 28 days notice of any price change. [192] Given the potential damaging impact to alternative network rollout, option 2 includes a proposed requirement for BT to notify contract/pricing changes 90 days in advance to allow Ofcom to consider potential issues and gather feedback from industry participants if necessary. This requirement would apply specifically to commercial terms where the price or other contractual conditions are conditional on the volume and/or range of services purchased.

A15.68 If we reach a view that certain commercial terms raise sufficient concerns to warrant intervention, and BT does not make changes voluntarily, we would propose to use our powers under our proposed SMP conditions to require BT to modify these terms.

A15.69 Under both options, we would expect Openreach to explain to us why any commercial terms that could deter alternative investment are necessary to achieve consumer benefits. We would expect an explanation why any such benefits are likely to outweigh the impact on emerging competition, such that consumers will be better off in the long run. We would welcome discussion with Openreach on new commercial arrangements as soon as is practicable.

Our preferred option

A15.70 Given the importance we are attaching to network competition in this review, we want to ensure that we implement an option which is effective in prohibiting the types of arrangement that we describe above. To the extent that we are satisfied that option 2 provides sufficient certainty in this regard to Openreach, alternative network operators, and purchasers of wholesale services, we consider that option 2 is more proportionate than option 1 because we would only intervene where the commercial terms threaten the emergence of new competition. Although we would expect to consent to desirable commercial terms under option 1, limiting Openreach's commercial flexibility upfront could deter Openreach from bringing forward commercial terms in the first place. However, to the extent that consultation responses, further analysis or future market developments might indicate that option 2 is not effective, we would expect to implement option 1.

A15.71 Therefore, we are consulting on option 2 as our preferred option, with option 1 as a backstop.

[192] Excluding the extension of the duration of a Special Offer at the same or a lower price where 1 working day notice is required. See For WLA markets see 2018 WLA statement, annex 33, page 117, SMP Condition 9.4 available at https://www.ofcom.org.uk/__data/assets/pdf_file/0024/112488/wla-statement-annex-33.pdf [accessed 19 November 2019]. For BCMR markets see 2019 BCMR and PIMR statement, annex 26, page 80, BCMR SMP condition 6.4 available at https://www.ofcom.org.uk/__data/assets/pdf_file/0026/154592/annex-26-legal-instruments.pdf [accessed 19 November 2019]

A15.72 This approach would be timelier than relying on competition law because we could prohibit problematic commercial terms relatively quickly. It would provide alternative network investors with reassurance that we would act swiftly.

Period in advance of conclusion of this review

A15.73 We are concerned that the risk that Openreach could design commercial terms which undermine alternative network operator rollout is not confined to the forward look period of this review but exists today. The powers we are proposing in this consultation to use to address this risk are already available under the SMP conditions imposed in the 2018 WLA and 2019 BCMR market reviews. Therefore, we will monitor any commercial arrangements proposed by Openreach on an ongoing basis and would expect to use these existing powers to intervene to prohibit any arrangements which we consider would deter alternative network rollout. In deciding whether to intervene we would apply the 'analytical framework' set out previously.

Points raised by stakeholders in the March consultation

A15.74 Below we discuss several stakeholder responses to the March 2019 consultation to further explain our concerns and reasons for the *ex ante* regulation we are proposing. This is not an exhaustive discussion of stakeholder responses.

Openreach suggestions for differential geographic pricing

A15.75 Openreach argued that geographic discounts not targeted at undermining the business case of new entrants should be permitted. [193] Specifically Openreach considered it should be permitted to use geographic discounts:

- Aimed at established competitors (e.g. Virgin Media); and
- That were cost-justified and applied across areas with a similar cost base.

A15.76 As discussed above, we propose to include a consent process whereby we can agree to geographic differences in pricing where this is objectively justified and consist with our overall objectives. Openreach should use this consent process and explain to us how the differential pricing it proposes would meet our criteria (see "Process for granting consent for geographic price variations"). This allows us to grant pricing flexibility when it would benefit consumers and is unlikely to damage emerging competition. We do not consider that it is possible to set general rules around the types of geographic discount that would be eligible for consent in advance because this is likely to be context specific.

BT/Openreach incentives to invest in FTTP

A15.77 BT argued that restricting Openreach's pricing flexibility and ability to compete could dampen its incentives to invest in FTTP. [194]

[193] Openreach response to March 2019 consultation, paragraph 74
[194] BT response to March 2019 consultation, paragraph 1.35.

A15.78 Our remedies package as a whole is designed to encourage investment by both Openreach and alternative network operators (see Section 1 of Volume 3). Investment by alternative network operators is an important driver of Openreach's own FTTP investment. We note that Openreach has responded to alternative network FTTP rollout announcements by expanding its own FTTP plans. Our proposals to restrict Openreach's use of geographic discounts provide a proportionate degree of support to alternative network operators during this critical window for rival expansion, and should be considered in the context of the broader package of proposals.

A15.79 We recognise that our proposals will restrict Openreach's pricing flexibility. We also note that Openreach has SMP and incumbency advantages described earlier. Overall, we do not consider that the playing field is unduly tilted in favour of alternative network operators.

Price floor alternative

A15.80 Several stakeholders suggested a price floor in addition or as an alternative remedy to the prohibition on geographic discounts. CityFibre argued that a price floor would reduce investment risk and make it easier/quicker for alternative operators to finance and deploy fibre networks.[195] CityFibre referred to a paper it submitted in response to the 2017 WLA consultation which suggested that we set a price floor for services with speeds greater than 100 Mbit/s based on the long run incremental costs of a reasonably efficient operator (REO).[196] [✂[197]]

A15.81 TalkTalk and Vodafone argued for a price floor in the context of their alternative proposals for adaptive remedies.[198] TalkTalk argued that a price floor based on REO costs should be adopted when there is sufficient alternative provider deployment.[199] [✂] argued that a prohibition of geographic discounts was not sufficient and it would like a "clearer price floor".[200]

A15.82 [✂] If the first order test failed it considered it should be able to present evidence and analysis to allay concerns about the impact on competition.[201]

A15.83 We recognise that a price floor remedy could, in principle, add to the support for competing investments by new entrants. A price floor could provide greater reassurance to alternative network investors by guaranteeing a minimum price for a certain period. It could also mitigate against the risk that Openreach sets prices uniformly, but at a low level, in order to deter competition.

A15.84 A price floor could also permit Openreach greater commercial flexibility to vary prices geographically.

[195] CityFibre response to March 2019 consultation, paragraph 6.1.1
[196] CityFibre response to March 2019 consultation, page 49, paragraph 4.3.5
[197] CityFibre response to March 2019 consultation, 4.3.7
[198] Vodafone response to March 2019 consultation, paragraphs 7.1 to 7.4
[199] TalkTalk response to March 2019 consultation, paragraph 1.17
[200] [✂] response to March 2019 consultation, page 3.
[201] Openreach response to March 2019 consultation, paragraph 11b.

A15.85 However, there are problems with introducing a price floor. The strength of the advantages described above would depend on the level of the price floor. Responses indicate that stakeholders have very different views on the appropriate level of the floor. In summary, [✂]

A15.86 A floor set too high would risk artificially inflating prices which could (i) result in consumer detriment due to high prices, (ii) discourage FTTP take-up, and (iii) would fail to give Openreach the additional commercial flexibility it argues for. A price floor could deter Openreach from investing if it considered that the floor meant it was unable to compete effectively on price with alternative providers.

A15.87 A floor set too low might give Openreach more commercial flexibility, but would not be as effective at preventing Openreach from setting low prices selectively to discourage competitive network build.

A15.88 We consider that the prohibition on geographic discounts remedy we are proposing is a simpler and more proportionate means of addressing our competition concern. It has the advantage that it allows Openreach to compete on price for FTTP, so long as this is not geographically targeted, with the possibility of allowing for geographic differentiation through the consent mechanism where this is justified. Our emphasis on supporting the emergence of new competition does not extend to permanent protection or measures that risk eliminating price competition with the consequential harm to consumers that would result.

Impact of our proposals

A15.89 BT considered that the benefits of our proposed pricing restrictions were unlikely to outweigh the costs. [202] It argued that our proposals to restrict Openreach's commercial flexibility were not needed because our other proposals (access to Openreach's physical infrastructure and keeping regulated wholesale charges flat in real terms) would provide incentives for alternative network investment. [203]

A15.90 BT considered that the benefits of providing a more certain investment environment for alternative operators (by limiting Openreach's pricing flexibility) should be set against the risk that our proposals could prevent Openreach from competing, leading to higher prices for consumers. It added that if entry is inefficient and unsustainable in the long run then this would impose costs on consumers. [204]

A15.91 BT seems to suggest that our proposals to restrict Openreach's geographic pricing flexibility will not improve the incentives for competitive network investment. We disagree. We consider that Openreach does have the incentive and ability to deter alternative network rollout using targeted geographic price reductions. This is supported by responses from alternative network operators. [205] We consider that our proposals are a proportionate way to address this concern. If targeted price reductions by Openreach did stifle rollout by rivals and hence network competition, the harm to consumers could be very considerable and enduring.

[202] BT response to March 2019 consultation, paragraph 4.30.
[203] BT response to March 2019 consultation, paragraph 4.32.
[204] BT response to March 2019 consultation, paragraphs 4.34 to 4.35.
[205] For example, CityFibre and Gigaclear.

A15.92 Given the challenges facing new rival networks in becoming established, we consider that it is unlikely that our proposals would contribute to any inefficient entry. Rather, it is designed to prevent targeted action on the part of Openreach that has the potential to reduce the scope of efficient competitive entry.

A16. Cost modelling for active services

A16.1 In Volume 4, we set out our proposals to implement different charge controls in Area 2 and Area 3, reflecting our assessment of where we consider there is a potential for network competition.

A16.2 In Section 1 of Volume 4 we set out our Area 2 proposal to cap prices with a flat real (i.e. CPI-0%) control for the following Wholesale Local Access (WLA) services:

a) MPF SML1 rentals; and

b) 40/10 FTTC services.

A16.3 In Section 2 of Volume 4 we set out our Area 3 proposals to set cost based charges in Area 3 for the following WLA services:

a) MPF SML1 rentals; and

b) FTTC at all bandwidths.

A16.4 In Sections 1 and 2 of Volume 4, we also set out our proposals for leased lines services:

a) leased line access (LL access) services including Ethernet and WDM services at all bandwidths in Areas 2 and 3;

b) Leased line inter-exchange connectivity services including Ethernet and WDM services at all bandwidths to BT only and BT + 1 exchanges;

A16.5 We have undertaken cost modelling to understand the likely evolution of efficient costs of the relevant services [206] over this review period. This allows us to understand how setting a CPI-0% cap compares with the accounting costs that we expect BT to face.

A16.6 The purpose of the modelling is to understand the broad implications of keeping prices flat [207] on BT's cost recovery, ensuring our proposals strike a reasonable balance between protecting consumers and allowing BT to recover efficiently incurred costs.

A16.7 We have calculated the cost of services in Area 3 by forecasting the unit cost by service on a national basis and then applying our forecast volumes for Area 3 to these national costs.

A16.8 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 lines and the 2018 WLA charge controls. We refer to this model as the 'Top Down model'.

A16.9 Table A16.1 below summarises our proposed charge controls for Area 2 and Area 3.

[206] Within this annex we refer to relevant services, these consists of: all rentals and connections including mainlink for the Ethernet 1Gbit/s and below basket, all rentals and connections including mainlink for the Ethernet VHB basket, all FTTC rentals covering all bandwidths for the FTTC rentals basket and MPF SML1.
[207] In real terms.

Table A16.1: Proposed charge controls in Area 2

Basket/service	Proposed level
LL access	CPI-0%
MPF SML1 rentals	CPI-0%
FTTC 40/10 rentals	CPI-0%

A16.10 Our modelling suggests that, in **Area 2,** a CPI-0% charge control instead of a control set on a FAC basis could lead to BT recovering around [208]:

a) £100m to £450m more over the review period on CI access services at 1 Gbit/s and below;

b) £140m to £490m more over the review period on CI access services at Very High Bandwidths, which is an upper bound estimate;

c) £125m more over the review period on MPF SML1 rentals;

d) £90m less to £215m more over the review period on FTTC 40/10 rentals.

A16.11 For FTTC other bandwidth rentals which we are not proposing to charge control in Area 2, our modelling suggests possible over recovery of £210m to £590m over the review period.

A16.12 The above recovery estimation for CI access services at Very High Bandwidths (VHB) assumes Openreach will price to the cap for VHB services. As explained in Section 1 Volume 4, in practice we do not believe that this is likely to occur. Given this, the recoverability estimation presented here is higher than that which is likely to occur in practice.

Table A16.2: Proposed charge control X ranges in Area 3

	Proposed level
LL access	CPI-0%
MPF SML1 rentals	CPI-CPI
FTTC all bandwidths rentals	CPI-5.75% to CPI-15.0%

A16.13 In **Area 3**, for LL access a CPI-0% charge control instead of a control set on a FAC basis could lead to BT recovering around [209]:

a) £20m to £85m more over the review period on CI access services at 1 Gbit/s and below; and

b) £30m to £110m more over the review period on CI access services at Very High Bandwidths. [210]

[208] Numbers below are in 2018/19 real terms and for GEA services include our estimate of volume discounts and are compared against a control with a glidepath to FAC by the end of the period.
[209] Numbers below are in 2018/19 real terms
[210] As explained for Area 2 above, this recovery estimation assumes Openreach will price to the cap for VHB services which we do not consider to be likely to occur and so the actual over recoverability would be lower.

A16.14 For MPF SML1 rentals and FTTC rentals in Area 3, we are proposing cost-based charge controls (with a potential RAB uplift) so are not forecasting over recovery over the charge control period.

Table A16.3: Proposed charge controls for Inter Exchange circuits (IEC)

	Proposed level
LL IEC	CPI-0%

A16.15 For inter-exchange leased lines, a CPI-0% charge control instead of a control set on a FAC basis Nationally could lead to BT recovering around [211]:

a) £80m to £410m more over the review period on all inter-exchange connectivity services including Ethernet and WDM services at all bandwidths to BT only and BT + 1 exchanges. [212]

A16.16 In this annex we set out:

- the overall modelling approach we have taken;
- the details of certain key assumptions in the model; and
- the outputs of the model and the implications for BT's cost recovery.

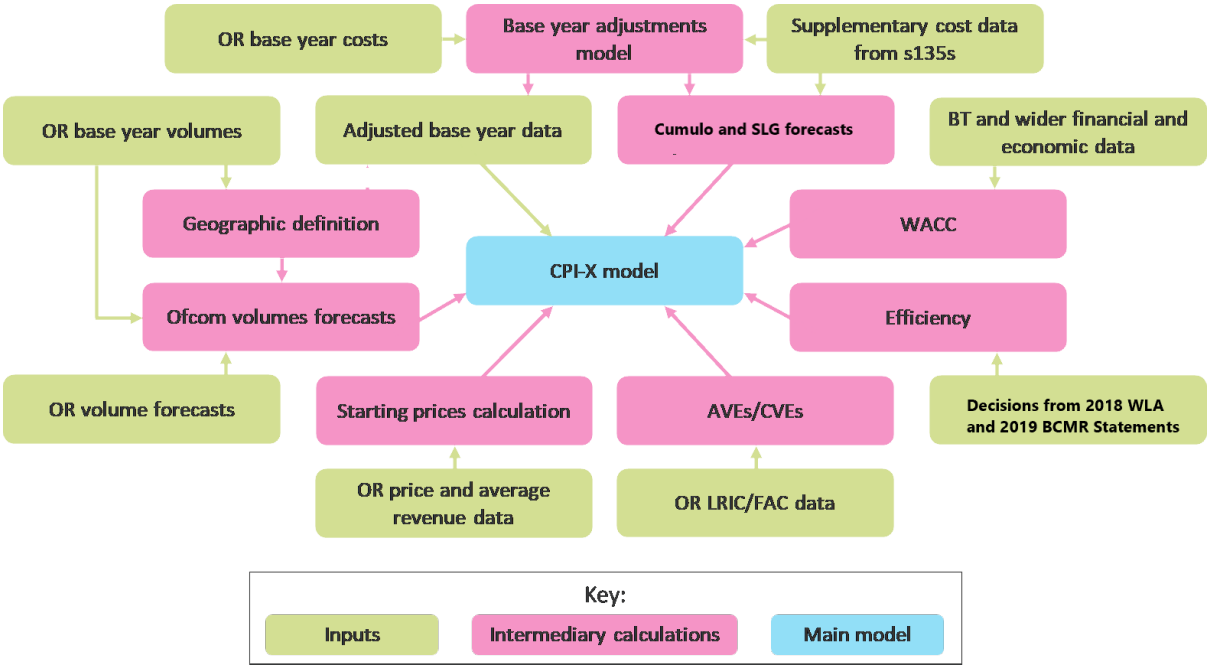
Overall approach to cost modelling

A16.17 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 A16.1 below.

[211] Numbers below are in 2018/19 real terms

[212] As explained for Area 2 above, this recovery estimation assumes Openreach will price to the cap for VHB services which we do not consider to be likely to occur and so the actual over recoverability would be lower.

Figure A16.1: The Top-Down model structure



Note: in this Figure 'OR' refers to Openreach. Other acronyms are described later in this annex.

Approach to modelling

A16.18 Consistent with 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

A16.19 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.[213] This is based on forward-looking costs plus some relevant sunk costs, such as the cost of duct.

A16.20 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 line, MPF and 40/10 FTTC.

A16.21 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

[213] 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

A16.22 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 cost for all copper assets capitalised from 2017/18 through to the end of the charge control period to be fully depreciated by 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 more costs to FTTC rentals.

e) Fifth, we forecast revenues in each year until the end of the charge control, absent a charge control over the forecast period.

f) Finally, we compare revenues and costs for each set of relevant services.

v) For leased line services, this is done to assess the effect of setting a CPI-0% control rather than a CCA-FAC-based charge control in Area 2 and for inter exchange circuits at BT only and BT+ 1 exchanges.

vi) For the FTTC 40/10 Rental service, again this is done to assess the effect of setting a CPI-0% control rather than a CCA-FAC-based charge control in Area 2

vii) For MPF rentals and FTTC rentals (at all bandwidths) in Area 3, this is done to calculate the annual price change needed to bring revenues in line with costs in the final year of the control (i.e. the 'X' in the CPI-X control).

A16.23 We describe each of the steps and key assumptions used in more detail below.

Base year costs

A16.24 The first step in our top-down modelling is establishing the relevant costs in the base year for the charge control. These base year costs are based on regulatory accounting data provided by

BT. We use BT's 2017/18 restated RFS costs as the starting point for our base year.[214] We then adjust the data to reflect our view of BT's efficiently-incurred costs. These adjustments are quantified in Table A16.4 and discussed separately below.

Table A16.4: Summary of adjustments to our base year model on Relevant Services (£m)[215]

	PI* Operating costs (opex) (£m)	PI Mean Capital Employed (MCE) (£m)	Non-PI Operating costs (opex)[216] (£m)	Non-PI CCA Depreciation (£m)	Non-PI Mean Capital Employed (MCE) (£m)
2017/18 restated RFS total unadjusted	69.1	2,091.4	644.0	591.2	3,818.3
Remove cumulo costs[217]	-	-	-88.0	-	-
Restructuring charges and property provision costs smoothed for 3-year average	-0.1	-	-1.5	-	-
Incorrectly allocated overheads	-	0.4	-4.5	-	0.7
Change in pensions service costs	0.2	-	3.0	-	-
Fibre CCA revaluation	-	-	0.2	-25.9	-101.6
Replace Excess Construction Charges (ECCs)	-	-	36.1	-4.0	-87.7
Remove Ethernet service level guarantee (SLG) payments	-	-	-20.5	-	-

[214] Although the 2018/19 RFS has been published, we have not had sufficient time to obtain the relevant data from Openreach and perform the necessary adjustments and checks to make the data for 2018/19 usable in our model. Our intention is to update the base year data for our Statement.
[215] The costs associated with the PI market are based upon a number of assumptions which we and will continue to be analysed before the final Statement. As such these costs may change as improvements are introduced.
[216] Excluding holding gains and losses and other CCA adjustments
[217] The removal of all cumulo costs is the first adjustment made to the 2017/18 restated base data. All other adjustments below have been made excluding cumulo.

Remove Openreach repayment works	-2.0	-75.0	-	-3.1	-40.9
2017/18 restated revised total	67.2	2,016.8	568.9	558.2	3,588.9

** PI refers to physical infrastructure, such as Openreach's ducts and poles*

Source: Ofcom figures calculated from analysis on BT data

Adjustment to remove cumulo costs

A16.25 BT's cumulo rate costs are the non-domestic rating costs BT pays on its rateable network assets.

A16.26 BT's rates bill is expected to rapidly 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 Top Down cost model. This is consistent with the approach taken in the 2019 BCMR and 2018 WLA charge control modelling.

Adjustment to smooth restructuring charges and property rationalisation provision costs

A16.27 Restructuring costs are associated with changes in BT's organisational structure that result in employee redundancies (with costs from redundancies known as leaver payments).

A16.28 Property rationalisation provision costs relate to BT's strategy of consolidating its office space to enable the mothballing and subletting of buildings.

A16.29 As in the 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 by smoothing them over a three-year period. [218]

Adjustment removing overheads incorrectly allocated to SMP markets

A16.30 In the 2016 BCMR Statement we reviewed the rules used to attribute BT Group overheads. [219] Where we could not find a cost causal driver, we required BT to use a previously allocated costs (PAC) methodology to attribute BT Group overhead costs to services based on the amount of cost already attributed to those services. [220]

[218] 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.
[219] See Annex 28 of 2016 BCMR Statement.
[220] Specifically, the attribution would depend on how much operating cost, depreciation and return on capital had already been attributed to relevant services

A16.31 We have investigated organisation unit codes (OUCs) where the amount of cost attributed using Group PAC increased during this period, and also investigated OUCs where the description in BT's Accounting Methodology Document [221] indicated that they may not be relevant to services in SMP markets. [222]

A16.32 Where it has been clear that the costs should not have been allocated to SMP markets we have removed the costs from the base year data.

Adjustment reflecting the increase in pension service costs

A16.33 In early 2018 BT entered into new agreements with the trade unions on pension arrangements. [223] [224]

A16.34 In light of these changes to BT's pension schemes, we do not consider it is appropriate to use the 2017/18 restated pension costs as a basis for estimating the efficient level of costs as the 2017/18 restated costs will reflect the new pension arrangements for only a part of the financial year. Instead we believe BTs forecast pension expense in 2019/20 is a better estimation for the future efficient level of pension costs. [225] We have adjusted the base year costs to reflect the forecast 2019/20 pension expense.

Adjustment for fibre CCA indexation

A16.35 BT's current approach in the 2018/19 RFS [226] is to revalue its fibre assets by using a CPI indexation approach.

A16.36 Within the 2019 BCMR market review we decided that HCA was a better proxy for the CCA valuation of fibre assets. [227]

A16.37 For this Consultation we have adjusted the base year data to reflect the decision made within the 2019 BCMR i.e. using HCA as the CCA valuation for the Fibre assets. [228]

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[221] https://www.btplc.com/Thegroup/Policyandregulation/Governance/Financialstatements/2019/AccountingMethodologyDocument2018-19.pdf

[222] The following OUCs have been investigated during this market review: VR-'BT Security Design & Delivery', VU-'Security Solutions UK Global & UK Enterprise', VL/VN/VP-'Security Solutions AMEA, Americas and Europe', TNQ-'Global operations' and TLB-'Design, delivery and support of Voice network platforms and services'

[223] On 5 February 2018, BT announced that it had agreed with the Prospect union to close the BT Pension Scheme (BTPS) to managers from 31 May 2018. It also agreed to make some changes to the contribution rates for all managerial staff in the BT Retirement Saving Scheme (BTRSS). https://www.btplc.com/News/#/pressreleases/bt-to-close-defined-benefit-pension-scheme-for-10000-managers-2405030 [accessed 21 May 2019].

[224] On 19 March 2018, BT announced that it had agreed with the Communication Workers Union (CWU) to also close the BTPS to all team members from 31 May 2018. https://www.btplc.com/News/#/pressreleases/bt-announces-closure-of-its-defined-benefit-pension-scheme-2451910 [accessed 21 May 2019].

[225] This adjustment has made in the same way as described in the BCMR 2019 Statement, Annex 19, paragraphs A19.29-34. Except within this consultation, given it has now been well over one year since the announced removal of c.13,000 roles and the hiring of c.6,000 employees across engineering, customer service and cyber security areas, the forecast pension expense has not been adjusted to account for this change in headcount.

[226] Thus, in the 2017/18 restated base data.

[227] BCMR 2019 Statement, Annex 19, paragraph A19.54.

[228] This adjustment has made in the same way as described in the BCMR 2019 Statement, Annex 19, paragraph A19.55.

Adjustment for ECCs

A16.38 BT's current treatment of ECCs within the 2018/19 RFS is to capitalise all costs relating to both the fixed fee ECC cost recovered from connection services and other ECC costs recovered against separate additional ECCs.

A16.39 We do not agree with capitalising ECC costs. Instead, we consider that the costs should be expensed in the same period that the revenue is recognised. Therefore, for both fixed fee ECC and other ECC costs, where the revenue is recognised either in the connection fee or as an upfront additional charge, we treat these costs as an operating cost in the year they are incurred. [229]

Adjustment to Ethernet SLG Provision costs

A16.40 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. [230] These SLG payments are part of BT's operating costs.

A16.41 In previous charge controls we have allowed BT to recover an appropriate forward-looking estimate of these costs. Within this Consultation, we propose to continue to include these costs in the base year, but to adjust 2017/18 restated base year provision SLG costs for Ethernet as we do not consider them to be reflective of the efficient level of cost. [231] [232] We then forecast forward Ethernet SLG costs separately which is discussed in the SLG section below.

Adjustment for Openreach repayment works

A16.42 Openreach's repayments programme is made up of two sub-programmes: repayment alterations; and repayment damages. Repayment alterations relate to pre-planned jobs, where work is requested by external parties (e.g. local authorities) to alter the Openreach network due to building, redevelopment, utilities or transport projects such as HS2. Repayment damages relate to the repair of the Openreach network caused by third party damage and reported via the Openreach damage control unit.

