# Business connectivity market review

## Annexes 1-22

[✂] Redacted for publication

**CONSULTATION:**

Publication Date: 2 November 2018 [Updated on 19 December 2018]
Closing Date for Responses: 18 January 2019

# Contents

## Annex

# 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 18 January 2019.

A1.2 You can download a response form from https://www.ofcom.org.uk/consultations-and-statements/category-1/business-connectivity-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 BCMR@ofcom.org.uk as an attachment in Microsoft Word format together with the cover sheet (https://www.ofcom.org.uk/consultations-and-statements/consultation-response-coversheet).

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation:
BCMR
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 (BSL) 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 in 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, or simply seek clarifications, then for Volume 1, please contact Matthew.Thomas@ofcom.org.uk

(on 0207 981 3292) and for Volume 2, please contact Joe.Duffield@ofcom.org.uk (on 0207 981 4180). If contacting us by be email, please also copy in BCMR@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 our website, www.ofcom.org.uk, 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 at https://www.ofcom.org.uk/about-ofcom/website/terms-of-use.

## Next steps

A1.15 Following this consultation period, Ofcom plans to publish a statement in spring 2019.

A1.16 If you wish, you can register to receive mail updates alerting you to new Ofcom publications; for more details please see https://www.ofcom.org.uk/about-ofcom/latest/email-updates.

## 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 Jacqui Gregory, Ofcom's consultation champion:

Jacqui Gregory
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

## Volume 1: Market review

### Contemporary Interface (CI) Access

Question 4.1: Do you agree with our proposed approach to product market definition? Please provide evidence to support your views.

Question 4.2: Do you agree with our proposed CI Access product market definition? Please provide evidence to support your views.

Question 5.1: Do you agree with our proposed approach to geographic market analysis for CI Access? Please provide evidence to support your views.

Question 5.2: Do you agree with our proposed definition of geographic markets for CI Access? Please provide evidence to support your views.

Question 6.1: Do you agree with our proposed approach to SMP assessment for CI Access in the UK excluding the Hull Area? Please provide evidence to support your views.

Question 6.2: Do you agree with our proposed SMP findings for CI Access in each of the geographic markets defined? Please provide evidence to support your views.

### CI Inter-exchange connectivity

Question 7.1: Do you agree with our assessment of inter-exchange connectivity? Please provide evidence to support your views.

Question 7.2: Do you agree with the proposed market definition? Please provide evidence to support your views.

Question 7.3: Do you consider that our list of BT exchanges for de-regulation is correct? Please provide evidence to support your views.

Question 7.4: Do you agree with our list of Principal Core Operators (PCOs)? Please provide evidence to support your views.

## Traditional interface (TI) services

Question 8.1: Do you agree with our proposal not to regulate the low bandwidth TI services market on the basis that it no longer fulfils the three-criteria test set out in the European Commission Recommendation? Please provide evidence to support your views.

## Hull Area

Question 9.1: Do you agree with our proposal to deregulate the retail market for CI services at all bandwidths in the Hull Area? Please provide evidence to support your views.

Question 9.2: Do you agree with our analysis and proposed findings in relation to the wholesale market for CI Access services at all bandwidths in the Hull Area? Please provide evidence to support your views.

Question 9.3: Do you agree with our proposal to deregulate wholesale TI services at all bandwidths in the Hull Area? Please provide evidence to support your views.

## Approach to remedies

Question 10.1: Do you agree with our proposed approach to remedies? Please provide reasons and evidence in support of your views.

## General remedies

Question 11.1: Do you agree with the general remedies that we propose? Please provide reasons and evidence in support of your views.

## Specific dark fibre remedy for inter-exchange connectivity

Question 12.1: Do you agree with the aims and effect of our proposed dark fibre remedy? Please provide evidence to support your views.

Question 12.2: Do you agree with our proposed scope of the remedy? Please provide evidence to support your views. Please provide evidence to support your views.

Question 12.3: What scope do you expect to have for cost savings as a result of the proposed dark fibre remedy? How large do you expect any cost savings to be? Please provide evidence to support your views.

Question 12.4: How many orders for dark fibre would you envisage placing during the two-year review period? Please provide evidence to support your views.

Question 12.5: Do you agree with our proposed timeline for dark fibre implementation? Please provide evidence to support your views.

### Specific remedies for active products

Question 13.1: Do you agree with the specific network access remedies that we propose for CI services at all bandwidths in the business connectivity markets? Please provide evidence to support your views.

### Specific remedies for interconnection and accommodation

Question 14.1: Do you agree with the specific remedies for interconnection and accommodation that we propose? Please provide evidence to support your views.

### Quality of services (QoS) remedies

Question 15.1: Do you agree with our proposals regarding the application of QoS standards, KPIs, SLAs and SLGs over the period of this review? Please provide evidence to support your views.

### Remedies in the Hull Area

Question 16.1: Do you agree with the remedies in the Hull Area that we propose? Please provide evidence to support your views.

## Volume 2: Leased line charge control

### Objectives and approach in setting the leased lines charge controls

Question 2.1: Do you agree with the proposed form of charge controls? Please provide evidence to support your views.

### Charge control design

Question 3.1: Do you agree with each of our proposals in relation to the design of charge controls for active services at 1 Gbit/s and below? Please provide evidence to support your views.

Question 3.2: Do you agree with each of our proposals in relation to the design of charge controls for active VHB services? Please provide evidence to support your views.

Question 3.3: Do you agree with each of our proposals in relation to the design of charge controls for accommodation services, Excess Construction Charges and Time Related Charges? Please provide evidence to support your views.

## Inter-exchange dark fibre charge control

Question 4.1: Do you agree with our proposals in relation to the design of a charge control for inter-exchange dark fibre? Please provide evidence to support your views.

## Implementation, compliance and legal tests

Question 5.1: Do you agree with each of our proposals in relation to the implementation of charge controls? Please provide evidence to support your views.

# A5. Regulatory framework

A5.1 This annex provides an overview of the market review process to give some additional context and understanding of the matters discussed in this document, including the draft legal instruments published in Annex 23.

A5.2 Market review regulation is technical and complex; and requires us to apply legislation and 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 developing our proposals on this market.

## 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 applicable rules[2] 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).

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, 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 [accessed 30 October 2018].
[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 These stages are normally carried out together.

## Market definition

A5.8 The Act provides that, before making a market power determination[3], 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 EC Recommendation[4] and SMP Guidelines[5] 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.

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 cumulative 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).

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-

[3] 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.

[4] *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).* http://eurlex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014H0710&from=EN.

[5] 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): https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2018.159.01.0001.01.ENG&toc=OJ:C:2018:159:TOC.

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.

A5.15 The 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 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[6] in the absence of regulation based on significant market power (known as a 'Modified Greenfield Approach').[7] The 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.

A5.16 The 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. Ofcom's approach to market definition follows that used by the UK competition authorities, which is in line with the approach adopted by the EC.

A5.17 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[8] (relating to the application of the Chapter I or II prohibitions or Article 101 or 102 of the Treaty on the Functioning of the European Union[9]) or the Enterprise Act 2002.[10]

# Market analysis

## Effective competition

A5.18 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

[6] The 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 – see paragraph 14.
[7] SMP Guidelines, paragraphs 13-17.
[8] http://www.legislation.gov.uk/ukpga/1998/41/contents [accessed 30 October 2018].
[9] Previously Article 81 and Article 82 of the EC Treaty, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:083:FULL:EN:PDF.
[10] http://www.legislation.gov.uk/ukpga/2002/40/contents [accessed 30 October 2018].

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.

A5.19 In carrying out a market analysis, the key issue for an NRA is to determine whether the market in question is effectively competitive. The 27th recital 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".

A5.20 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 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.

A5.21 In that regard, the SMP Guidelines set out, additionally to market shares, a number of 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.[11]

[11] SMP Guidelines, paragraph 58.

A5.22 A dominant position can derive from a combination of these criteria which when taken separately may not necessarily be determinative.

### Sufficiency of competition law

A5.23 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 SMP Guidelines clarify that, if NRAs designate undertakings as having SMP, they must impose on them one or more regulatory obligations.

A5.24 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 possible to reduce such regulation over time as markets become more competitive, allowing greater reliance on *ex post* competition law.

A5.25 *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.

A5.26 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

A5.27 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.

A5.28 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.

A5.29 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
- transparent in relation to what is intended to be achieved.

A5.30 Additional legal requirements may also need to be satisfied depending on the SMP obligation in question. For example, in the case of price controls, the NRA's market analysis must indicate that the lack of effective competition means that the telecoms provider concerned may sustain prices at an excessively high level or may apply a price squeeze to the detriment of end-users and that 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. In that instance, NRAs must take into account the investment made by the telecoms provider and allow it a reasonable rate of return on adequate capital employed, taking into account any risks specific to a particular new investment, as well as ensure that any cost recovery mechanism or pricing methodology that is mandated serves to promote efficiency and sustainable competition and maximise consumer benefits.

A5.31 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[12] that would make the network access unnecessary, the investment of the network operator who is required to provide access[13], and the need to secure effective competition[14] in the long term.

A5.32 To the extent relevant to this review, we demonstrate the application of these requirements to the SMP obligations in question in the relevant parts of this document which set out proposals on remedies. 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

[12] Including the viability of other network access products, whether provided by the dominant provider or another person.
[13] Taking account of any public investment made.
[14] Including, where it appears to us to be appropriate, economically efficient infrastructure-based competition.

secured or furthered by our regulatory intervention, and that it is in accordance with the six European Community requirements in section 4 of the Act. This is also relevant to our assessment of the likely impact of implementing our proposals.

## Ofcom's general duties – section 3 of the Act

A5.33 Under the Act, our principal duty in carrying out 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.

A5.34 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.

A5.35 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 the Business Connectivity Market Review (BCMR), 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.

A5.36 We have also had 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 in the interest of consumers in respect of choice, price, quality of service and value for money.

A5.37 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 and Article 3 of the BEREC Regulation

A5.38 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. In summary, these six requirements are:

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

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

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

iv) 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);

v) 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

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

A5.39 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.

A5.40 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.

A5.41 Further, Article 3(3) of the Regulation establishing BEREC[15] requires NRAs to take utmost account of any opinion, recommendation, guidelines, advice or regulatory best practice adopted by BEREC.

A5.42 Accordingly, we have taken due account of the applicable EC recommendations and utmost account of the applicable opinions, recommendations, guidelines, advice and regulatory best practices adopted by BEREC relevant to the matters under consideration in this review.

## Impact assessment – section 7 of the Act

A5.43 The analysis presented in this document represents an impact assessment, as defined in section 7 of the Act.

A5.44 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, Ofcom is committed to carrying out and publishing impact assessments in relation to the majority of its policy decisions.[16]

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[15] *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.

[16] For further information about Ofcom's approach to impact assessments, see the guidelines, *Better policy-making: Ofcom's approach to impact assessment*, which are on the Ofcom website: http://stakeholders.ofcom.org.uk/binaries/consultations/better-policy-making/Better_Policy_Making.pdf.

A5.45 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.

A5.46 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects, and practices on equality.[17] This assessment is set out in Annex 6.

## Regulated entity

A5.47 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").

A5.48 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).[18]

A5.49 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.

A5.50 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".

[17] 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.
[18] *Viho v Commission*, Case C-73/95 P [1996] ECR I-5447.
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:61995CJ0073:EN:PDF.

# A6. Equality impact assessment

A6.1 Ofcom is required by statute to assess the potential impact of all our functions, policies, projects and practices on equality.[19] 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.

A6.2 Unless we otherwise state in this document, it is not apparent to us that the outcome of this consultation will have a differential impact on any equality group.

A6.3 Further, we have not considered it necessary to carry out separate EIAs in relation to race or sex equality or equality schemes under the Northern Ireland and Disability Equality Schemes. 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[20] or disabled consumers compared to consumers in general.

A6.4 The aim of this consultation is to define the retail and wholesale leased lines markets in the UK and assess the state of competition.

## Equality impact assessment

A6.5 We have considered whether our proposals are likely to have an adverse impact on promoting equality. In particular, we have considered whether it is 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, and, in Northern Ireland, political opinion and persons with dependants.

A6.6 We do not have detailed sectoral information on the businesses that purchase wholesale leased lines services or whether there is a correlation between the customers of their products or services and the defined equality groups. We also do not have information on any correlation between retail leased lines services and the defined equality groups.

A6.7 However, we do not have any reason to suspect that there would be a correlation between the affected consumers and businesses and any of the above defined equality groups. We also do not find any reason to suspect that our proposals have the potential for negative impacts on members of the defined equality groups. On that basis we believe that it would be disproportionate to commission relevant research and have not done so.

[19] 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.
[20] 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.

# A7. Product dynamics

A7.1 In this annex we analyse the product dynamics in the business connectivity markets and how these affect prices and competition. We first look at the evolution of volumes and costs since 2009 and then go on to assess how these trends interact with regulation and BT's pricing incentives, to explain market outcomes.

A7.2 We use the analysis in this annex to help inform our proposals on market definition and significant market power (SMP) assessment for Contemporary Interface (CI) services.

## Volume and cost trends

A7.3 Bandwidth demand is growing rapidly driven by new applications such as cloud computing, video conferencing, and smartphone use. Industry forecasts suggest that bandwidth demand will increase by a factor of 3 between 2016 and 2021, growing at a rate of around 20% per annum.[21]

A7.4 To meet their increasing bandwidth needs, leased line customers migrate to higher bandwidth products. This has manifested itself in the changing distribution of leased line volumes by bandwidth over time (see Figure A7.1). In 2010 <10 Mbit/s lines represented nearly all of BT's leased line volumes, they now only represent c.20%.[22] Over this time, 100 Mbit/s has become the most popular speed, accounting for around 60% of BT's leased line volumes, while 1 Gbit/s lines have increased in popularity and now represent around 15% of BT's leased line base.

A7.5 In addition, demand for very high bandwidth (VHB) circuits – which we define as circuits offering speeds above 1 Gbit/s – is expected to accelerate during this review period, driven mainly by mobile and fixed network backhaul customers, due to the move to fifth generation mobile technology (5G) and the transition from copper to fibre broadband respectively. Demand for VHB circuits from enterprises is also expected to grow, although it will remain low relative to the demand from mobile and fixed network backhaul customers.

A7.6 This is confirmed by our recent engagement with telecoms providers and by the research we commissioned on large enterprises[23], which found that:

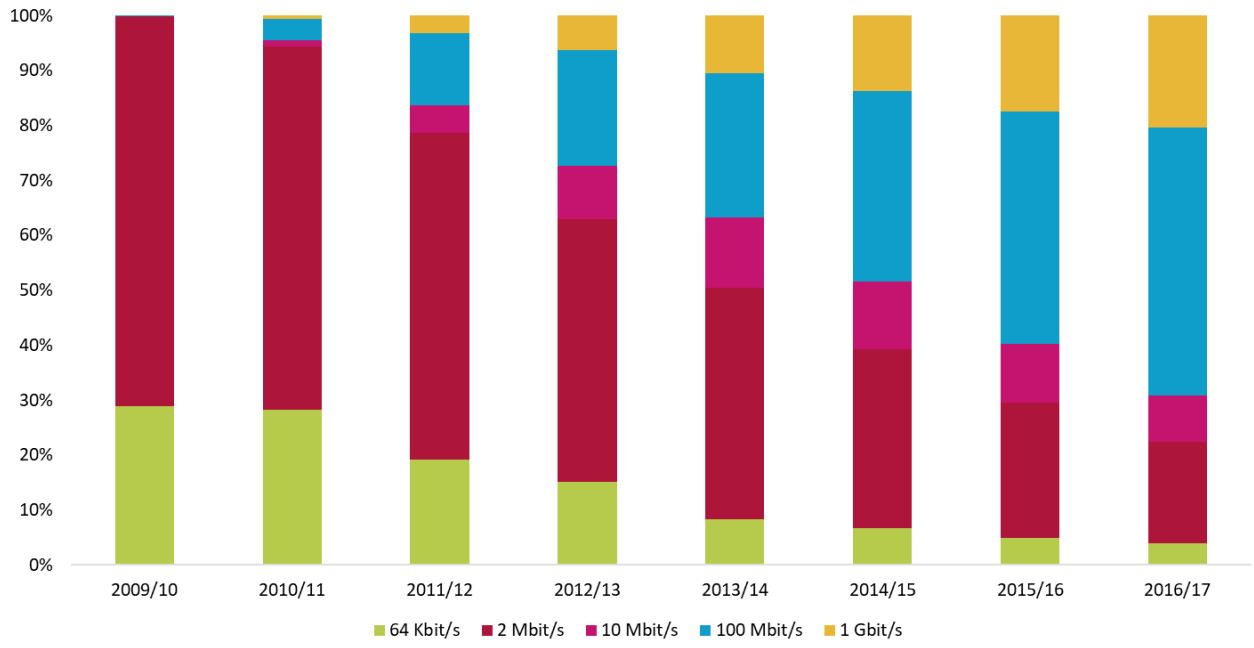
- Mobile Network Operators (MNOs) expect traffic to grow exponentially with 5G, and 10 Gbit/s and *n* x 10 Gbit/s links will be the norm for these customers in the next three to five years; and

[21] Cisco, 2017. *The Zettabyte Era: Trends and Analysis*. www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/vni-hyperconnectivity-wp.html [accessed 30 October 2018].
[22] Ofcom analysis based on BT's Regulatory Financial Statements (RFS).
[23] Cartesian, 2018. *Business Connectivity Market Assessment*. www.ofcom.org.uk/__data/assets/pdf_file/0009/113112/cartesian-business-connectivity-market-assessment.pdf.

- demand for 10 Gbit/s from large enterprises is growing, with some enterprises already requesting 100 Gbit/s.

A7.7 This trend is consistent with a product lifecycle where demand for a particular bandwidth is low at the beginning (when early adopters take up the product) then increases as the product becomes mass-market and late adopters begin to take it up. At some point, as leased line customers continue to migrate upwards and new higher bandwidth services are launched, demand for the product falls.