A16.43 Within BT's RFS, repayments work activity that is capitalised is attributed to the same network components that contained the original (now altered) asset, and so in some cases the costs will have been attributed to regulated markets. [233] The revenues are however wholly attributed to the Openreach residual market. We believe that revenues should be matched to costs and

[229] This adjustment has made in the same way as described in the BCMR 2019 Statement, Annex 19, paragraphs A19.58-62.
[230] For example, see page 84 of BT's 2017/18 AMD.
[231] We have reviewed the repair SLG costs and do not consider there to be an issue with the level of repair SLG costs.
[232] Our calculations for what an efficient level of SLG provision costs in the base year is consistent with that described in the BCMR 2019 Statement, Annex 19 Paragraph A19.74 except we have since obtained updated data from Openreach, so have used a 4 month run rate to June 2019.
[233] Openreach capitalise an asset where improvements on the old can be identified. Capitalising the value of the new asset less the value of the old asset that is being improved.

therefore have made an adjustment to reattribute any capitalised repayment work costs [234] previously attributed to regulated markets to the Openreach residual market.

A16.44 The methodology for attributing repayments works costs within BT's RFS has been in place since the creation of Openreach (January 2006). To reattribute these costs, we therefore consider the cumulative impact back to 2006. [235]

IFRS 16

A16.45 We have not adjusted our base year costs to reflect the changes which will come into effect from 2019/20 in relation to IFRS16.

A16.46 This means that operating lease expenses are included within operating expenses and not capitalised. This treatment is consistent with previous charge controls.

Forecasting costs

Overall approach

A16.47 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 in the 2019 BCMR and 2018 WLA. [236]

A16.48 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.

A16.49 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.

[234] As well as any associated depreciation.
[235] The calculation of the adjustment has been done in the same way as that described in the BCMR 2019 Statement, Annex 19, paragraphs A19.79-A19.85.
[236] 2019 Promoting competition and investment in fibre networks – review of the physical infrastructure and business connectivity markets, Volume 3, Annex 18.

Key modelling assumptions

Volume forecasts

A16.50 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.

A16.51 We are forecasting the costs and revenues of Openreach's regulated relevant services, on a service-by-service basis.

A16.52 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.

A16.53 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.

BCMR forecasts

A16.54 Openreach provided us with two sets of volumes forecasts [237]:

a) a short-run forecast covering 2019/20, broken down by individual service; and

b) a long-run forecast covering 2020/21 to 2023/24, broken down by broad bandwidth categories and technology only.

A16.55 Neither forecast breaks services down by geography with both sets of data providing forecasts on a national basis.

Adjustments to Openreach's BCMR forecasts

A16.56 We have identified some areas where we consider adjustments are needed to Openreach's BCMR forecasts to make them appropriate for use in our Top Down model [238]:

- adjustments to convert the more aggregated long-run forecasts into suitable service-level growth rates;
- a bespoke forecast of main links; and
- an adjustment to reflect the potential impact on volumes of the PIA remedy.

Converting the more aggregated long-run forecasts into suitable service-level growth rates

A16.57 Openreach's long-run forecast aggregates services into broad categories, with all services within a given category receiving the same growth rate. We have adjusted the growth rates for some services, which we consider should have a different growth rate to the rest of the

[237] Openreach response dated 26 September 2019 to question 12 of the FTMR/S.135/210819 request. Forecasts were requested up until the end of the charge control 20225/26 however only to 2023/24 were available.
[238] 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 Consultation, both forecast and actual volumes were provided excluding Northern Island and then growth rates applied to the RFS 2017/18 restated actuals. As such, no separate specific adjustment is required to align the two data sets.

category they have been included with based on how we expect demand for these services to develop over the charge control period:

- we assume a lower growth rate for 10 Mbit/s services compared to 100 Mbit/s services;
- we assume lower growth rates for WES/BES services compared to EAD services at the same bandwidth, given the planned closure of the legacy WES/BES platform by mid-2020; and
- we assume higher growth for LA services compared to their non-LA equivalents, consistent with historical trends.

A16.58 In each case, we change the growth rates of both the adjusted services and the remaining services within a category such that the total volume growth of each broad service category remains in line with Openreach's original forecast.

Main link forecast

A16.59 Openreach's forecasts do not include forecasts for main link services. 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 PIA remedy

A16.60 In the 2019 BCMR, we set out our decision to give unrestricted access to Openreach's network of underground ducts and poles. Unrestricted access will allow telecoms providers to use PIA to provide business connectivity in more circumstances than the previous mixed usage arrangements under our 2018 WLA decision. Additional use of PIA products may increase competitive pressure on some of Openreach's wholesale active products. Consequently, Openreach may see a reduction in its future volumes of leased lines services.

A16.61 We consider that only new external connections, as opposed to existing circuits, would use PIA. This is because existing circuits are likely to be subject to contractual obligations in the short-term and there are also likely to be other costs associated with any active circuit migration. Costs could be both financial (e.g. the cost of blowing fibre), and non-financial (e.g. end customers would likely face service downtime when switching to the new service). This means that the take up of PIA will increase over the charge control period as the contacts on existing leased lines rentals expire.

A16.62 We consider that if a telecoms provider did try to migrate an existing customer, the disruption caused may result in the customer switching provider. Even if an existing customer was prepared to accept the migration of an existing service, we would expect it to try and obtain a large price reduction. This would limit telecoms providers' incentives to seek to migrate existing active services to services deployed using PIA. Therefore, we have assumed that telecoms providers will use PIA in this review period for new leased lines, rather than to replace existing lines and so have not assumed a one-off bulk migration within our forecasts.

A16.63 We have considered a range for the volumes of new circuits that could be cannibalised over the charge control period 2021/22 to 2025/26. At the lower bound of our range, no Openreach

new connections would be lost to other telecoms providers in any year. At the higher bound of our range, c.15% of Openreach's 100 Mbit/s, 1 Gbit/s and 10 Gbit/s EAD LA[239] rentals base in 2025/26 would be cannibalised by PIA.[240] Overall, we expect that this high scenario would amount to a c.45,000 loss in the rental base in the final year of the charge control across all bandwidths.

Impact of the dark fibre remedy

A16.64 Given our approach to modelling the cost of a dark fibre circuit (see Annex 19), we do not consider it appropriate to account for any 1-to-1 substitution of active to dark fibre circuits. We expect any fixed costs 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.[241]

A16.65 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. Therefore, we consider it appropriate to account for this impact.

A16.66 Based on 2019 BCMR circuit data, we have estimated that ([✂]) access circuits 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 reduced leased line volumes by ([✂]) in 2025/26 as aggregation will result in two circuits becoming one, i.e. the volume of these circuits will reduce by half. This impact has been proportionately across all 1Gbit/s and below circuits and we have assumed that it will take five years for the full impact to occur.[242]

A16.67 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 have not made specific adjustments in these areas.[243]

Bandwidth-level rentals forecasts

A16.68 Having made the above adjustments to Openreach's service-level volume forecasts, we have constructed two scenarios to represent our upper and lower-bound service volume forecasts. In producing these scenarios, we have captured two key factors that we believe have the most material impact on the growth of service volumes in a basket of active services at 1 Gbit/s or lower:

- exogenous volumes growth, i.e. if more or fewer customers are buying leased lines overall; and
- changes in the average bandwidth demanded, i.e. if customers tended to purchase higher- or lower-bandwidth services when purchasing a leased line.

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[239] Our expectation that it will be more economically viable to use PIA over shorter distances.
[240] A linear increase over the charge control period up to 15% in the final year has been assumed.
[241] This is because the total number of leased lines does not fall when there is a 1-to-1 substitution and we have estimated the cost of dark fibre based on 1Gbit/s EAD circuits.
[242] 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 Business Connectivity Market Review 2016 https://www.ofcom.org.uk/__data/assets/pdf_file/0022/55381/final-annexes-32-34.pdf
[243] 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.

A16.69 Greater exogenous volumes growth would tend to decrease unit costs as fixed and common costs are spread over a wider base. The reverse is true for lower exogenous volumes growth.

A16.70 If the average bandwidth demanded rises, with customers purchasing more 1 Gbit/s services and fewer 10 Mbit/s and 100 Mbit/s services, total costs would increase as higher-bandwidth services tend to cost more. However, volumes also affect revenue forecasts, and the ultimate effect on the value of X depends on the balance between the cost and revenue effects. As higher bandwidth services also tend to have higher returns, total revenue would rise faster than total costs if average bandwidth demanded rises. This would then produce a larger value of X. The reverse would be true if average bandwidth demanded were to fall.

A16.71 We have produced our 'high case' forecast by assuming that there is both some greater generalised demand for leased lines and some increase in the average bandwidth demanded. Both of these factors lead to larger (absolute) values of X and so work in combination to create an upper bound for values of X as a result of volumes changes. Similarly, our 'low case' combines lower generalised demand for leased lines with a decrease in average bandwidth demanded to generate a lower bound.

WLA forecasts

A16.72 We have taken a similar approach to forecasting WLA service volumes as in the 2018 WLA Statement. [244] However, we now forecast ultrafast services separately from FTTC, we forecast over a longer time period (up to 2025/26), and we no longer forecast ancillaries. [245]

A16.73 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.

A16.74 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); [246] and number of businesses from the Department for Business, Energy and Industrial Strategy (BEIS); [247]

[244] Ofcom, 2018 WLA Statement, Annex 10, 28 March 2018 https://www.ofcom.org.uk/__data/assets/pdf_file/0020/112493/wla-statement-annexes-17-27.pdf

[245] We do not consider it appropriate 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 proposed control for ancillaries.

[246] MHCLG, 12 July 2016, Live tables on household projections.http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households [accessed 22 November 2019].

[247] BEIS, 10 October 2019, *Business population estimates 2019.* https://www.gov.uk/government/statistics/business-population-estimates-2019 [accessed 22 November 2019].

- Copper and GEA service volume data from Openreach [248] for the financial years 2013/14 through to 2023/24 using our statutory information gathering powers, of which the final five years are forecast data. [249]
- 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.

A16.75 We propose to project 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 multiply these by the BEIS business site forecasts and MHCLG fixed line household forecasts to estimate the number of future Openreach lines. [250] We propose some adjustments to this forecast to account for the impact of future competitor network roll-out.
- **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.

A16.76 In summary, we estimate the following key trends from 2018/19 to 2025/26:

- the total number of fixed line households will increase from 26 million to 27 million;
- the total number of Openreach lines will fall from 25.0 million to 22.6 million;
- the total number of customers on alternative networks will increase from around 6 million to 10 million;
- broadband penetration on Openreach's network will increase from 83% to 87%; and
- the proportion of Openreach broadband lines that use fibre (i.e. FTTC, Gfast and FTTP) will increase from 53% to 93%.

A16.77 Table A16.5 below sets out our estimated base case impact of these forecast key trends on the main rental volumes. [251] These forecasts are for the average number of lines in each year, to be consistent with BT's RFS.

[248] Openreach response dated 26 September 2019 to questions 6, 8 & 10 of the FTMR s.135 notice (dated 21 August 2019).
[249] In our volumes forecast model we have used the RFS and information provided directly by Openreach using our powers. The scope of the data captured is different from that published in Ofcom's telecommunications market data update table as the telecommunications table includes competitor's network infrastructure available in the UK (for example Virgin Media).
[250] 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.
[251] For the purposes of calculating our proposed 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 A16.5: Summary table of WLA and WFAEL volume forecasts (base case, mid-year rentals)

	2018/19 Actuals		2025/26 Forecasts	
	Number of lines (millions)	Share of all Openreach lines	Number of lines (millions)	Share of all Openreach lines
MPF lines [252]	5.3	21%	1.0	4%
WLR lines [253]	4.4	18%	2.0	9%
WLR + SMPF	4.3	17%	0.4	2%
MPF + GEA FTTC [254]	4.3	17%	7.7	34%
WLR + GEA FTTC	6.4	26%	7.1	31%
FTTP	0.3	1%	4.4	18%
Total Openreach lines	**25.0**		**22.6**	

Source: Ofcom 2019 WLA Volumes Module

Efficiency

A16.78 As part of our cost forecasting, we take a view on the cost savings (efficiency) we expect BT to achieve over the review period.

A16.79 We consider that the evidence and analysis we used to support our assumptions in the 2019 BCMR Statement and 2018 WLA Statement, continue to provide an appropriate basis to inform our modelling. It is unlikely that there is significant new information available which would materially affect the efficiency ranges.

A16.80 We do not consider that a full update of the efficiency analysis for this Consultation would be appropriate given how recently we have estimated BT's future efficiency. However, if further data becomes available that will materially change our view on efficiency we will update our estimates.

A16.81 In the previous charge controls, we use several sources of evidence to inform our efficiency assumptions, including historical data and forecast data sources. Our chosen efficiency assumptions reflected the different weights we gave to each source of evidence that was reviewed, the resulting assumptions are outlined below.

a) For business connectivity services: [255]

viii) 4% to 7% per annum for our operating cost efficiency target; and

ix) 3% to 6% per annum for the capital cost efficiency target.

[252] Includes only MPF lines that are not purchased with GEA.
[253] Includes both residential and business lines that use WLR but without a SMPF or GEA service, as well as SOTAP.
[254] Note that our MPF + GEA FTTC and WLR + GEA FTTC includes GEA-FTTC, Gfast, SOGEA, and SOGfast volumes.
[255] We note that the 2019 BCMR Statement only provided efficiency estimates for the 1 Gbit/s and below services. However, for this Consultation we have used the same efficiency estimates for the above 1 Gbit/s services.

b) For WLA services:

x) 3.5% to 6.5% per annum for our operating cost efficiency target; and

xi) 1% to 5% per annum for the capital cost efficiency target.

Asset Lives

A16.82 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.

A16.83 Consistent with previous charge controls, we are 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 is for GEA DSLAMs.

A16.84 In the 2018 WLA [256] we undertook analysis to assess the actual replacement time of GSLAM cabinets and concluded that the appropriate asset life to use for this asset was within the range of 7.1 to 9.1. For this consultation we intend to adjust the asset life of the GSLAM asset to reflect this revised asset life.

Asset volume elasticities (AVEs) and cost volume elasticities (CVEs)

Overall approach to calculating AVEs/CVEs

A16.85 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.

A16.86 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.

A16.87 For this Consultation, we use the same methodology to calculate AVEs and CVEs as we did in the 2019 BCMR Statement and 2018 WLA Statement. [257]

A16.88 As discussed above, we have used the base data for 2017/18 restated from the 2018/19 RFS. One of the impacts of using a restated year's costs for the base year data is that there is now a different set of network components to that in the same published year. [258] We have used LRIC to FAC ratios as a proxy for AVEs and CVEs based on BT's LRIC model outputs. As explained below, we calculate AVEs and CVEs at a network component level so, to ensure there is a

[256] See Annex 14, paragraphs A14,143 to A14.148 of the 2018 WLA Statement.
[257] See Annex 18 of the 2018 WLA Statement. See Annex 18, Paragraphs A18:64-A18:77 of the 2019 BCMR Statement.
[258] It is often the case that new network components are required to be introduced or existing network components revoked, as directed by Ofcom within the reporting statements.

consistent set of AVEs and CVEs for the 2017/18 restated component set, we have been required to use BTs 2018/19 LRIC model.

A16.89 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. [259] This is consistent with the approach we adopted in the 2014 FAMR, 2016 BCMR, 2018 WLA and 2019 BCMR.

A16.90 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. [260] 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 CPI-X model.

Cross checks and adjustments

A16.91 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 in total cost for that component). We have therefore checked that all the estimated CVEs and AVEs are between zero and one. We found that three components had CVEs which were marginally above 1. We set the CVEs for these components to 1 for this consultation and will investigate with BT before we finalise the modelling for the statement.

Adjustment to non-pay CVE for Openreach Admin Fee component

A16.92 As in the 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 [261] and so we would 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

A16.93 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.

[259] 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.
[260] 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*. https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/LRICModelRelationshipsandParameters2015-16.pdf.
[261] See the description of the base LICENCEFEE in BT's 2017 AMD, page 47.

A16.94 We propose to set the AVE for the component FTTC Fibre Rollout Funding to zero as we do not anticipate there to be any further subsidised FTTC build and hence no further funding associated with any changes in FTTC rentals volumes.

A16.95 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

A16.96 We make an adjustment to the AVE for access fibre similar to, and for the same reasons as, the one we made in the 2019 BCMR Statement.[262] Access fibre costs are used by a number of Ethernet and FTTC/P components and are an important element of the respective baskets 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 A16.6 below.

A16.97 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.

A16.98 In this Consultation we have used the AVEs below for access fibre, Column 2 in Table A16.6. The estimates are for the adjusted AVE for access fibre costs used by each of the components and 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.

A16.99 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 A16.6: Adjusted component AVEs

	2018/19 BT LRIC model AVE output[263]	Ofcom Calculated AVE Access Fibre	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

[262] See paragraphs A18.75 of the 2019 BCMR Statement.
[263] This output excludes the Duct cost category 'CEFAZZZZZZD3ZZZZ'

GEA FTTC Access Fibre Spine	([✂]) 0-0.1	([✂]) 0.4-0.6	([✂]) 0.4-0.6

A16.100 We have used these values across all our scenarios for cost modelling for active services.

Dynamic AVEs/CVEs

A16.101 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.

A16.102 However, as volumes are forecast to change quite significantly, then this approach will assume significant change 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, representing 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

A16.103 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.

A16.104 Our approach to forecasting inflation is consistent with that adopted in both the 2019 BCMR Statement and the 2018 WLA Statement. In summary:

- **Pay operating cost inflation.** We have considered a range of evidence when setting our pay cost inflation assumptions, including historical and forecast BT data and external pay cost indices. We adopt a pay cost inflation rate within our forecasts 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 have weighted separate inflation estimates for energy, accommodation and all other non-pay costs. We adopt a non-pay cost inflation rate within our forecasts of 2.3% per annum across the forecast period.
- **Asset price inflation.** We adopt asset price change assumptions that ensure duct and copper assets are 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)). The geometric mean of the OBR's RPI forecast between 2018/19 and the first year of the review period, 2020/21, is 3.0% per annum. The geometric mean

of the OBR's CPI forecast between 2021/22 to 2023/24 [264] is 2.0% per annum. We assume that all other asset prices, including those for fibre assets [265], stay constant in nominal terms.

WACC

A16.105 The Top-down model requires an estimate of the appropriate forward-looking weighted average cost of capital (WACC) for active services. The WACC is also an important input to our estimates of both inter-exchange and access dark fibre prices.

A16.106 We estimate a pre-tax nominal WACC of 7.9% for Other UK Telecoms, which will cover Active wholesale Leased Lines and FTTP (including G.Fast) and a pre-tax nominal WACC of 7.1% for Openreach, which will cover copper access lines, Dark Fibre, DPA and FTTC services.

A16.107 A range of 6.9% to 8.9% for the Other UK Telecoms WACC and 6.1%-8.1% for the Openreach WACC is proposed for the purposes of the Top-down model. [266] We explain our estimation of the WACC, along with our responses to stakeholder comments, in Annex 21.

Costs forecast separately

Cumulo

A16.108 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'. [267]

A16.109 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 2015. The next reviews are expected to take effect from April 2020 in Northern Ireland, April 2021 in England and Wales, and April 2022 in Scotland. The following reviews are then expected to take effect from April 2024 in England and Wales, and April 2025 in Scotland and Northern Ireland.

Forecasts of BT's cumulo rates costs

A16.110 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,

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[264] We recognise that the final year of the review period is 2025/26. However, the OBR's forecasts only go out to 2023/24.
[265] 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.
[266] When creating scenarios as part of setting a cost-based charge control we would normally use low and high sensitivities of around ± one percentage point around our central estimate of the WACC.
[267] 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 20 February 2018].
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.

applied assumptions about rates in the pound, and estimated the impact of the English transition scheme. [268]

A16.111 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. [269] 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 [270] to reflect growth in MPF connection and VULA rollout. We have not done so for this consultation as there have been no changes to BT's RVs in any of the four nations since they were last reset in 2017/18, 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 2021 and April 24 reviews in England and Wales referred to above. We have no evidence to support what the impact of these future reviews might be.

A16.112 We have used the rates in the pound published for 2017/18, 2018/19 and 2019/20 and have forecast them forward as we did in the 2018 WLA Statement by indexing by CPI out to 2025/26.

A16.113 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 in 2020/21.

A16.114 Overall, we have forecast BT's cumulo costs almost to increase from around £167m in 2017/18, to £311m in 2020/21 and then to £342m in 2025/26.

Attributions of BT's cumulo costs

A16.115 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 direct to services.

A16.116 Our attribution method has three steps:

a) 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.

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[268] *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.

[269] See Table A21.1 in the 2018 WLA Statement.

[270] 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 though 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.

b) 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.

c) Attribute the cumulo costs apportioned to non-GEA services using the Profit Weighted Net Replacement Methodology that we have described in previous consultation and Statements [271]. This requires forecasts of NRCs for all BT's services that attract attributions of BT's cumulo costs. For services within the top-down model we have used the forecast growth in service NRCs generated from the top-down model. For services outside the top-down model we have derived growth rates from a simple analysis of trends in NRCs for the relevant markets as reported within BT's RFS. [272]

Service Level Guarantee (SLG) costs

A16.117 We have removed Ethernet SLG costs [273] from the 2017/18 restated base data and then added our forecasts of Ethernet SLG costs back into our total operating cost for each year in the model. Our treatment of Ethernet SLG costs is similar to our treatment of BT's cumulo costs, except that Ethernet SLG costs also form part of the costs for dark fibre services. The modelling approach we have used in relation to Ethernet SLG costs is the same as in the 2019 BCMR Statement.

A16.118 SLG payments in both 2016/17 and the early parts of 2017/18 are atypical. This was largely due to Openreach working to clear the tail of older provision orders which tended to be more complex and had higher SLG payments. [274] Due to this, we have not relied on 2017/18 restated RFS data and instead have estimated a steady-state level of SLGs costs in 2018/19 from recent payment levels and used this estimate as the base from which we forecast payments in the future.

A16.119 We then forecast this base cost forward using:

a) Our forecast growth rate for connections volumes – we would expect more connections overall to lead to more connections that incur an SLG payment; and

b) An assumption of rental price changes, as SLG payments are a function of monthly rental prices. [275]

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[271] See for example, paragraph A21.69, in Annex 21 to the 2018 WLA statement, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/112493/wla-statement-annexes-17-27.pdf [accessed 5 December 2019]

[272] For example, some cumulo rates costs are attributed to TISBO services. To generate an appropriate growth rate for NRCs for TISBO services we have analysed the change in the total non-current assets attributed to TISBO services over the period 2012/13 to 2017/18 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 TISBO services over the charge control period.

[273] We have not made any adjustments to the WLA SLG costs within the base data.

[274] Openreach response dated 3 July 2018 to question 14 of 7th LLCC s.135 notice.

[275] 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.

Scrap Copper and copper accelerated depreciation

Sale of scrap copper

A16.120 As set out in the 2018 WLA Statement [276], we again propose to make an adjustment to the copper line services to reflect the other operating income BT will receive when they sell any scrap copper.

A16.121 Within the 2018 WLA Statement 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.

A16.122 We estimated the total net proceeds from the sale of copper to be £240m and 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. [277] We have not performed any updated analysis to revise this estimated other operating income as we have not identified any new information which could materially change our previous estimate.

A16.123 Within this Consultation we propose to again make an adjustment to reflect this income BT will receive in the future and have used the £16m other operating income figure within the 2018/19 RFS [278] as a per annum amount of other operating income and have allocated this to copper line services based on volumes.

Accelerated copper depreciation

A16.124 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 there useful lives (this is commonly referred to as 'asset stranding'). We believe that it is appropriate and in line with our objectives to give Openreach the opportunity to recover these efficiently incurred costs.

A16.125 To allow BT to fully recover its forward-looking capital expenditure on copper assets we propose 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. [279]

A16.126 Under our proposal, we have assumed that any additional depreciation that is required to bring the asset's net book value to zero after 2030/31 can be recovered in this charge control period. We refer to the recovery of this additional required depreciation as 'accelerated depreciation'. To avoid over-recovery, we would not allow any further recovery of this capital expenditure post 2025/26.

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[276] 2018 WLA Statement, Annex 22.
[277] 2018 WLA Statement, Annex 22, paragraph A22.57.
[278] 2018/19 RFS page 41.
[279] Forecast copper capital expenditure has been calculated using actual copper capital expenditure for 2018/19 from Openreach response to Question 6 FTMR/OR/171019 s.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.

A16.127 The accelerated depreciation will then be spread across the 5 years of the charge control and all copper line services based on volumes. We have ensured that the net present value of the costs added is 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.

A16.128 The impact of this proposal is to bring forward c.£1,400m of nominal costs into the current review period. This is equivalent to our estimate of the net present value of the depreciation profile post 2030/31 of the assets capitalised from 2017/18 to 2025/26 which we have calculated as c.£680m.

Cap MPF and WLR unit costs

A16.129 We are proposing to keep the MPF rental charge equal to 2021/22 start price level [280] [281] over the charge control period.

A16.130 When we previously set the MPF and 40/10 FTTC charge controls as part of the WLA 2018 we reallocated common costs between copper and fibre services. We are only relying on outputs from our Top Down models this time, however, to maintain consistency, we are proposing a similar reallocation to avoid price instability in Area 3 that may arise from transitioning between two different modelling approaches. [282]

A16.131 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.

A16.132 This results in moving c.£325m nominal costs, over the 5-year charge control period, out of MPF SML1 rentals and into FTTC rentals. Using this approach both lead to prices remaining stable and to BT being able to recover its efficiently incurred costs.

Revenue forecasting

A16.133 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.

A16.134 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). We then compare the projected revenues and costs in the final year of the period to work out the value of X.

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[280] In nominal terms.
[281] Where the unit cost is below the 20/21 start price, we have not altered the unit cost.
[282] In the WLA 2018, we used two models – a top down copper cost model and a bottom-up FTTC model.

A16.135 We have explained how we have produced our volume forecasts above. Our approach to forecasting service level prices is described below.

Prices

A16.136 The Top Down model calculates prices from 2017/18 restated through to the start of the charge control 2021/22.

A16.137 Both the 2017/18 restated and 2018/19 published RFS contains volume and revenue data. For these two years the price for each relevant service has been calculated by dividing the revenues by the volumes with no further adjustments.

A16.138 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.

A16.139 In the WLA 2018 Statement, prices for FTTC 40/10 rentals were required to reduce by CPI-14% in 2019/20 and CPI-4% in 2020/21. MPF rentals with SML1 were required to reduce by CPI-2.4% in 2019/20 and CPI-2.1% in 2020/21. FTTC Other bandwidth rentals did not have cost-based charge controls.

A16.140 We requested Openreach price list data for all relevant services which showed the price of each individual service from 31 March 2019 for each month through to 1 December 2019. [283]

A16.141 We have calculated prices for 2019/20 to 2021/22 differently for leased line and WLA services as explained below.

Leased line Services

A16.142 We calculated the 2019/20 and 2020/21 leased line prices by:

a) calculating the average price for 2019/20 for each service using the Openreach price list data assuming no further price changes in 2019/20;

b) using the price from a) and 2018/19 volumes to calculate a basket revenue, separately for the Ethernet less than 1Gbit basket and the Ethernet VHB basket;

c) comparing assumed basket revenues calculated in b) to the 2018/19 actual basket revenue to assess compliance with the existing CPI-CPI control;

d) applying the required basket price change to satisfy compliance (calculated in c)) to the calculated average prices in a). [284]

WLA Services

A16.143 In 2018/19 Openreach introduced volume related discounts for its GEA services. We recognise that, for FTTC rentals, we need to calculate two different prices for our modelling. The first we refer to as the 'headline price' and the second the 'discounted price'.

[283] Openreach response to Question 31 FTMR/BT/27092019 S.135

[284] This method assumes that all further price changes which are required to meet compliance will be made flat across all services in the basket. This is a simplifying assumption as it is not possible to know where Openreach will make their price reductions in advance of any announcements.

a) The headline price is needed to calculate the 'X' for which the prices per the Openreach price list need to change under our cost based charge control in Area 3.

b) The discounted price is the price we should look at when considering BTs potential over or under recoverability as this is the average price will BT actually charge.

Headline prices

A16.144 We calculated the 2019/20 WLA headline prices by taking the average of: the price per the Openreach price list as at 31 March 2019 and the price at the end of the year found by reducing this year start price by the relevant CPI-X control for 2019/20.

A16.145 We calculate the 2020/21 WLA headline prices by taking the average of: the 2019/20 year-end price (explained above) and the price at the end of the year found by reducing this year start price by the relevant CPI-X control for 2020/21.

A16.146 We calculate the 2021/22 WLA headline start prices by taking the average 20/21 prices (explained above).

Discounted prices

A16.147 We calculated the 2019/20 FTTC discounted prices by taking the average of: the 2018/19 RFS price [285] [286] and the price at the end of the year found by reducing the 2018/19 RFS price by the relevant CPI-X control for 2019/20.

A16.148 We calculate the 2020/21 FTTC discounted prices by taking the average of: the 2019/20 discounted price (explained above) and the price at the end of the year found by reducing this 2019/20 discounted price by the relevant CPI-X control for 2020/21.

A16.149 We calculate the 2021/22 FTTC discounted start prices by taking the discounted price at the end of 20/21 (explained above).

[285] This average price is found by taking the revenues and dividing by the volumes.
[286] The 2018/19 RFS includes the volume discounts allowed under the 2018 WLA. As the volume discounts were introduced part way through 2018/19 this price will not represent a full year of discounts and so will be higher than an actual average price across the full year. We have not made any adjustments to account for this.

Outputs of the model

Area 2

Levels of cost recovery

Table A16.7: Area 2 level of cost recovery in addition to a cost based charge control (£m)

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
MPF	£9m	£18m	£26m	£34m	£42m	£129m
40/10 FTTC	£5m	£12m	£19m	£24m	£30m	£90m
Higher bandwidth FTTC	£34m	£65m	£90m	£112m	£132m	£433m
1Gbit and below leased lines	£20m	£38m	£54m	£69m	£83m	£264m
Above 1Gbit leased lines	£16m	£35m	£54m	£75m	£97m	£277m
Total	£83m	£167m	£243m	£314m	£385m	£1,192m

Table A16.8: Area 2 level of cost recovery in addition to a cost based charge control (£) per customer per month

	2021/22	2022/23	2023/24	2024/25	2025/26
MPF	£0.14	£0.27	£0.40	£0.53	£0.66
40/10 FTTC	£0.09	£0.23	£0.37	£0.50	£0.63
Higher bandwidth FTTC	£0.55	£1.06	£1.52	£1.95	£2.34

Area 3

Levels of cost recovery

Table A16.9: Area 3 level of cost recovery in addition to a cost based charge control (£m)

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
1Gbit and below leased lines	£4m	£8m	£11m	£14m	£16m	£53m
Above 1Gbit leased lines	£3m	£7m	£11m	£16m	£23m	£60m

Charge control

Table A16.10: Proposed charge control X ranges in Area 3

	Proposed level
MPF	CPI-CPI
All bandwidth FTTC	CPI-5.75% to CPI-15.0%

National

Levels of cost recovery

Table A16.11: National level of cost recovery in addition to a cost based charge control (£m) month

	2021/22	2022/23	2023/24	2024/25	2025/26	Total
Leased line inter-exchange connectivity services including Ethernet and WDM services at all bandwidths to BT only and BT + 1 exchanges	£12m	£26m	£41m	£57m	£75m	£210m

Summary of modelling inputs

Table A16.12: Low and high-cost scenario parameters assumed

Parameters	Low	High
WACC	Other UK Telecoms: 6.9% Openreach: 6.1%	Other UK Telecoms: 8.9% Openreach: 8.1%
Efficiency	LL operating costs: 7.0% LL capital costs: 6.0% WLA operating costs: 6.5% WLA capital costs: 5.0%	LL operating costs: 4.0% LL capital costs: 3.0% WLA operating costs: 3.5% WLA capital costs: 1.0%
Volumes	LL: assumed higher exogenous growth, greater demand for higher bandwidth services, no impact of PIA and no impact of Dark Fibre WLA: assumed lower Openreach FTTP and greater impact from alternative networks	LL: assumed lower exogenous growth, greater demand for lower-bandwidth services, high impact of PIA and high impact of Dark Fibre WLA: assumed greater Openreach FTTP and lower impact from alternative networks
Accelerated depreciation	Depreciation after 2030/31 brought forward	Depreciation after 2030/31 brought forward

A17. Fibre network cost modelling approach and outputs

A17.1 In Volume 4 Section 1, we set out our proposed approach to charge controlling Wholesale Local Access (WLA) services and leased line access (LL access) services in Area 2. We propose to set a charge control on MPF and GEA FTTC 40/10 at a level to support investment by a rival entrant deploying a fibre network.

A17.2 In Volume 4 Section 2, we set out our proposed approach to setting a charge control in Area 3. We propose a RAB style approach to support BT's deployment of a fibre network where we do not believe it will face material competitive fibre deployment.

A17.3 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 proposals in Section 1 and Section 2. Specifically, we have used our modelling to:

- verify that our charge control proposals for Area 2 are consistent with our policy objective of promoting network competition through alternative fibre investments (i.e. the entrant price-cost test); and
- estimate the 'k' factor in our RAB model for Area 3.

A17.4 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 both residential and business customers 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 re-use existing physical infrastructure (i.e. using Duct and Pole Access (DPA)) as opposed to building physical infrastructure.

A17.5 In this annex, we set out our proposed approach to modelling the costs of deploying a fibre network. This includes:

- The structure of the model.
- Approach to modelling service volumes.
- Approach to dimensioning and costing the fibre network.
- Approach to verifying the outputs of our modelling.
- The scenarios and outputs we have used for our entrant price-cost test.

A17.6 The scenarios and outputs relating to estimates of the 'K' factor for Area 3 are set out in Annex 18.

A17.7 We published our initial proposals on our approach to modelling a fibre network in June 2019 (June 2019 Consultation).[287] In this annex, we also respond to the main themes raised by stakeholders responding to that consultation.

Key modelling choices

Bottom-up approach to cost modelling

A17.8 We could model the costs of deploying a fibre network using either a bottom-up approach or a top-down approach to modelling.

- A 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 the total cost of this network equipment using evidence of the capital and operating costs of each piece of equipment.
- A 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, the modelled costs are calculated using cost-volume elasticities which reflect assumptions about the way the cost of high-level network components change as traffic rises or falls.

A17.9 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. In addition, we note that it would be difficult to conduct top-down modelling for estimating the costs of a large-scale fibre network since a large-scale fibre network does not exist yet in the UK (and therefore total network cost information would be unavailable).

A17.10 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

A17.11 We consider that fibre networks will be able to offer a wide range of services, to both residential and business customers.

A17.12 The model has functionality to dimension a fibre network that is capable of offering the following types of services:

- Fibre to the premises (FTTP) services.
- Leased line services using Ethernet and/or WDM[288] technology.

[287] Promoting competition and investment in fibre networks, Initial consultation on the approach to modelling the costs of a fibre network, 21 June 2019 https://www.ofcom.org.uk/__data/assets/pdf_file/0021/153255/consultation-modelling-fibre-network.pdf.

[288] Wavelength Division Multiplexing.

- Dark fibre services.
- Duct and Poles Access (DPA) services.

A17.13 In response to our June 2019 Consultation, several stakeholders commented that an alternative network operator may not offer either leased line services and/or dark fibre services/DPA when deploying a fibre network (since the operator could be focused on fibre broadband provision).[289] Some suggested that the model should have the flexibility to reflect different business models including leased lines only, mixed deployment and FTTP only deployments.

A17.14 We note that the model already has this flexibility as demand assumptions can be flexed to replicate different types of deployment in different geographic areas.[290] We have used this flexibility in assessing the costs of deploying an FTTP network in different geographic areas. For Area 2, we agree with TalkTalk that an entrant operator is unlikely to offer DPA services in practice and therefore assume that DPA services are not offered in our entrant price-cost test. For Area 3, we have modelled the costs of deploying an FTTP network for Openreach and have assumed that DPA services are not provided.[291]

Network scope

A17.15 We have restricted the span of the modelled network to the following network segments:

- The segment from the Access Node (Exchange) to the premises, for all the services in scope (e.g. FTTP; Ethernet and Optical Leased Lines; Dark Fibre; and Duct and Pole Access).
- 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).

A17.16 In response to our June 2019 Consultation, some stakeholders raised concerns regarding the exclusion of network elements beyond the Aggregation Node.[292] Vodafone requested that we should ensure that costs associated with these network elements are not material for all network roll-out models. While Virgin Media requested further clarification.

A17.17 As mentioned above, we have used the outputs of our modelling for:

- conducting the entrant price-cost test for Area 2; and
- estimating the 'k' factor in our RAB model for Area 3.

A17.18 We consider that modelling the costs beyond the Aggregation Node is not needed for these purposes.

A17.19 For the entrant price-cost test we are using the model outputs to evaluate whether our proposed price controls are consistent with new entry build plans. These price controls refer to Openreach's wholesale access services, for which wholesale customers (i.e. access seekers) need to invest in their own backhaul and core networks in order to use them. Therefore, our interest here relates to the costs to an entrant of building its own access network, as opposed

[289] TalkTalk, p.2; CityFibre, para. 1.2.12; and IIG, para. 4.3.2.
[290] We note that the model is unable to estimate the costs of a leased lines only network.
[291] This is a modelling simplification that we think is appropriate given that we expect there will be limited alternative network provision that uses DPA in Area 3.
[292] Vodafone, p.6; and Virgin Media, p.6.

to using Openreach's. We therefore consider that excluding the costs beyond the aggregation node (i.e. interconnection point) is appropriate in this case.

A17.20 In addition, we do not consider that modelling the costs beyond the Aggregation Node is relevant for our RAB calculations. In this case, our aim is to model the costs of deploying an FTTP network for Openreach in Area 3. This means extending Openreach's fibre network from the fibre exchange to the premises (i.e. the last mile), and hence does not involve incurring costs in the core network.

Network coverage

A17.21 The model offers the flexibility of estimating the costs of deploying a fibre network with national or subnational footprints (i.e. in particular geographic areas only). We have used postcode sectors as the geographic unit for our cost modelling.

A17.22 In response to our June 2019 Consultation, TalkTalk said that postcode sectors are insufficiently granular to model the costs of an FTTP network, as competitive conditions may not be sufficiently homogenous across postcode sectors. [293] While Virgin Media commented that postcode sectors strike a pragmatic balance of granularity without introducing unnecessary complexity. [294]

A17.23 The use of postcode sectors as the geographic unit for our cost modelling aligns with our approach to assessing conditions of competition in different geographic areas, as set out in Annex 8. There are around 11,000 postcode sectors in the UK. We consider that this provides sufficient geographic granularity while, at the same time, avoids introducing too much complexity to our modelling.

Scorched node/Scorched earth approach

A17.24 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.

A17.25 We have used scorched node for our RAB model in Area 3. The aim of our RAB calculation is to model Openreach's costs of deploying an FTTP network in Area 3. We therefore consider a scorched node approach to be appropriate as Openreach is likely to take into account existing Access Nodes in considering how to carry out this deployment. However, we have used a

[293] TalkTalk, p.3.
[294] Virgin Media, p.6.

scorched earth approach for our entrant price-cost test in Area 2, as we consider a rival new entrant is more likely to dimension its network with flexibility over the location of Access Nodes, in order to minimise costs.

Reuse of existing physical infrastructure

A17.26 Physical infrastructure, such as ducts and poles, is a key input in the building of a fibre network. An operator deploying a fibre network can either (i) reuse existing physical infrastructure; (ii) build new physical infrastructure; or (iii) a combination of both. Our model allows the functionality to estimate the costs of deploying a fibre network under any of these scenarios.

A17.27 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).

A17.28 Where the modelled network reuses existing physical infrastructure, we propose to 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.

A17.29 In our June 2019 Consultation, we proposed a base case assumption that would model a fibre network which reuses existing physical infrastructure where spare capacity is available and only builds new physical infrastructure where this is not available or feasible.

A17.30 In its response, CityFibre said that PIA is not fit for scale deployments according to their experience.[295] It also said that it is very unlikely that Openreach's existing infrastructure has the space required for the high fibre count required for metro rings of a ring-based network architecture.[296] It noted that PIA is as yet an unproven product for use at that scale and Ofcom should be cautious about assuming it will be a significant component in new fibre network deployments.

A17.31 We note that although our modelling assumes maximum reusage of existing infrastructure where possible, the spare capacity assumed for this infrastructure can be flexed to model different levels of duct and poles reusage.

A17.32 To inform the level of reusage in our analysis we have drawn on both the evidence that we have gathered relating to the potential re-use of existing physical infrastructure (i.e. PIA usage – see Annex 7), which suggests a wide range of possible outcomes, and our model calibration exercise outlined later in this annex. As a result of this, we have made the following reusage assumptions for the modelled network:

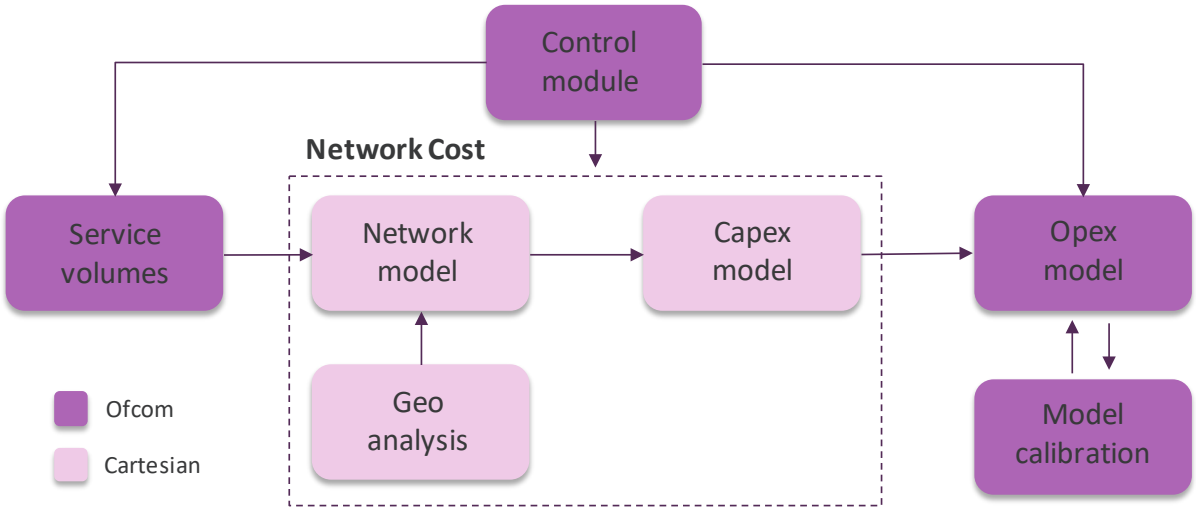
- For the entrant price-cost test, we assume the re-use of physical infrastructure varies between 30% and 50%.
- For our RAB calculations, we assume that Openreach can re-use between 70% and 80% of its physical infrastructure in Area 3.

[295] CityFibre, para. 1.2.23.
[296] CityFibre, p.32.

Model structure

A17.33 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 A17.1: Module structure of the fibre network model



Source: Ofcom

A17.34 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 and operate the dimensioned fibre network.
- Network Opex – uses the outputs from the Network Cost module (along with the Volumes module) to calculate the costs of running the modelled network.

A17.35 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 which accompanies this consultation document.

Service volume forecasts

A17.36 Below we set out our proposed 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.

Deployment scenarios

A17.37 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

A17.38 We are using the model to cross-check our proposed approach to charge controlling WLA services in Area 2; and the costs of deploying a fibre network in Area 3.

A17.39 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). [297]

A17.40 Therefore, the model has the functionality to include up to twenty different deployment scenarios, which can be used to model different scales (and speeds) of network deployment.

A17.41 Since the June 2019 Consultation, we have added the functionality to sequence the deployment of a network across an exchange area (in addition to the previous functionality that sequenced deployment by lowest cost to highest cost postcode sector). This is discussed further below and in the Cartesian report.

Leased Lines

A17.42 In our June 2019 Consultation we proposed to model leased lines deployment as a proportion of total fibre deployment, where the proportion can vary by geographic market (i.e. Area 1, Area 2 and Area 3).

A17.43 In response, Vodafone queried whether the proportion was determined in an arbitrary manner. [298] While INCA disagreed with our proposed approach and said that the proportion was likely to vary geographically as well as over time. [299]

A17.44 Since our June 2019 Consultation we have considered the data provided by network operators based on their business plans. This suggests 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 the modelling period.

[297] 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.
[298] Vodafone, p.10.
[299] INCA, p.4.

Take-up profiles

FTTP

A17.45 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. [300]

A17.46 We expect take-up to vary by geographic area, for example, due to the differing levels of network competition.

A17.47 Our base case assumptions for long-run take-up are 33% for our entrant price-cost test and 90% for our RAB calculations.

Leased Lines

A17.48 As mentioned above, we model total demand for leased lines as a proportion of FTTP coverage.

A17.49 The total demand for leased lines is then broken down by:

- Bandwidth – ethernet electronic costs may vary depending on the bandwidth required. Therefore, we propose to model the proportion of leased lines that require 100Mbit/s, 1Gbit/s, and 10Gbit/s bandwidths. For optical services, we do not propose to model the breakdown by bandwidth given that the network model assumes the same wavelength card for all optical services; [301]
- Circuit type – given that costs vary by circuit length, we propose to model the proportion of leased lines that are local access (LA), inter-exchange, and non-LA circuits with two access tails; [302] and
- Dark-fibre.

Network dimensioning and costing

Network dimensioning

A17.50 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 (ii) estimates the capex for the dimensioned network. Further details of our proposed approach are set out in the Cartesian Report published alongside this consultation document.

A17.51 Ofcom has built the model module which determines the operating costs of the modelled network.

A17.52 We propose to dimension the network as follows:

- For FTTP, to size the network based on coverage first and then capacity.

[300] 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.
[301] From a cost modelling perspective, this means that the bandwidth mix for optical services is not important.
[302] We expect the proportion of non-LA circuits with only one access tail to be small so do not propose to model these as we think it would add a disproportionate amount of complexity.

- 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

Sequencing of rollout

A17.53 In our June 2019 Consultation, we proposed to determine the sequence of network deployment based on costs, by ranking the postcode sectors from lowest to highest cost to deploy. We used a detailed 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.

A17.54 Several stakeholders criticised our proposed approach to determining the sequence of rollout for FTTP. TalkTalk and CityFibre said that such approach was too simplistic and was unlikely to reflect how networks are deployed in reality.[303] They suggested that Ofcom should adopt an approach based on SPC Network's proof of concept model which includes a wider set of factors to determining where investment will occur. Virgin Media added that the proposed approach would systematically underestimate costs as it takes cost minimisation as a prior assumption.[304]

A17.55 We have not adopted SPC Network's proof of concept model since we consider this would introduce significant and disproportionate complexity into our modelling relative to improving the accuracy of the outputs.

A17.56 However, since our June 2019 Consultation, we have added further functionality to the model so that a network can be dimensioned in sequence of whole exchange areas. More specifically, the model now 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 actually 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. We recognise that this may not reflect the exact way in which an entrant would deploy its network but consider that this provides a reasonable approximation for the costs of deploying an alternative FTTP network at scale.

A17.57 We have used this new functionality to inform our entrant price-cost test and RAB calculations.

Geographic coverage and cost disaggregation

A17.58 Network elements such as fibre and duct can span across multiple postcode sectors. For example, to connect a premises to an Access Node, a network operator may need to deploy duct and fibre across more than one postcode sector.

A17.59 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

[303] TalkTalk, p.7; IIG, para. 4.4.2 to 4.4.5; and CityFibre, p.35.
[304] Virgin Media, p.11.

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.

A17.60 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.

A17.61 In response to our June 2019 Consultation, TalkTalk said that constructing the model at a more granular level than postcode sector would avoid the risk of double counting as well as not creating inaccuracy in estimating sub-national costs. [305]

A17.62 We consider that modelling at a more geographic granular level as suggested by TalkTalk would only exacerbate the double counting problem described above, while increasing the complexity of our modelling significantly. Because FTTP network elements do not span across more than one exchange area, we consider that any inaccuracy that our approach may cause is likely to be immaterial when considering large geographic areas (as in our entrant price-cost test and RAB calculations) as these are likely to capture whole exchange areas.

Leased Lines

A17.63 In our June 2019 Consultation we proposed to model network elements for supplying leased lines (including dark fibre) as an overlay to the FTTP network, i.e. leased lines as incremental to FTTP services. We said that while FTTP network elements are mainly driven by coverage, network elements which are specific to leased lines tend to be driven by take-up.

A17.64 In response to our June 2019 Consultation, some stakeholders disagreed with this proposed approach. INCA said that considering leased lines as incremental to FTTP would likely result in an inappropriate initial network design and dimensioning, and could result in overstated costs over time. [306] CityFibre agreed with INCA saying that adding leased line capacity as demand increased is not an efficient way to dimension a network. [307]

A17.65 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.

A17.66 To address the potential overstatement of costs we have ignored the demand for leased lines in our entrant price-cost test. We consider that this makes our cost estimate for an entrant operator conservative as leased lines should help in the recovery of common costs. This reinforces our provisional conclusion that the entrant price-costs test is not failed.

[305] TalkTalk, para. 4.5.
[306] INCA, para. 22.
[307] CityFibre, p.35.

A17.67 We set out how we have considered the impact of leased lines in our RAB calculations in Annex 18.

Determining the amount of new physical infrastructure

A17.68 Once the total amount of fibre cables needed to satisfy the demand for each service modelled is calculated, the model then calculates the amount of physical infrastructure required to carry these fibre cables. The model allows for this physical infrastructure to be new or existing.

A17.69 To work out the proportion of infrastructure that can be reused, 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.

A17.70 If enough capacity is found to be available, the model assumes no new physical infrastructure is required. On the contrary, if insufficient capacity is found, the model assumes new physical infrastructure will need to be built.

A17.71 As mentioned above, the model has the flexibility to change the balance of new physical infrastructure versus re-use of physical infrastructure by varying the assumptions around spare capacity.

Network costing

Capex

A17.72 Network capex is calculated in the Network Cost model. Details on the approach taken are set out in the Cartesian Report published alongside this consultation document.

Opex

A17.73 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;
- DPA payments – costs associated with the use of Openreach's PIA services;
- 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.

A17.74 We have taken a different approach to modelling opex costs for which a clear driver could be identified and those for which one could not. For those costs for which a clear driver could not be identified, we have 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. These costs include maintenance, repairs, power and business overheads. We consider this approach is appropriate given that we would expect these costs to be proportionate to the size of the network, which can be proxied by the GRC.

A17.75 Table A17.1 sets out the drivers and unit costs we have used to model each opex cost element identified in the list above.

Table A17.1: Opex cost elements, drivers and unit costs

Opex cost element	Driver	Unit cost (2019/20)	
		FTTP	Leased Lines
Provision costs [308]	Provision volumes	£20	£200
SLG costs	New connections	£4	£10
	Line rentals	£0.5	£5
System and processing costs	Software configuration volumes	£3	
PIA Duct – Seg1	Metres of duct reused (seg 1)	£0.17	
PIA Duct – Seg 2	Metres of duct reused (seg 2)	£0.31	
PIA Duct – Seg 3	Metres of duct reused (seg 3)	£0.62	
PIA Poles	Metres of poles reused	£0.13	
Cumulo	Line rentals	[✂]	
Other opex: repair, maintenance, power and overheads	% of GRC	£1	

A17.76 To estimate PIA payments for the modelled network we have used the following unit costs:

- **PIA Duct:** we use Openreach's PIA rental charges for different duct types. For Segment 1, we use the PIA rental charge for a blend of 3+ and 2 bores 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 10% uplift.

[308] Costs associated with the provisioning of new services not captured in the capex model.

- **PIA Poles:** we use Openreach's PIA rental charges for single and multi-user pole attachments [309] 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. For other costs associated with the use of PIA (e.g. ancillary PIA charges), we load these costs into our per metre cost assumption by applying a 10% uplift.

A17.77 In response to our June 2019 Consultation, several stakeholders raised concerns about our proposed approach to modelling opex. TalkTalk said that our proposed simplified approach to estimating opex (based on % of GRC) needed to be tested against data (both historical and forecast). [310] It also said that important cost categories were missing, such as network planning, network design, marketing and sales, and that capex and opex efficiencies needed to be considered. [311] Cityfibre and INCA said that opex costs may vary between operators of different scales, which may warrant a more direct analysis than we have proposed. [312] While Virgin Media agreed with our simplified approach but stressed the importance of calibrating the model against the costs faced by network operators. [313]

A17.78 Since our June 2019 Consultation, we have added capex and opex efficiency assumptions to the model.

A17.79 In our top-down cost modelling analysis set out in Annex 16 we have assumed an efficiency factor of 3% for capex and 4.8% for opex. These assumptions relate to Openreach's existing copper and fibre network. Given that we are dimensioning an efficient FTTP network in this case, we would expect future efficiency gains for our modelled network to be lower than what we have assumed for Openreach's existing coper/fibre network. [314]

A17.80 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 [315], and 2.5% for opex cost elements such as SLG, system and processing costs. For opex cost elements modelled as a percentage of GRC, we have not applied an efficiency factor as this is indirectly captured through the GRC measure. [316]

A17.81 We have also verified the appropriateness 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. As further explained in the next subsection, we believe that our approach to modelling opex results in levels that are broadly consistent with the cost evidence provided by operators.