**Figure A7.1: Distribution of BT business connectivity circuits by bandwidth**




*Source: Ofcom based on BT's Regulatory Financial Statements (RFS) volumes data for rental Tradition Interface (TI) and CI services (excluding services above 1 Gbit/s). 64 Kbit/s and 2 Mbit/s volumes reflect TI local ends and were adjusted (divided by a factor of 2) to convert to circuits.*

A7.8 Trends in the business connectivity markets also indicate that equipment costs are declining over the product cycle by 4.9 to 7.3% per year.[24] On an absolute basis, these costs are relatively constant across Ethernet services for bandwidths of 1 Gbit/s and below (Section 3 of Volume 1 provides more information on the equipment used for these services). For bandwidths above 1 Gbit/s, equipment costs are higher, around triple the costs for lower bandwidths based on our analysis of BT's Regulatory Financial Statements (RFS).[25]

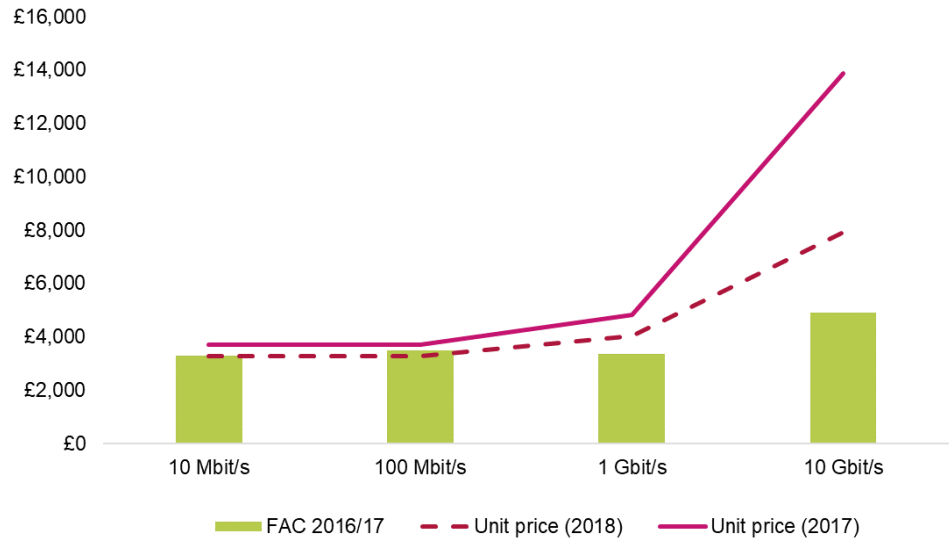
[24] BT response dated 11 November 2014 to the 4th 2016 LLCC s.135 notice.
[25] We have updated estimates from BT's 2016/17 RFS to reflect the changes announced as part of BT's 2017/18 Charge Control Notification.
https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2018/ChangeControlNotification2017-18.pdf

A7.9 The equipment cost differential between 1 Gbit/s and 10 Gbit/s has been declining over time. In the 2016 BCMR we noted that the equipment costs underlying the 10 Gbit/s service had reduced considerably with the introduction of Openreach's 10 Gbit/s Ethernet Access Direct (EAD) service and, as a result, the cost differential between 1 Gbit/s and 10 Gbit/s had narrowed.[26] Since then, BT's RFS suggests equipment costs for 10 Gbit/s EAD have reduced further by nearly half.[27] As technology for 10 Gbit/s continues to evolve, it is reasonable to assume that this cost gap will continue to narrow in the future.

## The bandwidth gradient

A7.10 Historically, BT's charges have followed a bandwidth gradient, which means that charges increase with bandwidth. This bandwidth gradient has been greater than equipment cost differentials alone, also reflecting differences in willingness to pay, price discrimination (though to some extent constrained by competition), and differences in regulation.[28]

**Figure A7.2: EAD prices and fully allocated costs**




*Source: Ofcom based on BT's 2016/17 RFS and Openreach's price list as at April 2018. Costs and prices are stated on a Total Cost of Ownership (TCO) basis and include rental, connection and main link costs/charges. Connection costs/charges are spread over a three-year period and discounted using a 9% Weighted Average Cost of Capital (WACC). For main link costs/charges, we assume a 5km link distance. As in our dig distance cost analysis (Annex 10), we have removed operating costs and overheads associated with Ethernet electronics based on 2017/18 RFS cost data which splits out the costs for EAD equipment. In our view, the allocation of*

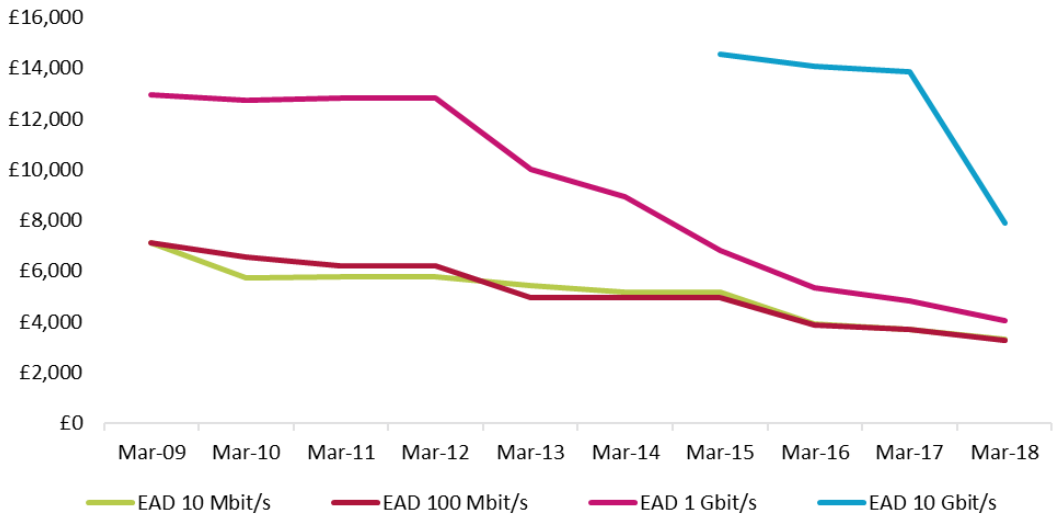
[26] 2016 BCMR, paragraph 4.181.
[27] In the 2016 BCMR we estimated equipment costs for 10 Gbit/s EAD of [✂]. We have now updated our estimate of these costs and have come down to [✂] based on BT's 2017/18 flat file (for service SD163).
[28] For charge-controlled products, the bandwidth gradient can also reflect efficient common cost recovery where products with a higher willingness to pay make greater contributions to common costs, allowing fewer common costs to be recovered from lower bandwidth products. This is less important for non-charge-controlled products as higher charges for these products do not reduce the amount of common costs to be recovered by charge controlled products.

*these costs (operating costs and overheads) do not reflect the underlying incremental costs of the service but rather BT's cost allocation rules.*

A7.11 Since 2009, BT's Ethernet services of 1 Gbit/s and below have been subject to price controls which require charges to reflect costs in aggregate. BT has historically set prices for services above 1 Gbit/s (which were not subject to price regulation) with a greater premium above cost. As at March 2017, we estimate that whereas EAD 100 Mbit/s prices were 2% below Fully Allocated Cost (FAC), EAD 1 Gbit/s prices were 32% above FAC and those for EAD 10 Gbit/s were [✂]% 100-150% above FAC.[29] This differential has reduced significantly since April 2018, when BT reduced EAD 10 Gbit/s charges by nearly 40% (see Figure A7.2).

A7.12 Over time, we find that BT's Ethernet prices are declining and the price gap across bandwidths is narrowing, making the bandwidth gradient flatter and more cost reflective (see Figure A7.3). This is likely due to a combination of price regulation, upward migration and competition from alternative networks.

**Figure A7.3: Evolution of EAD charges – Annualised Total Cost of Ownership (TCO)[30]**




*Source: Ofcom based on Openreach's price list.*

A7.13 Upward migration may impact the evolution of prices as relative charges across bandwidths affect decisions to migrate. The lower the incremental charges for high bandwidths (relative to lower bandwidths), the sooner lower bandwidth customers will migrate to more profitable higher bandwidth products. This means that, independent of competitive pressure from other operators, BT may find it profitable to reduce the relative charge for high bandwidth services if it encourages enough customers from lower bandwidths to migrate and pay higher charges. The loss from lower margins from existing

[29] Ofcom analysis based on BT's 2016/17 RFS and Openreach's price list as at March 2017.
[30] The annualised TCO includes rental, connection, and main link charges. Connection charges are spread over a three-year contract term and discounted based on a 9% WACC. For Main link charges we assume a 5km link distance.

high bandwidth customers could be more than offset by the gain from the additional customers upgrading their service, provided that customers migrate in sufficient numbers.

A7.14 This is supported by internal pricing documents from Openreach which indicate that:

- [✂].[31] This means that the revenue loss from a price cut on 1 Gbit/s would be partially offset by the gain from additional migration from 100 Mbit/s. This is not true for a price cut on 100 Mbit/s where potential migration from lower bandwidths would be minimal given the small 10 Mbit/s volumes; and
- expected demand growth for VHB services in the next five years, mainly from MNO and fixed network backhaul customers, and the presence of competition, partly explain Openreach's decision to cut its EAD 10 Gbit/s price and introduce OSA Filter Connect with a 30%[32] discount over its standard Optical Spectrum Access (OSA) product.[33]

A7.15 Given Openreach's low VHB volumes ([✂] circuits), relative to its 1 Gbit/s volume base ([✂] circuits), it is plausible that the gain from additional migration from 1 Gbit/s (caused by the cut in VHB charges) more than compensates for the loss from lower margins on existing VHB customers. This appears to be confirmed by Openreach's commercial assessment of its VHB price cut, which shows that [✂].[34]

A7.16 Openreach's internal pricing documents also suggest that competition plays a role in shaping these price trends. Notably, the size of BT's recent VHB price cuts may be influenced by the presence of competition. In its pricing documents, Openreach highlighted [✂].[35] However, the size of the price cut (nearly 40%) also suggests that it is likely that competition was previously insufficiently robust so as to force BT to reduce its prices earlier.

A7.17 In addition, our analysis shows that the bandwidth gradient affects competition and service shares in the market. The higher BT's prices, the greater scope for competition as this affects the incentives to dig (also described in Section 4 of Volume 1). Other operators base their build/buy decisions on a comparison between BT's prices and the cost of construction and adding their own equipment: the higher BT's charges, the further it is economic for operators to dig to connect customers to their network. Note that, if we assume that other operators face similar equipment prices to Openreach, this greater competitive distance is driven by the premium BT charges above costs.

[31] Openreach response dated 20 April 2018 to Question 5 of the 8th BCMR s.135 notice. See document entitled *Leased Line Charge Control Ethernet Prices for April 2018.*
[32] We set out our analysis of the discount in Annex 14.
[33] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice. See document entitled *New pricing and product launches for VHB portfolio*, page 6.
[34] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice. See document entitled *Product Proposals: Ethernet & Optical Response to Dark Fibre*, slide 7.
[35] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice. See document entitled *New pricing and product launches for VHB portfolio*, page 2.

A7.18 Given the historically high charges for VHB it is unsurprising that BT has a lower service share for VHB than for lower bandwidths, where charges are closer to the underlying costs. This is illustrated in Table A7.4, below.

**Table A7.4: Ofcom estimates of BT service shares**

| Service | 2008 BCMR | 2013 BCMR | 2016 BCMR | This consultation |
|---|---|---|---|---|
| TI Low bandwidth (<8 Mbit/s) | 89% | 88% | 89% | n/a |
| CI services of 1 Gbit/s and below | 73% | 74% | 57% (affected by same data issues described in Annex 12) | [✂%] 71%-80% |
| CI services >1 Gbit/s and WDM | 39% | 57% | 30% (affected by same data issues described in Annex 12) | [✂%] 51%-60% |

*Source: 2016 BCMR. BT service shares in the UK excluding Hull Area for TI Low bandwidth and excluding Hull Area and West East and Central London Area plus (WECLA+) for Alternative Interface Symmetric Broadband Origination (AISBO) and Contemporary Interface Symmetric Broadband Origination (CISBO) services.*

A7.19 However, steady migration to higher bandwidths, together with BT's recent price cut and its impact on dig distance, means that it is reasonable to anticipate that BT's service share for VHB will increase.

## Implications for our competition assessment

A7.20 The analysis above suggests that prices for higher bandwidth products tend to reduce over time and become more cost reflective. This is relevant when thinking about competition in the long term, and what competitive prices are for market definition purposes.

A7.21 The analysis also suggests that the relationship between BT's prices and competition may be circular. On one hand a lack of competition results in the ability to charge significantly above costs. On the other, the higher BT's prices (relative to costs), the more attractive it is for alternative operators to dig and compete in the market. This means that service shares for higher bandwidth services (where BT's prices have historically been higher and above costs) may understate BT's market power.

# A8. CI Access market definition: demand-side substitution analysis

A8.1 In this annex we assess the extent to which customers see different Contemporary Interface (CI) Access services as substitutes from the demand side.

A8.2 The structure of this annex is as follows:

- our approach to assessing demand-side substitution, including our critical loss analysis for assessing the Small but Significant Non-transitory Increase in Price (SSNIP) test and the focal products to which we apply the test;
- our SSNIP analysis for each focal product; and
- our provisional conclusion on demand-side substitution.

## Our approach

A8.3 We have used the SSNIP framework (outlined in Section 4 of Volume 1) to assess the boundaries of the CI Access product market from the demand side. The overarching question is whether enough CI Access customers would switch to an alternative service in response to a SSNIP (typically of 5-10%) such that the SSNIP would become unprofitable.

A8.4 As part of our assessment we have conducted a critical loss analysis. This analysis estimates the switching rate necessary to make the SSNIP unprofitable, i.e. the critical loss. It then asks whether the proportion of customers that would switch in response to a SSNIP would exceed this critical loss. If enough customers would switch, the evidence would point to a wider market encompassing the focal product as well as the candidate substitute. If an insufficient number of customers would switch, the evidence would support a narrower market that includes the focal product exclusively.

### Focal products

A8.5 To perform the SSNIP test we need to decide what the starting point of the analysis is, i.e. the focal product. The general practice is to start from the narrowest possible product market (the focal product) and assess whether the market could be broader to include additional substitutes.

A8.6 We apply our SSNIP analysis to the following focal products which account for 99%[36] of Openreach's wholesale leased line volumes:

- 10 Mbit/s,
- 100 Mbit/s,
- 1 Gbit/s, and
- 10 Gbit/s.

[36] Openreach response dated 18 January 2018 to question A of the 1st BCMR s.135 notice.

A8.7 We do not consider bandwidths of 2.5 Gbit/s, 40 Gbit/s and 100 Gbit/s explicitly in our analysis given their minimal volumes. However, we expect these bandwidth products to face similar competitive conditions to those for 10 Gbit/s. We refer to these services collectively as very high bandwidth (VHB) services in our analysis.

## Relevant price

A8.8 To implement the SSNIP analysis we need to determine the price to which we apply the SSNIP. We have used Openreach's price list to inform this price and have taken the minimum price available for each focal product under the assumption that this better reflects competition in the market (i.e. this is the price that is likely to place the strongest constraint within and across different bandwidths).

A8.9 Given that we are interested in distinguishing between access and inter-exchange, we base our assessment on the charges for Openreach's Ethernet Access Direct Local Access (EAD LA) services (rather than on Openreach's standard EAD services which include Main Link charges capturing inter-exchange costs). These are also the most popular Openreach CI Access services for each of the focal products analysed, except for 10 Gbit/s where OSA is the most popular service, albeit on the back of a low volume base.

A8.10 For each focal product we consider the wholesale charge for the following two scenarios:

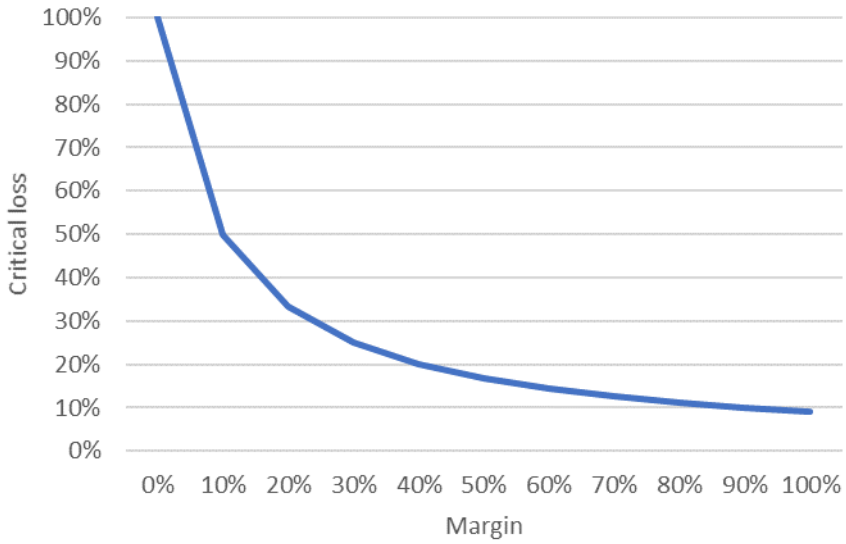
- an existing CI Access customer – who only needs to pay a migration charge to switch from the focal product to the candidate substitute; and
- a new CI Access customer – who needs to pay a connection charge to purchase either the focal product or the candidate substitute.

## Critical loss

A8.11 The critical loss threshold or break-even critical loss is the amount of switching needed to render a SSNIP unprofitable. This is determined by two factors: the price increase and the margin.

A8.12 For any given increase in price, the higher the margin the less switching is required to render a SSNIP unprofitable. Therefore, for a given price increase, we only need to know the margin to know the critical loss. The figure below shows the relationship between the margin and critical loss for a 10% price increase.

**Figure A8.1: Relationship between the critical loss and the assumed margin for a 10% SSNIP**




*Source: Ofcom based on the standard critical loss formula.*[37]

## Intertemporal switching, migration, and the relevant assessment period

A8.13 Switching in response to the SSNIP may not occur immediately as leased line customers are typically tied to minimum contract periods. We therefore need to consider the time horizon over which we ascertain the impact of a SSNIP on customer switching.

A8.14 The European Commission (EC) significant market power (SMP) Guidelines are silent on the exact time horizon of a SSNIP, stating that additional products should be included if they would restrain sufficiently pricing "in the short term". Office of Fair Trading (OFT) guidance[38] emphasises substitution within a year, while previous issues of the Federal Trade Commission/Department of Justice guidelines referred to a two-year period over which substitution responses take place.[39]

A8.15 In general, we consider that the most relevant time horizon is likely to be that which the hypothetical monopolist considers when making its pricing decisions. Internal pricing documents from Openreach suggest that pricing decisions are assessed by considering the

[37] Harris, B.C. and Simons, J.J., 1989. *Focusing Market Definition: How Much Substitution is Necessary?*, Research in Law and Economics, 12, pp. 207-26, 1989.
[38] OFT, 2004, *Market definition: Understanding competition law* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/284423/oft403.pdf.
[39] In addition to the previous guidelines (https://www.justice.gov/atr/horizontal-merger-guidelines-0#32, accessed 30 October 2018), more recent guidelines from 2010 (https://www.ftc.gov/sites/default/files/attachments/merger-review/100819hmg.pdf) refer to entry being rapid enough to make unprofitable overall the actions causing those effects.

impact of pricing proposals on revenues and costs over a medium-term period of [✂] years.[40]

A8.16 Contract periods can also provide an indication of how long the effects of a price change may take to fully materialise. This is consistent with what the Tribunal said in its judgment in the 2016 BCMR appeal: "the duration and frequency of renewal or change of leased line contracts by customers" is "highly relevant as regards the appropriate duration of a SSNIP analysis"[41]. For CI Access services, contract durations typically range from one year to five years, with the median duration being one year for wholesale contracts and 3 years for retail contracts. This suggests that most switching decisions are likely to happen within a short time period (no more than 3 years) after the price increase.

A8.17 In addition to the time horizon of analysis, the profile of switching may affect the profitability of the SSNIP. In its Judgment, the Tribunal suggested that the critical loss threshold may be impacted by the profile of switching and migration occurring because of a SSNIP and that this could be more accurately accounted for by considering a discounted cash flow approach. Although we recognise that this is the ideal approach for assessing the effects of a SSNIP we do not consider that it would have a material impact on the standard critical loss thresholds given the short timeframes involved for the likely switchers. We have therefore not explicitly modelled the profile of switching when assessing the profitability of the SSNIP.