A17.82 As part of our cost verification exercise outlined below, we have adjusted some of the parameters in our opex modelling so as to better align the outputs of our model against operators' data. Our base case assumption for opex costs modelled as a % of GRC is 3% for our

[309] We calculate a blended charge based on the national profile of single and multi-user pole attachments.
[310] TalkTalk, paragraphs 4.13 and 4.14.
[311] TalkTalk, paragraphs 4.15 and 4.16.
[312] CityFibre, p.35; and INCA, para. 23.
[313] Virgin Media, p.13.
[314] We would expect efficiency gains for our modelled FTTP network to be mainly driven by frontier efficiency rather than by both frontier and catch-up efficiency.
[315] 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.
[316] The GRC measure already captures efficiencies applied to capex elements.

entrant price-cost test and 5% for our RAB calculations. We have allowed this percentage to be higher for the initial years of rollout in line with operators' data.

Outputs and cross-checks

A17.83 Bottom-up cost models are good for assessing how costs change as service volumes change, but they can sometimes not produce the right level of costs. 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.

A17.84 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;
- Opex per home passed; and
- Opex per line.

A17.85 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.

A17.86 As a result of these cross-checks, we have adjusted our assumptions around the re-use of existing physical infrastructure and opex as a % of GRC.

A17.87 Tables A17.2 and A17.3 below compare the cost metrics of our calibrated model against the cost evidence received from operators. Table A17.2 shows the comparison for a national FTTP deployment, while Table A17.3 shows it for a subnational FTTP deployment. Note that we have excluded DPA payments from the opex cost metrics as operators typically assume different levels of PIA usage.

Table A17.2 Cost verification for national deployment (£, nominal)

	Ofcom (20y period)	Openreach - FTTP cost modelling	Openreach –Existing copper/fibre network
Capex per home passed	£359	[✂ £]	
Final drop cost per connection	£195	[✂ £]	
Opex as % of cum. capex	7%	[✂ %]	
Opex per home passed	£34 – 40	[✂ £]	[✂ £]
Opex per line	£58 - 60	[✂ £]	[✂ £]

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 and FTTP business plan. Data regarding Openreach's existing copper/fibre network is based on BT's 2017/18 RFS. PIA payments were removed from opex metrics. The opex range estimates from our model represent the outputs for the period between the year when deployment is completed and year 20 from the start of deployment.

Table A17.3. Cost verification for a sub-national deployment (£, nominal)

	Ofcom (20y period)	Openreach	CityFibre	Hyperoptic	Comparator range
Homes passed	5m	[✂]	[✂]	[✂]	2m to 5m
Capex per home passed	£297	[✂ £]	[✂ £]	[✂ £]	£277 - 306
Final drop cost per connection	£190	[✂ £]	[✂ £]	N/A	[✂ £]
Opex as % of cum. capex	4.2 – 4.6%	N/A	[✂ %]	[✂ %]	[✂ %]
Opex per home passed	£15 - 18	N/A	[✂£]	[✂ £]	[✂ £]
Opex per line	£54 - 60	N/A	[✂ £]	[✂ £]	[✂ £]

Source: Ofcom based on information provided by Openreach, Cityfibre and Hyperoptic in response to our s.135 information notices. PIA payments were removed from opex metrics. The opex range estimates from our model represent the outputs for the period between the year when deployment is completed and year 20 from the start of deployment.

A17.88 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. As more data on the network operators' business plans and network deployments becomes available, we expect to carry-out further cross-checks for our Statement.

Entrant price-cost test

A17.89 In this sub-section, we provide outputs from the proposed FTTP model for the entrant price-cost test described in Volume 4 Section 1.

A17.90 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 flexed to derive our cost range estimate.

Approach to cost recovery

A17.91 To convert our modelled capex and opex to a service unit cost basis we have calculated a flat annuity over the 20-year modelling period (including a terminal value). In other words, we have

calculated the unit charge that an entrant would have to charge in order to recover its incurred costs.

A17.92 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 a portion of final drop capex (customer equipment) and lead-to-cash opex is recovered through connection charges, implying a connection fee of c.£90. All other FTTP costs are assumed to be recovered from rental charges.

Base case scenario

A17.93 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 3.5 million premises by 2025/26. This is consistent with the scale of deployments announced by some telecom providers such as Hyperoptic, CityFibre and FibreNation (see Table A7.1).
- **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).
- **PIA usage:** we assume that 40% of the entrant's network 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 go as high as 70% (see Table A7.2 and Table A7.3).
- **WACC:** We assume that the entrant's cost of capital for FTTP is similar to that of the incumbent for the same services (i.e. the Other UK Telecoms WACC of 7.9% in nominal terms). This is because we consider that an entrant is unlikely to face a different systematic risk profile to Openreach's. However, 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 components (compared to 10 and 20 years, respectively, for Openreach).
- **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.[317] This implies an average cost of around £60 per FTTP customer per year, which is in line with the cost levels we have seen in the business plans and cost modelling submitted by operators.

Low and High cost scenarios

A17.94 To derive our range of cost estimates we have flexed the assumptions in our base case scenario as follows:

[317] We allow for a higher percentage in the initial years of rollout as suggested by the information we received from operators.

- **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.
- **PIA usage:** we have assumed PIA usage of 50% in our low case scenario and 30% in our high case scenario, compared to the 40% in our base case scenario.

A17.95 Based on the assumptions above we estimate that the entrant operator would have to charge between £8.50 and £12.75 per month in order to recover its efficiently incurred costs over the analysed period.

A18. RAB design

Introduction

A18.1 In Volume 4 Section 2, we propose a RAB charge control for MPF and GEA FTTC services to incentivise Openreach's investment in fibre networks in Area 3.

A18.2 In this annex, we provide details relating to the proposed RAB charge control including further explanation of our approach to calculating the charges for MPF and GEA FTTC services where Openreach invests in fibre networks.

Details relating to the proposed RAB in Area 3

A18.3 In Volume 4 Section 2, we set out our proposals for charge controlling wholesale local access (WLA) services in Area 3. In that section, we propose a RAB charge control whereby copper services contribute to the cost recovery of the fibre network. We explain that Openreach has suggested indexed pricing for Area 3 which would be one form of RAB that we call a "forecast approach".

A18.4 We explain that while a forecast approach is our preference, we would need a firm commitment from Openreach to proceed on this basis. We would also need to assess whether the level of recovery and build represented value for money.

A18.5 In the absence of those commitments, we propose a "post-build approach". In this annex, we focus on the design choices that would apply under a post-build approach.

Key design choices

A18.6 Under a post-build approach, Openreach will only receive additional revenue through our charge control once it invests in fibre. It will then be able to recover the costs of the copper and fibre network across all the copper and fibre services it sells.

A18.7 To implement a post-build RAB charge control, there are some key design choices we need to make, including:

a) Which services will be subject to the charge control.

b) The basis of charge controls and the path of prices.

c) The services across which copper costs and fibre costs will be recovered.

A18.8 We set out our proposed approach for each with reference to our overarching objectives for Area 3.

Services that will be subject to charge controls

A18.9 As set out in Volume 4 Section 2, pre copper retirement in an exchange area, we propose to set charge controls on MPF and all FTTC services in Area 3 and allow pricing flexibility on Openreach's fibre services (FTTP and G.Fast).

A18.10 This brings higher bandwidth GEA 55/10 FTTC and GEA 80/20 FTTC services into the scope of the charge control for the first time (as well as MPF and GEA 40/10 FTTC services that are currently subject to a charge control).

A18.11 Post copper retirement in an exchange area we propose to set a charge control on FTTP 40/10 and allow price flexibility for higher bandwidth services.

Basis of charge controls and path of prices

A18.12 We propose a CPI-X + K control for MPF and FTTC charges.

A18.13 Under our proposal, X is the value used each year to bring MPF and FTTC charges into line with costs by the end of the charge control period; and K is the additional contribution to fibre cost recovery from copper services each year as Openreach invests in fibre. We refer to this as a "post-build" RAB approach since the K is triggered as a result of Openreach investing in fibre. Absent any fibre investment by Openreach, MPF and FTTC services do not make an additional contribution to fibre cost recovery (i.e. the K factor is zero).

A18.14 In calculating the cost of each service, we do not propose to include a hypothetical ongoing network (HON) uplift.[318] This is because, we do not believe that adjusting prices above cost through a HON will lead to significant additional competitive investment (and thereby encourage Openreach to invest in fibre networks). We consider that a RAB approach, which directly provides incentives for Openreach to invest, is more suitable in Area 3.

A18.15 We propose to set the charge control for MPF and FTTC services based on Openreach's national costs. We consider that our approach allows Openreach's cost recovery overall (across Area 2 and Area 3) and is consistent with cost recovery over time. We also consider that setting charges based on national costs will allow for recovery of forward-looking costs in Area 3. We discuss the detail of our cost modelling for MPF and FTTC services in Annex 16. In calculating the cost of copper services, we have also sought to minimise the stranding of any copper assets due to the retirement of the copper network.

A18.16 As discussed in Section 3, we are proposing a glidepath to gradually bring MPF and FTTC rental charges in line with cost by the final year of the control. In the table below we set out the ranges for our proposed charge controls for MPF and FTTC services (absent investment in fibre).

Table A18.1: Proposed monthly rental prices for copper WLA services in Area 3 – no build (£)

	Proposed X
MPF SML1 rentals	-CPI
FTTC all bandwidths rentals	-5.75% to -15.0%

Services across which copper costs and fibre costs will be recovered

[318] A HON uplift is where the value of heavily depreciated assets is increased to reflect the costs of maintaining an ongoing network. This normally increases depreciation and mean capital employed, resulting in higher costs.

A18.17 We propose that the costs of copper services (FTTC and MPF) will be recovered entirely from copper service revenues. This is consistent with the historical approach to cost recovery for these copper services.

A18.18 We propose that the costs of fibre services (FTTP and G.Fast) will be recovered from revenues relating to both fibre and copper services: i.e. FTTP, G.Fast, FTTC and MPF. As explained above, under the proposed post-build RAB approach, the charge controls for MPF and FTTC services will include a K factor which is the additional contribution that MPF and FTTC services make to the recovery of fibre costs (should Openreach invest in fibre).

A18.19 Later in this annex, we set out how we propose to estimate the K factor. In summary, we first forecast how much of Openreach's investment in FTTP and G.fast can be recovered directly from fibre customers. This then allows us to estimate how much of the fibre costs needs to be recovered from MPF and FTTC services to make the investment profitable (via applying the K factor). Henceforth we refer to this as the 'fibre shortfall'.

A18.20 In terms of geography, we propose to recover the fibre costs across all MPF, FTTC and fibre customers in Area 3. We consider this is consistent with our objectives to preserve investment incentives and to protect consumers from excessively high prices – it spreads the costs as widely as possible to those consumers who will eventually be the main beneficiaries of the investment in fibre services, i.e. broadband consumers in Area 3.

A18.21 Table A18.2 below provides an illustrative example of the range of path of MPF prices under the proposed post-build RAB charge control should Openreach deploy to 1m premises a year in Area 3, reaching 5m by the end of the period.

Table A18.2: Proposed monthly rental prices for copper WLA services in Area 3 – 1m build per annum (£ nominal)

Monthly rentals	2021/22	2022/23	2023/24	2024/25	2025/26
MPF SML1 rentals	7.11	7.11	7.11	7.11	7.11
K factor (1m per annum) [319]	0.22-0.45	0.45-0.92	0.69-1.40	0.93-1.91	1.19-2.44
Combined	7.33-7.56	7.56-8.03	7.80-8.51	8.04-9.02	8.30-9.55

Approach to calculating the K factor

Methodology for calculating the fibre investment shortfall

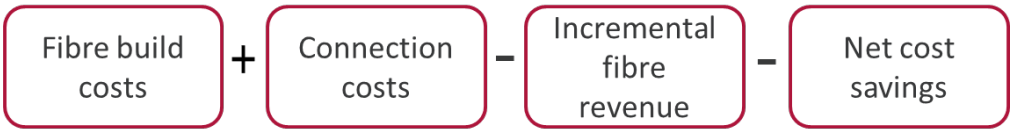
A18.22 The purpose of the proposed RAB charge control is to strengthen Openreach's fibre business case in Area 3. We aim to achieve this by ensuring that the total costs of Openreach's networks providing FTTP, G.fast, MPF and FTTC is recovered by total revenues from those services across Area 3.

[319] For illustrative purposes, K factors calculated assuming CPI is 2.0% in each year.

A18.23 As explained earlier, absent any fibre investment by Openreach, our proposed charge control for MPF and FTTC services sets charges to our forecast of costs by the end of the control period. Therefore, to ensure total costs (across fibre and copper) are recovered we need to calculate the shortfall in Openreach's investment case for its fibre deployment in Area 3 (relative to not investing), i.e. the fibre shortfall.

A18.24 To calculate the fibre shortfall we consider Openreach's incremental costs and revenues from building a fibre network compared against the costs/revenues from continuing to operate the legacy (copper) network. As such, any potential shortfall in Openreach's fibre investment case can be assessed by examining the following components:

Figure A18.1: Methodology for calculating the fibre shortfall



A18.25 We have used information from Openreach's internal business planning documents and our own modelling of the costs of deploying a fibre network to estimate each of the components above.

Fibre build and connection costs

A18.26 We have calculated the capex costs of building the fibre network, connecting customers and running the network using our bottom-up full-fibre model (supplemented by information provided by Openreach).

A18.27 As discussed in Annex 17, our bottom-up fibre model calculates the total cost of deploying and running a fibre network by estimating the number of network components needed to deploy the fibre network (e.g. civils costs, fibre, exchange equipment) and combining this with estimates of the capital and operating costs for each component.

A18.28 We highlight several key assumptions used in our modelling of costs below:

- **Geographic coverage**: we have selected postcode sectors defined as Area 3 to calculate the specific build and connection costs.
- **Scorched node/Scorched earth approach**: we model the costs on a scorched node basis which assumes the fibre network is deployed from the location of Openreach's existing access nodes.
- **Re-use of physical infrastructure**: we assume 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 re-use 70% to 80% of existing ducts and poles in its fibre deployment to Area 3.

- **Connection costs**: this is driven by the cost per connection of c.£200 and take-up assumptions: 70% after 3 years and 90% after 5 years of passing a home with fibre. This is based on our analysis of Openreach's business planning assumptions. [320]

A18.29 Full details of our approach to modelling the costs of deploying a fibre network are found in Annex 17.

A18.30 In calculating the build and connection costs, we have calibrated our assumptions using actual and forecast data and business plan information from Openreach to ensure their reasonableness. For example, we have compared our estimates to data on capex per home passed from Openreach's business plans and cost modelling. We have also examined information gathered from Openreach to inform our range for re-use of existing physical infrastructure.

A18.31 Table A18.3 below sets out our estimates of the average capex per premises passed (covering both build and connection costs) for each one million tranche in Area 3.

Table A18.3: Build and connection capex per premises passed

1m increments from cheapest to most expensive	Capex per premises (£)
0-1m	500 - 550
1m-2m	550 - 650
2m-3m	600 - 650
3m-4m	600 - 750
4m-5m	600 - 750
5m-6m	650 - 800
6m-7m	750 - 950
7m-8m	850 - 1100
8m-8.8m	1350 - 2000

Source: Ofcom bottom-up full-fibre model

A18.32 This suggests that within Area 3 build costs vary with a particular step increase in costs for the final two to three million premises. The amount of re-use of physical infrastructure assumed is a key determinant of the capex forecasts and is driving the relatively wide ranges. Following this consultation, we intend to gather more evidence on Openreach's likely re-use of physical infrastructure in Area 3.

Incremental fibre revenue

A18.33 We anticipate that Openreach will be able to earn additional revenues from selling fibre services, compared to selling legacy copper services. This will reflect the additional value consumers place on the higher speed and reliability of fibre services relative to copper services. [321]

[320] Openreach slides entitled [✂""] provided to Ofcom on 29 July 2019.
[321] As set out Annex 22, we also propose that post-copper retirement the FTTP 40/10 charge control includes a premium of £1.50-£1.85.

A18.34 We have used information from various sources to estimate the additional fibre revenue that might be earned. This includes operators' current fibre prices (and take-up) and Openreach business plan information.

A18.35 For modelling purposes, in estimating incremental fibre revenues we have assumed that Openreach sets higher prices for higher bandwidth fibre services (i.e. for speeds above 40/10 FTTP) for 10 years. We also assume for modelling purposes that these mark-ups do not change. However, we also note that this assumption does not have a large impact on the fibre investment shortfall estimate due to the effect of discounting future revenues to a present value basis.

A18.36 We estimate that customers would be willing to pay on average a premium of £1.50 - £4.00 per month for fibre services (compared to copper services).

A18.37 We have assumed that Openreach recovers £0 revenue from connection charges. This is based on [✂]. [322]

Net cost savings

A18.38 We anticipate that Openreach could benefit from operating cost savings over the life of the fibre investment from being able to retire its copper network. These savings mainly relate to lower maintenance costs as the number of faults on the FTTP network will be significantly lower than on the copper network. We have also included the likely cost savings relating to the closure of copper local exchanges, such as accommodation and power.

A18.39 These cost savings will partially offset by:

- Additional costs associated with setting up new systems to deal with FTTP connections, testing and maintenance, and the costs of installing and maintaining new OLT electronics at the exchange.
- Cannibalisation of BT's current leased lines revenues which may occur if some customers opt to migrate to FTTP services when they become available.

A18.40 Based on 2017/18 data on copper accommodation and FTTC cabinet operating costs, we have estimated a net cost savings per line of [✂£] per month.

Approach to setting recovery of the fibre shortfall – calculating the K factors

A18.41 Based on the approach outlined above, we have calculated the fibre shortfall across Area 3 (on a present value basis) for different levels of deployment.

A18.42 The next step is to convert the fibre shortfall estimates into annuitised per line values. These annuitised values per line are the K factors in our proposed post-build RAB control. Under our proposed approach, K factors would be added to MPF and FTTC charges to contribute to the recovery of fibre costs to ensure Openreach's cost recovery across its fibre and copper network.

A18.43 We propose to apply the K factors to MPF and FTTC for individual 200,000 premises tranches of Openreach's fibre network build. Accordingly, a K factor will be added to MPF and FTTC charges

[322] Openreach slides entitled [✂""] provided to Ofcom on 29 July 2019.

on deploying to 200,000 premises, a separate (higher) K factor will be added on deploying to 400,000 premises, and so on. Therefore, as Openreach expands its fibre network (in tranches of 200,000 premises) MPF and FTTC charges will increase as their contribution to the recovery of fibre costs increases.

A18.44 The main assumptions we use in calculating the per line annuity are:

- Deployment profile: Openreach's deployment of its fibre network across Area 3 is sequenced from lowest cost postcode sectors to highest cost postcode sectors.
- Payback period: Openreach's investment case has a 20-year payback period. This is in line with the business plan information we have gathered from Openreach and other network operators.
- Discount rate: We have used our proposed pre-tax real WACC for Openreach's fibre services of 5.8% to discount the cashflows over the payback period.
- Volume of lines: The shortfall in Openreach's fibre investment case is recovered across all 8.8 million lines in Area 3 over the payback period. This includes both copper lines and fibre lines. This reflects the constraints copper service prices have on fibre service prices (as noted above), and our proposal to link the 40/10 FTTP anchor price cap to the MPF-FTTC price levels when copper retirement occurs. [323]

A18.45 Table A18.3 above shows that our model predicts that the rate of increase in the build and connection costs rises as Openreach expands its fibre deployment in Area 3. This reflects our assumption that Openreach's deployment profile is sequenced from lowest cost exchanges area to highest cost exchange areas.

A18.46 We recognise that this is a simplifying assumption and that in reality fibre build is unlikely to be sequenced in such a way. In practice, the sequence of fibre deployment is likely to be more aligned with BT exchange areas (which will pick up some lower cost postcode sectors and some higher postcode sectors). As such, we would anticipate that the incremental differences in build and connection capex to be lower as Openreach's deployment progresses, particularly over the range of build we might expect in the charge control period (in the low millions).

A18.47 Therefore, in setting the charge controls we propose to smooth out the K factors based on the average build and connection costs across 7 million premises within Area 3. We do not necessarily believe that Openreach will deploy to these 7 million premises. Rather we believe that the average cost of deploying to these 7 million premises will be representative of the average cost that Openreach will face when building in Area 3.

A18.48 On this basis, we have estimated a K factor in the range of £0.04 per month and £0.09 per month for each 200,000 tranche of Openreach's fibre network deployment (in real terms). This is equivalent to £0.22 per month to £0.45 per month for each million premises Openreach passes.

[323] In Section 3, we propose that where legacy services are not present in Area 3 the 40/10 FTTP anchor price cap will be set on the basis of the 40/10 MPF+FTTC price cap plus the fibre premium of £1.50 - £1.85. Hence, should the 40/10 MPF+FTTC price cap increase as the K factor is applied, this will also result in the 40/10 FTTP price cap increasing.

A18.49 Table A18.4 below summarises our estimates of the K factors (per month) for different levels of fibre deployment. In this summary table we have presented K factors in relation to fibre deployments for each million premises reached.

Table A18.4: Summary of proposed K factors (real)

Premises covered	K factors (£ per month)
1,000,000	0.22 - 0.45
2,000,000	0.44 - 0.90
3,000,000	0.66 - 1.35
4,000,000	0.88 - 1.80
5,000,000	1.10 - 2.25
6,000,000	1.32 - 2.70
7,000,000	1.54 - 3.15
8,000,000	1.76 - 3.60
8,800,000	1.94 - 3.96

A18.50 This indicates that where Openreach's fibre coverage reaches one million premises, MPF and FTTC charges would be raised by £0.22 - £0.45 per month; where Openreach's fibre coverage reaches two million MPF and FTTC charges would be raised by £0.44 - £0.90 per month (or a further £0.22 - £0.45 per month relative to fibre deployment reaching one million premises).

A18.51 We have produced the ranges for the K factor based on different assumptions for Openreach's capex per home passed and the incremental revenue from selling fibre services:

- **Capex:** In our lower bound estimate, there is lower build and connection capex based on the assumption that 80% of existing duct and poles in Area 3 can be reused as Openreach deploys its fibre network. In our upper bound estimate, capex is higher based on the assumption that only 70% of existing duct and poles can be reused.
- **Incremental fibre revenue:** In our lower-bound estimate, we assume incremental fibre revenue is higher due to Openreach being able to sell fibre services at a higher premium (at £4.00 additional revenue per month). In our upper-bound estimate, we assume incremental fibre revenue is lower with additional revenue per month of £1.50.

Implementation of RAB control

A18.52 To determine the level of the K factor that will apply for each year of the charge control, we propose to require BT to report the number of homes it passes with fibre in Area 3 each year.

A18.53 We propose to gather this network coverage information on the 31 October of each year, which will be five months before the start of each charge control year (running from 1 April to 31 March). We consider this will provide a sufficient window of time for Ofcom to carry out all

the necessary checks on the coverage information and for Openreach to notify customers of price increases as K factors are applied.

A19. Dark Fibre Cost Modelling

A19.1 In Volume 3 Section 6, we propose BT is required to provide network access to dark fibre services connecting to the local exchange (dark fibre local access) in Area 3 and inter-exchange connectivity (dark fibre inter-exchange) between BT only exchanges. In Volume 4 Section 2 and Section 4, we propose to impose a cost-based charge control on dark fibre local access and dark fibre inter-exchange.

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A19.3 This annex sets out our proposals for the following aspects of the dark fibre charge control:

- **Cost standard –** we propose setting 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 active ethernet services –** we propose setting prices for a set of 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 (relevant to EAD only). However, we consider it appropriate to separate out the one-off cost associated with initially testing a connection and the per annum charge associated with using a patch panel (both at the customer end and a BT exchange).
- **Methodology for estimating efficient costs –** we identify three elements which make up the cost stack for dark fibre services: passive infrastructure costs, other costs not specific to dark fibre, and costs that are 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 –** in Volume 4 Section 6 we identify two ancillary services specific to providing dark fibre services: a cessation charge and a right when tested (RWT) 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), we propose that they are offered and charged on the same basis as for active services.

A19.4 The table below summarises the proposed set of maximum charges relating to dark fibre services.

Table A19.1: Initial charges in 2021/22 and CPI-X for dark fibre services

	Access tail (single fibre)	Access tail (dual fibre)	Main link for IEC and access circuits (single fibre)	Main link for IEC and access circuits (dual fibre)

Connection (per circuit)	£1,419 (CPI-2.5%)	£2,838 (CPI-2.5%)	£322 (CPI-7.4%)	£644 (CPI-7.4%)
Rental (per circuit per year)	£701 (CPI-7.0%)	£1,402 (CPI-7.0%)	£20 (CPI-5.8%)	£40 (CPI-5.8%)
Main link dark fibre (per metre per year)	n/a	n/a	£0.15 (CPI-4.2%)	£0.30 (CPI-4.2%)
Patch panel at customer premises (per panel per year)	£19	£19	£19	£19
Patch panel at exchange (per panel per year)	£86	£86	£86	£86
Initial testing	£119	£119	£119	£119
Cessation charge	£170 (CPI+0%)	£170 (CPI+0%)	£170 (CPI+0%)	£170 (CPI+0%)
RWT charge	£305 (CPI+0%)	£305 (CPI+0%)	£305 (CPI+0%)	£305 (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

A19.5 We propose to set a cost-based charge control with reference to the relevant components of BT's underlying passive infrastructure, as opposed to adopting an active-minus approach.

A19.6 To inform our choice of cost standard, we note that setting charges at incremental cost would be consistent with achieving allocative efficiency. However, for a multiproduct firm with economies of scope, pricing all services at incremental cost would not be sustainable as the firm would not be able to recover its common costs.

A19.7 When common costs need to be recovered through charges, some (though not necessarily all) service prices need to be marked up above incremental cost. Including a mark-up will lead to some inefficiency, and a pricing rule, such as Ramsey pricing, can be used to minimise this inefficiency. However, using a Ramsey pricing approach has practical difficulties due to the amount of information on the elasticity of demand that is required. Regulators therefore tend to use other methods to set prices in practice, for example, by allocating common costs based on FAC or long-run incremental costs plus some mark-up for common costs (LRIC+).

A19.8 FAC usually reflects using accounting rules and assumptions for the recovery of common costs for different services. When accounting data is prepared on a current cost accounting (CCA) basis, the data reflects forward-looking costs rather than the actual prices at the time the relevant assets were purchased, giving better signals for efficient investment and entry rather than historic costs. Costs on a LRIC+ basis also usually reflect forward-looking costs. In practice there is often little difference between CCA FAC and LRIC+.

A19.9 When setting charge controls on BT using BT's accounting cost data, we have typically done so based on a CCA FAC standard. Charges set on this basis should encourage entry where the entrant is as or more efficient than BT. In addition, it has the advantages of being transparent and practicable to implement as BT's costs are known and are based on its RFS which are publicly available to stakeholders each year.

A19.10 We therefore consider that the most practical and transparent option is to start from BT's CCA FAC data and use data from BT's RFS where possible when estimating the unit FAC for dark fibre services (both the inter-exchange variant and the local access variant). As explained below, BT is likely to incur additional costs not currently captured in the RFS in providing dark fibre. We propose to estimate these separately but, as far as practicable, to estimate the unit FAC of these additional costs.

Basing costs on active Ethernet services

A19.11 BT's wholesale Ethernet products (or EAD) are the main products that BT currently supplies for a range of services spread across lower bandwidths and some VHB circuits. In view of our design objective for the dark fibre remedies (both inter-exchange and local access variants), we consider that Ethernet products are also a suitable benchmark for the proposed dark fibre variants.

A19.12 The typical charging structure for BT'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. [324]

A19.13 We propose that the dark fibre inter-exchange connectivity and local access variants charging structure should be consistent with the respective variant of BT's EAD products. 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 propose to 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.

[324] The main link charge depends on the radial distance between the two BT exchanges.

A19.14 We propose to set the charge control for dark-fibre services in relation to the underlying components needed for a circuit. This means we propose to set a charge control for:

- Local access dark fibre variant (defined as the circuit between the customer end site and the nearest BT fibre exchange);
- Inter-exchange dark fibre variant (the circuit between BT exchanges); and
- Any combination of access and inter-exchange variants.

A19.15 When a dark fibre circuit includes both an access and inter-exchange variant, we propose that charges be set such that the rental and connection charges of the inter-exchange dark fibre variant is excluded. 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 local access dark fibre rental and connection charges; plus
- the appropriate number of patch panel and initial testing charges; plus
- the inter-exchange dark fibre main link rental charge.

Dual fibre circuits

A19.16 We propose to require BT to offer both one and two fibre dark fibre circuits. We propose that 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 A19.1 above.

A19.17 We would expect a dual fibre circuit to not 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.

Methodology for estimating efficient costs

A19.18 We propose to construct the cost stack for dark fibre services (i.e. connection, rental, main link, patch panel and initial testing services) from the following three 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 that are required for, but not specific to, a dark fibre circuit. 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.
- Element C: Costs that are specific to a dark fibre circuit. For example, Openreach needs to install a patch panel to provide a termination point for the fibre within the exchange. Openreach does not have to install a patch panel when providing active services.

A19.19 We consider that the relevant costs that BT incurs when providing an EAD circuit provide the best reference point for estimating the likely costs of a dark fibre circuit. We therefore propose

to use CCA FAC information on EAD services derived from BT's RFS to inform our estimates of elements A and B. [325]

A19.20 More specifically, we propose to estimate starting charges by using 2017/18 costs (restated in the 2018/19 RFS):

- for EAD LA 1 Gbit/s service to calculate the costs of elements A and B for dark-fibre local access.
- for EAD 1 Gbit/s service as reported in BT's 2018/19 RFS to calculate the costs of elements A and B for dark-fibre inter-exchange.

A19.21 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.

A19.22 To estimate element C, we have constructed cost estimates using an engineering led approach consistent with what we set out in the 2019 BCMR. We do not expect the costs for this element to vary significantly over time so propose to set the same charges across all years.

Adjustments to BT's RFS information

A19.23 In Annex 16, we set out a set of 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.

A19.24 The AlixPartners report notes that if average unit fibre costs are calculated using fibre asset utilisation from previous periods, and if the asset utilisation is falling, this would lead to average unit costs being too low. If there is no adjustment made for how utilisation will change over time, this could pose a cost recovery risk for Openreach. [326]

A19.25 We have made an adjustment to our leased line 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. [327] 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.

Classification of components

A19.26 We propose to 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 proposed classification for the components used to provide EAD and EAD LA services in BT's 2018/19 RFS (which serves as the input for the indicative starting charges presented in this consultation).

[325] Although BT launched an inter-exchange connectivity dark fibre product in December 2019, it has yet to report information within BT's RFS to inform our estimates.
[326] AlixPartners report, paragraph 53.
[327] 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.

A19.27 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.

A19.28 Passive components relate to the passive elements of an EAD circuit and so may include costs that are relevant to a dark fibre circuit (but may depend on whether the dark fibre is a local access variant or an inter-exchange variant). These include:

- Existing physical infrastructure assets such as junction boxes, manholes, lead-in duct and spine duct;
- 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. [328]

A19.29 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;
- 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.

[328] 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.

- 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 A19.2: Proposed classification of components used to provide inter-exchange and access dark fibre services based on EAD components found in BT's 2018/19 RFS

EAD component	Classification	Dark fibre connections	Local access rental	Inter-exchange rental	Main link rental
Ethernet Electronics	Active				
Ethernet Monitoring Platform	Active				
Cumulo Non NGA	Active				
Junction boxes	Passive		✓		✓
Lead-in duct	Passive		✓		✓
Manholes	Passive		✓		✓
Spine duct	Passive		✓		✓
Ethernet main links	Passive				✓
Routing and Records	Passive	✓			
Ethernet Access Direct Fibre	Passive		✓		
Ethernet Excess Construction costs	Passive	✓ [329]			
Openreach sales and product management	Shared	✓	✓	✓	✓
OR Systems and Development – Ethernet	Shared	✓	✓	✓	✓
OR Service Centre – Provision Ethernet	Shared	✓			
SLG Ethernet Assurance	Shared		✓	✓	
SLG Ethernet Provision	Shared	✓			

[329] We propose to include ECCs for the dark fibre access variant but exclude these costs for the inter-exchange variant.

Ofcom Administration fee – Openreach	Shared	✓	✓	✓	✓
Revenues Receivables	Shared	✓	✓	✓	✓

A19.30 We set out in detail below the rationale for including and excluding these components in the various dark fibre services.

Passive infrastructure costs ('element A')

A19.31 For each dark fibre service (e.g. connections, rental, main link) we propose to include in element A of the cost stack 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 inter-exchange dark fibre or local access dark fibre respectively.

Physical infrastructure assets

A19.32 We propose:

- that element A of the dark fibre main link service should include the full unit FAC of the PIA components attributed to the EAD main link service.
- That element A of the inter-exchange dark fibre rental service should exclude the full unit FAC of the PIA components attributed to the EAD rental service. The EAD rental service will include duct costs that are not part of inter-exchange connectivity. The inter-exchange dark fibre circuit 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 in element A of the cost stack within the Ethernet Main Links component
- that element A of the local access dark fibre service should include the full unit FAC of the PIA components attributed to the EAD LA service.

Ethernet Main Links

A19.33 We propose:

- that element A of the inter-exchange dark fibre main link service should include the full unit FAC of the Ethernet Main Links component attributed to the EAD main link service.
- that element A of the local access dark fibre service should not include costs relating to the Ethernet Main Link component.

Routing and Records

A19.34 We propose:

- that element A of the inter-exchange dark fibre connection service should include the full unit FAC of the Routing and Records component that is attributed to the EAD connection.
- that element A of the local access dark fibre connection service should include the full unit FAC of the Routing and Records component that is attributed to the EAD LA connection.

EAD fibre

A19.35 We propose:

- not to include the costs of the EAD Fibre component that are attributed to the EAD rental service in element A of the inter-exchange dark fibre rental service. The two ends (or served locations) of an inter-exchange dark fibre circuit will both be in BT exchanges. Therefore, an inter-exchange dark fibre circuit 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 in element A of the cost stack within the Ethernet Main Links component.
- to include the full unit FAC of the EAD Fibre component that are attributed to the EAD LA rental service in element A of the local access dark fibre rental service. The dark fibre service from the served customer location to the BT exchange will require fibre.

Ethernet Excess Construction and Ethernet Excess Construction Capex

A19.36 We consider that will be little, if any, extra construction work that will be required for the inter-exchange dark fibre connection service as the infrastructure supporting connectivity between BT exchanges is already in place. Therefore, we propose:

- not to include the costs of the Ethernet Excess Construction Capex components that are attributed to the EAD connection service in element A of the inter-exchange dark fibre connection service.

A19.37 We consider that Ethernet Excess Construction will be relevant to local access dark fibre since there will be circumstances where infrastructure is needed to support connectivity between a customer site and a BT exchange. Therefore, we propose:

- To include the full unit FAC of the Ethernet Excess Construction costs attributed to the EAD LA connection service in element A of the local access dark fibre connection service.

Other costs not specific to dark fibre services ('element B')

A19.38 For each both local access dark fibre service and inter-exchange dark fibre, we propose to include in element B of the cost stack 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 proposed 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.

A19.39 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)

A19.40 In BT's RFS, Openreach Systems and Development (Ethernet) costs are attributed to Ethernet connection, rental and main link services based on service volumes. [330]

A19.41 Our analysis based on billing data between 2015/16 and 2017/18 suggests that around [✂]% of Openreach Systems and Development costs specifically relate to active services. We consider the remainder of these component costs will either be dark fibre specific or be shared cross dark fibre and active services.

A19.42 We propose:

- To include [✂]% of the unit FAC of the Openreach Systems and Development (Ethernet) attributed to each EAD service to the corresponding inter-exchange dark fibre service.
- To include [✂]% of the unit FAC of the Openreach Systems and Development (Ethernet) attributed to each EAD LA service to the corresponding local access dark fibre service.

Openreach Service Centre – Provision (Ethernet) and SLG Ethernet Provision

A19.43 In BT's RFS, Openreach Service Centre – Provision (Ethernet) costs are attributed to Ethernet connection services based on service volumes.

A19.44 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.

A19.45 We therefore propose:

- to include in the unit FAC of element B of the inter-exchange dark fibre connection service the unit FAC of the Openreach Service Centre – Provision (Ethernet) component that is attributed to the EAD connection service.
- to include in the unit FAC of element B of the local access dark fibre connection service the unit FAC of the Openreach Service Centre – Provision (Ethernet) component that is attributed to the EAD LA connection service.

A19.46 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 an inter-exchange dark fibre service and EAD service; and a local access dark fibre service and EAD LA service.

A19.47 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).

A19.48 We propose:

[330] 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).

- to include in the unit FAC of element B of the inter-exchange dark fibre connection service 39% of the unit FAC of the Openreach Service Centre – SLG Ethernet Provision component that is attributed to the EAD connection service.
- to include in the unit FAC of element B of the local access dark fibre connection service the 55% of the unit FAC of the Openreach Service Centre – SLG Ethernet Provision component that is attributed to the EAD LA connection service.

Openreach Service Centre – Assurance (Ethernet) and SLG Ethernet Assurance

A19.49 In BT's 2018/19 RFS there are no costs reported in the Openreach Service Centre – Assurance (Ethernet) component. We therefore discuss our proposed approach in relation to the costs of the SLG Ethernet Assurance component only.

A19.50 SLG 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 an inter-exchange dark fibre circuit or local access dark fibre circuit relative to an EAD circuit or EAD LA circuit respectively.

A19.51 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. We do not think it is appropriate to deviate from our previous estimation given that it was based on an average over a two-year period (between November 2016 and October 2018). Based on this fault rate information, we consider dark fibre SLGs to occur [✂]% of the time when compared to EADs.

A19.52 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 adjusted the unit FAC of the SLG Ethernet Assurance component based on the difference in rental charges between an inter-exchange dark fibre service and EAD service; and a local access dark fibre service and EAD LA service.

A19.53 We propose:

- to include [✂]% of the unit FAC of the SLG Ethernet Assurance component that is attributed to the EAD rental service within the unit FAC of element B of the inter-exchange dark fibre rental service.
- to include [✂]% of the unit FAC of the SLG Ethernet Assurance component that is attributed to the EAD LA rental service within the unit FAC of element B of the local access dark fibre rental service.

Openreach Sales and Product Management

A19.54 In BT's RFS, Openreach Sales Product Management costs are attributed to connection, rental and main link services based on a survey of staff in the Openreach Sales Product Management team. This survey splits each team member's full-time equivalent (FTE) hours between Ethernet services and various other services (e.g. LLU MPF, LLU SMPF, PSTN). The survey is not however sufficiently granular to identify time relating to each individual Ethernet service. The surveyed FTE hours are therefore split between Ethernet services using revenue and volume data.

A19.55 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. We propose to maintain the same approach.

A19.56 Therefore, we propose:

- to include in the unit FAC of element B of each inter-exchange dark fibre service 19% of the unit FAC of the Openreach Sales Product Management component that is attributed to the corresponding EAD service.
- to include in the unit FAC of element B of each local access dark fibre service 19% of the unit FAC of the Openreach Sales Product Management component that is attributed to the corresponding EAD LA service.

Ofcom Administration Fee and Revenue Receivables

A19.57 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.

A19.58 We propose to adjust the unit FAC of the Ofcom Administration Fee (Openreach) and Revenue Receivables components to reflect the relative prices of EAD and inter-exchange dark fibre services; and the prices of EAD LA and local access dark fibre services respectively. We consider that this approach would be consistent with BT's approach to attributing the costs of these components in its RFS.

A19.59 We propose:

- to include 1% and 12% of the unit FAC (rentals and connections respectively) for the Ofcom Administration Fee and Revenue Receivables component costs attributed to the EAD service within the unit FAC of element B of the corresponding inter-exchange dark fibre service.
- to include 32% and 73% of the unit FAC (rentals and connections respectively) for the Ofcom Administration Fee and Revenue Receivables component costs attributed to the EAD LA service within the unit FAC of element B of the corresponding local access dark fibre service.

Costs specific to dark fibre services ('element C')

A19.60 We estimate the unit FAC of the following activities, both at BT exchanges and customers' premises, that we have identified as being specific to dark fibre services (i.e. not currently incurred by Openreach when providing EAD services or EAD LA services):

- patch panel costs; and
- initial testing / birth certificate costs.

A19.61 We then use these estimated costs to determine charges for the patch panel and initial testing dark fibre services.

A19.62 We first discuss the labour rates we use which are common to our estimation of both patch panel and initial testing costs. We then discuss the specific assumptions for patch panel and initial testing costs in turn.

Labour rates

A19.63 Both patch panel and initial testing costs 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.

A19.64 We have followed the approach used in the BCMR 2019 that relied on Openreach cost estimates specific to dark fibre services in its DFA Final Reference Offer that was required as part of the BCMR 2016 but was not implemented. In the DFA Final 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.

A19.65 We propose to 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 2018/19 was £39.80 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 in 2017/18 was £50.95.

A19.66 As we are proposing to adopt 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 continue to consider the 20% uplift in the 2019 BCMR to be appropriate.

A19.67 Therefore, we propose FAC pay rates of £47.76 per hour for the less qualified engineer and £61.14 per hour for the more qualified engineer.

Patch panel

A19.68 The handover point for BT's EAD service to the purchasing telecoms provider is the EAD Network Termination Equipment (NTE) installed at each of the two served locations. The EAD NTE is the electronic equipment that lights the fibre and provides an active service. The purchasing telecoms provider can then connect its own equipment to the NTE via either an Ethernet or optical interface.

A19.69 To provide inter-exchange and local access dark fibre services, Openreach needs to install some form of passive NTE to hand over the service to the purchasing telecoms provider.

A19.70 We propose the following approach to estimating the per circuit unit FAC for patch panels:

- estimate the costs of installing a patch panel as the sum of the equipment cost of the patch panel plus the FAC cost of labour, assuming the work would be undertaken by a less qualified engineer; and
- convert this to an annual cost per circuit by assuming the costs would be capitalised over an assumed life of [✂] years.

A19.71 As our estimated cost of a patch panel varies depending on whether it is at a BT exchange or a customer's premises, we have set separate charges depending on where the patch panel is located.

Initial testing

A19.72 Initial testing costs would be incurred when providing an inter-exchange dark fibre circuit or local access dark fibre circuit as, given the lack of electronic equipment, the circuit needs to be manually tested by an Openreach engineer to confirm the performance of the line before handover.

A19.73 We propose to estimate the unit FAC of this initial testing by combining our FAC labour rate assumption with activities and associated timings supporting Openreach's estimate of the cost of this element. In relation to those activities and timings, we have followed the approach used in the BCMR 2019 that relied on Openreach related its DFA Final Reference Offer that was required as part of the BCMR 2016 but was not implemented.

A19.74 For both inter-exchange and local access dark fibre, we assume that initial testing takes 2.5 hours and use our estimate of the FAC labour rate for a less qualified engineer of £47.76 per hour. We consider that Openreach should be able to design processes for initial testing so that there is not a material difference in the time or cost required whether testing a single or dual fibre circuit.

A19.75 We therefore propose to set the charge for initial testing of dark fibre circuits at £119 for both single and dual fibre circuits. This is a one-off charge that applies per dark fibre service that is connected and is the same for any dark fibre service, i.e. access and inter-exchange.

Treatment of non-domestic rates

A19.76 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.

A19.77 We provide more background on NDRs when discussing our approach to forecasting BT's cumulo costs (see Annex 16).

A19.78 With respect to fibre assets, rating precedent has determined that as a general rule of thumb, the person 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.

A19.79 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

A19.80 In Volume 4 Section 3, we set out our proposals for charge control design. In summary, we propose

- To set a 5-year control for dark fibre services.
- To set charges to cost at the start of the control period and thereafter align charges to our forecast of costs over the 5-year control period.
- To set single service charge controls for each local access dark fibre service and inter-exchange dark fibre service.

Pricing of ancillary services

A19.81 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.

A19.82 The first group relates to services that Openreach already offers to provide active services (e.g. TRCs). In Volume 4 Section 6 we propose that this group should be offered and charged for on the same basis as for active services.

A19.83 The second group relates to those that are specific to dark fibre services. These comprise of:

a) 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, in contrast to an active circuit which can be ceased remotely using the electronic equipment.

b) and Right When Tested (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.

A19.84 We propose that for both services are charge controlled to allow Openreach to recover its FAC. We propose a CPI-0% charge control.

A19.85 Further details on our proposed approach to pricing ancillary services can be found in Volume 4 Section 6.

A20. The calculation of PIA maximum charges

A20.1 In Section 5 of Volume 4 we set out our proposals for 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 to other telecoms providers. [331]
- Asset costs – these relate to the cost of the existing physical infrastructure to which access is granted.

A20.2 In previous assessments we included a third component – productisation costs. However, as discussed in Section 5 we no longer need to identify these separately as any productisation costs are included within the revised base data we are using. [332]

A20.3 This annex explains in more detail the proposed calculations that we make to estimate the costs of both the above elements. We discuss network adjustments first and then asset costs but before we do so will make a couple of observations that affect the calculation of both elements.

a) We are setting maximum charges for PIA rental services out to 2025/26. So, for both components we forecast costs over the charge control period out to 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 web-site.

b) When we calculate fully allocated costs we include a return on capital employed assuming a WACC of 7.1%. 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.

c) 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 three poles PIA services: Cables up a pole, Manifolds and Attachments.

Network Adjustment costs

A20.4 As we explain in Section 5, we propose that the costs of network adjustments should be recovered across all SMP products that use the physical infrastructure, subject to a financial

[331] These costs are essentially asset costs which Openreach has not incurred to date and so are not reflected in the base costs data for the asset component. We therefore estimate these separately.
[332] Openreach's response dated 4 June 2019 to the s.135 notice titled Promoting competition and investment in fibre networks dated 17 April 2019, question 3. Openreach noted that it had identified two types of productization costs in its 2017/18 RFS and "had included these productisation costs in the duct and pole components" costs that it had provided.

limit. We explain that we include an allowance for a proportion of the costs of making network adjustments (appropriately capitalised) in the calculation of PIA rental charges.

A20.5 To estimate these costs, we use a very similar methodology to that we employed in the 2018 WLA. The main difference is that we estimate the costs of network adjustments each year from 2019/20 to 2025/26.

A20.6 We have modelled the network adjustment costs that need to be recovered from all users of the infrastructure over the review period as follows:

a) We assume that network adjustment costs to be recovered were £67.74 per premises passed in 2017/18. This is the same value that we assumed in the 2018 WLA.[333] We also assume, as before, that £16.66 relates to the pole element and the remainder, [✂£] 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.

b) Using our formal 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. We have used these plans to inform our estimates that between [✂] and [✂] million premises will be passed by new networks built using Openreach's physical infrastructure over the period from 2019/20 to 2025/26[334].

c) 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.

d) We assume these costs will be capitalised and so we depreciate this capital expenditure using an asset life of 20 years for poles related activities and 40 years for duct and footway boxes activities.

e) 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.

f) We have not included any estimates of incremental network adjustments incurred by Openreach. We assume that any such amounts are included within our forecasts of Openreach's PIA related capital expenditure that we use when assessing asset component costs.

A20.7 This process results in fully allocated network adjustment costs in 2025/26 (including a return on capital employed) of £[✂] for poles and £[✂]m for duct and footway boxes.

A20.8 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.

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[333] Ofcom, 2018. *Statement: Wholesale Local Access Market Review*, Volume 3, paragraph 5.91.
[334] 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

A20.9 The calculation of the asset cost component of PIA is made using the following 3 steps.

a) **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 a scenario of BT's 2017/18 results as restated within its 2018 RFS.[335] This scenario recut the RFS data to show costs as if PIA had been included as a separate market, consistent with how we have directed BT to report PIA market costs from 2019/20 onwards. We make some adjustments to this base data and then forecast the resulting capital and operating costs over the period. These forecasts require assumptions about volume growth and future capital expenditure.

b) **Step 2**: 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 cost 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.

c) **Step 3**: 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.

A20.10 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 which we now explain.

Ducts and footway boxes

Step 1: Determination of the regulatory cost base for ducts and footway boxes

A20.11 The base data provided by BT, which, as described above, is consistent with a PIA market view, 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.

A20.12 Operating costs were split as follows:

a) Pay and non-pay costs.[336] These include contributions from Openreach and corporate overhead costs.

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[335] Openreach's response dated 4 June 2019 to the s.135 notice titled *Promoting competition and investment in fibre networks* dated 17 April 2019, question 2; Openreach's response dated 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 4.

[336]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.

b) CCA depreciation for the duct class work (LDD) with HCA depreciation, Supplementary depreciation, Holding Gains and Losses, and Other CCA adjustments identified separately.

c) 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.[337, 338] None of these other assets are revalued on a CCA basis within BT's RFS.

A20.13 Capital costs included the following items:

a) GRCs (Gross replacement costs) and NRCs (Net replacement costs) for the duct class of work (LDD);

b) GRCs and NRCs for other assets;

c) Net Current assets.

A20.14 In constructing this schedule BT excluded CCA depreciation and capital costs on duct that connects "copper cables to fibre cabinets since this infrastructure is not expected to be reused by PIA customers".

A20.15 We make one adjustment to this base data and remove capitalised costs (and the associated depreciation) incurred on repayment works since 2006 from the PIMR market.[339] This adjustment is consistent with the adjustment we make in the Top-Down model – see Annex 16. It is also consistent with our approach in the 2019 BCMR Statement in which we directed Openreach to move all capital costs associated with repayment works into the Openreach Residual market.

A20.16 To forecast the adjusted base data forward over the charge control period we require forecasts of volumes for each duct and footway box cost component. Openreach provided us with its latest estimate of the installed base of each component together with historical installation volumes over the last 7 years.[340] Assuming that none of these installation volumes were to replace old ducts or footway boxes we have calculated the implied annual growth rates.[341] These were all low and similar for all cost components. We have therefore used a single weighted average growth rate as our forecast of volume growth for all cost components from 2018/19 to 2025/26.

A20.17 We forecast the above adjusted base data over the charge control period as follows:

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[337] Openreach's response dated 4 June 2019 to the s.135 notice titled *Promoting competition and investment in fibre networks* dated 17 April 2019, question 2.

[338] The allocation of BDUK funding to assets is something that we intend discussing further with Openreach and BT.

[339] Openreach's repayments programme is made up of two sub-programmes: repayment alterations; and repayment damages. Repayment alterations relate to pre-planned jobs, where work is requested by external parties (e.g. local authorities) to alter the Openreach network due to building, redevelopment, utilities or transport projects such as HS2. Repayment damages relate to the repair of the Openreach network caused by third party damage and reported via the Openreach damage control unit.

[340] Openreach's response dated 30 October 2019 to s.135 notice titled *Promoting investment and competition in fibre networks* dated 17 October 2019, question 3.

[341] This may slightly overstate growth rates but the growth rate we have assumed is low, [✂%] per annum. Making a somewhat arbitrary adjustment for replacement volumes would not make a significant difference to our proposed charges

a) Capital costs associated with historic assets recorded within the main duct class of work, LDD as at 31 March 2018. 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 price movements. 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 set these as zero in the future. We assume no new capex on these assets as this is forecast in the next category. We classify all these costs – OCM depreciation and mean NRCs – as associated with assets installed before 31 March 2018.

b) Capital costs associated with "LDD" assets installed from 2018/19 onwards. We forecast these using the same process as for historic LDD assets, except that the opening balance is zero in 2018/19 and we forecast capital expenditure in each year. We have generated these capex forecasts from data Openreach provided on its historic forecasts of capex on the LDD class of work, suitably adjusted for capex on repayment works, and its expected capex envelope going forward.[342] Finally, we add a small allowance for assets in the course of construction (AICC) based on historic trends.[343]

c) Capital costs associated with other assets. These are not straightforward to forecast as they are a mix of a "negative" assets (the funding on BDUK assets) and support assets such as software and computing.[344] For simplicity we assume these remain constant in nominal terms over the charge control period.

d) Pay and non-pay costs. We forecast these in the same way as we forecast operating costs in other top-down charge controls. We assume efficiency savings of 4.5% per annum, consistent with assumptions we make in the other modelling we undertake as part of this consultation.[345] We assume a cost volume elasticity (CVE) of 0.9 on the basis that most of the costs are overheads and these have a high LRIC/FAC ratio within BT's LRIC model. None of these assumptions are critical to the final maximum charges we estimate as operating costs are a relatively low proportion of the duct and footway boxes cost base.

e) Net current assets and holding gains and losses are forecast using the standard formulae that we have applied in other recent top-down charge control models.

A20.18 As we explain below, in the next step we attribute costs associated with assets installed up to 31 March 2018 separately to those installed after that date. The final stage in this step is then to attribute the non LDD costs to assets installed in one of those two periods. We attribute pay

[342] Openreach's responses dated 11 and 17 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 7; 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 7.
[343] This is included in the base year MCE figures and is normally included within estimates of mean capital employed.
[344] 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.
[345] Annex 16 contains a short discussion about the efficiency targets we have used in the top-down modelling work.