## Relevant margin

A8.18 The margin is the difference between the original, pre-SSNIP revenue obtained from the diverted sales, and the avoided cost associated with providing those sales (expressed on a per customer basis).

A8.19 To inform this margin we have considered the following evidence:

- Openreach's Fibre First business case, which provides information on the net cash margin impact of the loss of Ethernet sales because of FTTP.[42] According to Openreach, these lost sales would mainly be 10 Mbit/s and 100 Mbit/s circuits. This evidence suggests an average margin of [✂] for low bandwidth Ethernet services.[43]
- BT's 2016/17 RFS, which provides a break-down of operating and capital costs for Openreach's CI services. We consider that operating costs are more likely to be avoidable, therefore we estimate the margin by taking the difference between the reported revenue (adjusted by Openreach's recent price cuts) and the reported operating cost for Openreach's EAD LA products. This suggests a margin of [✂] depending on the bandwidth.[44]

[40] Openreach response dated 20 April 2018 to question 4 of the 8th s.135 notice. See document 'New pricing and product launches for VHB portfolio', pages 19-20, and slide deck entitled "Product Proposals: Ethernet & Optical Response to Dark Fibre", slides 13-14.
[41] BCMR appeal judgment, paragraphs 312 and 313.
[42] This net cash impact is the difference between the forgone revenues and the avoidable costs from the lost sales.
[43] Openreach's response to question 3 of the 8th BCMR s.135 notice dated 20 April 2018.
[44] BT 2016/17 RFS and supplementary AFIs.

A8.20 Table A8.2 summarises this evidence. It suggests that the margin increases as the bandwidth gets higher. We have used these margins to inform the critical loss in our analysis (these are reported in the last column of the table). We consider the margin for 10 Gbit/s to be conservative as it may overstate the margin that would occur in a competitive market.

**Table A8.2: Evidence on margin by bandwidth and the critical loss threshold**

| Focal product | BT's 16/17 RFS adjusted by new prices | Openreach Fibre First business case | Range | Critical loss threshold |
|---|---|---|---|---|
| 10 Mbit/s | [✂]% | [✂]% | [✂]% | [✂]% |
| 100 Mbit/s | [✂]% | | [✂]% | [✂]% |
| 1 Gbit/s | [✂]% | N/A | [✂]% | [✂]% |
| 10 Gbit/s | [✂]% | N/A | [✂]% | [✂]% |

*Source: Ofcom analysis based on Openreach and BT data. We have assumed that the margin coming from the Openreach Fibre First business case relates mainly to 10 Mbit/s and 100 Mbit/s leased lines.*

## SSNIP analysis

A8.21 We present our SSNIP analysis for each focal product in turn below. For each focal product, we carry out our analysis by first assessing substitution to the next higher bandwidth (which we consider as the closest substitute). We then consider substitution to the nearest lower bandwidth, where relevant.

A8.22 For 100 Mbit/s, 1 Gbit/s and 10 Gbit/s we also assess substitution to asymmetric broadband, Ethernet in the first mile (EFM) and dark fibre. We do not consider this for 10 Mbit/s as our analysis of 100 Mbit/s already captures the possible constraints from these alternative services given the almost identical charge between 10 Mbit/s and 100 Mbit/s services.

A8.23 Table A8.3 summarises the candidate substitutes considered for each focal product.

**Table A8.3: Candidate substitutes considered for each focal product**

| Focal Product | 10 Mbit/s | 100 Mbit/s | 1 Gbit/s | 10 Gbit/s |
|---|---|---|---|---|
| 10 Mbit/s | | ✓ | | |
| 100 Mbit/s | ✓ | | ✓ | |
| 1 Gbit/s | | ✓ | | ✓ |
| 10 Gbit/s | | | ✓ | |
| Ethernet in the first mile (EFM) | | ✓ | ✓ | |
| Asymmetric broadband | | ✓ | ✓ | |
| Dark fibre | | ✓ | ✓ | ✓ |

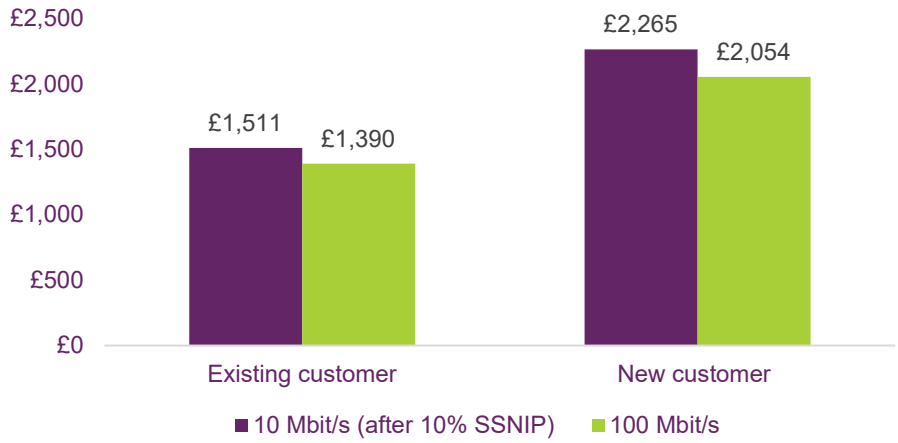
## SSNIP at 10 Mbit/s

A8.24 Figure A8.4 shows the price comparison between the price of 10 Mbit/s (after a 10% SSNIP) and the price of 100 Mbit/s for the two scenarios.

A8.25 It shows that a 10 Mbit/s customer would save £121 per annum by upgrading to 100 Mbit/s, with the additional benefit of getting 10 times more bandwidth. This upgrade would not require changing the underlying equipment, so we have only factored in the relevant migration charge.

A8.26 Likewise, a new customer would save £211 per annum by choosing to purchase a 100 Mbit/s circuit as oppose to a 10 Mbit/s circuit. The larger saving for this customer reflects the additional savings on connection charges.

**Figure A8.4: Price comparison between 10 Mbit/s (after 10% SSNIP) and 100 Mbit/s – annualised total cost of ownership (£)[45]**




*Source: Ofcom analysis based on Openreach prices for EAD Local Access as of April 2018.*

A8.27 Given the price and bandwidth differentials, we consider that a SSNIP at 10 Mbit/s is likely to result in significant substitution to 100 Mbit/s (in excess of 20%), rendering the SSNIP unprofitable. This suggests that 10 Mbit/s and 100 Mbit/s services are close demand substitutes.

## SSNIP at 100 Mbit/s

### Substitution to 1 Gbit/s

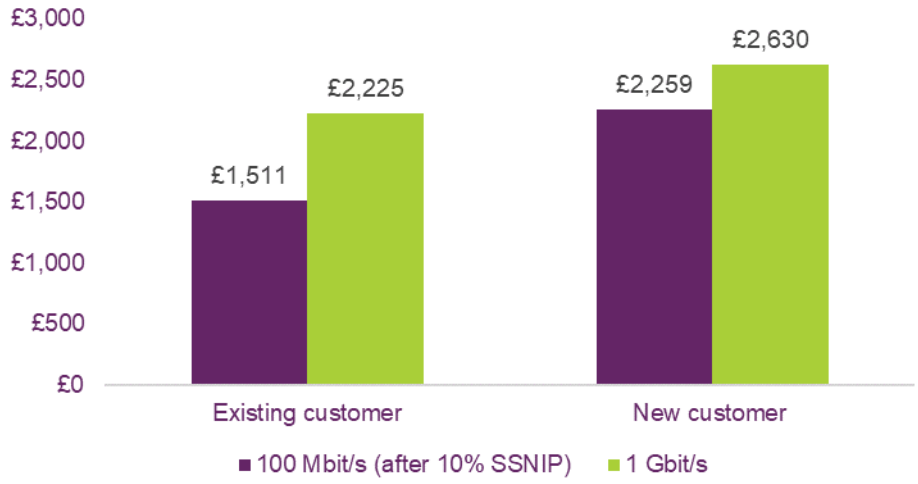
A8.28 Figure A8.5 shows the price comparison between the price of 100 Mbit/s (after a 10% SSNIP) and the price of 1 Gbit/s for the two scenarios.

A8.29 It shows that a 100 Mbit/s customer would find it cheaper to stay at 100 Mbit/s than to upgrade to 1 Gbit/s[46]. For new customers the choice between 100 Mbit/s and 1 Gbit/s is slightly more marginal as the price differential for these customers is £371 per year, with 1 Gbit/s also being more expensive than 100 Mbit/s.

[45] Prices are stated on a Total Cost of Ownership (TCO) basis and include rental and connection charges. Connection charges are spread over a three-year period by calculating the annuity which, when considered over the three-year period, is equivalent to the upfront connection charge on an NPV basis. To calculate this annuity, we assume a 9% discount rate or Weighted Average Cost of Capital (WACC).

[46] The price differential may vary in the future depending on whether the existing customer has an old or new equipment. This is because, since 2017, Openreach uses the same boxes for 100 Mbit/s and 1 Gbit/s and thus a change of equipment would not be required in this case (although an engineer visit may still be required)]. Openreach's response to question 5 of the 8th BCMR s.135 notice dated 20 April 2018, see document entitled "Leased Line Charge Control Ethernet Prices for April 2018", dated 26/02/18, page 3.

**Figure A8.5: Price comparison between 100 Mbit/s (after 10% SSNIP) and 1 Gbit/s – annualised total cost of ownership (£)[47]**




*Source: Ofcom analysis based on Openreach prices for EAD LA as of April 2018.*

A8.30 However, 100 Mbit/s customers could still find it attractive to switch to 1 Gbit/s if they value having additional bandwidth enough. The BDRC 2016 study indicates that bandwidth need is the most important factor affecting customers' decision to migrate,[48] suggesting that customers may consider moving to a higher bandwidth only when they require the additional bandwidth. The study however also identifies changes in relative prices as a factor (albeit a less important one) for migration decisions,[49] indicating that customers also factor value for money considerations into their migration decisions.

A8.31 Evidence from an Openreach pricing document[50] shows that demand for 1 Gbit/s may be sensitive to the relative prices between 100 Mbit/s and 1 Gbit/s. According to this document:

- [✂].[51] [52] [53]

A8.32 The document therefore suggests that a lower 1 Gbit/s price may encourage migration from 100 Mbit/s and that this migration could be substantial if the price differential between 100 Mbit/s and 1 Gbit/s is low enough ([✂]).

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[47] Prices are stated on a Total Cost of Ownership (TCO) basis and include rental and connection charges. Connection charges are spread over a three-year period by calculating the annuity which, when considered over the three-year period, is equivalent to the upfront connection charge on an NPV basis. To calculate this annuity, we assume a 9% discount rate or Weighted Average Cost of Capital (WACC).

[48] BDRC, 2016, *Business Connectivity Market Review: High bandwidth connections (BDRC 2016),* Figure 31. https://www.ofcom.org.uk/__data/assets/pdf_file/0020/32069/bdrc_ci_survey.pdf.

[49] BDRC, 2016. Figure 31

[50] Leased Lines Charge Control Ethernet Prices for April 18 document submitted by Openreach in response to Question 5 of the 8th notice dated 20 April 2018.

[51] LLCC 2017/18 Phase 2 Price reductions document submitted by Openreach in response to Question 5 of the 8th BCMR s.135 notice dated 20 April 2018, page 12.

[52] Leased Lines Charge Control Ethernet Prices for April 18, page 3.

[53] Leased Lines Charge Control Ethernet Prices for April 18, page 6.

A8.33 This document also indicates that a further reduction in the 1 Gbit/s EAD rental charge to [✂] may be needed in 2018 to comply with existing charge controls.[54] This means that in the near future 100 Mbit/s customers would save money by switching to 1 Gbit/s after a 10% SSNIP at 100 Mbit/s.

A8.34 Based on this evidence, we consider that a 10% SSNIP at 100 Mbit/s is likely to result in substitution to 1 Gbit/s in excess of 20%, rendering the SSNIP unprofitable. This suggests that 100 Mbit/s and 1 Gbit/s services are close demand substitutes.

### Substitution to 10 Mbit/s

A8.35 We consider that substitution from 100 Mbit/s to 10 Mbit/s is highly unlikely for several reasons. First, bandwidth demand is constantly increasing, so customers are more likely to consider switching to a higher bandwidth than to a lower bandwidth, particularly if switching to a lower bandwidth means losing 90% of the bandwidth.

A8.36 For 100 Mbit/s customers whose bandwidth need exceeds 10 Mbit/s, trading down to 10 Mbit/s is unlikely to be an option as they would be reluctant to reduce their bandwidth demand to get a 10% cost saving.

A8.37 For 100 Mbit/s customers with a bandwidth need below 10 Mbit/s (which numbers are shrinking), switching to 10 Mbit/s, although an option, may not be a straightforward choice as they may value the additional bandwidth. For these customers, staying at 100 Mbit/s would also prevent them from having to migrate back to 100 Mbit/s later when their bandwidth need exceeds 10 Mbit/s, which could happen relatively soon given the rate at which bandwidth demand is growing (see Annex 9).

A8.38 Therefore, we consider that a SSNIP at 100 Mbit/s is unlikely to result in substitution to 10 Mbit/s exceeding the critical loss of [✂], thus suggesting that there is an asymmetric relationship in the substitution between 10 Mbit/s and 100 Mbit/s services.

### Substitution to EFM

A8.39 Similar to substitution to 10 Mbit/s, substitution from 100 Mbit/s to EFM is likely to be limited by the slower speeds offered by the latter service. EFM can support speeds up to around 35 Mbit/s, but this is dependent on how close the customer is to the exchange. Data from BT suggests that the average speed of an EFM connection is closer to c.10 Mbit/s.[55]

A8.40 Migration analysis conducted by Openreach in 2015 shows that at that time very few EAD leased line customers ([✂]%) who ceased their service, and where identified as possible

[54] Leased Lines Charge Control Ethernet Prices for April 18, page 6.
[55] BT response to Question A1 of the 1st BCMR s.135 notice dated 18 January 2018.

migrations, ended up migrating to EFM.[56] This is despite EFM services being priced considerably lower than EAD leased lines.

A8.41 In addition, our recent engagement with telecoms providers suggests that EFM is considered a legacy service and will be gradually replaced mainly with FTTX[57] based asymmetric broadband:

- [✂] said that it considers EFM as a legacy technology and that it only uses it for new connections on a limited basis where suitable FTTX or fibre-based Ethernet services cannot be provided;[58]
- [✂] stated that it will use FTTX where possible ahead of EFM, although different coverage across the country will dictate uptake.[59] It also said that FTTP offers the opportunity to migrate EFM customers to a fibre-based solution as the copper platform approaches the end of its life and fibre is preferred to copper;[60] and
- [✂] said that it has intentions to migrate its EFM circuits to FTTX in the long-term due to platform lifecycle and market evolution to ultrafast FTTC and FTTP.[61]

A8.42 This is consistent with the volume forecasts submitted by telecom providers indicating that EFM volumes will decline by c.32% over the next four years, while FTTC volumes will triple.

A8.43 Based on this evidence, we consider that it is highly unlikely that more than [✂] of 100 Mbit/s customers would switch to EFM in response to a 10% SSNIP. Consequently, our initial view is that switching to EFM is unlikely to defeat a SSNIP at 100 Mbit/s, indicating that EFM and 100 Mbit/s are not close demand substitutes.

### Substitution to asymmetric broadband

A8.44 Substitution from 100 Mbit/s to asymmetric broadband is also bounded by the lower speed of the latter service. At present, the maximum upload speed that can be delivered over asymmetric broadband is 20 Mbit/s based on FTTC technology.

A8.45 These speeds are expected to reach 50 Mbit/s with the ongoing and future rollout of ultrafast technologies like G.fast and FTTP.[62] However, these higher speeds will still fall short of 100 Mbit/s, while coverage of these new technologies is likely to be limited for businesses over the course of this review period.

A8.46 Migration patterns suggest that few leased line customers consider FTTC as an alternative service. Openreach's 2015 migration analysis shows that at that time a small proportion

[56] Openreach response to Part 3 of the 15th BCMR s.135 notice dated 16 October 2016, see the document Ethernet Migration Analysis Update, page 2.
[57] FTTX means a connection of Fibre-To-The-Cabinet (FTTC) or Fibre-To-The-Premises (FTTP).
[58] [✂] response to Question 1a) of the 6th BCMR s.135 notice dated 27 April 2018.
[59] [✂] response to Question 1 of the 6th BCMR s.135 notice dated 20 April 2018, [✂].
[60] [✂] response to Question 5 of the 6th BCMR s.135 notice dated 20 April 2018.
[61] [✂] response dated 20 April 2018 to Question 1b) of the 6th BCMR s.135 notice.
[62] Responses of BT, TalkTalk and Vodafone to Question 5 of the 6th BCMR s.135 notice.

([✂]%) of those Openreach's EAD leased line ceases identified as possible migrations were identified as having migrated to FTTC.[63]

A8.47 This is consistent with the responses we received from telecom providers about the actual and expected impact of FTTX on the demand for Ethernet leased lines, suggesting the impact is likely to be small.

A8.48 TalkTalk stated that it does not anticipate FTTX to have a significant impact on the demand for Ethernet leased lines services in the next 3-5 years due to the following factors:

- "Customer bandwidth requirements evolution – existing Ethernet Leased Line customers will continue to see their bandwidth and network performance requirements evolve and grow - beyond the service levels of the initial contended broadband FTTP offerings"; and
- "Limited availability (coverage and business-specific) FTTP service – almost all FTTP rollouts are being targeted at residential areas and therefore we expect coverage of commercial premises to lag. In the next 3 years at least, premise coverage will not be significant enough to materially impact volumes".[64]

A8.49 BT expects most FTTP volumes to come from existing copper broadband customers. It stated that "[✂]".[65]

A8.50 Vodafone said that they do not see "customers migrate from Ethernet leased lines 100 Mbit/s or higher to FTTX in like for like circumstances. A change from Ethernet to FTTX would occur if there were a change in circumstances such as customers might change if an office location was reduced to a lower number of employees / if floor space taken at a location was reduced".[66]

A8.51 In addition, it considered that asymmetric broadband and leased lines should be seen more as complements rather than substitutes. Vodafone explained that it uses broadband (ADSL and FTTC) "as an access mechanism to connect small sites with a low assured bandwidth requirement cost effectively onto a wide area network" or as a "backup connection to Ethernet leased lines or broadband lines". While it uses Ethernet when "a customer site exceeds the smaller levels of demand to access the internet; needs equivalent download and upload speeds due to uploading, publishing or transfer large amounts of data and needs a rapid repair time due to the business critical status of the services being downloaded and uploaded".[67]

A8.52 Besides lower speeds, asymmetric broadband faces additional disadvantages against CI Access services, including higher latency, contention and a less reliable service. Telecoms providers can mitigate some of these disadvantages, for example, by over dimensioning

[63] Openreach response to Part 3 of the 15th BCMR s.135 notice dated 16 October 2016, see document entitled "Ethernet Migration Analysis Update", page 2.
[64] TalkTalk response to Question 1 of the 6th BCMR s.135 notice dated 20 April 2018.
[65] BT response dated 20 April 2018 to Question 1 of the 6th BCMR s.135 notice, PIR and Inflight Review, p. 4.
[66] Vodafone response dated 20 April 2018to Question 1 of the 6th BCMR s.135 notice.
[67] Vodafone response dated 20 April 2018 to the 6th BCMR s.135 notice.

the backhaul capacity to reduce contention or by applying traffic management methods to deliver lower error rates comparable to those of leased lines. However, quality differences are likely to remain due to the use of copper (rather than fibre) in the last mile.