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.

A20.19 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). One of these is the regulatory cost base for assets installed before 31 March 2018 and the other for assets installed after that date.

Step 2: Attribute the duct and footway regulatory cost base between different PIA services

A20.20 Openreach provided updated estimates of the attribution of its duct and footway costs between PIA cost components using a methodology analogous to that they had used in previous assessments. The attributions were in proportion to relative GRCs as estimated by a bottom-up evaluation using installation volumes and unit costs in 2017/18. The unit costs were derived from Openreach's Network Inventory Management System. Openreach also provided us with similar information over the period 2012/13 to 2017/18.[346] Whilst the attributions over this period were relatively stable, they were however very different to those that they had provided in previous years, implying significant increases in the proportion to be attributed to single bore duct and much less to 3+ bore duct.

A20.21 As we noted in Section 5, we propose to apply the "old" attribution used to set charges in the 2018 WLA to costs associated with assets installed up to 31 March 2018. We apply Openreach's revised attribution to assets installed after 31 March 2018 as we believe this provides a more robust view of its forward-looking incremental costs.

A20.22 In this step we first add network adjustment costs associated with duct and footway boxes to the regulatory costs associated with assets installed after 31 March 2018. We then attribute both sets of operating costs and mean capital employed as outlined above. We keep the attributions for each set (pre- and post-March 2018) fixed in each year. Finally, we 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 7.1%.

A20.23 The outputs are then 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 3: Calculate unit costs for each service in each year and set rental charges as a share of these unit costs

A20.24 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.

A20.25 We then estimate maximum charges that telecoms providers should pay as a share of this unit cost based on measures of relative utilisation – these are set out in Section 5 of Volume 4.

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[346] 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.

Duct PIA services

A20.26 For duct PIA services the shares of each unit cost are repeated in table A20.1 below.

Table A20.1: Proposed share of duct PIA services

PIA Service	Share of unit costs
Lead-in duct	90%
1 bore duct	50%
2 bores ducts	19%
3+ bore ducts	9%

A20.27 We outlined our proposal for a reduction in the lead-in duct share from 100% to 90% in Section 5 of Volume 4. We provide a fuller explanation here together with an explanation of how we have arrived at this 10% reduction.

A20.28 Currently, PIA users pay 100% of the unit cost of lead-in duct. There is no minimum term for PIA rental charges applicable to lead-in ducts; instead, rental charges are payable if the telecoms provider has a lead-in cable in place. This means that when a customer churns, the competing telecoms provider will continue to pay the rental charge unless it physically removes the lead-in cable.

A20.29 Competing telecoms providers are unlikely to remove the lead-in just to avoid paying rental charges. This is because the costs of removing a lead-in when a customer churns and re-installing it when a customer reconnects are likely to be significantly higher than the rental charges incurred in the period where the connection is inactive. Also, leaving the lead-in in place will also mean they can offer quicker reconnection were they to win back the customer. As a result, a competing telecoms provider is likely to continue paying rental charges even though they are not receiving any revenue from the premises.

A20.30 In our view, the current approach is not consistent with there being a level playing field between Openreach and competing telecoms providers using PIA. For example, it could result in a competing telecoms provider paying 100% of the unit cost of a lead in duct, when another telecoms provider (e.g. Openreach or a third competing telecoms provider) is using that same lead-in duct to serve the customer and generate revenues. [347] There is also a risk that Openreach will over-recover its costs, particularly in the event there is a third competing telecoms provider using the lead-in duct.

A20.31 We have considered two potential alternative options to address this issue.

[347] In addition, even where a competing telecoms provider has the customer, paying 100% of the unit cost does not reflect the value to Openreach from retaining its lead-in cable in the duct, ready to serve a customer.

a) **Option 1**: Telecoms providers would be charged, but only for as long as they are actively serving a customer. If and when the customer switches to another telecoms provider the rental charge would be paid by the new telecoms provider. To account for instances whereby a customer switches to an telecoms provider that does not use the lead-in duct, all telecoms providers with an active connection would pay an appropriate uplift i.e. overall PIA rental charges would be increased.

b) **Option 2:** Telecoms providers would continue to be charged for lead-in ducts if they have lead-in cable in place, even when they lose the customer. However, the charge that they pay would be lower than the lead-in unit cost to account for the possibility that the operator may lose the customer.

A20.32 We consider that Option 2 is the most appropriate approach for the following reasons:

a) Even when the telecoms providers do not have an end-customer connection they still occupy scarce space in Openreach's infrastructure. Consistent with our approach to other PIA rental charges, telecoms providers should pay for this;

b) Telecoms providers (including Openreach) derive a benefit from keeping the lead-in connection in place even when they lose the customer in that they have a competitive advantage over telecoms providers who do not have a connection in place. This is because they can compete for the customer with more certainty over the connection process and offer a quicker customer connection;

c) This approach would still allow the previous and new telecoms provider to find an agreement to transfer the ownership of the installed lead-in if desired. This way the previous telecoms provider would not incur rental charges for the entire period the customer is being served by another telecoms provider. Telecoms providers could also put in place additional mechanisms to ensure they only pay when they have an active end-customer connection.

A20.33 We propose the discount to be calculated based on the probability that the telecoms providers may lose a customer over this review period. We have undertaken some simple modelling assuming:

a) there is no demand at the start of the period but that this grows steadily out to 2025/26;

b) most of the demand is for broadband services, the contract period for which is typically 12-18 months. The remaining demand is for leased line services for which typical contract periods might be 3 years;

c) churn rates of around 10%. [348, 349]

A20.34 The assumptions we use produce different estimates of the base installed over the period surviving to the end of the period with a range 5-20%. Our proposal is that for this charge

[348] Ideally the churn rate should be for a network operator rather than one based on churn of retail customers. We would expect the churn rate for a network operator to be the lower of the two.
[349] Some support for this comes from Ofcom Switching Tracker, though this is a churn rate for retail customers. Ofcom 2018, *Ofcom Switching Tracker 2018 Data Tables.* p178, Table 25.

control period we adopt a value of 10%. We therefore propose to reduce the lead in duct element of the new composite lead in charge by 10%.

Footway Services

A20.35 For junction boxes and manholes, the shares are based on the expected (average) number of sub-ducts entering/existing a manhole or a joint box respectively. The shares of each unit cost are repeated in table A20.2 below.

Table A20.2: Proposed share of footway services

PIA Service	Share of footway box unit costs per sub-duct
Manholes	3%
Joint boxes	14%

Source: Ofcom analysis of Openreach data. [350]

Calculation of simplified lead in charges

A20.36 In Section 5 we noted that telecoms providers using a lead-in cable to connect into one or more premises need to purchase a combination of PIA services and that we are consulting on a proposal to introduce a flat, aggregated charge for a Simplified Underground PIA Lead-in service. This would be a consolidated, fixed price lead-in rental service that would apply from the telecoms provider's optical distribution point all the way to the building entry point of the end-customer premises.

A20.37 The calculation of this charge requires information on maximum charges and average volumes per premise for each of the following PIA services:

a) Lead-in duct (charged per metre)

b) Lead-in Link duct (i.e. a single bore spine duct also charged per metre)

c) Facility Hostings to enter and exit the distribution point and pass through any intermediate footway boxes or chambers

A20.38 Openreach provided us with the following estimates of these average volumes, calculated from a large and representative sample of [✂] premises across the UK: [351]

a) Lead in duct: [✂] per premises;

b) Lead in link duct: [✂] per premises; [352]

[350] Openreach response of 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 9.
[351] Openreach response of 10 December 2019 to question 2 of the s.135 dated 2 December 2019
[352] A telecoms provider buying lead-in Link can fill the 25 mm section of duct that he purchases with as many cables as will fit within this diameter and so could fit six 6mm cables within this space. However, Openreach explained (in its response dated 10 December 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 2 December 2019, question 1) that it is highly unlikely that every section of rented Lead-in Link will be filled to capacity. Based on information on

c) Joint Box exits: [✂] (i.e. Facility Hostings) per premises. [353]

A20.39 Multiplying the above average volumes by the current maximum charges for the relevant PIA services gives a charge for of £ 9.25 per connection. Under the current charge control Openreach can increase maximum charges by CPI annually up to March 2020 so a composite charge based on 2020/21 charges might be higher.

A20.40 When we estimate simplified lead in charges over the charge control period, we use the same average volumes as those Openreach provided, as given above, but we use the maximum prices we estimate for each of the relevant services.

Poles

Step 1: Determination of the regulatory cost base for poles

A20.41 As noted above, the base data provided by BT is a recut of BT's 2017/18 restated RFS data as if PIA had been reported as a separate market, included both operating costs and capital costs. However, the way this data has been derived is different to that for duct and footway boxes and is different to that we have used in previous assessments. The changes reflect work that we and Openreach have undertaken to understand better the cost of poles.

A20.42 Openreach's original view was that the costs of poles had been recorded historically under the main copper LDC class of work. We now understand that the costs were recorded under several classes of work, not only under LDC but also under dropwires plus an increasing proportion being recorded under various fibre classes of work.

A20.43 Openreach also provided us with updated estimates of the capital cost of installing a new pole based on detailed planning and costing data used by Openreach. They also provided these estimates going back several years. [354] This revealed that the unit cost of installing a pole had increased in recent years, particularly as a result of general cost inflation but also because the mix of activities had changed. For example, a much greater proportion of pole installations now incur road work or traffic management compared to a few years ago.

A20.44 This breakdown 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 the main document, we propose that in future poles' costs should exclude the costs of re-cabling to be consistent with our approach to pricing of other PIA services such as ducts. This reduces the costs of poles significantly. The

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the [✂] premises included in their inventory systems Lead-in Links, on average, are passed by 3 cables. The price of the Lead-in link is then calculated by using the average total lead-in cable length minus the lead-in Duct element divided by 3.

[353] Based on information on the [✂] premises included in their inventory systems Openreach estimates that there are [✂] 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 footnote 352, this is again divided by 3 to provide a per lead-in cable price.

[354] Openreach's response dated 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 2.

costs of any re-cabling activities would be charged separately and Openreach's internal re-cabling costs would be recovered through fibre and copper costs.

A20.45 Using the above information – pole installation dates, historic unit construction costs, and under which classes of work the poles were recorded – and inflation indices used by BT in its RFS for the various classes of work Openreach provided us with estimates of the GRC, NRC and Depreciation associated with the current installed base of poles.[355] These estimates excluded any capital costs associated with repayments activities on poles. It is these NRC and depreciation estimates that we have used within our regulatory cost base for poles in 2017/18.[356] It is also these NRC estimates that drove the attributions to poles costs in the recut of BT's RFS consistent with a PIA market view.[357]

A20.46 The other costs that formed part of our base year regulatory costs for poles came from BT's recut of the 2017/18 restated RFS data. For operating costs these were:

a) Pay and non-pay costs.[358] These included contributions from Openreach and corporate overhead costs.

b) A small amount of CCA depreciation associated with other assets required to provide PIA poles services. This mainly consisted of depreciation associated with the funding of BDUK assets plus some support assets such as software.[359, 360] None of these other assets are revalued on a CCA basis within BT's RFS.

A20.47 The other capital costs included in our base year regulatory costs were GRCs and NRCs for other assets and net current assets.

A20.48 We forecast all the above costs over the charge control period and to do so we require forecasts of volumes for poles and poles services.

A20.49 Openreach provided a schedule showing the installation date of its poles.[361] As for duct and footway boxes we have calculated implied annual growth rates, again assuming that none of these installation volumes were to replace assets.[362] Installation volumes (and hence implied volume growth) have declined in recent years. We use the average growth rate over the period

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[355] Openreach's response dated 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 2.

[356] As these costs exclude costs associated with repayment works activities, we therefore do not make any other adjustments to remove repayment works costs.

[357] There were small differences between the depreciation and NRCs generated in BT's recut of the RFS data for poles and these bottom-up estimates. There are several reasons for these differences, and we will continue to explore these with Openreach. Our view is that the bottom-up build estimates of NRCs and OCM depreciation are sufficiently robust for use as the base year costs for our regulatory cost base for poles for this consultation. We have however made some adjustments to the bottom-up build estimates of GRCs as we understand these include costs of some fully depreciated assets.

[358] 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.

[359] Openreach's response dated 4 June 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 17 April 2019, question 2.

[360] The allocation of BDUK funding to assets is something that we intend discussing further with Openreach and BT.

[361] Openreach's response dated 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 2a. Openreach noted that the data actually related to the preservation year but it took this as a "proxy for installation year".

[362] This may slightly overstate growth rates but the growth rate we have assumed is again low, [✂%] per annum. Making a somewhat arbitrary adjustment for replacement volumes would not make a significant difference to our proposed charges.

2015/16 to 2017/18 as our forecast of volume growth for all poles services (i.e. Attachments, Cables up a pole, and Manifolds) from 2018/19 to 2025/26.and for each type of pole [363]. This results in the number of attachments per pole remaining constant.

A20.50 We also forecast how future installation volumes might split between the current class of works used to record poles costs. We do this by a simple extrapolation of the trend in how the split has changed over the past few years. This results in the majority, roughly 75%, of new poles installed in 2025/26 being assumed to be recorded under fibre classes of work. [364]

A20.51 We forecast the regulatory cost base data over the charge control period as follows:

a) **Capital costs for poles.** We forecast opening and closing GRCs and NRCs for each year of the charge control period by class of work, 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. We forecast capital expenditure, OCM depreciation and price movements. [365] Using the installation profile provided by Openreach for each class of work we assume assets will be written out once they have been fully depreciated. We make no forecasts of any other CCA adjustments. Our forecasts of capex are derived from our volume forecasts by class of work multiplied by a unit installation cost. We use the latest 2017/18 unit cost as provided by Openreach and index this up annually by RPI, consistent with our asset inflation assumptions for all direct PIA assets.

b) **Capital costs associated with other assets.** As for duct footway boxes these consist of a mix of "negative" assets (the funding on BDUK assets) and support assets such as software and computing. [366] For simplicity we assume these remain constant in nominal terms over the charge control period.

c) **Pay and non-pay costs.** We forecast these in the same way as we forecast operating costs for duct and footway box cost components. We assume efficiency savings of 4.5% per annum and a CVE of 0.9. These assumptions have a greater impact on poles costs than for duct and footway boxes as operating costs are a higher proportion of the poles cost base.

d) **Net current assets and holding gains and losses.** These are forecast by using the standard formulae that we have applied in other recent top-down charge control models. [367]

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[363] The different types of poles are discussed in Step 3 below under cable attachments. For example, there are both pure and mixed feeder and distribution poles and cable poles.

[364] One of the implications of this change in the mix of poles is that it makes small changes to the implied asset life of poles over time die. We understand that Openreach is considering introducing a new COW under which to record poles costs but that this has not yet been implemented. If this were to happen then Openreach might set a different asset life for poles assets in the future and that might then lead us to consider a slightly different approach to the depreciation of poles costs.

[365] We calculate price movements 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.

[366] Openreach's response dated 11 October 2019 to the s.135 notice titled *Promoting investment and competition in fibre networks* dated 27 September 2019, question 6.

[367] 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.

A20.52 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 2: Attribute the poles regulatory cost base between different PIA services

A20.53 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.

A20.54 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 providers 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 a pole, with the remaining 7% of attributed to manifolds. We believe these assumptions contribute to incentivising efficient use of space on a pole. [368]

A20.55 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 7.1%.

A20.56 The outputs of this step are then the regulatory cost base for each poles service in each year of the charge control period.

Step 3: Calculate unit costs for each service in each year and set rental charges as a share of these unit costs

A20.57 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.

A20.58 We have already outlined in Section 5 how we set the maximum charges for each service as a share of these unit costs together. 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

A20.59 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

[368] 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.

'mixed' DP poles and 'mixed' feeder poles that carry both single- and multi-premises attachments.

A20.60 Different shares are calculated for each type of attachment. The calculation has two steps. First, the regulatory costs are allocated per each type of cable attachment based on the average number of those attachments per pole calculated for 'pure' poles only (i.e. 'pure' DP poles and 'pure' feeder poles for single-premises attachments and cable poles for multi-premises attachments). Second, the costs allocated per attachment are adjusted to avoid over-recovery due to the additional attachments on 'mixed' poles. [369]

A20.61 For single-end-user attachments, PIA users pay an amount equal to the unit cost attributed to single-end-user attachments, divided by the current number of (Openreach) attachments. There is no minimum term for PIA rental charges applicable to these attachments; instead, 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 lead-in ducts. For the same reasons set out in paragraphs A20.28 to A20.34, we propose to reduce the charge for single-end-user attachments by 10%.

Cables up poles

A20.62 For cables up poles the regulatory unit cost pole allocated to cables up poles are 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 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 estimated total number of cables up 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. [370]

Manifolds

A20.63 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 manifolds in each year plus the total number of DP poles in each year, as an estimate of the expected additional PIA manifolds. [371] The uplift by the total number of DP poles

[369] 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 in its response of 11 October 2019 to question 9 of the s.135 request issued on 27 September 2019. Openreach provided data on the volumes of different types of poles in its network in its response of 3 June 2019 to question 3 of the s.135 requests issued on 17 April 2019.

[370] Openreach provided data on the average number of cables up a pole in its response of 11 October 2019 to question 9 of the s.135 request issued on 27 September 2019.

[371] The total number of manifolds and DP poles in each year is calculated as part of the volume forecasts as outlined in Step 1 above. Openreach provided data on the number of manifolds on its network in its response of 11 October 2019 to question 9 of the s.135 request issued on 27 September 2019. Openreach provided data on the number of cable poles in its network in its response of 3 June 2019 to question 3 of the s.135 requests issued on 17 April 2019.

recognises that PIA manifold attachments may not be substitutional to Openreach's existing attachments, assuming one additional manifold for each existing DP pole.

A21. Cost of capital

A21.1 For those services we propose to regulate with cost-based charge controls, we require an appropriate return on the assets used, i.e. the risk-adjusted return required by investors on the mean capital employed (MCE).

A21.2 Recently, the returns made on regulated infrastructure in several sectors have been the subject of wider scrutiny and debate. Recognising the importance of this debate and, in anticipation of a suite of major periodic reviews across several sectors, the UK Regulators Network (UKRN) commissioned a study by academics and consultants to examine the latest evidence on expected returns. The report was published in 2018.

A21.3 One of the 2018 UKRN Report's recommendations was to differentiate the weighted average cost of capital (WACC), i.e. the concept of a purely forward-looking expected return on capital of a given degree of systematic risk, from the regulatory allowed return (RAR) which represents the regulator's view on the appropriate return on capital employed. The 2018 UKRN report identifies that the primary reason for the RAR differing from the WACC is a concern about "disincentivising investment, along with an asymmetric loss function which makes under-investment costlier than over-pricing". [372]

A21.4 For consistency with previous notation and because the allowed return is most significantly determined by the WACC, we typically refer to the WACC throughout this annex. Where aspects of the allowed return depart from the pure forward-looking expected cost of capital, we note where this is the case and explain why.

A21.5 In Sections 2 and 4 of Volume 4 we explain our proposals to set cost-based charge controls for passive access and dark-fibre (for both inter-exchange and access leased lines) – starting from 2021 (i.e. without a glide path from current charges to projected costs at the end of the control period). Our charge controls in Area 3 will be set to reflect costs, both of existing services and to allow Openreach to recover the costs of building FTTP. This means we need estimates of the WACC that (i) cover the charge control period up to 2026) and (ii) reflect the risks of existing and new network assets. [373]

A21.6 The WACC combines the cost of funding 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:

$$WACC = \frac{Ke * (1 - g)}{1 - t} + Kd * g$$

[372] 2018 UKRN Report, Page 6.

[373] 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 post-tax WACC for valuation purposes as the returns investors get will be after corporation tax.

Summary of our proposals in this consultation

A21.7 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 for the lines of business regulated in this review and the regulated activities within BT represent a large part of the company. [374] 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).

A21.8 As this consultation is less than six months after the 2019 BCMR Statement, we mainly use the same economy-wide parameters as in that statement. [375] We will carry out further analysis in 2020 and update the economy-wide parameters accordingly.

A21.9 We also propose to undertake a three-way disaggregation of the BT Group WACC, much as we did in the 2019 BCMR Statement and the 2018 WLA Statement. Our proposed estimates for the BT Group WACC and its three constituent parts (Openreach [376], Other UK Telecoms and Rest of BT) are shown in Table A21.1 below.

A21.10 As noted above, we propose to adopt much of our previous methodology to estimate the WACC and allowed return. In this consultation we propose revisions to only two company-specific parameters, namely:

a) the cost of debt, where we propose to simplify our approach and make it more transparent, in that we propose to directly use observed yields on a benchmark BBB index to calculate the cost of new and existing debt; and

b) the asset betas for disaggregated parts of BT Group – in particular to reflect a more forward-looking view of the services falling within Openreach.

[374] According to BT's 2019 RFS, markets in which BT was found to have SMP represented 40% of returns and 39% of MCE.
[375] We use the same RFR, expected market return (EMR), ERP and tax rate as in the 2019 BCMR Statement. However, we have updated inflation as we explain later in this annex. Previously, we referred to the EMR as the total market return (TMR), however we have amended our definition to take account of the fact that the parameter is an expected return to compensate for systematic risk rather than an observed total return which could be taken to imply compensation for both specific and systematic risk. The terminology is also consistent with the 2018 UKRN report.
[376] This was previously referred to as 'Openreach copper access', but as a short-hand and reflecting the wider scope of regulated products in that category we now use the shorter notation 'Openreach'. Our short-hand of "Openreach" should not be equated to all Openreach businesses – i.e. the full wholly owned BT subsidiary which offers services beyond just fixed access lines.

Table A21.1: Summary of WACC and component parameters

WACC component	BT Group	Openreach	Other UK Telecoms	RoBT	Source
Nominal RFR	1.5%	1.5%	1.5%	1.5%	See A21.18
Real (CPI-deflated) EMR	6.7%	6.7%	6.7%	6.7%	See A21.18
CPI inflation forecast	2.0%	2.0%	2.0%	2.0%	See A21.19
Nominal EMR	8.8%	8.8%	8.8%	8.8%	= (1+real EMR)*(1+CPI inflation)-1
Nominal ERP [377]	7.4%	7.4%	7.4%	7.4%	= Nominal TMR – Nominal RFR
Debt beta (βd)	0.10	0.10	0.10	0.10	See A21.33
Asset beta (βa)	0.68	0.57	0.65	0.98	See A21.33, A21.74 to A21.76
Asset beta weight	100%	25%	60%	15%	See A21.70 to A21.73
Gearing (forward looking) (g)	40%	40%	40%	40%	See A21.33
Equity Beta (βe)	1.07	0.88	1.02	1.57	= (βa - βd*g)/(1-g)
Cost of equity (post-tax) (Ke)	9.3%	8.0%	9.0%	13.1%	= Nominal RFR + ERP *βe
Cost of equity (pre-tax)	11.2%	9.6%	10.8%	15.7%	= Ke / (1-t)
Corporate tax rate (t)	17.0%	17.0%	17.0%	17.0%	See A21.18
Cost of debt (pre-tax) (Kd)	3.5%	3.4%	3.5%	3.7%	See A21.21 to A21.30
WACC (pre-tax nominal)	**8.1%**	**7.1%**	**7.9%**	**10.9%**	**=(Ke*(1-g))/(1-t)+(Kd*g)**
2019 BCMR Statement	*8.3%*	*7.1%*	*8.0%*	*11.0%*	

Source: Ofcom [378]

[377] Note: most of the figures shown in the table are rounded to one decimal point, but all intermediate calculations are unrounded. This explains why the nominal ERP is 7.4% rather than 7.3% as would be calculated by subtracting the nominal RFR (of 1.5%) from the nominal EMR (of 8.8%) shown in the table.

[378] 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 RPI. The real vanilla WACC (with respect to RPI inflation of 3.0%) is 3.9%, 3.0%, 3.7% and 6.1% for BT Group, Openreach, Other UK Telecoms and RoBT respectively.

Framework for estimating an appropriate rate of return

Key objectives

A21.11 Consistent with the 2019 BCMR Statement, we consider in this review our key objectives are:

- **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 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.

A21.12 We consider that our proposals in this consultation strike a reasonable balance between these objectives.[379] Our framework follows the same high-level principles established by the EC in its 2019 Notice. This Notice followed a 2016 report by Brattle for the EC which considered approaches used by European telecoms regulators to estimate the cost of capital.[380]

Overall approach

A21.13 We propose to estimate the cost of equity using the Capital Asset Pricing Model (CAPM). Under the CAPM the cost of equity 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, or ERP) and the systematic risk of the company (i.e. equity beta, βe):

$$Ke = RFR + ERP * \beta e$$

A21.14 Under our approach, the equity beta is estimated by first undertaking a three-way disaggregation of the BT Group asset beta (split between Openreach, Other UK Telecoms and the Rest of BT), before re-levering these asset beta estimates using a forward-looking gearing estimate to calculate equity betas.

A21.15 We propose to estimate the cost of debt by considering the weighted average cost of new and existing debt. We propose to simplify our approach to calculating the cost of new debt by

[379] European Commission, 6 November 2019, Commission Notice on the calculation of the cost of capital for legacy infrastructure in the context of the Commission's review of national notifications in the EU electronic communications sector (2019 Notice).
[380] Brattle, 2016, Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization (2016 Brattle Report).

basing it directly on yields of 10-year BBB rated bonds rather than building it up from the RFR with a separately estimated debt premium.

A21.16 As in recent charge control decisions, we continue to have regard to the cost associated with existing debt obligations when estimating the overall cost of debt. This is because an efficiently financed firm may not have anticipated the scale of the Bank of England's quantitative easing (QE) programme and the extent of the current low interest rate environment. Therefore, a cost of debt based primarily on current market rates may not be consistent with providing the regulated firm with a 'fair bet' on its financing costs when regulation (rather than competition) limits pricing. [381] We propose to base our estimate of the cost of existing debt by reference to the 10-year average yield on 10-year BBB-rated debt. [382]

A21.17 The overall cost of debt is also disaggregated three ways into Openreach, Other UK Telecoms and the Rest of BT.