A8.53 This is consistent with the results from the Cartesian 2018 study which suggests that businesses perceive "copper-based circuits (EFM or broadband) …to be less reliable" than fibre leased lines.[68]

A8.54 In addition, our meetings with telecoms providers indicate that limited FTTC coverage remains a barrier for further take-up of asymmetric broadband by businesses. Our Connected Nations 2017 report found that FTTC is available to 84% of small businesses, while only available to 74% small businesses in business parks and trading estates. [69] Verizon suggested an even lower average coverage rate of 49% for larger businesses.[70]

A8.55 We consider that this evidence in the round suggests that substitution from 100 Mbit/s to asymmetric broadband is unlikely to exceed [✂] in the event of a SSNIP. Therefore, our initial view is that asymmetric broadband and 100 Mbit/s services are not close demand substitutes.

### Substitution to dark fibre

A8.56 Dark fibre is another option leased line customers have to satisfy their connectivity needs. The only difference is that, with dark fibre, customers need to install the equipment and manage the network themselves. This is likely to limit the demand for dark fibre as few customers are likely to have the willingness and skills to do this. This should not be a problem though for wholesale customers who are used to managing networks.

A8.57 Pricing data from telecom providers suggests that dark fibre prices are high relative to 100 Mbit/s prices. We analysed the pricing of CityFibre's existing dark fibre contracts and estimate that the total cost of ownership (TCO) of these contracts ranges from [✂][71] on an annualised basis, with a median TCO of [✂]. This excludes the costs of installing and managing the electronics. Once these costs are included, the cost of dark fibre rises to £[✂] for the median contract. This compares against a TCO of £2,630 for a 1 Gbit/s EAD LA service.

A8.58 There are also non-price factors that are likely to limit the extent to which CI Access customers may see dark fibre as a close substitute. These are:

- the need for customers to light the fibre and manage the network themselves;

[68] Cartesian, 2018, *Business Connectivity Market Assessment.* https://www.ofcom.org.uk/__data/assets/pdf_file/0009/113112/cartesian-business-connectivity-market-assessment.pdf.
[69] Ofcom, 2017, *Connected Nations 2017 Report.* https://www.ofcom.org.uk/__data/assets/pdf_file/0024/108843/summary-report-connected-nations-2017.pdf.
[70] Verizon email sent by Matthew Peake on 14 May 2018.
[71] Annualised 3-year TCO calculation based on CityFibre's 2017 dark fibre connections. The TCO includes rental and connection charges. Connection charges were spread over a three-year contract term and discounted based on a 9% WACC.

- the limited footprint of dark fibre networks, which means that duct works are likely to be needed to connect a new customer; and
- the time to connect a customer site when duct works are required and the inconvenience of this for customers. The evidence suggests that it may take around nine months (178 working days) for duct works to be completed and this could be a source of significant disruption for customers (see paragraph A11.12 in Annex 11).

A8.59 This is consistent with the BDRC 2016 study which suggests that few low bandwidth customers see dark fibre as an alternative service, with only 3% of respondents using connections of 100 Mbit/s or less saying that they would consider dark fibre.[72] This is also in line with the dark fibre research we conducted as part of the BCMR 2016 indicating that dark fibre circuits are not used for bandwidths below 1 Gbit/s.[73]

A8.60 Therefore, the evidence appears to suggest that few 100 Mbit/s customers (less than 10%) would switch to dark fibre in the event of a SSNIP, making it highly unlikely that substitution to dark fibre would defeat a SSNIP at 100 Mbit/s. We are thus of the initial view that dark fibre and 100 Mbit/s CI Access services are not close demand substitutes.

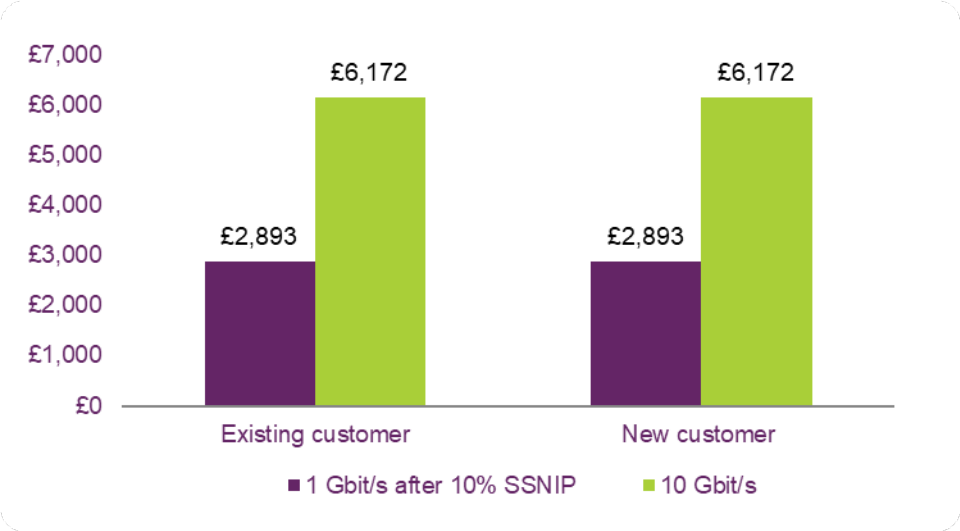
## SSNIP at 1 Gbit/s

### Substitution to 10 Gbit/s

A8.61 Figure A8.6 shows the price comparison between the price of 1 Gbit/s (after a 10% SSNIP) and the price of 10 Gbit/s for the two scenarios. We note that given that migration from 1 Gbit/s to 10 Gbit/s requires replacing equipment, price differentials look identical for the two scenarios.

[72] BDRC 2016, Figure 34a and 34b
[73] BCMR 2016, Figure 4.5.

**Figure A8.6: Price comparison between 1 Gbit/s (after 10% SSNIP) and 10 Gbit/s - annualised total cost of ownership (£)[74]**




*Source: Ofcom analysis based on Openreach prices for EAD LA as of April 2018.*

A8.62 The figure shows that a 1 Gbit/s customer would find it considerably cheaper to stay at 1 Gbit/s than to upgrade to 10 Gbit/s. This is similar for a new customer.

A8.63 We consider that the price differentials are such that is unlikely that a significant number of 1 Gbit/s customers (more than 12%) would switch to 10 Gbit/s in response to a SSNIP.

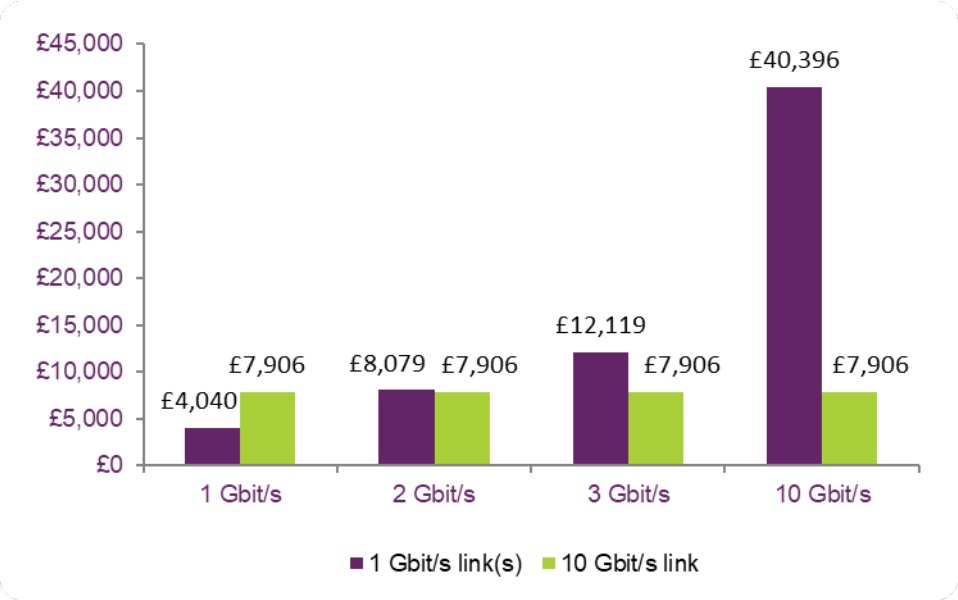
A8.64 In the 2016 BCMR we identified customers with multiple 1 Gbit/s circuits as the most likely to switch to 10 Gbit/s in response to a SSNIP at 1 Gbit/s.[75] This was because the decision to migrate for these customers was finely balanced as they were already indifferent between purchasing two 1 Gbit/s circuits (in the same route) or a single 10 Gbit/s circuit, i.e. the price of 10 Gbit/s was found to be almost equivalent to two times the price of 1 Gbit/s.

A8.65 This situation has now changed after Openreach's recent price cut of around 40% on EAD 10 Gbit/s charges, bringing the relative price of 10 Gbit/s down to less than twice the price of 1 Gbit/s. This is shown in Figure A8.7 below. Consequently, we now expect 1 Gbit/s customers using multiple 1 Gbit/s circuits (in the same route) to migrate to 10 Gbit/s irrespective of a SSNIP.

A8.66 The above evidence therefore suggests that demand-side substitution to 10 Gbit/s is unlikely to defeat a SSNIP at 1 Gbit/s, hence pointing at 1 Gbit/s and 10 Gbit/s not being close demand substitutes.

[74] Prices are stated on a Total Cost of Ownership (TCO) basis and include rental and connection charges. Connection charges are spread over a three-year period by calculating the annuity which, when considered over the three-year period, is equivalent to the upfront connection charge on an NPV basis. To calculate this annuity, we assume a 9% discount rate or Weighted Average Cost of Capital (WACC).
[75] BCMR 2016, paragraph 4.152.

**Figure A8.7: Price comparison between 1 Gbit/s and 10 Gbit/s by bandwidth demand – annualised total cost of ownership (£)**




*Source: Ofcom analysis based on Openreach prices for EAD LA as of April 2018.*

### Substitution to 100 Mbit/s

A8.67 For the same reasons that 100 Mbit/s customers are unlikely to switch back to 10 Mbit/s in the event of a SSNIP, 1 Gbit/s customers are unlikely to trade down to 100 Mbit/s in response to a 10% price increase, or at least not in sufficient numbers to render a SSNIP unprofitable. Again, this suggests there is an asymmetric substitution relationship between 100 Mbit/s and 1 Gbit/s.

### Substitution to asymmetric broadband and EFM

A8.68 We have established that substitution to asymmetric broadband and EFM is unlikely to sufficiently constrain the price of 100 Mbit/s to be considered in the same product market. We consider that substitution from 1 Gbit/s to asymmetric broadband and EFM is even less likely given the larger bandwidth differential involved. Therefore, we would not expect substitution to asymmetric broadband and EFM to defeat a SSNIP at 1 Gbit/s. Consequently, our initial view is that EFM and asymmetric broadband are not closed demand substitutes of 1 Gbit/s services.

### Substitution to dark fibre

A8.69 We consider that dark fibre is likely to be more attractive for 1 Gbit/s customers than for 100 Mbit/s customers. Pricing of dark fibre looks more competitive when compared to 1 Gbit/s charges, although 1 Gbit/s charges are still lower than the dark fibre price for the median contract, £2,630 compared to [✂] on a total cost of ownership basis.

A8.70 In addition, the dark fibre research we conducted as part of the 2016 BCMR uncovered that a non-negligible proportion of dark fibre customers (more than 20%) use dark fibre for

1 Gbit/s circuits.[76] The question is however whether a sufficient number of 1 Gbit/s customers [✂] would switch to dark fibre in the event of a SSNIP.

A8.71 The evidence suggests that this is unlikely for the following reasons:

- non-price factors including the time required to dig to a new customer site and the need for customers to light and manage the dark fibre circuit is likely to deter 1 Gbit/s customers from switching; and
- a small proportion of leased line customers of 1 Gbit/s or below (8%) say they consider dark fibre as an alternative service.[77]

A8.72 However, we recognise that CityFibre has been successful in offering dark fibre services to typical 1 Gbit/s customers and that the low dark fibre volumes could be a reflection of the limited availability of dark fibre as a result of the two main network providers (Openreach and Virgin Media) not supplying the service. Nevertheless, the evidence is ambiguous and customers may need time to adapt before they are able to switch from CI Access services to dark fibre in response to a small price increase.

A8.73 Based on this evidence we consider that substitution to dark fibre is unlikely to be enough [✂]% to render a SSNIP at 1 Gbit/s unprofitable, suggesting these services are not close demand substitutes.

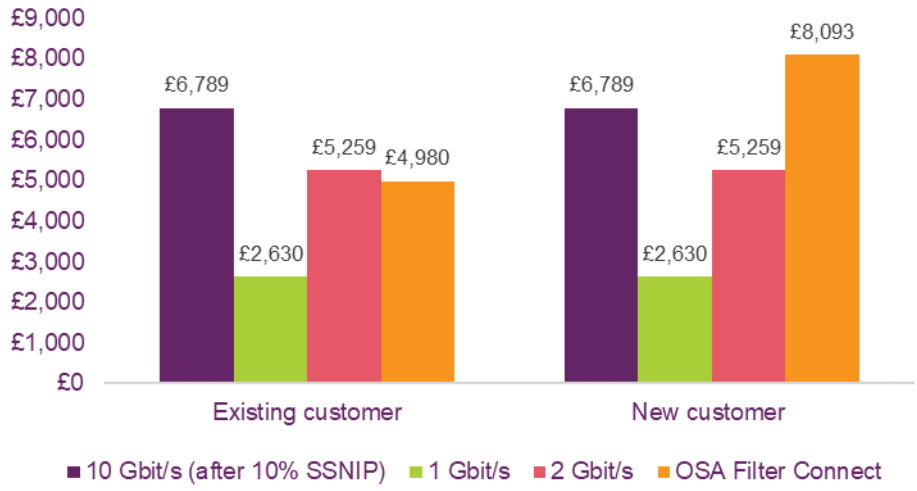
## SSNIP at 10 Gbit/s

### Substitution to 1 Gbit/s

A8.74 Figure A8.8 shows the price comparison between the price of 10 Gbit/s (after a 10% SSNIP) and the price of 1 Gbit/s and multiple 1 Gbit/s for the two scenarios.

[76] BCMR 2016, Figure 4.5.
[77] BDRC 2016, Figure 34a and 34b.

**Figure A8.8: Price comparison between 10 Gbit/s (after 10% SSNIP), 1 Gbit/s, multiple 1 Gbit/s and wavelength division multiplex – annualised total cost of ownership (£)[78]**




*Source: Ofcom analysis based on Openreach prices for EAD LA as of April 2018 and proposed prices for the OSA Filter Connect product (single fibre variant) as of March 2018.*[79]

A8.75 It shows that 10 Gbit/s customers with a bandwidth demand of less than 2 Gbit/s would find it cheaper to switch to 1 Gbit/s or multiple 1 Gbit/s. Nevertheless, we focus our analysis on 10 Gbit/s customers requiring between 1 and 2 Gbit/s (which we refer to as 2G customers)[80] as we do not expect customers requiring 1 Gbit/s or less to take 10 Gbit/s (for these customers, 1 Gbit/s would be a cheaper option even before the SSNIP). For 2G customers switching to multiple 1 Gbit/s would represent an annual cost saving of £1,530 (or a 23% discount over the 10 Gbit/s price).

A8.76 We consider that this cost saving is unlikely to be sufficient to encourage enough 2G customers to switch from 10 Gbit/s to 1 Gbit/s in response to a SSNIP. First, these customers are likely to place some value to having additional bandwidth (i.e. by switching to multiple 1 Gbit/s, 2G customers would lose 80% of their current bandwidth). Second, bandwidth demand is growing rapidly so 2G customers are unlikely to switch to 1 Gbit/s only to switch back to 10 Gbit/s later (when their bandwidth need exceeds 2 Gbit/s) and pay the associated 10 Gbit/s connection charges again.

A8.77 Our initial view is therefore that substitution to 1 Gbit/s is likely to be insufficient to render a SSNIP at 10 Gbit/s unprofitable. Together with our substitution analysis from 1 Gbit/s to 10 Gbit/s, this analysis suggests that demand-side substitution between 1 Gbit/s and 10 Gbit/s is likely to be weak in both directions.

[78] Prices are stated on a Total Cost of Ownership (TCO) basis and include rental and connection charges. Connection charges are spread over a three-year period by calculating the annuity which, when considered over the three-year period, is equivalent to the upfront connection charge on an NPV basis. To calculate this annuity, we assume a 9% discount rate or Weighted Average Cost of Capital (WACC).

[79] https://www.openreach.co.uk/orpg/home/updates/briefings/ethernetservicesbriefings/ethernetservicesbriefingsarticles/eth01218.do [accessed 30 October 2018].

[80] This is consistent with the way the Tribunal referred to multi-circuit customers.

### Substitution to dark fibre

A8.78 We consider that dark fibre is most appealing to 10 Gbit/s customers for a number of reasons:

- dark fibre prices look attractive when compared to current 10 Gbit/s prices, [✂] compared to £5,130 on a total cost of ownership basis;
- evidence from Openreach internal documents suggest that Openreach's 10 Gbit/s prices compete against dark fibre;[81] and
- previous dark fibre research suggests that most dark fibre circuits (70 to 80%) are used for VHB.[82]

A8.79 This evidence is consistent with consumer research indicating that 20% of VHB customers consider dark fibre as an alternative service, compared to 8% for lower bandwidth customers.

A8.80 However, non-price factors will limit the extent to which 10 Gbit/s customers would switch to dark fibre in response to a SSNIP. Similar to our analysis of substitution from 100 Mbit/s and 1 Gbit/s to dark fibre, 10 Gbit/s customers are likely to be reluctant to install the equipment and manage the network themselves as well as to wait for the dark fibre supplier to extend its network to connect their buildings.

A8.81 The evidence is thus ambiguous on whether a sufficient number of 10 Gbit/s customers (more than [✂]%) would switch to dark fibre in the event of a SSNIP to render the price increase unprofitable.

## Provisional conclusions on demand-side substitution

A8.82 Our SSNIP analysis above suggests that there is an asymmetric relationship in the substitution across leased lines of different bandwidths, up to 1 Gbit/s. In these instances, we find that higher bandwidth CI Access services are a close substitute to the next lower bandwidth service, but not the other way around. We also find that EFM, asymmetric broadband and dark fibre are not strong demand substitutes for these services as to defeat a potential SSNIP on either 100 Mbit/s or 1 Gbit/s.

A8.83 Our analysis shows that there is a possible break between 1 Gbit/s and VHB services as price differentials between these services remain high, though these differentials may be distorted by BT's high VHB prices.

A8.84 Dark fibre appears to place a stronger constraint on VHB than on lower bandwidths, but we consider the evidence to be inconclusive as to whether substitution to dark fibre would be enough to defeat a SSNIP on VHB.

A8.85 Our demand-side substitution analysis above does not capture the fact that network operators are able to supply the full range of bandwidths, and hence that the candidate

[81] Openreach, 2018. *New pricing and product launches for VHB portfolio*. Submitted by Openreach in response to Question 4 of the 8th BCMR s.135 notice dated 20 April 2018, page 2.
[82] BCMR 2016, Figure 4.5.

substitute may be supplied by the incumbent supplier. We take this into account in our analysis of supply-side substitution in Section 4 of Volume 1, where we consider that telecoms providers can seamlessly switch to different bandwidths once they connect the customer site. This leads to our provisional decision that there is a single market for CI Access services at all bandwidths.

A8.86 We note that our demand-side analysis is based on EAD LA charges as of April 2018. We acknowledge that Openreach has recently announced price reductions which will apply from 1 October 2018 (mainly on 1 Gbit/s rental charges). Although we have not considered these price reductions in our analysis, our view is that they do not impact our provisional conclusions on demand-side substitution, but rather reinforces them, making substitution from 100 Mbit/s to 1 Gbit/s even more likely.

# A9. Mobile backhaul market definition

A9.1 Mobile network operators are significant buyers of leased lines. We estimate that they currently use over [✂] leased line circuits and require leased line coverage across a wide geographic area. They use leased lines to connect from a base station to a point of aggregation in the mobile operator's network. We refer to these services as mobile backhaul.

A9.2 In this annex, we examine if there are significant differences in competitive conditions in the supply of mobile backhaul overall compared to other services in the Contemporary Interface (CI) Access market, particularly leased lines used by enterprise customers. If there were significant differences in the conditions of competition, there may be a case to justify a separate market.

A9.3 We find that although there are some differences between purchasers of mobile backhaul and enterprise customers, in both cases competition is determined by the proximity of rival networks to the customer site. Competitive conditions at a particular location are largely the same whether the end customer is a mobile operator or an enterprise customer. We therefore propose to include mobile backhaul within the CI Access market rather than define a separate market for this customer group. We also note that even if were to define a separate market for this customer group the resultant SMP assessment would be similar to that for enterprise customers.

## Background

A9.4 In the 2016 BCMR, we included mobile backhaul services within the relevant Contemporary Interface Symmetric Broadband Origination (CISBO) market.

A9.5 Since the last review, fourth generation mobile technology (4G) network has been rolled out and data usage has rapidly increased, increasing by over 40% in 2017.[83] As this trend continues, demand for higher bandwidth leased lines to backhaul mobile traffic is expected to grow, particularly as mobile network operators roll-out 5G at existing and new sites. For example, Three told us [✂].[84]

A9.6 Mobile network operators have historically been significant buyers of traditional interface circuits. However, some of the mobile network operators no longer have any traditional interface circuits remaining, while others confirmed that they would migrate to Ethernet services by the end of the review period. This annex therefore considers CI circuits only.

## Demand and supply-side substitution

A9.7 We begin our analysis by considering demand and supply-side substitution with respect to mobile backhaul.

[83] Ofcom, 2017, Connected Nations.
[84] Three response to the 5th BCMR s.135 notice, Question B2, dated 26 February 2018.

A9.8 Mobile operators use and are supplied the same types of CI circuits as other access customers. Therefore, in terms of demand-side substitution and supply-side substitution our assessment is the same as that set out in Section 4 of Volume 1 and Annex 8.

A9.9 We briefly consider below whether mobile network operators (MNOs) have a demand-side alternative in microwave links that are not as widely available to enterprise customers. However, we conclude that microwave links are not a substitute for leased lines such that they should be included in the relevant market definition.

## Microwave links

A9.10 Each mobile base station is connected to a mobile network node either by a leased line connection or by microwave radio.

A9.11 The table below shows that microwave backhaul is widely used by MNOs.

**Table A9.1: Microwave circuits as a proportion of all mobile backhaul circuits[85]**

| | MBNL, EE, Three[86] | Telefonica | Vodafone |
|---|---|---|---|
| Total backhaul circuits | [✂] | [✂] | [✂] |
| % Microwave | [✂]% | [✂]% | [✂]% |

*Source: Ofcom analysis based on the 5th BCMR s.135 notice to MNOs.*

A9.12 Microwave backhaul is available at much lower cost than fibre backhaul. To be a competitive constraint to fibre backhaul, there must be a sufficient number of sites at which if a hypothetical monopolist were to raise the price of fibre backhaul by a small amount, mobile operators would substitute fibre for microwave links such that a Small but Significant Non-transitory Increase in Price (SSNIP) would be unprofitable.

A9.13 We do not consider that microwave could act as a substitute for leased line mobile backhaul services, thus a SSNIP on a CI leased line is likely to be defeated. Microwaves are a poor substitute for Ethernet leased lines because of their:

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

A9.14 The growth in mobile data usage and corresponding increase in bandwidth requirements will make microwave a less viable substitute compared to CI leased lines, as microwave is more limited in its ability to support higher capacities.

A9.15 Microwave is also lower priced than fibre which means it would be used where it is viable, but it is only viable for a limited proportion of sites.

[85] The total number of circuits include all microwave, fibre and copper circuits. [✂].
[86] MBNL (Mobile Broadband Network Limited) is a joint venture company owned by H3G (Three) and EE.

A9.16 We therefore consider microwave links do not constrain leased line based backhaul, with the result that these services are not in the same market.

## Competitive conditions

A9.17 In Section 5 of Volume 1, we explained that each customer faces conditions of competition that are potentially unique to their location, and which depend primarily on the proximity of rival infrastructure, such that each location may constitute a separate geographic market. However, it was not practical to assess whether an operator has significant market power (SMP) for each customer site individually.

A9.18 In this annex we consider the similarities and differences in competitive conditions between mobile backhaul and enterprise CI Access, to determine whether these access links are part of the same relevant market. The key factors we consider are:

- how competitive conditions at an individual mobile base station differs from those at an enterprise site;
- how the volume and geographic spread of mobile backhaul links could mean it is more or less competitive than enterprise; and
- whether mobile network operators can purchase from multiple suppliers.

A9.19 In our conclusion we explain why consideration of these factors leads us to conclude that there is not a separate market for mobile backhaul.

### Competitive advantage from proximity

A9.20 BT's advantage in providing circuits to mobile operators at an individual location is the same advantage as that we have set out in Sections 4 and 6 in relation to other enterprise customers.

A9.21 We have explained that:

- BT has an extensive network across the UK, but rival networks are much more limited in coverage;
- the ability of a firm to supply a particular customer depends on the proximity of its network to that customer. A supplier with a network that is closer to the customer has a significant cost advantage over one that is further away. BT more commonly has an existing duct connection to a customer site whereas rivals typically need to extend their network to reach a site. The competitive advantage from having an existing duct (or fibre) connection compared to a rival who needs to dig is significant even at short distances. Where it does not have a duct connection BT needs to dig shorter distances; given the cost of digging per metre this can be a significant advantage. Telefónica O2 told us [✂][87]; and
- BT has an advantage compared to rivals as it is able to supply faster due to its greater proximity and customers face greater inconvenience choosing a telecoms provider

[87] Telefónica meeting with Ofcom, 15 March 2018

located further away; for example, due to greater uncertainty over the time taken to extend the network.

A9.22 The factors summarised above all relate to the advantage a telecoms provider has in providing a customer at a particular location. We consider that these factors are the same regardless of whether the customer is an enterprise customer or a MNO.

## Volume and geographic spread of leased line circuits purchased

A9.23 Mobile operators buy the same circuits as enterprise customers but need to purchase a large number across a very wide geographic footprint to provide national coverage.

A9.24 Vodafone said "Mobile backhaul is akin to Enterprise access in that sites are connected with an EAD circuit to either the BT exchange or a CP PoP [Point of Presence, a telecom provider's network node]. However mobile backhaul is far more challenging to provide compared to the average enterprise access customers due to the requirement to connect a very high volume of sites with high bandwidth across every geography in the UK. We find that a mobile operator is a super normal enterprise."[88]

A9.25 Vodafone noted that the Experian data of enterprise customers suggested even the largest customers (for example Tesco and Boots) have far fewer sites than mobile network operators. These enterprises may have between 2000 and 3000 sites nationally[89], compared to Vodafone and Telefónica combined which have over [✂] sites to provide national coverage.[90]

A9.26 The large volume requirement may give mobile network operators the ability to negotiate bespoke deals. Virgin Media and BT have both said they have separate teams to manage relationships with mobile operators, and other purchasers of backhaul.

A9.27 Mobile backhaul requirements could also be an important source of demand to enable other telecoms providers building leased line infrastructure to gain entry or scale. Openreach noted that MNOs "[✂]".[91] CityFibre have also said "MNOs are one of only two predominant anchor tenant options[92] for competitive [telecoms providers] entering new towns and cities. An anchor tenant must have sufficiently large requirement for business connectivity circuits within that town or city, from which additional connections can then be provided to other customers." [93] Therefore, it is possible there is more competition for mobile backhaul leased lines. However, as explained above, BT (as both the incumbent supplier and owner of a ubiquitous network) will have a significant advantage in being able

[88] Vodafone submission to Ofcom, "Mobile Backhaul", follow on material from 5 March 2018 meeting
[89] Vodafone submission to Ofcom, "Mobile Backhaul", follow on material from 5 March 2018 meeting
[90] Cornerstone Telecommunications Infrastructure Limited (CITL) is a joint venture between Vodafone and Telefónica to manage the network sites for both companies. [✂]
[91] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017
[92] The other option being the local authority
[93] CityFibre submission to Ofcom, 31 May 2018

to supply all or most of the necessary sites at a much lower cost and quicker timeframe than a rival telecoms provider which needs to build to the sites.

A9.28 The MNOs typically purchase backhaul from BT Wholesale[94] in the form of an integrated managed service: Managed Ethernet Access Service (MEAS). To supply MEAS BT Wholesale uses inputs from Openreach, primarily EAD leased lines, as well as its own core network.[95]

A9.29 In principle, another telecoms provider could use underlying Openreach services to provide a rival managed service, though BT Wholesale has a competitive advantage from economies of scale associated with its wide network. BT Wholesale is connected to more local exchanges nationally compared to other telecoms providers, enabling it to aggregate mobile backhaul traffic and provide connectivity on a nationwide basis. Also, as a supplier of other managed services, such as fixed wholesale broadband access, BT may be in a better position than its rivals to exploit the economies of scale and scope in providing managed services to MNOs. It would do this by aggregating mobile backhaul traffic with other traffic. This is because the lowest unit costs are obtained by buying the highest capacity circuit and then filling it. As one circuit can be used to backhaul the traffic of multiple services and/or of multiple customers, the greater the number of services using a backhaul circuit, the lower the unit cost of that circuit is.

A9.30 We note that there is evidence that some MNOs are shifting away from the use of MEAS, though they will still use Openreach services. For example:

- [✂];[96] and
- [✂].[97]

## Ability to purchase from multiple suppliers

A9.31 As shown in Tables A9.2 and A9.3, BT currently has a very high share of Ethernet circuits sold to MNOs. BT's share of supply to MNOs is very high across all geographies in the UK.[98] BT's share of supply to MNOs is also highest in BT Only areas, in common with the CI Access Market as a whole.

A9.32 There are only a few mobile operators and they tender infrequently for circuits. This could result in swings in BT's share of supply.

[94] BT Wholesale is now part of BT's Enterprise division which was formed in May 2018.
[95] MEAS is provided by BT Wholesale, downstream of Openreach, thus downstream of the CI Access Market.
[96] [✂] meeting with Ofcom, [✂] 2018
[97] [✂] response to the 5th BCMR s.135 notice, Question B2, dated [✂] 2018.
[98] The methodology to calculate the market share in the contemporary interface access market and BT's share of supply to mobile operators differs. BT's share of supply to mobile operators is based on the inventory of all mobile backhaul circuits, market shares in the contemporary interface access market are based on 2017 connections.

**Table A9.2 Telecoms providers' share of supply to mobile network operators**

| | MBNL, EE,Three | Telefonica | Vodafone | Total |
|---|---|---|---|---|
| BT[99] | [✂]% | [✂]% | [✂]% | [✂]% |
| Virgin Media | [✂]% | [✂]% | [✂]% | [✂]% |
| Other | [✂]% | [✂]% | [✂]% | [✂]% |

*Source: Ofcom analysis based on the 5th BCMR s.135 notice to MNOs.*

**Table A9.3: BT's share of supply to mobile network by geographic market**

| | BT share of supply[100] to MNOs | BT's market share in CI Access |
|---|---|---|
| BT Only | [✂]% | [✂]% |
| BT+1 | [✂]% | [✂]% |
| HNR Rest of UK | [✂]% | [✂]% |
| Metros combined[101] | [✂]% | [✂]% |
| CLA | [✂]% | [✂]% |

*Source: Ofcom analysis based on the 5th BCMR s.135 notice to MNOs.*

A9.33 Mobile operators have historically been subject to some minimum volume commitments in their contracts with BT. The length of contracts and the volume commitments may imply that switching providers for MNOs is more difficult than enterprise customers. [✂].

A9.34 Telefónica, Three and Vodafone have told us they prefer to buy services from few suppliers because there are costs associated with managing supply chains. Costs include developing systems to handle each supplier's processes. One operator said that the cost savings other providers can offer would be quickly dwarfed by the management costs.

A9.35 Our analysis shows that all mobile network operators use at least BT and Virgin Media. Other suppliers used include [✂], among others. We also note that BT's share of supply [✂]% is lower than its share of [✂]% in 2014 suggesting that mobile network providers are increasingly purchasing from telecoms providers other than BT.

[99] Openreach and BT Wholesale combined service share.
[100] Openreach and BT Wholesale combined service share.
[101] Sample too small to present the Metro Areas individually

## Conclusion

A9.36 We propose to include mobile backhaul within the CI Access market rather than define a separate market for this customer group.

A9.37 MNOs purchase large volumes of leased lines and require connectivity across the UK. Mobile operators' large volume requirements may give them the ability to negotiate bespoke deals and their importance in sponsoring entry may mean there is more competition for their contracts. However, the volumes mobile operators require may also limit their choice of supplier and as a result of the size of BT's network and the economies of scale it can achieve, it may have an advantage in winning mobile backhaul contracts.

A9.38 If MNOs needed a single supplier this could mean national competition and therefore a separate product market. However, although they have said they prefer to source from a single supplier, they can and do use multiple telecoms providers for their mobile backhaul needs where others have infrastructure presence and are able to offer leased line services.

A9.39 As with enterprise customers, one of the most important factors in determining competitive advantage is proximity. The competitive advantage from having an existing connection compared to a rival who needs to dig is significant. The competitive advantage from having a closer network to the customer will give the provider a cost advantage as it will require a shorter dig. Therefore, at an individual site, either an enterprise site or mobile radio base station, the competitive conditions are similar regardless of the customer.

A9.40 We find that although there are some differences between purchasers of mobile backhaul and enterprise customers, ultimately in both cases competition is determined by the proximity of rival networks to the customer site. We consider competitive conditions as between MNOs and enterprise customers to be sufficiently homogenous. We propose not to define a separate market for this customer group, and to include mobile backhaul within the CI Access market. We also note that even if were to define a separate market for this customer group the resultant SMP assessment would be similar to enterprise customers.

A9.41 We have also proposed that microwave backhaul is not a substitute for CI leased lines and therefore is not part of the CI Access market because it is highly unlikely that a MNO would switch from fibre to microwave in response to a SSNIP.

# A10. Economic dig distance and cost analysis

A10.1 This Annex sets out the structure, assumptions, and results of the Excel model we have produced to analyse the economic dig distance (Annex 16). This model is one of several criteria we use to understand the competitive conditions in different geographic areas, with data on actual dig distances (Annex 11) also informing this work.

## Background

A10.2 Leased lines are services provided using physical network infrastructure. When a telecoms provider wants to supply a leased line to a new customer, it needs to connect that customer's sites to its network infrastructure. Some of the customer's sites might be located outside of the telecoms provider's network coverage area and the supplier might therefore need to extend the reach of its network using civil engineering works.

A10.3 Civil engineering costs associated with extending physical network infrastructure are largely sunk, common to most fixed telecommunications services, and represent a significant proportion of the total cost of provisioning a new customer as explained in more detail in Section 3 of Volume 1.

A10.4 When deciding whether to extend its network to reach a new customer, a telecoms provider will compare these costs to the revenues it expects to earn and to the costs of any available alternative means of supplying the customer without incurring the costs of digging. The most likely alternative is purchase of a regulated service from Openreach. Telecoms providers are often faced with a decision to either build their own network or buy wholesale services from Openreach on regulated terms (or sometimes on commercial terms from other networks). We have undertaken a cost modelling exercise to estimate the typical breakeven dig distance for telecoms providers.

A10.5 The typical cost of digging and laying fibre varies depending on location, which reflects a range of cost variables such as the material being dug, surface type (e.g. block paving has higher reinstatement costs), wayleave costs, construction permits (including lane closures, parking bay suspensions, etc.), restrictions on the time of works (higher labour rate for night work), traffic management, and contract (construction firms offer volume discounts).

A10.6 The following section sets out our approach to modelling dig costs and the economic dig distance for a range of scenarios and leased line services.

## Model structure and assumptions

A10.7 The economic dig distance model uses a bottom up approach to estimate the maximum average route distance from a telecoms provider's nearest network flexibility point to an end-customer's premises that it would be economic for the telecom provider to serve, such that it would break even (on a net present value basis) over the average life of a leased line service contract.

A10.8 The model calculates the economic dig distance for three leased line services: 100 Mbit/s, 1 Gbit/s and 10 Gbit/s. We have not modelled 10 Mbit/s as the revenues and costs of this service are almost identical to those of 100 Mbit/s.

A10.9 In conducting this analysis, we have focused on a build/buy comparison, i.e. a comparison of build costs with Openreach's wholesale charges for leased lines. Most telecoms providers (e.g. Vodafone, Virgin Media, and Colt) explained to us that when they supply a premises to which they did not have an existing connection, they would only extend their network if they could do so at a lower cost than they would incur by purchasing a wholesale leased line product from Openreach (or another provider).[102] This therefore reflects actual build decision-making by telecoms providers. It also reflects the distance at which they are able to compete effectively using their own network, rather than being reliant on Openreach, and thus provides an analysis of how close competitors need to be located to a customer premises in order to be an effective competitor.

## Revenue assumptions

A10.10 To model the revenues of each leased line service, we use the wholesale charges for the equivalent Openreach Ethernet Access Direct Local Access (EAD LA) leased line services, as summarised in Table A10.1 below.

A10.11 As explained in Section 4 of Volume 1, EAD LA products are the most popular for the various bandwidths considered, except for 10 Gbit/s (though this is on the back of a low volume base). Using EAD LA charges also has the advantage that these charges exclude inter-exchange costs, allowing the analysis to focus on the access elements of the network.

**Table A10.1: Modelled leased line services and key revenue assumptions**[103]

| Service | Connection (one-off) | Rental (annual) |
|---|---|---|
| EAD LA 100 Mbit/s | £1,875 | £1,374 |
| EAD LA 1 Gbit/s | £1,875 | £1,950 |
| EAD LA 10 Gbit/s | £5,590 | £4,146 |

*Source: Openreach price list as of April 2018.*

## Network assumptions

A10.12 For each leased line service, we modelled four network scenarios, each reflecting a different assumed level of pre-existing, dedicated physical network connectivity between

[102] We note that some telecoms providers (CityFibre and Zayo) instead base their build decisions on the retail value of the contract. However, these are a minority.