Market parameters

A21.18 Some of the CAPM parameters reflect economy-wide factors that affect all firms. We recently considered these economy-wide factors as part of the 2019 BCMR Statement and propose to adopt the same approach to their estimation for the next control period. For the purposes of this consultation, we have adopted the same values for these economy-wide parameters as in the 2019 BCMR Statement given that this was only published six months ago. Specifically, we assume:

a) **Nominal RFR of 1.5%:** In the 2019 BCMR Statement we looked at recent average yields on gilts and benchmarked the calculated nominal RFR against nominal forward rates for ten-year gilts taken out around the end of the charge control. We propose to adopt a similar methodology for estimating the RFR in this review. We note that while the average yield on a 10-year index linked gilt continues to fall, our estimate of RPI inflation is likely to be higher on the basis of a new forecast period. [383] For this consultation, we therefore maintain the nominal RFR at 1.5%.

[381] A 'fair bet' approach to estimating the cost of debt is one which gives the regulated firm an opportunity, but not a promise, to recover efficiently incurred financing costs.
[382] Over the averaging period, BT was rated BBB-, BBB and BBB+. Therefore, we reference BBB rated debt because the index includes BBB-, BBB and BBB+ rated debt.
[383] The 2019 BCMR Statement assumption of 2.8% RPI inflation in 2020/21 is lower than longer run OBR estimates of around 3%.

b) **Real EMR of 6.7% (CPI-deflated)**: In the 2019 BCMR statement we used a real EMR of 6.7% (CPI deflated), representing a decrease from the EMR used in the 2018 WLA Statement of 7.1%. Our approach places most weight on historical ex post approaches;[384] but also has regard to other estimates (for example, historical ex-ante approaches and forward-looking calculations such as the Dividend Growth Model used in Europe Economics' October 2018 report for Ofcom[385]). We will review any new evidence on the EMR and implications for the ERP in our next publication for this market review. However, we expect that the real EMR (CPI deflated) will remain in the 6% to 7% range recommended in the 2018 UKRN report.

c) **Corporate tax rate of 17%:** HM Treasury states that "[…] At Budget 2016, the government announced a further reduction to the Corporation Tax main rate (for all profits except ring fenced profits) for the year starting 1 April 2020, setting the rate at 17%".[386] We propose to use a corporate tax rate of 17% since this represents the best estimate of what the tax rate will be for the next control period.

Inflation assumptions

A21.19 Forecast CPI is available from the OBR until 2023/24.[387] We also note that the Bank of England's target rate of inflation for monetary policy is 2% for CPI. When we use a forecast for RPI inflation in the statement, we propose to refer to the OBR's 1% CPI-RPI wedge to forecast long-run RPI i.e. 3.0%.[388]

Nominal EMR and ERP

A21.20 Based on our CPI forecast assumption the nominal EMR is 8.8%, from which, the implied nominal ERP is 7.4%.[389] Although this represents a slight increase in the ERP from the 2019 BCMR statement, it is still within the range implied by historical ex post estimates of the ERP (around 5%) and the ERP derived from a more forward-looking model, e.g. the Bank of England's DGM model (7.5% to 10%) considered in the 2019 BCMR Statement.

Cost of debt

A21.21 Our proposals on cost of debt start from observed bond yields. This differs from the expected return on bonds due to the risk of default in any corporate bond. However, when setting the allowed return, it is appropriate to reflect this risk of default in regulated prices – since we are

[384] Our 6.7% estimate is derived from a range of 6.0% to 7.3%, where the low end of the range (6%) is 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%) represents the top end of the range as proposed by Europe Economics' October 2018 report for Ofcom.
[385] See Europe Economics, 2018. Cost of Capital: Total Market Return (Europe Economics' October 2018 report).
[386] https://www.gov.uk/government/publications/rates-and-allowances-corporation-tax/rates-andallowances-corporation-tax.
[387] OBR, The economy forecast: Inflation, updated on 13 March 2019. https://obr.uk/forecasts-in-depth/the-economy-forecast/inflation/.
[388] OBR, Revised assumption for the long-run wedge between RPI and CPI inflation, March 2015.
[389] Note that because intermediate calculations are unrounded this is 7.4%, rather than 7.3% which is implied by subtracting the nominal RFR (1.5%) from the nominal EMR (8.8%). This calculation is based on assuming the marginal investor is tax-exempt (hence we do not make an adjustment for tax to the nominal RFR. This is consistent with CAPM theory but we recognise that it is a simplifying assumption.

concerned with the costs faced by the issuer (in this case BT), a point made by one of the authors of the 2018 UKRN report.[390] The 2018 UKRN report noted that this difference was expected to be small (10 to 20 bps) for the credit ratings expected for UK regulated companies (i.e. A to BBB).[391]

Cost of new debt

A21.22 In the 2019 BCMR Statement we considered the outstanding weighted tenor on BT's fixed rate debt when assessing which benchmark bond to use when estimating the debt premium. We are proposing to modify our approach to additionally consider the average tenor at issuance of BT's debt since this could also be relevant when estimating the cost of new debt to be issued by BT. As at 28 February 2019, we estimate that BT's fixed rate listed debt (all currencies) had an average tenor at issuance of around 14 years and an average outstanding tenor of around 8 years.[392] Given this, we consider that looking at bonds with a 10-year maturity would give a reasonable estimate of the cost of new debt.[393]

BBB yields

A21.23 Figure A21.2 shows spot yields over the last two years for an index of BBB bonds with ten-year maturity. The average yield over the last year was 2.9%, while over two years the average was 2.7%.

Figure A21.2: Spot yields on an index of a ten-year BBB bond

Source: Bloomberg, Ofcom analysis. Data to 28 February 2019.

A21.24 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. On this basis, we propose to use a cost of new debt

[390] 2018 UKRN Report, Section 9.2, Recommendation 2, Page 86.
[391] 2018 UKRN Report, Section 4.7.1, Pages 59 to 60.
[392] Ofcom analysis of S&P Capital IQ data as at 28 February 2019.
[393] We recognise that BT could issue new debt with longer or shorter maturities to the average tenor at issuance and the average outstanding tenor. For example, in June 2017 BT issued three tranches of debt with maturities of five, seven and ten years while in June 2018 BT issued three further tranches of fixed rate debt with maturities of 15, 20 and 24 years.

of 2.9% (which is in line with the 12-month average yield of BBB rated debt). Given the uncertainty in estimating the cost of new debt and given we propose that the overall regulated return includes an allowance for existing debt (which we explain below) we consider that a point estimate of 2.9% for the cost of new debt is reasonable at the present time.

Cost of existing debt

A21.25 In the 2019 BCMR Statement we based the cost of existing debt on the effective interest rate on BT's existing bonds. Much of this analysis was redacted on confidentiality grounds. To cross check these estimates we considered the ten-year average yields on a benchmark index of bonds with a similar credit rating to BT.

A21.26 In the interests of transparency, we propose to calculate the cost of existing debt by reference to ten-year average yields on 10-year BBB rated bonds. Over the last ten years BT has been rated BBB- or BBB+ [394] so we consider yields on these bonds would capture the cost of existing debt. As at 28 February 2019 the ten-year average yield on BBB rated bonds was 4.0%.

A21.27 In BT's 2019 Annual report, BT reported a weighted average effective fixed interest rate of 4.0% for 2019. [395] On this basis we consider our 4.0% estimate reasonably reflects the cost of BT's existing debt and we propose in the interests of transparency to use benchmark bond indices going forward.

Our proposal

A21.28 Because the cost of new debt (2.9%) is less than that of BT's existing debt on average (4.0%), we consider that a reasonable allowance for the cost of debt would fall between those rates. For this Consultation we propose to use a figure around the midpoint of this range.

A21.29 As noted in previous decisions, when estimating the cost of debt, it may be appropriate to 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. [396] In its Bristol Water decision, the CMA allowed for a ten basis points uplift in the cost of debt for a notional company. [397]

A21.30 Taking the data above in the round, we propose a pre-tax nominal cost of debt for BT Group of 3.5% which is around the midpoint of the range of new and existing debt, rounded to recognise an allowance for issuance costs.

BT Group equity beta, asset beta, debt beta and gearing

A21.31 For this consultation, we propose no changes to the gearing, equity beta, asset beta or debt beta for BT Group. We will review the evidence for these parameters next year.

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[394] Per S&P Capital IQ.
[395] BT Annual Report 2019, Page 164
[396] See paragraph A20.71 of the 2018 WLA Statement.
[397] See Appendix 10, paragraphs 48-53, CMA Bristol Water (October 2015). https://assets.digital.cabinet-office.gov.uk/media/5627997640f0b60368000001/Appendices_5.1_-_11.1_and_glossary.pdf.

A21.32 The BT Group asset beta is estimated by un-levering the equity beta calculated from actual returns on BT equity compared to the FTSE All Share index – using BT's average gearing over the estimation period and a constant debt beta. The BT Group equity beta has been around 1 over sufficiently long averaging periods which means that, over a sufficiently long averaging horizon, BT Group is close to the market average equity beta – which by definition is 1.[398] Therefore, we consider an important sense check on any forward asset beta, forward gearing and debt beta assumptions are that they yield a BT Group equity beta at or close to 1.

A21.33 For this consultation, we have used the 2019 BCMR Statement values of a BT Group asset beta of 0.68, a debt beta of 0.10 and a forward-looking gearing assumption of 40%. Combined, these give a BT Group equity beta of 1.07.[399]

Disaggregation of BT Group asset beta

A21.34 In the past we decided to disaggregate the BT Group beta as:

a) We regulate a significant part of BT (39% of MCE and 41% of EBIT in 2018/19), so the BT Group beta is significantly influenced by the returns on the products we regulate; and

b) It is necessary to reflect the systematic risk of the defined benefit pension scheme (which the BT Group beta does) because we do not allow pension deficit repair payments in charge controls and BT has the largest such scheme of any listed company in the UK or regulated telecoms company in Europe.[400]

A21.35 In 2005 we set out an evaluation framework for considering how we could disaggregate the BT Group beta.[401] The two key aspects of this framework were:

a) 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

b) there was evidence available to assess variations in risk.[402]

A21.36 Based on the framework we split the BT Group beta between Openreach's copper access network and the rest of BT (including in the latter retail calls, broadband and leased lines).[403] Separating out only copper access was appropriate in a world where voice and internet access

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[398] This is because the returns of an average company will move in perfect alignment with market returns i.e. be perfectly correlated.
[399] 2019 BCMR Statement, Annex 21, Table A21.1. Equity beta = (asset beta – debt beta*gearing)/(1-gearing).
[400] Pension assets represent 184% of BT Group's enterprise value, more than three times that of Belgacom, the European incumbent with the second largest pension scheme (based on Ofcom analysis of S&P Capital IQ) and, based on previous advice commissioned by Ofcom, would be expected to affect the BT beta. See, Ofcom Pensions Review Statement, December 2010, Section 7.
https://www.ofcom.org.uk/__data/assets/pdf_file/0019/47701/statement.pdf
[401] Ofcom's approach to risk in the assessment of the cost of capital, August 2005 (August 2005 Statement), paragraph 5.24.
https://www.ofcom.org.uk/__data/assets/pdf_file/0021/41970/final.pdf
[402] Examples included: a) it was possible to identify benchmark firms that were close to 'pure play' comparators in terms of having 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).
[403] August 2005 Statement, paragraph 1.22.

(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, consumers 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. [404]

A21.37 However, 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. [405] Over the control period, we expect further decline in fixed voice usage yet an increase in the connectivity offered as an integral part of fixed line services. As such, we consider that it is necessary to revisit the question of what is meant by access services. Before doing so, we recap on the approach to disaggregation adopted in recent reviews.

A21.38 In our last three fixed telecoms reviews we split the BT Group asset beta between Openreach [406] Other UK Telecoms and the Rest of BT:

- Openreach included wholesale access to copper lines to customer premises and, since March 2018, wholesale access to BT's network of duct and poles. In the 2019 BCMR Statement we also included interexchange dark fibre in Openreach;
- Other UK Telecoms included BT's wholesale and retail leased lines, retail and wholesale voice, mobile, broadband and bundled services; and
- Rest of BT (RoBT) primarily includes BT's ICT operations from its Global Services and Business and Public Sector divisions. [407]

A21.39 This is illustrated in Figure A21.3, which shows the relative weights put on each disaggregated part of BT in the 2019 BCMR Statement (such that the weighted sum of the disaggregated asset betas equals the BT Group asset beta).

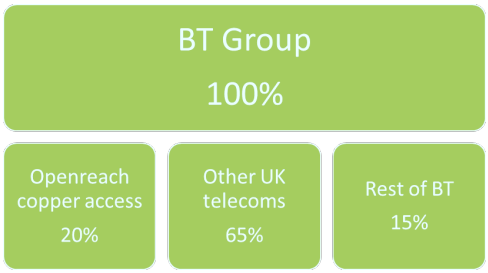
[404] Ofcom's approach to risk in the assessment of the cost of capital - first consultation, January, paragraph 5.39 to 5.40. https://www.ofcom.org.uk/__data/assets/pdf_file/0019/50743/cost_capital.pdf

[405] 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 (https://www.asa.org.uk/rulings/plusnet-plc-a17-384339.html); and b) In 2005 there were 7.5m homes with broadband whereas at the end of 2018 there were 26.6m broadband connections.(2005 Communications Market Review - https://webarchive.nationalarchives.gov.uk/20160703015033/http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/cm05/ and 2019 Communications Market Review - https://www.ofcom.org.uk/__data/assets/pdf_file/0028/155278/communications-market-report-2019.pdf).

[406] 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.

[407] On 1 April 2016, BT reorganised its divisions and the UK-focused parts of Global Services moved into a new 'Business and Public services' division (which also includes the old BT Business division) while multinational and international clients continued to be served from Global Services.

Figure A21.3: Weights used in the 2019 BCMR Statement



Source: Ofcom

A21.40 We do not propose changing the three broad parts of the BT Group disaggregation (Openreach, Other UK Telecoms and RoBT), but do propose some revisions to the services and weightings going forward. The following section outlines our proposals and the proposed weightings for corresponding asset betas.

Basis of assessment of relative risk

A21.41 We consider that the Openreach category should continue to capture services associated with lower systematic risk than BT overall. In keeping with the philosophy underpinning the original disaggregation of the BT Group beta (as above), but updated for current demand and technologies, we propose to associate Openreach with fundamental connectivity, i.e. the basic building block for connectivity to customer premises.

A21.42 Increasingly, copper lines do not represent fundamental connectivity on their own. A number of factors suggest that i) broadband is becoming the 'basic building block' for communications services consumed at a fixed location, ii) people are consuming ever more data (and hence require services capable of delivering that growing data usage) and iii) consumers rarely downgrade their broadband service, e.g.

a) Currently c.70% of retail broadband volumes relate to superfast broadband (SFBB) and above, i.e. FTTC/FTTP/cable. We forecast that c.83% of retail broadband volumes will relate to SFBB by 2020/21 and by 2025/26 we forecast that 95% of all retail broadband lines will be SFBB (Figure A21.4). This overall pattern also holds true at the Openreach level where we expect SFBB and above to comprise 77% of total Openreach broadband volumes by 2020/21 (Figure A21.5);

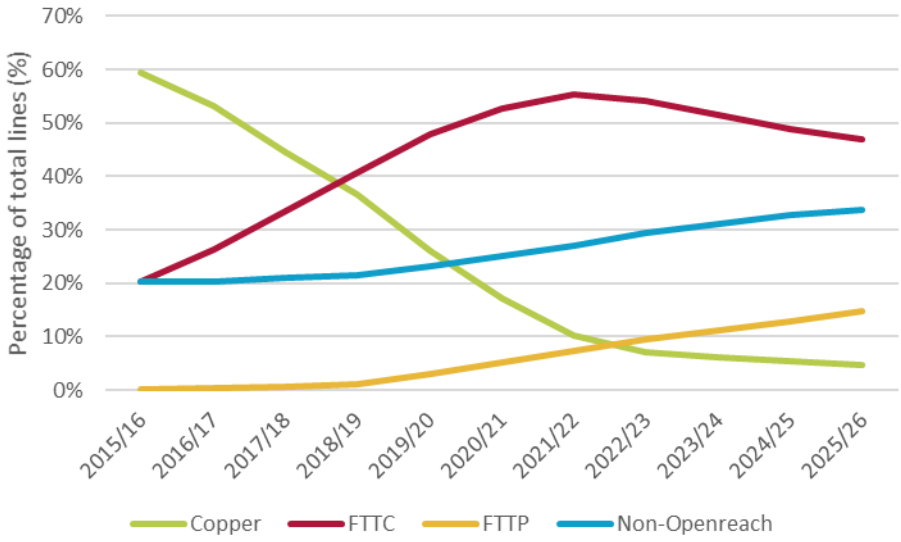
b) Rather than being an add-on to copper lines, FTTC is increasingly becoming the reason that demand for copper access lines remains, i.e. as it allows consumers to obtain SFBB. We estimate that FTTC currently represents 60% of Openreach broadband lines and we expect this to increase to 77% by 2022/23 before falling in later years due to the growth in FTTP take-up.[408] The number of FTTC connections overtook copper only broadband connections in 2018. This is clearly demonstrated in Figures A21.4 and A21.5;

[408] Note: Even if 100% of OR lines were FTTC, it would still not represent the whole market due to cable and alt-net FTTP.

c) Consumers are using more data from their broadband connection, 240GB a month in 2018, up 50% a year since 2013; [409] and

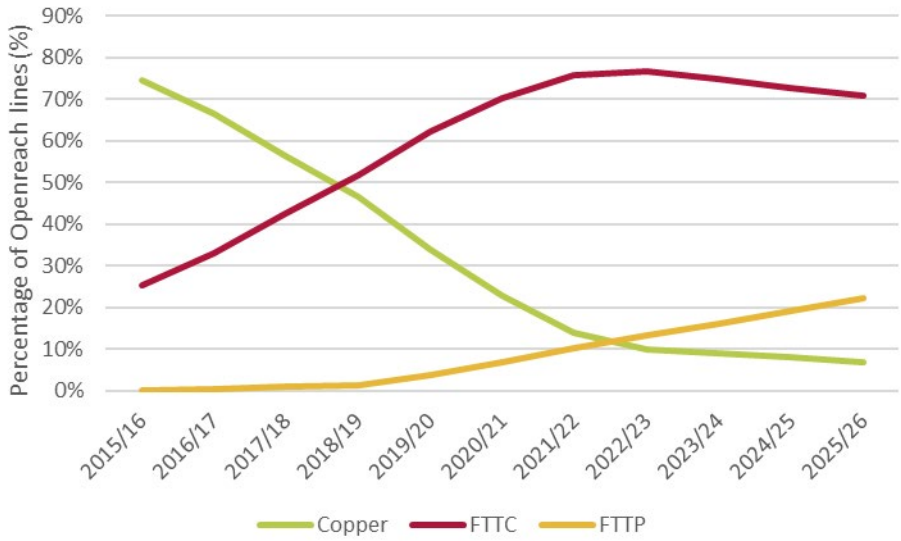
d) Retail providers are seeking to migrate copper customers to SFBB services e.g. by offering free or automatic upgrades meaning consumers have little incentive to downgrade to copper services. [410]

Figure A21.4: % split of total broadband lines



Source: Ofcom modelling

Figure A21.5: Percentage split of Openreach broadband lines



Source: Ofcom modelling

[409] Ofcom 2019 Communications Market Report.
[410] Volume 2, Section 6.

A21.43 Against this backdrop, we consider that systematic risk associated with overall broadband demand is likely now to be relatively low. As at 31 March 2005 there were c.21m Openreach residential lines all of which were copper.[411] As at 30 September 2019 there were c.25m Openreach lines (which were a mix of copper and fibre).[412] As such, despite the significant growth in wireless connectivity via mobile networks and despite some degree of economic slowdown around the financial crisis, demand for fixed lines in general held up strongly and broadband take up and usage grew very strongly (broadband volumes on the Openreach network increased from c.2m lines to c.21m over the same time period as above). We therefore see the previous resilience in copper access lines carrying over to broadband lines in general.

A21.44 Given this, we have considered whether it is appropriate to continue treating both FTTC and FTTP as facing higher systematic risk than copper lines by reference to the following:[413]

a) **Systematic demand risk:** services that exhibit more demand risk would be expected to have higher betas while products that have less demand risk (i.e. products and services that are 'necessity' items) would have lower betas; and

b) **Operational leverage:** services that have greater operational 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 betas.

FTTC and copper

Systematic demand risk

A21.45 As SFBB has now matured and become the mass-market way to consume broadband and as FTTC rollout is completed, we would expect the systematic demand risk of FTTC to have reduced.

A21.46 Given SFBB is the main way people will consume internet access from a fixed location over the period, and there is limited propensity for people to downgrade to SBB, we consider that going forward SFBB and SBB will share similar levels of systematic risk.

A21.47 FTTC could face slightly higher demand risk compared to basic copper services as there is a bandwidth gradient and a customer may upgrade or downgrade their speeds in response to

[411] BT Group Q4 04/05 financial results. https://www.btplc.com/Sharesandperformance/downloads/Financialpresentations/q405KPIs.pdf

[412] BT Group Q2 19/20 financial results. https://www.btplc.com/Sharesandperformance/Financialreportingandnews/Quarterlyresults/2019-2020/Q2/Downloads/KPIs/q219-KPIs.pdf

[413] These two factors are consistent with Brattle's methodology for assessment of NGA betas in its 2016 report to the European Commission. Brattle also proposed a third category, long-term payoffs, arguing that investments that take a longer time to payoff are riskier as their cashflows are less certain and the WACC has a greater impact. We consider that this effect is likely to overlap with the effects we consider in relation to demand risk and operational leverage in the present case, so have omitted separate consideration of the time to payoff below. Nevertheless, we note that at this point in time, there is a longer time to payoff for FTTP given investment in FTTP only recently commenced, whereas FTTC investment began around ten years ago and coverage is largely completed. Brattle's report is available here: https://op.europa.eu/en/publication-detail/-/publication/da1cbe44-4a4e-11e6-9c64-01aa75ed71a1/language-en

macroeconomic events.[414] However, although there could be some revenue volatility due to the bandwidth gradient, this may be limited where the 40/10 FTTC variant represents the 'entry-level product' and customers rarely downgrade from SFBB to SBB.

A21.48 On this basis we consider that the increasingly shared demand risk between copper access and FTTC points to including FTTC in Openreach going forward.

Operational leverage

A21.49 The incremental capital expenditure required to roll out FTTC was low in comparison to the outlay required to roll out an FTTP network (as FTTC was an overlay to the copper network). For example, to 2017/18 we estimate FTTC capex has totalled [✂£] to pass and connect 26m premises.[415] In contrast, based on Ofcom modelling we estimate FTTP could cost significantly more ([✂£]) to roll out nationwide. Given that commercial FTTC roll out is now complete, we consider that going forward FTTC services will exhibit lower operational leverage.[416]

A21.50 However, the transition to full-fibre could raise operating leverage risks for both FTTC and basic copper lines, e.g. additional cabinet provisioning for a small number of premises (e.g. where FTTC cabinet capacity is full), potential decommissioning costs for the copper network and running the copper/FTTC network in tandem with an FTTP network.

A21.51 On balance we consider that consideration of operational leverage also points to including FTTC in Openreach alongside basic copper lines, but there is an argument to apply a slightly higher asset beta than in our previous charge control decision.

Proposal

A21.52 We propose that going forward FTTC sits with copper access line services within Openreach, reflecting our view that systematic demand risks for services over FTTC are likely to have converged with the demand risks previously associated with basic copper lines. However, we think there is an argument for a slightly higher asset beta than previously to reflect, for example, potential operational leverage risks during the transition to full-fibre.

FTTP

Systematic demand risk

A21.53 FTTP volumes are increasing year-on-year with copper switch off expected at the latest by 2033 (year of the Government's full fibre target set out in the Future Telecoms Infrastructure Review). At this point, FTTP will be the only way of receiving a fixed internet (and telephony)

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[414] e.g. in a downturn, they might downgrade to an underlying connection at 40/10Mbps and upgrade to 80/20Mbps in an upturn.

[415] Capex information from Openreach response dated 19 November 2019 to s135. dated 5 November 2019 and premises passed taken from BT Q4 2018/19 financial results, page 8.
https://www.btplc.com/Sharesandperformance/Financialreportingandnews/Quarterlyresults/2018-2019/Q4/Downloads/Newsrelease/q419-release.pdf

[416] FTTC capex sourced from Q15b of the 34th WLA 2018 s.135 notice & 30th 2016 BCMR s135 notice. FTTP capex forecast based on Ofcom's bottom up model.

connection. Further, we are proposing that once ultrafast (speeds above 300Mbps) coverage exceeds 75% in an exchange area, Openreach will no longer be required to offer new copper services where fibre is available, and 2 years after that date, if ultrafast coverage in that exchange is complete, all copper charge controls will be removed from that area where fibre is available.[417] These factors point to FTTP becoming the primary means of delivering broadband in the next decade, and we would expect this to be associated with reducing demand risk in future.

A21.54 Speeds that can only be delivered via FTTP currently attract a retail premium.[418] To the extent this means these services are currently perceived as a luxury product, this could imply a higher income elasticity of demand and greater beta risk. This would reduce over time if consumers exhibited a propensity to upgrade akin to that seen from copper broadband to FTTC and, as set out in Section 6 of Volume 2, it may be that to achieve high volumes of sales more attractive prices will need to be offered.

A21.55 Therefore, although we consider that FTTP demand risk remains greater than for FTTC and copper lines, we expect this demand risk to converge in the future but is more likely after the next control period (i.e. beyond 2025/26).

Operational leverage

A21.56 FTTP capex is expected to be greater per premise passed compared to FTTC. Further, FTTP is in the build phase and will be throughout the next control period whereas the capital expenditure programme on FTTC is virtually complete. This would imply much higher operating leverage for FTTP during the build phase and hence a higher asset beta, other things equal.

Proposal

A21.57 Once FTTP is rolled out and the copper network is decommissioned, we would expect the systematic risk of FTTP to reduce, since it would be the primary means of consuming broadband amongst residential and small business consumers. At that point in time, it might be appropriate to include FTTP services within Openreach.

A21.58 However, given the higher operational leverage associated with FTTP during the next control period and the uncertainty around the take-up of FTTP connections, we propose that FTTP sits in the higher risk category of Other UK telecoms.

A21.59 We next consider whether it is appropriate to continue including leased lines services in OUKT.[419]

[417] Volume 3, Section 2.
[418] See Volume 2, Section 2, for example Figure 2.10.
[419] Leased lines are dedicated high capacity connections mostly used by businesses (for point to point connections, e.g. between bank branches) or other operators to backhaul data to their own networks.

Leased lines (active and dark fibre)

A21.60 As stated above, we require a WACC for cost-based charge controls for access dark fibre and a WACC for cross checking returns on active leased lines for both access and inter-exchange circuits.