[103] We note that this annex is based on EAD LA charges as of April 2018. We acknowledge that Openreach has recently announced price reductions which will apply from 1 October 2018 (mainly on 1 Gbit/s rental charges). In terms of the results of our bottom up cost model, this rental reduction will shorten the economically viable dig distance for 1Gbit/s services.

the closest network flexibility point and the end-customer premises. Table A10.2 below characterises these scenarios.

**Table A10.2: Network scenarios modelled**

| | Fibre connected | Duct connected with tubing | Duct connected without tubing | Network extension (new duct required) |
|---|---|---|---|---|
| Existing telecoms provider Infrastructure | Trench, duct, footway boxes, tubing, fibre cable | Trench, duct, footway boxes, tubing | Trench, duct, footway boxes | None |
| Incremental telecoms provider Infrastructure Required | None | Fibre cable | Tubing, fibre cable | Trench, duct, footway boxes, tubing, fibre cable |

*Source: Ofcom analysis.*

A10.13 We have assumed the following incremental network elements:

- a survey by the telecoms provider of the actual or proposed route when duct connected, or new duct required;
- blown fibre cable when duct connected, or new duct required;
- blown fibre tubing when duct connected but no tubing in place or new duct required;
- clearance of duct blockages when new duct required;
- trenching and ducting when new duct required, assuming a mix of 90% of the new duct route built under the footway and 10% under the carriageway;
- new footway boxes every 100m when new duct is required, with a final footway box installed outside the end-customer's premises; and
- active equipment at both ends of the leased line across all scenarios.

## Model assumptions

### Passive and active costs assumptions

A10.14 In order to derive an estimated total cost per metre for each scenario, we split the costs into passive infrastructure costs, which are typically distance-dependent, and costs associated with active equipment, which are not dependent on distance (with the exception of the lasers).

A10.15 Our assumptions for both passive and active costs for each network scenario are presented in Table A10.3 below.

A10.16 Our passive costs are informed by Openreach's Excess Construction Charges (ECC)[104] and Physical Infrastructure charges, which reflect Openreach's network extension costs. These are Openreach charges to wholesale customers for network extensions.

A10.17 Our active costs are based on Openreach's annual depreciation of the unit fully allocated cost (FAC) for the Ethernet Electronics Capital cost (i.e. cost component CO487). This cost covers the cost of the equipment and its installation and excludes other operation costs e.g. maintenance costs.[105]

**Table A10.3: Costs assumptions**

| Category | Unit | £ excluding VAT | Source |
|---|---|---|---|
| Survey | £ per survey | 244.53 | Openreach's Excess Construction Charges |
| Blown fibre tubing | £ per metre | 3.83 | Openreach's Excess Construction Charges |
| Blown fibre | £ per metre | 1.74 | Openreach's Excess Construction Charges |
| Duct under a footway | £ per metre | 63.25 | Openreach's Excess Construction Charges |
| Duct under carriageway | £ per metre | 116.07 | Openreach's Excess Construction Charges |
| Footway box[106] | £ per box | 855.23 | Openreach's Excess Construction Charges |
| Break through customer site walls | £ per break | 220.83 | Openreach's Excess Construction Charges |
| Blockage clearance | £ per blockage | 536.52 | Openreach's Physical Infrastructure charges for Ancillary Activities |
| 100 Mbit/s Ethernet Electronics equipment and installation | Annual depreciation per circuit (£) | 306.00 | BT's 2017/18 RFS |

[104] Openreach's Excess Construction Charges cover the additional costs of either providing additional service or dealing with situations where the cost of providing service is more than the Openreach price list. See: https://www.openreach.co.uk/orpg/home/products/serviceproducts/excessconstructioncharges/excessconstructioncharges.do [accessed 30 October 2018].

[105] By excluding other operation costs the distances resulting from the model are likely to be to some extent overstated across all scenarios and products.

[106] We use the cost of a small footway box (£855.23) rather than a medium (£1,487.14) or large one (£2,656.91) to have a conservative estimate of the costs. This is also the reason why we have not included the cost of a new carriageway box.

| Category | Unit | £ excluding VAT | Source |
|---|---|---|---|
| 1 Gbit/s Ethernet Electronics equipment and installation | Annual depreciation per circuit (£) | 285.00 | BT's 2017/18 RFS |
| 10 Gbit/s Ethernet Electronics equipment and installation | Annual depreciation per circuit (£) | [✂] 795 to 1,193[107] | BT's 2017/18 flat files |

*Source: Ofcom analysis.*

A10.18 Active costs are derived for each leased line service by multiplying the cost of Ethernet Electronics equipment and their installation by the asset life used in BT regulatory accounts, which is around five years.

A10.19 Note that the passive and active costs we have considered in our analysis do not include a return on capital employed explicitly. This is because our discounted cash flow (DCF) analysis captures this return implicitly through the application of a discount rate i.e. Weighted Average Cost of Capital (WACC).

### Assessment period and economic dig distance calculation

A10.20 We have modelled the revenues and costs over a three-year period i.e. the payback period. We consider three years to be a reasonable period for assessing the economic dig distance. In our meetings with telecoms providers, it was suggested that build or buy decisions are assessed by considering the costs over the duration of the contract and the evidence from the circuit inventory data submitted by telecoms providers indicates that this is typically three years i.e. the median contract length of a leased line customers is approximately three years. Nevertheless, we have produced results for longer pay-back periods as a sensitivity, including five years.

A10.21 To calculate the economic dig distance, we discount the annual revenues and annual costs over the pay-back period by applying a 9% discount rate.[108] The breakeven distance is such that the total discounted revenues equal the total discounted costs. We then estimate the economic *route* dig distance: the maximum distance from a telecoms provider's nearest network flexibility point to an end-customer's premises following the layout of streets and other infrastructure at which it would be economically viable for the provider to dig. We also estimate the economic *radial* dig distance: the straight line distance from a provider's nearest network flexibility point to an end-customer's premises at which it would be economically viable for the provider to dig.

[107] For the model results discussed below, we have taken the midpoint between these numbers.
[108] This is broadly consistent with the Other UK telecoms WACC assumed in the 2018 WLA Charge Control which would be applicable to leased lines. Annex 21 sets out our latest view of the appropriate WACC for leased lines.

## Model results

A10.22 This section sets out the outputs of our modelling for the scenarios for which additional infrastructure is required.

A10.23 Table A10.4 below suggests that the costs of serving a customer are significantly higher when a network extension is needed to connect the customer (e.g. £2,062 for a 10-metre distance) compared to when a duct connection already exists (e.g. between £262 and £309 for a 10-metre distance, depending on the availability of fibre tubing).

**Table A10.4: Passive costs by route distance (£)**

| Distance | Duct connected with tubing | Duct connected without tubing | Network extension (new duct required) |
|---|---|---|---|
| 10 metres | 262 | 309 | 2,062 |
| 20 metres | 279 | 374 | 2,803 |
| 30 metres | 297 | 439 | 3,544 |
| 40 metres | 314 | 504 | 4,285 |
| 50 metres | 332 | 569 | 5,026 |
| 60 metres | 349 | 633 | 5,767 |
| 70 metres | 366 | 698 | 6,508 |
| 80 metres | 384 | 763 | 7,249 |
| 90 metres | 401 | 828 | 7,990 |
| 100 metres | 419 | 893 | 9,586 |
| 200 metres | 593 | 1,541 | 17,851 |
| 500 metres | 1,115 | 3,486 | 42,648 |
| 1000 metres | 1,985 | 6,727 | 83,975 |
| 2000 metres | 3,725 | 13,209 | 166,629 |

*Source: Ofcom analysis.*

A10.24 Table A10.5 and Table A10.6 below present our economic dig distances. These are shown for our base case assumption of a three-year payback period, as well as for a five-year payback period as a sensitivity. As expected, they show that the economic dig distance is higher where the connection needs to be dug than where the customer site is already duct connected. It also shows that the economic dig distance increases with bandwidth.

**Table A10.5: Economic route dig distances (metres)**

| Service | Duct connected with tubing | Duct connected without tubing | Network extension (new duct required) |
|---|---|---|---|
| **Three-year payback** | | | |
| EAD LA 100 Mbit/s | 2,237 | 600 | 38 |
| EAD LA 1 Gbit/s | 3,211 | 862 | 61 |
| EAD LA 10 Gbit/s | 6,789 | 1,822 | 133 |
| **Five-year payback** | | | |
| EAD LA 100 Mbit/s | 3,406 | 914 | 65 |
| EAD LA 1 Gbit/s | 4,754 | 1,276 | 97 |
| EAD LA 10 Gbit/s | 8,242 | 2,212 | 167 |

*Source: Ofcom analysis*

A10.25 Given that our network reach analysis is based on the radial distance between telecoms providers' networks and customers' sites, we have converted the route distances (in Table A10.5 above) into radial distances (in Table A10.6 below). This conversion involves dividing each given route distance by 1.4. We have used similar conversion factors in previous work[109] based on applying Pythagoras' theorem.[110]

[109] For instance, footnote 29 of the 2017 WLA Consultation: https://www.ofcom.org.uk/__data/assets/pdf_file/0022/105682/Recovering-the-costs-of-investment-in-network-expansion.pdf mentions that "telephone lines tend to follow the layout of streets, rather than travel in straight radial lines from exchanges to street cabinets and onto customer premises, the derived radial distances are converted into route distances that follow the typical rectilinear pattern of streets by applying a conversion factor (typically in the range 1.2 – 1.4)."

[110] Pythagoras' theorem states that for a right-angled triangle, the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.

**Table A10.6: Economic radial dig distances (metres)**

| Service | Duct connected with tubing | Duct connected without tubing | Network extension (new duct required) |
|---|---|---|---|
| **Three-year payback** | | | |
| EAD LA 100 Mbit/s | 1,598 | 429 | 27 |
| EAD LA 1 Gbit/s | 2,294 | 616 | 43 |
| EAD LA 10 Gbit/s | 4,849 | 1,302 | 95 |
| **Five-year payback** | | | |
| EAD LA 100 Mbit/s | 2,433 | 653 | 47 |
| EAD LA 1 Gbit/s | 3,395 | 911 | 69 |
| EAD LA 10 Gbit/s | 5,887 | 1,580 | 120 |

*Source: Ofcom analysis.*

# A11. Network extensions and their impact on competition

A11.1 This annex sets out evidence on telecoms providers' network extensions. This is used to inform the product market definition and significant market power (SMP) assessments set out in Sections 4, 5, and 6.[111]

A11.2 We present three types of evidence:

- **Empirical evidence on the impact of network extension on lead times**: this includes evidence on the importance of lead times to customers when choosing a supplier and evidence on the impact of network extensions on lead times. This is based on two pieces of research we commissioned and information we collected via responses to s.135 notices.
- **Qualitative evidence on build vs. buy strategy:** this section presents qualitative evidence on how providers decide whether to build (i.e. extend their network by building new duct) or buy (i.e. buy an active wholesale leased line product from another provider) to supply a leased line to a customer's site outside their existing network reach. This is based on information we gathered at the meetings we held with leased line providers.
- **Empirical evidence on 2017 network extensions**: this covers evidence on: how often telecoms providers had to extend their networks to connect new customers; the build vs buy decision for Openreach's rivals; and how far providers usually dug. This is based on providers' responses to s.135 notices.

A11.3 To summarise, this evidence suggests that:

- lead times are important for leased line customers to the extent that having an existing connection to the customer site is one of the main factors considered by customers when choosing a provider;
- network extensions significantly increase lead times;
- a longer dig distance is likely to imply longer lead times;
- build-only providers (those with a strong preference to build as that is their business strategy) tend to build when it is profitable to do so and, collectively, account for approximately 2% of 2017 connections;
- build vs buy providers (those without a strong preference for either option) tend to build when it is less costly than to buy and, collectively, account for approximately 33% of 2017 connections;
- Openreach accounted for [✂]% of the [✂] network extensions done by all providers in 2017. Out of the [✂] network extensions not done by Openreach, Virgin accounted for [✂]% and CityFibre for [✂]%;

[111] The evidence in this annex also informs our SMP assessment for VHB (Annex 14).

- Openreach had existing duct for the [✂] of the customer ends it connected in 2017 ([✂]%) 81% - 90%. It only extended its network for [✂]% of the customer ends it connected in 2017;
- Openreach's rivals had existing duct for a lower proportion of the customer ends they connected in 2017 (45%) when compared to Openreach. They only built for [✂]% of the customer ends they connected in 2017;
- Openreach's rivals were unlikely to build to connect customers' sites that were not already connected to their networks. Collectively, they only built for [✂] connections (9% of the [✂] connections not already connected to their networks);
- four providers accounted for 99% of the [✂] digs that took place in 2017 ([✂]);
- providers tend to dig short distances. Close to 80% of digs involved a distance of 50m or less ([✂]% of [✂] Openreach digs, and [✂]% of [✂] rival digs), and close to 90% of digs involved a distance of 100m or less ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs);
- a minority of digs were long distance, suggesting a low propensity of rivals to dig when they are located further away. About 15% of digs involved a distance above 100m ([✂]% of [✂] Openreach digs, and [✂]% of [✂] rival digs);
- the vast majority of long distance digs by Openreach's rivals were carried out by build-only providers (i.e. CityFibre, EU Networks and Zayo) as their business strategy is to build (out of the [✂] rival digs above 100m, build-only providers collectively accounted for 78%, and CityFibre individually accounted for 56%); and
- for Openreach, the median dig distance was [✂] 0-25 metres compared to a mean distance of [✂] metres; while for Openreach's rivals the median was 14 metres compared to a mean of [✂] metres. We consider that the median rather than the mean provides a better indication of the distance to which operators are most likely to extend their network for the reasons set out in paragraph A11.32.

# Empirical evidence on the impact of network extension on lead times

## Evidence on the importance of lead times

A11.4 This evidence is based on the results of the 2016 BDRC-Continental study[112] and the 2018 Cartesian study.[113] It indicates that:

- having an existing connection to the customer site is one of the main factors considered by customers when choosing a provider;
- long and uncertain lead times are some of the key problems faced by customers on the provisioning of fixed services;

[112] BDRC-Continental, 2016, *High bandwidth connections*, https://www.ofcom.org.uk/__data/assets/pdf_file/0020/32069/bdrc_ci_survey.pdf.
[113] Cartesian, 2018, *Business Connectivity Market Assessment*, https://www.ofcom.org.uk/__data/assets/pdf_file/0009/113112/cartesian-business-connectivity-market-assessment.pdf.

- longer-than-expected lead times may be associated with monetary costs to the customer; and
- a longer dig distance is likely to imply longer lead times.

### BDCR 2016 study for Ofcom

A11.5 We commissioned BDRC-Continental to interview 241 business customers (not resellers) of high bandwidth leased line services (i.e. Ethernet leased line services of more than 50 Mbit/s speeds or WDM-based leased line services) to explore:

- their requirements and preferences from high bandwidth leased line services;
- their willingness to switch and the possible barriers to doing so;
- the choice of suppliers; and
- market trends.

A11.6 This study found the following with regards to lead times:

- more than half of respondents (51%) indicated that one of the reasons they had chosen their leased line supplier was because it already had a connection to their site. This reason was more likely to be mentioned by respondents who buy leased line services of speeds higher than 100 Mbit/s (61% of respondents who buy WDM connections; 60% of respondents who buy Ethernet leased lines over 1 Gbit/s; and 61% of respondents who buy Ethernet leased lines 1 Gbit/s and below but more than 100 Mbit/s) compared to respondents who buy lower speeds (43% of respondents who buy Ethernet leased lines at 100 Mbit/s and below but more than 50 Mbit/s).[114] This evidence indicates that already having a connection to the customer site is an important factor on end-users' choice of supplier;
- two in five respondents (41%) indicated they had experienced an obstacle when they migrated from a slow bandwidth connection (e.g. an Asymmetric Digital Subscriber Line (ADSL), Integrated Services Digital Network (ISDN), or analogue leased line connection[115]) to a high bandwidth connection (i.e. any service with bandwidth above 50 Mbit/s).[116] The most frequent obstacle was "time taken to deliver service/long delay in installation" (9% of those migrating indicated they experienced this obstacle); followed by "Other criticism of provider – e.g. poor communication, poor customer service" (8%); and "Lead time for the new service up and running" (6%).[117] This evidence indicates that lead times can be an obstacle when end-users migrate to higher bandwidth leased lines; and
- almost half (44%) of the respondents who experienced at least one obstacle when migrating to higher bandwidth leased lines indicated that there were costs associated with the main obstacle they experienced (14% indicated a cost of £1,000 to £4,000;

[114] BDRC-Continental, 2016, *High bandwidth connections,* Figure 23 (Important selection criteria for HBW supplier) and Figure 24 (Important selection criteria for HBW supplier).
[115] BDRC-Continental, 2016, Figure 28 (What HBW line replaced).
[116] BDRC-Continental, 2016, Page 14 (Migration).
[117] BDRC-Continental, 2016, Figure 32 (Obstacles when migrating).

13% indicated a cost of £5,000 to £9,000; and 17% indicated a cost of >£10,000).[118] This evidence suggests that lead times may be associated with monetary costs given that "time taken to deliver service/long delay in installation" and "lead time for the new service up and running" were the most frequent and third most frequent obstacles experienced by end-users, respectively.

### 2018 Cartesian study for Ofcom

A11.7 We commissioned Cartesian to interview 75 executives in technology and procurement roles of UK large businesses, with responsibility for business connectivity; 16 senior personnel in Communication Service Providers (CSPs), with insight into the business connectivity supply chain; and 6 senior representatives of UK mobile network operators and mobile access infrastructure providers, with insight into mobile backhaul connectivity.

A11.8 This study explored four areas:

- how UK large businesses use communication services;
- how satisfied UK large businesses are with their communication services;
- how UK large businesses see their communication needs evolving over the next 5 years; and
- how UK large businesses design their business connectivity supply chain.

A11.9 This study found the following with regards to lead times:

- on a scale from 1 (lowest) to 10 (highest satisfaction score), the provisioning of fixed services was the most prevalent area of dissatisfaction (with a mean score of 5.3), particularly for fibre leased lines;[119] and
- the key problems associated with the provisioning of fixed services include long lead times, delays, uncertain delivery deadlines and a lack of communication from the service provider. Wayleaves, the supplier's organisational structure and lack of a seamless migration process were perceived as the main contributing factors.[120]

## The evidence on the impact of network extensions on lead times

A11.10 The overall finding from the evidence presented in this section is that network extensions significantly increase lead times.