A21.61 In previous decisions, we have reasoned that leased lines are riskier than copper access services because business demand is more sensitive to macroeconomic conditions e.g. businesses may change the number of leased lines in response to market conditions (and in the extreme could go out of business and stop taking leased lines altogether). As we have no significant new information regarding active leased lines, we propose that they remain in OUKT. In any case, this would not affect the charge controls for active leased lines as our proposal is that these are held at current (real levels) for the next control period. [420]

A21.62 In the 2019 BCMR we considered that passive leased lines were lower risk than active leased lines. Specifically, we applied the Openreach WACC to dark fibre inter-exchange circuits. We reasoned that dark fibre services were associated with lower systematic risk because changes in bandwidth requirements in the access part of the network were unlikely to translate into significant changes in demand for dark fibre, since a single dark fibre connection can be used to serve foreseeable bandwidth requirements. [421] We continue to think this reasoning applies to dark fibre inter-exchange circuits. We next consider the demand risk for access circuits.

Systematic demand risk for dark fibre access leased lines

A21.63 We anticipate that dark fibre leased lines in the access network will be used to support the following types of service:

a) **Enterprise/business customers**: We have previously argued that these services exhibit more elastic demand as businesses are more likely to scale their connectivity demand according to macroeconomic activity; and

b) **Mobile base stations**: Arguably these circuits would be lower risk since they form a basic network building block supporting multiple mobile services and demand is likely to be inelastic as mobile network operators require backhaul for both coverage and capacity mobile sites. Furthermore, we do not expect mobile traffic to be particularly sensitive to incomes going forward given the robustness of demand for mobile connectivity – i.e. it is far more likely to be seen as a necessity than a luxury by consumers.

A21.64 We currently have very limited information on the split of these volumes. [422] BT has provided aggregate leased lines volumes for 2019. This data shows volumes increasing year on year leading to both monthly volatility and variances against forecasts through time. However, the data does not allow us to identify whether this volume volatility reflects specific risks or systematic risks. In addition, we do not have whole market volumes for leased lines so changes

[420] While BT volume information indicates that leased lines are more volatile and harder to predict than some other services, the difference is not large and could reflect businesses taking new contracts with alternative suppliers and therefore represent specific rather than systematic risk.
[421] 2019 BCMR Statement, Annex 21, paragraph A21.184.
[422] As BT does not know the purpose of the leased line once it has been purchased by a CP.

in volumes could reflect switching behaviour as businesses move between alternative suppliers.

A21.65 However, given that charges for dark-fibre are not based on bandwidth (so demand risk associated with a bandwidth gradient is not applicable) and we anticipate that there is a reasonable likelihood that dark fibre access will be often used to support mobile backhaul (and hence supporting multiple mobile services), we anticipate that dark fibre circuits are likely to face relatively inelastic demand, at least relative to active leased lines. This would support putting them in a risk category closer to that of other services included within Openreach.

Operational leverage for dark fibre access

A21.66 We anticipate that operational leverage for dark fibre is likely to be lower than active leased lines as no electronics are required to deliver dark fibre. Electronics make up a material proportion of the capital expenditure used to deliver active leased lines and have a relatively short economic life. [423]

Proposal

A21.67 For these reasons, we propose that dark fibre access services should sit within Openreach.

Overall proposal for consultation

A21.68 We propose to maintain our previous conclusions on the inclusion of DPA and inter-exchange dark fibre in Openreach since these represent basic network building blocks supporting multiple downstream services.

A21.69 For the reasons explained above, we also propose that FTTC and access dark fibre sit within Openreach.

Figure A21.6: Proposed split of services

Openreach	Other UK telecoms
Copper access lines	FTTP
FTTC	Active leased lines
Dark Fibre - access and inter-exchange circuits	
Duct and pole access (DPA)	

Asset beta weightings

A21.70 Table A21.7 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.

[423] On a forward-looking basis, active electronics make up the majority of capex related to active leased lines, whereas for dark fibre no electronics are required to provide the service (as customers install their own equipment).

Table A21.7: Estimated share of Openreach (i.e. including FTTC and dark fibre) within BT Group

	2014/15	2015/16	2016/17	2017/18	2018/19	5Y Average
EBITDA	32%	33%	33%	33%	30%	32%
Regulatory NRC/EV	18%	20%	18%	24%	26%	21%

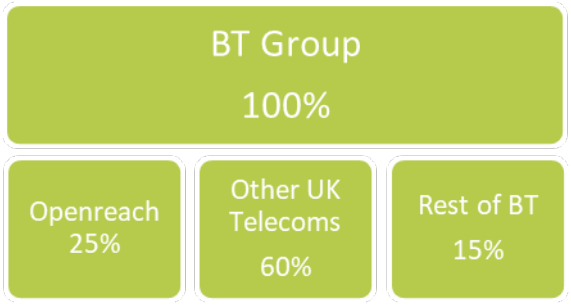
Source: Ofcom [424]

A21.71 In estimating the relevant weightings, we have considered the same period as used for estimating the BT Group asset beta – i.e. the last five years. Based on the five-year averages above, we propose a weighting of 25% for Openreach. [425]

A21.72 To estimate the weightings of RoBT, previously we considered the proportion of BT Group EBITDA that relates to Global Services, as this was the division which historically contained ICT and managed network (ICT) services. However, since BT's ICT operations (which are captured in our RoBT disaggregated asset beta) are now spread across its Global Services and other divisions (due to the 2016 reorganisation described above), we asked BT to provide EBITDA figures for ICT services following the reorganisation. Our analysis based on BT's submission, suggests that over the past five years, EBITDA for BT's ICT services represented between [✂%] of BT Group EBITDA [426]. As such we propose to apply a (rounded) weighting of 15% to the RoBT, which captures BT's ICT operations.

A21.73 Based on the analysis above, we propose the following asset beta weightings in Table A21.8.

Table A21.8: Proposed asset beta weightings



Source: Ofcom

[424] EBITDA is estimated using information reported in BT's RFS (specifically the 'performance summary by market table'), with EBITDA equal to total revenue less HCA operating costs (excluding depreciation). 'Openreach' includes EBITDA associated with WLR and WLA (excluding FTTP) markets. Total EBITDA is equal to that reported in BT's annual report based on restated values. NRC is taken from the cost models supporting the 2018 WLA Statement and this consultation (for 2018/19) divided by BT's average enterprise value for the year, derived from Bloomberg.

[425] This is also broadly consistent with the Openreach (as defined in Table A21.7) contribution to BT Group total EBITDA less capex (27%). EBITDA less capex is a good proxy for annual cash returns which would be a relevant consideration for the asset beta weighting.

[426] 2018 WLA Statement, paragraph A20.163 (for 2014/15 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).

Asset betas

A21.74 In the 2019 BCMR Statement we decided to use an Openreach asset beta of 0.55. This was based on the midpoint of BT Group (0.68) and listed UK network utility asset betas (0.39). [427] Because of the changes to the services within Openreach and Other UK telecoms above, we propose to use an Openreach asset beta slightly above the midpoint of the range between that of the network utilities and BT Group. Based on otherwise unchanged benchmark company asset betas we propose to use a value of 0.57 in this consultation. This is because:

a) Two competing access networks (i.e. copper+FTTC competing against FTTP during the transition period) would tend to increase the operating leverage of each; and yet,

b) we would expect the Openreach asset beta to be below the average asset beta of retail telecoms providers (0.63) as these companies offer services over access lines (which tend to face greater demand risk). [428]

A21.75 In the 2019 BCMR Statement we decided to use an Other UK telecoms asset beta of 0.65 based on the midpoint of the 0.55 to 0.75 range used previously. [429] We propose to maintain a value for the Other UK telecoms asset beta at 0.65 in this consultation as the data cut off is the same as used in the 2019 BCMR Statement.

A21.76 In determining the asset beta for each disaggregated part of BT Group, we also need to take account of the relevant weightings and comparator asset beta evidence since we require the weighted sum of disaggregated betas to reconcile to that of BT Group. An Openreach asset beta of 0.57 combined with the weightings proposed above and the Other UK Telecoms asset beta at 0.65 means the RoBT asset beta is the same as in the 2019 BCMR Statement (0.98) i.e. broadly the midpoint of the ICT range. [430]

Disaggregation of BT Group cost of debt

A21.77 Consistent with previous market reviews, we consider 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 Other UK Telecoms or the RoBT (at the same level of gearing).

A21.78 BT Group's credit rating is BBB. In the 2019 BCMR Statement we estimated a one notch uplift to the credit rating (as would likely be the case for Openreach as its rating would be closer to the average listed utility credit rating of BBB+) which would decrease the cost of debt by c.0.1% point. We also concluded that Other UK telecoms would likely share the same credit rating of BBB as BT Group (i.e. have the same cost of debt).

[427] 2019 BCMR Statement, paragraphs, A21.206 to A21.208.
[428] 2019 BCMR Statement, table A21.16.
[429] 2019 BCMR Statement, paragraphs A21.220 to A21.223.
[430] 2019 BCMR Statement, paragraph A21.219.

A21.79 Based on a cost of debt for BT Group of 3.5% estimated for this consultation, we propose to use a cost of debt of 3.4% for Openreach and 3.5% for Other UK Telecoms. Based on the same disaggregation weightings used for the asset betas above, this implies a cost of debt of 3.7% for RoBT. [431]

Our proposals on the disaggregated WACC

A21.80 Table A21.9 summarises the pre-tax nominal WACC for BT Group and the three-way disaggregation which follow from the proposals above. For this consultation, we invite stakeholder views on the revisions to the methodology for estimating the cost of debt and the relative risk of regulated services given current and expected changes in demand and technology for broadband.

Table A21.9: BT pre-tax nominal WACC for BT Group and disaggregated lines of business

	BT Group	Openreach	Other UK Telecoms	RoBT
Pre-tax nominal WACC	8.1%	7.1%	7.9%	10.9%

Source: Ofcom

[431] ROBT cost of debt is calculated for presentation purposes only since we do not regulate services supplied within what we describe as RoBT. 3.4% x 25% [Openreach] + 3.5% x 60% [Other UK Telecoms] + 3.7% x 15% [RoBT] = 3.5% [BT Group].

A22. Estimating the 40/10 fibre premium

Introduction

A22.1 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 propose 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 is not available (see specification of Wholesale Local Access (WLA) charge control in Volume 4 Section 3).

A22.2 In this annex we explain how we have estimated the level of 40/10 fibre-premium.

A22.3 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 broadband service with higher and more stable speeds (relative to broadband provided over copper with the same stated headline speed).
- The additional benefits to end-users from a broadband service that is more reliable service (i.e. subject to lower faults) relative to broadband provided over copper.
- The additional benefits to access seekers purchasing a fibre broadband services as a result of cost-savings through delivering a more reliable service to customers; and lower exchange-based costs.

Value to consumers

A22.4 Consumers that 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.

A22.5 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.

A22.6 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.

A22.7 As discussed in Volume 3 Section 6, at present customer willingness to pay for very high bandwidths is limited. However, it is more apparent at lower bandwidths, as evidenced by the

rapid migration away from low bandwidth standard broadband products to FTTC that we expect over the review period.

A22.8 We think an average differential of £1.10 is reasonable to allow for the higher speeds that 40/10 FTTP would deliver as compared to 40/10 FTTC products.

A22.9 We note 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 more. These customers comprise of:

- 20% of 36Mbit/s FTTC lines having a minimum speed around or below the headline ADSL2+ speeds (25Mbit/s).[432]
- 2% of premises to which FTTC services are not available.[433]

A22.10 Our view is that even today customers are moving away in large numbers from the lowest speeds, and it may be that towards the end of this period the ADSL2+ speeds will be substandard for a "superfast" broadband product. For the 2% of customers that only get ADSL speeds the value increase may be larger still.[434]

A22.11 We do not explicitly estimate the value to customers from having a more reliable service with fibre. However, evidence from France and Spain indicates that a bedded-in fibre service suffers from lower fault rates than copper-based services. Furthermore, we would expect that the value of uninterrupted services to customers will be higher by the end of the control period as customer demands from their broadband services increase.

Cost saving for access seekers of FTTP

A22.12 We expect that telecoms providers purchasing access to Openreach' s network will experience savings as a result of purchasing a 40/10 FTTP service over a 40/10 FTTC service. These savings are as a result of two factors:

a) Lower ancillary costs: the need to purchase fewer ancillary services due to the greater reliability of an FTTP network; and

b) Lower exchange-based costs: telecoms providers purchasing access to an FTTP network need to connect to may fewer exchanges than a copper network. This will lead to lower network costs for the purchasing telecom provider.

A22.13 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, there is significant uncertainty over the extent of these cost savings. We have requested data from access seekers regarding the level of cost savings they expect. From this data we have estimated that access seekers will realise a saving of between £0.4 and £0.75 per line per month.[435]

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[432] UK Home Broadband Performance, The performance of fixed-line broadband delivered to UK residential customers, Ofcom, May 2019 https://www.ofcom.org.uk/__data/assets/pdf_file/0020/147332/home-broadband-report-2018.pdf
[433] Connected Nations Update Summer 2019, Ofcom, September 2019 https://www.ofcom.org.uk/__data/assets/pdf_file/0024/166650/connected-nations-update-summer-2019.pdf
[434] Our £5 value is a simple average of the price differential (initial offer price) between standard broadband and superfast broadband across five telecoms providers.
[435] [✂]

A22.14 When added to the consumer 40/10 fibre premium we get a total 40/10 fibre premium of between £1.50 and £1.85 per line per month.

Treatment of G.fast

A22.15 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 product.

A22.16 While we acknowledge that G.fast can offer higher speeds to FTTC, we also consider that additional speeds to consumers will be limited by the length of copper connection to the premises and other factors, such as internal wiring, (unlike FTTP).

A22.17 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. In short, a 40/10 service based on G.fast is unlikely to materially improve speeds for the cohort of customers that we assume in our analysis will benefit from increased broadband speeds.

A22.18 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 (from lower fault rates) or the reduction in ancillary costs (for access seekers) that apply to FTTP relative to FTTC will be relevant to G.fast.

A23. 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 Charge Change Notice (ACCN)	A contractual notification, issued by BT, of a change to the price of a regulated network access service.
Accumulated CCA depreciation	Totality of deductions made to the gross replacement cost of a tangible fixed asset to reflect its cumulative consumption since acquisition.
Accumulated HCA depreciation	Totality of deductions made to the original purchase price of a tangible fixed asset to reflect its cumulative consumption since acquisition.
Active leased line	A permanently connected communications link between two sites, dedicated to the customers' exclusive use, and provided with active electronics at either end of the connection.
ADSL (Asymmetric Digital Subscriber Line)	A variant of DSL that supports higher bandwidth on downlink transmissions i.e. from the exchange to the end-user rather than from the end-user to the exchange.
AFI (Additional Financial Information)	Detailed financial information provided in confidence to Ofcom as part of BT's Regulatory Financial Statements.
AI (Alternative Interface)	Leased line services typically using an Ethernet interface. Referred to in the 2019 BCMR as Contemporary Interface (CI).
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, backhaul, and 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.
BEIS	Department for Business, Energy & Industrial Strategy.
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.
BoR	Board of Regulators which is part of BEREC, and is sometimes used when referring to BEREC documents in the form , for example, BoR (12)
BT	British Telecommunications plc.
BT CCN (Change Control Notification)	BT's publication of RFS methodology changes that were implemented between the 2017 RFS and the 2018 RFS.
BT TSO (Technology and Service Operations)	BT's internal technology unit responsible for creating and operating BT's networks, platforms and IT systems. Now named BT Technology.
BTL (Bulk Transport Link)	An Openreach Ethernet interconnection product providing high bandwidth, point-to-point connections between an Openreach Handover Point (OHP) to a telecoms provider's site.
BTPS (BT Pension Scheme)	A defined benefit pension plan for BT employees that closed to new members in 2001.
BTRSS (BT Retirement Savings Scheme)	A new defined contribution group pension plan for BT employees set up on 1 April 2009 to replace the BT Retirement Plan, which in turn replaced the BT Pension Scheme (BTPS).
BTW (BT Wholesale)	The part of BT which provides wholesale services to telecoms providers, referred to in the 2016 BCMR. BTW is now in the BT Enterprise division which was formed in May 2018.
CAGR (Compound Annual Growth Rate)	The year-on-year smoothed annualised growth rate of an investment. It can be calculated as follows: CAGR = $(\frac{\text{EndingValue}}{\text{BeginningValue}})^{(\frac{1}{\text{numberofyears}})}$-1.
CAPM	Capital Asset Pricing Model.
Capex (Capital Expenditure)	The firm's investment in fixed assets.
CBDs (Central Business Districts)	The central business districts of urban centres.
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 of iCCD (Certainty MSL)	A QoS standard to assess Openreach's ability to deliver Ethernet circuits on the date initially provided to the customer.
CI (Contemporary Interface)	A set of modern technologies used for delivery of leased line services (e.g. Ethernet or wavelength-division multiplexing).
CISBO (Contemporary Interface Symmetric Broadband Origination)	A service defined in the 2016 BCMR consisting of wholesale leased line services using CI technologies.
CLA (Central London Area)	A proposed geographic market in central London.
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.
CoW (Class of Work)	A type of activity which engineers are engaged in and is a code for engineers to book their time to, for tracking of costs.
CP (Communications Provider)	An organisation that provides electronic communications services. We refer to as telecoms provider.
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.
CRF (Common Regulatory Framework)	The European Union harmonised framework for the regulation of electronic communications by Member States.
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.
CTCS (Core Transmission Costing System)	A BT core network costing system which models the volumes and network usage associated with the transmission across the BT Core network.
Cumulo rates	**Cumulo Rates** is 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.
CSH (Customer sited handover)	CSH is where Openreach provides a POC for a leased line service, that it is required to provide, at the site of the interconnecting telecoms provider, requiring Openreach to extend its network to the operational building of a third part.
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.
DAM (Detailed Attribution Methods)	A document prepared by BT which sets out the methodologies used to attribute its costs to prepare the Regulatory Financial Statements.
DC (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. A carrier neutral data centre is owned and operated entirely independently of network providers and allows interconnection to and between multiple telecoms providers.
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.
DF (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.
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. ADSL, HDSL (High bit rate Digital Subscriber Line) and VDSL (Very high data rate Digital Subscriber Line) are all variants of xDSL.
EAD (Ethernet Access Direct)	An Ethernet product offered by Openreach providing high bandwidth, point-to-point connections.
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 amortization.
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.
EOI (Equivalence of Input)	A remedy designed to prevent a vertically-integrated company from discriminating between its competitors and its own business in providing upstream inputs. This requires BT to provide the same wholesale products to all telecoms providers including BT's own downstream division on the same timescales, terms and conditions (including price and service levels) by means of the same systems and processes, and includes the provision of the same commercial information about such products, services, systems and processes to all telecoms providers (including BT).

EPMU (Equi-Proportional Mark-Up)	An approach to allocating common costs to products proportionally to the product's share of total LRIC.
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.
Exchange	The BT telephone exchange, to which customers are directly connected.
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.
FCM (Financial Capital Maintenance)	An approach to CCA in which an allowance is made within the capital costs for the holding gains or losses associated with changes over the year in the value of the assets held by the firm. In contrast to OCM, the FCM approach seeks to maintain the financial capital of the firm, and hence the firm's ability to continue financing its business.
Fibre channel	Standardised storage area network protocol operating at bandwidths between 1 Gbit/s and 16 Gbit/s.
FRO (Final Reference Offer)	The product description and associated pricing published by Openreach on 1 December 2016 in relation to its Dark Fibre Access product.
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.
FTTX (Fibre-to-the-X)	An access network structure in which the optical fibre is used for any part of the network from the exchange to the end-user's premises. This general term encompasses both FTTC and FTTP. The remaining part of the access network is usually copper wire but could use another technology, such as wireless.

GBCI (General Building Cost Index)	A national index that measures the costs of construction work including materials and labour.
Gbit/s	Gigabits per second (1 Gigabit = 1,000,000,000 bits). A measure of bandwidth in a digital system.
GBV (Gross Book Value)	The original (historical) price paid for an asset, without any depreciation deducted.
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.
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.
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 Areas)	Geographic areas with at least two rival leased lines providers within a specific distance from a business site, as defined in this consultation.
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).
IBH (In Building Handover)	An interconnection between BT and another telecoms provider's network which is where BT provides a point of handover (POH) at co-location space rented by a telecoms provider inside a BT exchange.
iCDD (initial Contractual Delivery Date)	In Ethernet provisioning, 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.

ISH (In Span Handover)	An interconnection between BT and another telecoms provider where the BT interconnect circuit terminates (is handed over) at a point between BT's site and the telecoms provider's site.
ITU	International Telecoms Union.
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.
LA (Local Access)	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.
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's Premises Equipment.
Leased line	A permanently connected communications link between two sites dedicated to the customers' 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.
Lower percentile	A QoS standard put in place in the 2016 BCMR and Temporary Conditions to protect against the risk that Openreach's focus would shift exclusively to the tail or more complex Ethernet provisioning orders, to the detriment of the easier 'quick win' circuits.
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, except in the case of short-term investments and borrowings, where daily averages are used in their place.
MCT (Mobile Call Termination)	The wholesale service provided by an MCT provider to allow an originating telecoms provider to connect a caller with the intended mobile call recipient on that MCT provider's network.
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 (Managed Ethernet Access Service)	This is a service provided by BT Enterprise (previously BT Wholesale) to provide connectivity from multiple mobile base station sites back to a mobile core network.
MISBO (Multiple Interface Symmetric Broadband Origination)	Leased line terminating segments supporting high bandwidth services – either an Ethernet interface with bandwidths greater than 1 Gbit/s or services of any bandwidth/interface delivered using WDM equipment.
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.
MSL (Minimum Service Level)	A term used in the 2016 BCMR referring to the level of service performance we consider to be acceptable and at which we set Openreach standards to meet. This term is now referred to as QoS standards.

MTTP (Mean Time To Provide)	A QoS standard measuring the average time to provide an Ethernet circuit excluding customer caused delays.
NCA (Net Current Assets)	A measure of the amount of capital being used in day-to-day activities by the company. It is equal to current assets less current liabilities.
NDRs (Non-Domestic Rates)	A form of property tax paid by organisations and businesses to contribute towards the cost of local services.
NGA (Next Generation Access)	A new or upgraded access network capable of supporting much higher capacity broadband services than traditional copper access networks. Generally an access network that employs optical fibre cable in whole or in part.
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.
OCM (Operating Capability Maintenance)	A CCA convention, where the depreciation charge to the profit and loss account relates to the current replacement cost of the firm's assets, taking account of specific and general price inflation. As the name suggests, the OCM approach seeks to maintain the operating capability of the firm. Cumulative OCM depreciation is the sum of the individual in-year OCM depreciation over the asset life up to the year being forecast, adjusted to reflect any changes in asset values over time.
ODTR (Optimal Time Domain Reflectometer)	An instrument used to test the performance of fibre links and detect problems, in particular 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 Division	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 financing costs such as interest charges.
OSA (Optical Spectrum Access)	An Openreach WDM service.

OSEA (Optical Spectrum Extended Access)	Openreach WDM services supporting longer circuits 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.
PAC (Previously Allocated Costs)	BT's cost attribution system allocates costs to the different levels of their cost exhaustion system. When we propose that these costs should be allocated based on all previously allocated total costs we mean that each division, market, service, and component (i.e. the different levels of the cost exhaustion system) should be allocated these costs based on the previously allocated total costs at that level of the cost exhaustion system divided by the total of all previously allocated total costs within BT.
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.
PTO (Precision Test Officer)	An Openreach technician who undertakes optical fibre testing and fault diagnosis.
PTR (Pricing Transparency Report)	A report detailing the charges that a telecoms provider makes to its customers for certain services.
PVEO (Price, Volume, Efficiency and Other) analysis	A form of analysis that groups price movements into four categories.
QE	Quantitative easing.
QoS (Quality of Service) standards	The level of provisioning and fault repair QoS performance standards that we have set Openreach to meet, previously known as MSLs.

RANF (Revised agreement for Access Network Facilities)	The Reference Offers which set out revised terms and conditions on which Openreach will provide local loop unbundling services.[436]
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 Assets 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.
Remitted Matters	The matters that the Competition Appeal Tribunal remitted to Ofcom for consideration, following the BCMR judgment of 10 November 2017.
RFR	Risk-free Rate.
RFS (Regulatory Financial Statements)	The financial statements that BT is required to prepare by Ofcom. They include the published RFS and AFI provided to Ofcom in confidence.[437]
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.
RoUK (Rest of the UK)	A geographic market set out in the 2016 BCMR, consisting of an area outside the Central London Area, Central Business Districts, and the Hull Area.
RPI (Retail Price Index)	A measure of inflation published monthly by the Office for National Statistics. It measures the change in the cost of a basket of retail goods and services.
RWT (Right When Tested)	When a line tests as 'OK' when tested remotely or tested by an onsite engineer visit.

[436] See: LLU Contract, Openreach [accessed 11 June 2019].
[437] Available at: Regulatory financial statements, BT [accessed 11 June 2019].

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.
SMP (Significant Market Power)	The significant market power test is set out in European Directives. It is used by National Regulatory Authorities (NRAs), such as Ofcom, to identify those telecoms providers which could act, to an appreciable extent, independently of the market in order to determine of additional obligations should be imposed on them under the relevant Directives.
SoR (Statement of Requirement)	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.
TAN (Trunk Aggregation Node)	In the 2013 BCMR we identified 85 of BT's 107 OHPs to be major nodes. At the time, we considered that BT's competitors would be unlikely to connect to each major node, because some were geographically close to each other. We therefore decided to group the 85 major nodes into

	56 Trunk Aggregation Nodes (TANs). We found the core/backhaul conveyance between TANs to be competitive, however conveyance within each TAN was not competitive and therefore not part of the competitive core.
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.
Temporary Conditions	The temporary regulation Ofcom imposed in business connectivity markets in November 2017 to safeguard competition and protect the interests of consumers until the new analysis is complete. The Temporary Conditions Statement, including associated Annexes, published by Ofcom on 23 November 2017 imposed the temporary conditions.
The Act	The Communications Act 2003.
Time-limited discount	A temporary reduction in the charge for a service. After a certain period of time, the relevant charge is set back to its original level (before the change was implemented). These are marketed as 'Special Offers.'
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.
TPI (Tender Price Index)	A national index that measures tender prices charged for construction work.
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.
UKRN	UK Regulators Network.
VHB (Very High Bandwidth)	Bandwidths above 1 Gbit/s.
VLB (Very Low Bandwidth)	Bandwidth below 2 Mbit/s.

VOA (Valuation Office Agency)	An executive agency of HM Revenue & Customs (HMRC). Amongst 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' 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' 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.