A11.11 This evidence is based on information about the time it takes Openreach to provide different types of leased line Ethernet orders (all orders, orders with duct work, and quick wins), and the relationship between time-to-provide and dig distance.[121]

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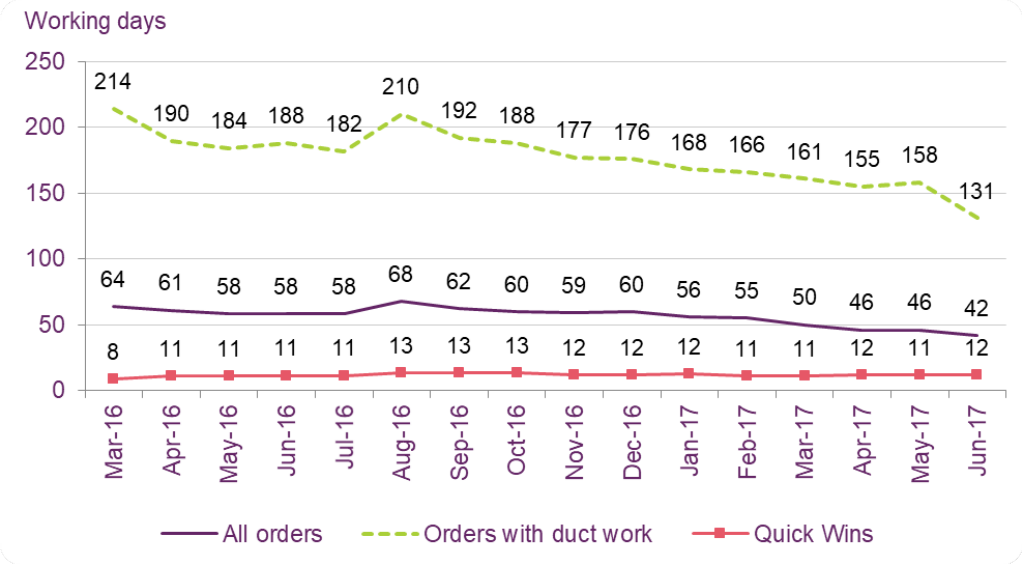
[118] BDRC-Continental, 2016, Figure 32 (Cost of main obstacle when migrating).
[119] BDRC-Continental, 2016, page 7.
[120] BDRC-Continental, 2016, page 7.
[121] We collected this information from: Openreach response dated 28 February 2018 to the BCMR Quality of Service Measures BCMR s.135 notice; Openreach response dated 22 May 2018 to the 12th BCMR s.135 notice; Openreach response dated 11 November 2015 to the 14th 2016 BCMR s.135 notice; Openreach response dated 4 December 2015 to the 2016

A11.12 Figure A11.1 below shows the Mean Time to Provide (MTTP) – i.e. the average number of working days excluding customer delay that it takes Openreach to complete an order – between March 2016 and June 2017 was significantly higher for orders that involved duct work (on average 178 working days)[122] compared to all orders (on average 56 working days). This duct work includes both cases of constructing new duct and also instances where existing duct needed to be repaired or cleared from blockages. Assuming these times are similar to the times faced by the industry overall, the higher MTTP associated with duct work means that operators who extend their networks to supply a leased line have a significantly longer lead time compared to all orders.

**Figure A11.1 Mean Time To Provide (MTTP) for all orders, orders with duct work, and Quick Wins**




*Source: Openreach response dated 28 February 2018 to the BCMR Quality of Service Measures s.135 notice sent on 13 February 2018; and Openreach response dated 22 May 2018 to the 12th BCMR s.135 notice.*

A11.13 In addition, the evidence shows that orders that involve installing new duct are more likely to require permission for wayleaves and traffic management (i.e. closing roads and/or pavements). In turn, these activities can increase the time to provide.

A11.14 Even though this information does not directly indicate a relationship between lead times and dig distance (i.e. the distance over which Openreach installed new duct), we are of the view that lead times are a function of dig distance to some extent.

A11.15 This is because since duct work implies longer lead time and it is reasonable to assume that a longer distance implies more duct work and a greater probability of wayleaves and traffic management issues; then a longer distance is likely to imply longer lead times. This is in line with information we collected for the 2016 BCMR, which suggested to Ofcom a

BCMR QoS s.135 notice sent on 26 November 2015; and Openreach response dated 20 January 2016 to the 2016 BCMR QoS s.135 notice sent on 12 January 2016.

[122] We refer to orders that involved duct work as the orders that involved duct activity at the A and B end of the circuit.

positive correlation of 0.23 between time-to-provide and the length of new duct installed by Openreach.[123]

A11.16 Figure A11.1 also shows the MTTP between March 2016 and June 2017 was significantly longer for orders that involved duct work (on average 178 working days) compared to the orders Openreach categorised as quick wins (on average 12 working days)[124] – the latter are the orders we use as a proxy for orders for which Openreach already had a fibre connection for the reasons set out below. This comparison suggests that operators who extend their networks to supply a leased line are likely to experience significantly longer lead times compared to operators that already have a fibre connection to the customer's site.

A11.17 In our view, quick wins are a good proxy for orders for which Openreach already had a fibre connection given that they capture orders for which Openreach expected:

- no Excess Construction Charges (i.e. the additional costs Openreach charges customers to provide additional service or to deal with situations where the cost of providing service is more than the Openreach price list);[125]
- no duct work (neither new duct nor instances where existing duct needed to be repaired or cleared from blockages); and
- potentially, but not necessarily, limited splice (splice only where fibre exists and with a fibre blow of up to 600m either way from the central point externally, or 150m internally to connect to desired Network Termination Equipment location).

## Qualitative evidence on build vs buy strategy

A11.18 This section presents qualitative evidence on how providers other than Openreach decide whether to build (extend their network) or buy (buy an active wholesale leased line product from another provider) to supply a leased line to a customer's site that is not currently connected to their network.

A11.19 This section is based on the views expressed by providers verbally or in writing in the context of several one-to-one meetings we held with them between March and June 2018.

A11.20 In broad terms, there are two distinct groups of providers:[126]

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[123] Ofcom analysis based on Openreach response dated 11 November 2015 to the 14th 2016 BCMR s.135 notice; Openreach response dated 4 December 2015 to the 2016 BCMR s.135 notice sent on 26 November 2015; and Openreach response dated 20 January 2016 to the 2016 BCMR s.135 notice sent on 12 January 2016.
[124] [✂]. Source: Openreach response dated 22 May 2018 to the 12th BCMR s.135 notice.
[125] See www.openreach.co.uk/orpg/home/products/serviceproducts/excessconstructioncharges/excessconstructioncharges.do [accessed 30 October 2018].
[125] See www.openreach.co.uk/orpg/home/products/serviceproducts/excessconstructioncharges/excessconstructioncharges.do. [accessed on 30 October 2018].
[126] We identified these groups based on information we gathered at the meetings we held with leased line providers.

- build-only providers (i.e. CityFibre, EU Networks, and Zayo) have a strong preference to build as that is their business strategy. They either do not to make a build vs buy decision or rarely do so.
- build vs buy providers (i.e. Vodafone, Colt, Surf, [✂], Verizon, MS3, [✂], KCOM, [✂], SSET, and Virgin Media) do not have a strong preference for either option.

A11.21 Build-only providers tend to build only when it is profitable to do so, otherwise they would usually decide not to serve the customer's site. For instance, Zayo indicated that it usually considers the Net Present Value, Return On Investment, and pay-pack period in the round when deciding whether to build or utilize another means for deploying fibre for long term utilization and ownership. Zayo only leases dark fibre as a last resort for deployment of time critical network extension supporting complex customer connectivity solutions.[127]

A11.22 Collectively, build-only providers accounted for approximately 2% of 2017 connections, while build vs buy providers accounted for approximately 33% of 2017 connections.[128]

A11.23 Build vs buy providers tend to build when it is less costly than to buy and take into consideration different factors in this decision. These factors may include: the net present value of the expected revenues and costs of each option over a payback period equal to the customer's contract length (usually three years), and lead times.

A11.24 Build vs buy providers may still build where it is economically better to buy for a single circuit, but would usually do so in the context of network rollout programmes (e.g. [✂]) rather than in the context of incremental extensions for individual sites.

A11.25 The points below provide an indication of how [✂] makes its build vs buy decision,[129] and the importance given by [✂] to lead times:[130]

- [✂];
- [✂];
- [✂];
- [✂];
- [✂] indicated that the lead times associated with build and buy are important. [✂] mentioned that supplying a leased line service to a new customer's site can take (i) *days* when the site is already connected to [✂] network (e.g. three to four days); (ii) *weeks* when [✂] buys an active wholesale leased line product from another provider (usually when the customer's site is connected to another provider's network but not to [✂]); or (iii) *a month or more* when [✂] digs and installs a new duct to extend its network to reach the customer's site (usually when the customer's site is not connected to any network).

[127] Ofcom notes from meeting with Zayo on 23 May 2018.
[128] We based this on information we gathered at the meetings we held with leased line providers as explained further in footnote 153 in Table A11.2.
[129] Ofcom notes from meeting with Vodafone on 1 March 2018 and Vodafone letter to Ofcom dated 19 April 2018.
[130] Ofcom notes from meeting with [✂] on 14 May 2018.

# Empirical evidence on 2017 network extensions

A11.26 We analyse the Contemporary Interface (CI) Access circuits connected by telecoms providers in 2017 in the UK to estimate how often providers usually dig and the distances they typically dig to extend their network to new customers' sites. We use this to inform our SMP assessment of CI Access circuits in Section 5 of Volume 1.[131]

A11.27 We present the distances telecoms providers dug to connect their networks to customers' sites as *radial* distances (i.e. the straight-line distance between networks and sites ignoring the layout of streets and other infrastructure), as opposed to *route* distances (i.e. the actual distance providers dug to connect networks and sites following the layout of streets and other infrastructure). This allows us for a like-for-like comparison between the distances presented in this section and our 50m *radial* buffer distance.[132]

A11.28 We converted route distances into radial distances by dividing each given route distance by 1.4. We have used similar conversion factors in previous work.[133]

A11.29 The main findings from this analysis include:

- Openreach accounted for [✂]% of the [✂] network extensions done by all providers in 2017. Out of the [✂] network extensions not done by Openreach, Virgin Media accounted for [✂]% and CityFibre accounted for [✂]%;
- Openreach had existing duct for the [✂] of the customer ends it connected in 2017 ([✂]%) 81% - 90%. It only extended its network for [✂]% of the customer ends it connected in 2017;
- Openreach's rivals had existing duct for a lower proportion of the customer ends they connected in 2017 (45%) when compared to Openreach. They only built for [✂]% of the customer ends they connected in 2017;
- Openreach's rivals were unlikely to build to connect customers' sites that were not already connected to their networks. Collectively, they only built for [✂] connections (9% of the [✂] connections not already connected to their networks);
- four providers accounted for 99% of the [✂] digs that took place in 2017 ([✂]);
- providers tend to dig short distances. Close to 80% of digs involved a distance of 50m or less ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs), and close to 90% of digs involved a distance of 100m or less ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs);
- a minority of digs were long distance, suggesting a low propensity of rivals to dig when they are located further away. About 15% of digs involved a distance above 100m ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs);

[131] This evidence and its breakdown by bandwidth also informs Annex 14 (SMP assessment for VHB).
[132] Section 5 of Volume 1 discusses our 50m radial buffer distance in detail.
[133] For instance, footnote 29 of the August 2017 WLA Consultation www.ofcom.org.uk/__data/assets/pdf_file/0022/105682/Recovering-the-costs-of-investment-in-network-expansion.pdf mentions that "telephone lines tend to follow the layout of streets, rather than travel in straight radial lines from exchanges to street cabinets and onto customer premises, the derived radial distances are converted into route distances that follow the typical rectilinear pattern of streets by applying a conversion factor (typically in the range 1.2 – 1.4)."

- the vast majority of long distance digs by Openreach's rivals were carried out by build-only providers (i.e. CityFibre, EU Networks and Zayo) as their business strategy is to build (out of the [✂] rivals' digs above 100m, build-only providers collectively accounted for 78%, and CityFibre individually accounted for 56%);[134] and
- for Openreach, the median dig distance was [✂] 0-25 metres compared to a mean distance of [✂] metres; while for Openreach's rivals the median was 14 metres compared to a mean of [✂] metres. We consider that the median rather than the mean provides a better indication of the distance to which operators are most likely to extend their network for the reasons set out in paragraph A11.32.

A11.30 This analysis is based on the datasets we collected from 15 providers (CityFibre[135], Colt[136], EU Networks[137], Fibrespeed[138], Interoute[139], KCOM[140], Level3[141], MS3[142], Openreach[143], SSE[144], Surf[145], Verizon[146], Virgin Media[147], Vodafone[148], and Zayo[149]) which we processed as described in Annex 12.[150] This data identifies:

- each leased line and dark fibre connection made in 2017 and whether it was connected on-net or off-net (responses to question C1);
- for each on-net connection, whether it was connected using an existing fibre connection (i.e. no need to blow fibre) (C1 viia), it was connected using existing duct but not fibre (C1 viib), or digging was required (i.e. no existing duct or fibre) (C1 viic); and
- for each on-net connection that involved digging, the actual distance dug (C2 viii), the distance between the newly connected building and the nearest flexibility point (C2 ix), the interface delivered (C2 x), the bandwidth delivered (C2 xi), and the cost of connecting to the building (C2 xii).

[134] As mentioned in the section on Qualitative evidence on build vs buy strategy, build-only providers have a strong preference to build.
[135] CityFibre response dated 17 January 2018 to the 1st BCMR s.135 notice.
[136] Colt response dated 17 January 2018 to the 1st BCMR s.135 notice.
[137] EU Networks response dated 17 January 2018 to the 1st BCMR s.135 notice.
[138] Fibrespeed response dated 19 January 2018 to the 1st BCMR s.135 notice.
[139] Interoute response dated 17 January 2018 to the 1st BCMR s.135 notice.
[140] KCOM response dated 17 January 2018 to the 1st BCMR s.135 notice.
[141] Level3 response dated 17 January 2018 to the 1st BCMR s.135 notice.
[142] MS3 response dated 17 January 2018 to the 1st BCMR s.135 notice.
[143] Openreach response dated 18 January 2018 to the 1st BCMR s.135 notice.
[144] SSE response dated 17 January 2018 to the 1st BCMR s.135 notice.
[145] Surf response dated 17 January 2018 to the 1st BCMR s.135 notice.
[146] Verizon response dated 17 January 2018 to the 1st BCMR s.135 notice.
[147] Virgin response dated 17 January 2018 to the 1st BCMR s.135 notice.
[148] Vodafone response dated 17 January 2018 to the 1st BCMR s.135 notice.
[149] Zayo response dated 18 January 2018 to the 1st BCMR s.135 notice.
[150] Paragraphs A12.38 to A12.40 ('Dig variables') explain how we processed the raw circuit ends data we received in response to s.135 notices to inform our analysis of the empirical evidence on 2017 network extensions. We note that (i) we classified as 'on-net duct connected' the circuit ends with missing information on type of connection; and (ii) we allocated digs randomly for customer-to-customer circuit ends.

## Incidence of network extensions and build vs buy decision

A11.31 Table A11.2 below presents the number of CI Access circuits ends connected in 2017 in the UK, their breakdown by how they were connected, and an indicator of the likelihood of build vs buy. This information is presented for the four providers with the highest number of digs in 2017 (Openreach, CityFibre, Virgin Media, and Vodafone) and Openreach's rivals grouped together (CityFibre, Virgin Media, Vodafone, EU Networks, Colt, Zayo, Surf, KCOM, MS3, Interoute, Level3, SSE, Verizon, and Fibrespeed).

**Table A11.2 CI Access circuit ends connected in 2017 in the UK – Type of connection and likelihood of build vs. buy[151]**

| | Openreach[152] | Other providers (total)[153] | CityFibre | Virgin Media | Vodafone |
|---|---|---|---|---|---|
| **a) CI Access circuit ends connected in 2017** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **b) on-net duct-connected (i.e. no need to build)** | [✂]<br>81% - 90% | [✂]<br>(45%) | [✂]<br>41% - 50% | [✂]<br>71% - 80% | [✂] |
| **c) on-net not duct-connected (i.e. build)** | [✂]<br>11-20% | [✂]<br>(5%) | [✂] | [✂] | [✂] |
| **d) off-net (i.e. buy)** | [✂]<br>(0%) | [✂]<br>(49%) | [✂] | [✂] | [✂] |
| **e) Likelihood of build vs buy [ c / (c + d) ]** | Does not apply | 9% | [✂]% | [✂]% | [✂]% |

*Source: Stakeholder responses to the 1st BCMR s.135 notice.*

A11.32 This evidence indicates that:

- Openreach completed [✂] network extensions in 2017 which represents [✂]% of the [✂] network extensions done by all providers in 2017. Out of the [✂] network extensions not done by Openreach, Virgin Media accounted for [✂] ([✂]%), while CityFibre accounted for [✂] networks extensions ([✂]%);

[151] Paragraphs A12.38 to A12.40 ('Dig variables') explain how we processed the raw circuit ends data we received in response to s.135 notices to inform our analysis of the empirical evidence on 2017 network extensions. We note that (i) we classified as 'on-net duct connected' the circuit ends with missing information on type of connection; and (ii) we allocated digs randomly for customer-to-customer circuit ends.

[152] For Openreach the number of CI Access circuit ends connected in 2017 that were fibre connected was [✂], which is equivalent to [✂]% of Openreach's [✂] CI Access circuit ends connected in 2017. In comparison, for Openreach's rivals the proportion of fibre-connected ends was less than [✂]% of the [✂] CI Access circuit ends they connected in 2017 (we were unable to estimate the exact figure for rivals due to data limitations).

[153] As mentioned in the section on Qualitative evidence on build vs buy strategy above, we have classified providers other than Openreach into one of two groups: build-only providers (i.e. CityFibre, EU Networks, and Zayo) and build vs buy providers (i.e. [✂]). We have made this classification based on the information gathered at the meetings we held with leased lines providers. However, we also considered how many of a given provider's 2017 connections were done off-net (i.e. they bought the connection from another provider) as per their responses to the 1st BCMR s.135 notice. Build-only providers made [✂] connections in 2017 (2% of all 2017 connections), of which on average 7% were done off-net. build vs buy providers made [✂] connections in 2017 (33% of all 2017 connections), of which on average 43% were done off-net.

- Openreach had existing duct for the [✂] of the customer ends it connected in 2017. Openreach had a total of [✂] customer ends, of which [✂]% 81% - 90% already had duct in place. Openreach only extended its network (i.e. built) for [✂] customer ends or [✂]% of the customer ends it connected in 2017;
- Openreach's rivals had existing duct for a lower proportion of the customer ends they connected in 2017 when compared to Openreach. Collectively, they connected a total of [✂] customer ends, of which only 45% already had duct in place. They only built for [✂] customer ends or [✂]% of the customer ends they connected in 2017;
- Openreach's rivals were unlikely to build to connect customers' sites that were not already connected to their networks. Collectively, they only built for [✂] connections (9% of the [✂] connections not already connected to their networks). At an individual level, Vodafone built for only [✂]% of the connections not already connected to its network, while Virgin did so for [✂]% of the connections not already connected to its network. We categorised CityFibre as a build-only provider and it does not make a build vs buy decision; and
- four providers accounted for 99% of the [✂] digs that took place in 2017 ([✂]).

A11.33 Table A11.3 below presents this information broken down by bandwidths.

**Table A11.3 CI Access circuit ends connected in 2017 in the UK by bandwidth – Type of connection and likelihood of build vs. buy**

| | Openreach | Other providers (total) | CityFibre | Virgin Media | Vodafone |
|---|---|---|---|---|---|
| | | 10 Mbit/s | | | |
| **a) CI Access circuit ends connected in 2017** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **b) on-net duct-connected (i.e. no need to build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **c) on-net not duct-connected (i.e. build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **d) off-net (i.e. buy)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **e) Likelihood of build vs buy [ c / (c + d) ]** | Does not apply | [✂]% | [✂]% | [✂]% | [✂]% |
| | | 100 Mbit/s | | | |
| **a) CI Access circuit ends connected in 2017** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **b) on-net duct-connected (i.e. no need to build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **c) on-net not duct connected (i.e. build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **d) off-net (i.e. buy)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **e) Likelihood of build vs buy [ c / (c + d) ]** | Does not apply | [✂]% | [✂]% | [✂]% | [✂]% |
| | | 1 Gbit/s | | | |
| **a) CI Access circuit ends connected in 2017** | [✂] | [✂] | [✂] | [✂] | [✂] |

| | Openreach | Other providers (total) | CityFibre | Virgin Media | Vodafone |
|---|---|---|---|---|---|
| **b) on-net duct-connected (i.e. no need to build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **c) on-net not duct-connected (i.e. build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **d) off-net (i.e. buy)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **e) Likelihood of build vs buy [ c / (c + d) ]** | Does not apply | [✂]% | [✂]% | [✂]% | [✂]% |
| **VHB** | | | | | |
| **a) CI Access circuit ends connected in 2017** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **b) on-net duct-connected (i.e. no need to build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **c) on-net not duct-connected (i.e. build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **d) off-net (i.e. buy)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **e) Likelihood of build vs buy [ c / (c + d) ]** | Does not apply | [✂]% | [✂]% | [✂]% | [✂]% |
| **Dark fibre** | | | | | |
| **a) CI Access circuit ends connected in 2017** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **b) on-net duct-connected (i.e. no need to build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **c) on-net not duct-connected (i.e. build)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **d) off-net (i.e. buy)** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **e) Likelihood of build vs buy [ c / (c + d) ]** | Does not apply | [✂]% | [✂]% | [✂]% | [✂]% |

*Source: Stakeholder responses to the 1st BCMR s.135 notice.*

## Dig distances

A11.34 Table A11.4 below presents the distances providers dug to extend their network to new customers' sites in 2017 as radial distances. This information is presented for the four providers with the highest number of digs in 2017 (Openreach, CityFibre, Virgin Media, and Vodafone) and Openreach's rivals grouped together (CityFibre, Virgin Media, Vodafone, EU Networks, Colt, Zayo, Surf, KCOM, MS3, Interoute, Level3, SSE, Verizon, and Fibrespeed).

**Table A11.4 CI Access circuit ends connected in 2017 in the UK – Radial dig distances for on-net circuits without duct connected**

| Dig Distance (metres) | Openreach | Other providers (cumulative total %) | CityFibre | Virgin Media | Vodafone |
|---|---|---|---|---|---|
| **0 to 25** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 50** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 75** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 100** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Any distance** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Mean** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Median** | [✂] 0-25m | 14m | [✂] 0-25m | [✂] 0-25m | [✂] 0-25m |

*Source: Stakeholder responses to the 1st BCMR s.135 notice.*

A11.35 This evidence indicates that:

- providers tend to dig short distances. Close to 80% of digs involved a distance of 50m or less ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs), and close to 90% of digs involved a distance of 100m or less ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs);
- a minority of digs were long distance, suggesting a low propensity of rivals to dig when they are located further away. About 15% of digs involved a distance above 100m ([✂]% of [✂] Openreach's digs, and [✂]% of [✂] rivals' digs);
- the vast majority of long distance digs by Openreach's rivals were carried out by build-only providers (i.e. CityFibre, EU Networks and Zayo) as their business strategy is to build (out of the [✂] rivals' digs above 100m, build-only providers collectively accounted for 78%, and CityFibre individually accounted for 56%);[154] and
- for Openreach, the median dig distance was [✂] 0-25 metres compared to a mean distance of [✂] metres; while for Openreach's rivals the median was 14 metres compared to a mean of [✂] metres.

A11.36 We consider that the median rather than the mean provides a better indication of the distance to which operators are most likely to extend their network. This is because mean dig distances are skewed by the minority of very long distances dug. In our view, these long-distance digs are likely to be exceptional and not representative of what providers would be more generally willing to dig. We note that the majority of long-distance digs are carried out by build-only providers, i.e. providers who have a strong preference to build and either do not make a build vs buy decision or rarely do so. The small number of long-distance digs for build vs buy providers may also be exceptional and explained by situations when the total contract value of an unusually large contract justifies the dig, when the

[154] As mentioned in the section on Qualitative evidence on build vs buy strategy, build-only providers have a strong preference to build.

provider is digging for an anchor tenant, roll-out programmes and situations where it was less costly to build than to buy because dig costs in that area were unusually low.

A11.37 Table A11.5 below presents this information broken down by bandwidths.

**Table A11.5 CI Access circuit ends connected in 2017 in the UK by bandwidth – Radial dig distances for on-net not duct connected**

| | Openreach | Other providers (total) | CityFibre | Virgin Media | Vodafone |
|---|---|---|---|---|---|
| **10 Mbit/s** | | | | | |
| **0 to 25** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 50** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 75** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 100** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Any distance** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Mean** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Median** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **100 Mbit/s** | | | | | |
| **0 to 25** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 50** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 75** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 100** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Any distance** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Mean** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Median** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **1 Gbit/s** | | | | | |
| **0 to 25** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 50** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 75** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 100** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Any distance** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Mean** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Median** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **VHB** | | | | | |
| **0 to 25** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 50** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 75** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 100** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Any distance** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Mean** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Median** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Dark fibre** | | | | | |
| **0 to 25** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 50** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 75** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **0 to 100** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Any distance** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Mean** | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Median** | [✂] | [✂] | [✂] | [✂] | [✂] |

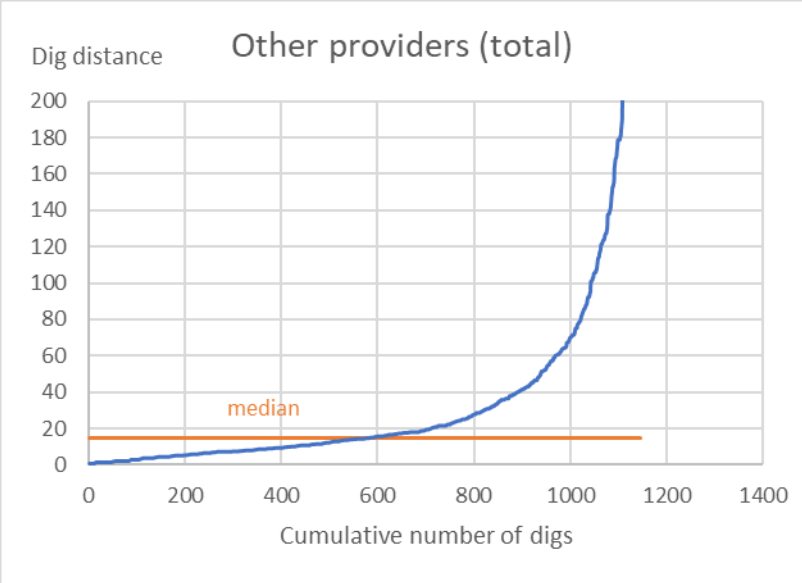
*Source: Stakeholder responses to the 1st BCMR s.135 notice.*

A11.38 Figure A11.6 below shows the cumulative distribution of the radial distances dug by providers in 2017.

**Figure A11.6 CI Access circuit ends connected in 2017 in the UK for selected providers – Distribution of dig distances**[155]

**Openreach** [✂]

**Other providers (total)**




**CityFibre** [✂]

**Virgin Media** [✂]

**Vodafone** [✂]

*Source: Responses to BCMR s.135 notices (see paragraph A11.26)*

A11.39 This evidence supports the point that for a relatively small proportion of customer ends providers had to dig unusually long distances, which suggests that the median (rather than mean) is a more representative measure of the distance providers tend to dig.

[155] For some providers the number of digs reported in Figure A11.6 is slightly smaller than that reported in Tables A11.2, A11.3, A11.4, and A11.5 above. This is because Figure A11.6 excludes instances in which providers have informed a dig but failed to inform the associated dig distance.

# A12. Approach to data processing

A12.1 In this annex, we explain our approach to cleaning the data, including the physical network infrastructure data and the leased lines data obtained from telecoms providers used to perform our network reach and service share analyses.

A12.2 We also explain the methodology we use in these analyses, as well as that of classifying geographic markets in the UK based on their levels of competition. We then outline results from these analyses which relate to the base case scenario, where a buffer distance of 50m is applied.[156]

A12.3 The data used in our analyses include:

- postcode data;
- physical network infrastructure data;
- network sites data;
- business locations data; and
- leased lines data.

## Postcode data

A12.4 In the 2016 BCMR geographic market areas were defined with individual postcode sectors using Dotted Eyes as our data source. This data source was updated in 2017 by Miso[157], providing the locations of postcodes, postcode sectors and their associated polygons.[158]

A12.5 When verifying the postcode and postcode sector polygons in Northern Ireland, we found that the polygon shapes in the Miso data differed when compared to those created by Ofcom from another data source, Ordnance Survey.[159] For polygons in Northern Ireland this other data source is used.[160]

A12.6 This postcode data is used to determine the locations of businesses and network sites for our network reach analyses, as well as the locations of exchanges in our inter-exchange analysis and a small number of circuit ends in our leased lines data.

## Physical network infrastructure data

A12.7 We asked telecoms infrastructure providers to supply digital maps of their duct networks. Coordinates of these duct networks were extracted where possible and used to map the network infrastructure of each provider.

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[156] Refer to Annex 11 for detail in determining the buffer distance that is used.
[157] Miso is a division of Dotted Eyes Ltd offering mapping data and software.
[158] The polygons for each postcode and postcode sector represent the geographic coverage of the postcode or postcode sector.
[159] This is due to Miso's manual creation of Thiessen polygons from postcode points in their source data.
[160] Postcode polygons in Great Britain were consistent between the two sources of polygons.

A12.8 To supplement this data, we also asked telecoms infrastructure providers to supply the easting and northing location details[161] of all their flexibility points.[162] These are points where existing physical links can be accessed to connect an end-user premises and from which telecoms infrastructure providers would consider extending their network to provide services to additional end-user premises. Examples of flexibility points include buildings where fibre terminates on an Optical Distribution Frame or underground chambers where fibre can be accessed, such as where ducts meet at a junction. This allowed us to map the network infrastructure of providers where duct maps were not available or usable.

## Network sites data

A12.9 We requested from each telecoms provider a list of network sites, which we defined as locations in the telecoms provider's network where it had installed transmission equipment that is used for leased lines and which is capable of serving more than one business customer. Network sites are distinct from flexibility points in that the former are buildings where a telecoms provider has telecom equipment that allows for the transmission, switching, routing and/or aggregation of traffic[163], whereas the latter are physical locations from which a provider can extend its copper, fibre or coax network. Therefore, although a network site can serve as a flexibility point, the reverse is normally not true.

A12.10 For each network site, we requested address details (or geographic coordinates where no postal address was available), a brief description of the nature of the site and whether it coincides with a customer site.

A12.11 Using these details of each network site we filtered out sites that were out of scope, such as those labelled as test sites, those associated with out of scope products, those that are inactive, and those coinciding with customer sites.

## Business locations and mobile sites data

A12.12 To carry out our network reach analyses, we require data on UK business size and locations. For the 2016 BCMR we used Market Location as our source of UK business information, where we extracted the locations of businesses which employed >250 employees.[164] This formed a list of large businesses and their corresponding postcodes.

A12.13 We have continued to use this data source for this consultation. Our intention was to use circuit inventory data in our access network reach analysis but, as detailed in the leased

[161] Eastings and northings provide the coordinates of any given location in the UK in metres east and north of an origin just to the south-west of the Isles of Scilly.
[162] In many cases flexibility point data was provided as eastings and northings. Where data was provided as latitude and longitude we converted this to eastings and northings (using software called MapInfo), and where data was provided as postcodes we used our postcode data to convert to eastings and northings of the postcode centroid.
[163] For example, a telecoms provider's own network equipment rooms, the common equipment room in a multi-tenant building, or an end-customer equipment room from which you serve other customers.
[164] This number of employees is at a national level.

lines data section below, we are unable to use the inventory data due to quality concerns. There are insufficient volumes in the new connections data to use as an effective weight in our network reach analyses due to the geographic granularity required. This contrasts with our service share analysis which is calculated over larger geographic areas, so the smaller volumes in the new connections data are sufficient. We also considered using Ordnance Survey as a data source, which provides the exact coordinates of business sites rather than their address. However, this dataset does not provide information on the number of employees of a business, which we use to filter for large businesses. Consequently, there would be a loss of accuracy in identifying an appropriate sample of business sites likely to demand leased lines. We consider that using this alternative dataset would not allow us to adequately implement our methodology.

A12.14 To ensure that business sizes and locations have not changed materially since this data was collated, we will be updating this data for our statement.

A12.15 Mobile sites require leased lines as well as large businesses. The Mobile Network Operator (MNO) inventory data, an output of the leased lines data discussed below, contains all leased lines and dark fibre products used by mobile network operators. Using this data, we determine the locations of MNOs' cell sites by identifying those postcodes where a leased line used by a MNO terminates. These locations of mobile sites are added to those of large businesses for our access network reach analysis.

## Leased lines data

A12.16 We requested data from each telecoms provider on all live leased lines they supply and purchase.[165] We then collated and cleaned this data to generate the following three datasets:

- the inventory dataset, containing all live leased lines and dark fibre products supplied by telecoms providers;
- the MNO inventory dataset, containing all live leased lines and dark fibre products used by MNOs; and
- the connections dataset, containing all leased lines and dark fibre products connected by telecoms providers in 2017.

A12.17 We have used the inventory dataset for calculating service shares in the Hull Area. Due to data quality issues affecting large parts of the UK other than the Hull Area, we have not relied on the inventory dataset and have instead used the connections dataset to analyse service shares in those other areas. However, we have performed sensitivity analysis using the inventory dataset.[166]

A12.18 We have used the MNO inventory dataset alongside the business locations data to carry out the network reach analysis.

[165] Stakeholder responses to questions A1, A2, C1 and C2 of the 1st BCMR s.135 notice and questions A1 and A2 of the 5th BCMR s.135 notice.
[166] See Annex 13.

## Data collation

A12.19 To collate the responses from all telecoms providers, we created a list of common variables based on the information requested. This required us to rename and generate additional variables based on the data provided by each telecoms provider. In some cases, this was as simple as changing a variable name from "technology" to "interface". However, in other cases it involved extracting information from one variable to generate another, based on rules described by the telecoms provider that supplied the data.

A12.20 To identify the access portion of the telecommunications network, we converted each telecoms provider's datasets from circuits to circuit ends.

A12.21 Following this, there were some data anomalies specific to each telecoms provider that we needed to address. For example, for those telecoms providers who responded with a list of orders rather than active circuits, we dropped all orders that were classed as administrative changes. This was to avoid overestimating the number of circuits supplied by these telecoms providers.[167] Through this process, we dropped 16,120 circuit ends from the inventory dataset [✂] and 4,962 circuit ends from the connections dataset [✂].

A12.22 [✂].

A12.23 Following this, a matching exercise between the different datasets submitted by each telecoms provider had to be carried out on an individual basis. While some variables were required for both the inventory and the connections datasets, they might have only been provided in the inventory data (i.e. they were missing from the connections data). In these cases, we matched the responses based on a unique ID, which, depending on the telecoms provider, might have been an order number, a circuit ID, or a site ID.

A12.24 After having carried out all the steps described above, we obtained raw datasets containing 1,005,574 observations in the inventory dataset, 92,079 in the MNO inventory dataset, and 167,496 in the connections dataset.

## Data cleaning

A12.25 Due to differences in telecoms providers' internal systems and the complexity of the data requested, the way information was reported for each variable varied widely across telecoms providers. We therefore had to make sure that information was recoded in a consistent manner for the variables used in our analysis. Below, we describe the steps that we undertook to clean the data, which we applied consistently throughout the inventory dataset, the MNO inventory dataset and the connections dataset.

### CI products

[167] This was only possible in cases where the telecoms provider included some sort of order type variable indicating whether the order was a new order or an administrative change.

A12.26 We looked for key words of products, interfaces, and physical links that we wanted to exclude. We then flagged these exclusions via the dummy variable *productmarket*, which takes on a value of one if the product does belong to the CI markets, zero otherwise. We assumed that any circuits in our dataset not flagged for exclusion are part of a relevant CI product market.[168]

A12.27 We have excluded the following categories of circuits:

- circuits classed as analogue, PDH/SDH[169], time division multiplex (TDM), radio base station (RBS), KiloStream, and MegaStream on the basis that these are Traditional Interface (TI) circuits;[170]
- Cablelink circuits, as these are only used for access to network equipment within a BT exchange or to connect to infrastructure close to a BT exchange, which means that they are not end-to-end access or inter-exchange circuits;
- leased lines used for specialist applications such as CCTV, Broadcast, and Street Access;[171]
- business-grade connectivity services provided over Ethernet in the first mile (EFM) and asymmetric broadband, captured by the digital subscriber line (DSL) category;[172]
- wavelength division multiplex (WDM) bearers, as the presence of wavelengths would lead to double counting of circuits; and
- circuits transmitted via radio, as these are not included in any of the relevant markets for this BCMR.

A12.28 The full rationale behind the exclusions of these circuits is set out in the CI Access product market definition, which can be found in Section 4 of Volume 1.

A12.29 The result of this process is that 14.85% of circuit end observations are excluded from the CI markets in the inventory dataset, 61.19% in the MNO inventory dataset, and 3.81% in the connections dataset (Table A12.1). We therefore reduced the number of observations to 856,285 in the inventory dataset, 35,737 in the MNO inventory dataset, and 161,119 in the new connections dataset.

[168] In this process, we had to make some assumptions. For example, we assume that circuits labelled "Private line" are TDM circuits, which fall outside the scope of this BCMR (this is about 1,127 circuit ends in the inventory dataset and 12 ends in the new connections dataset).
[169] Plesiochronous / synchronous digital hierarchy
[170] In the MNO inventory dataset, we have also excluded managed connectivity products based on TI (MEAS E1X15, MEAS E1X2, MEAS E1X25 and MEAS E1X7).
[171] See Section 4 of Volume 1, paragraph 4.15.
[172] See Section 4 of Volume 1, paragraphs 4.34, 4.37, and 4.77.

**Table A12.1: CI products identification**

| Circuit end observations* | Inventory | MNO inventory | Connections |
|---|---|---|---|
| **All products** | 1,005,574 | 92,079 | 167,496 |
| **Non-CI products** | 149,289 (14.85%) | 56,34 (61.19%) | 6,377 (3.81%) |
| **CI products** | 856,285 (85.15%) | 35,737 (38.81%) | 161,119 (96.19%) |

*Source: Ofcom's analysis of the stakeholder responses to the 1st and 5th BCMR s.135 notices*
**At this stage of data processing, a circuit end may be captured by more than one observation where it is supplied by one telecoms provider to another. In this case, the circuit end will be classified as "on-net" for the telecoms provider who supplies it using their own network and as "off-net" for the purchasing telecoms provider.*

### Dark fibre

A12.30 To flag dark fibre circuit ends, we standardised the dark fibre field using regular expressions. We generated a *df* variable to take on a value of one if that circuit end belongs to a dark fibre circuit, zero otherwise. We also carried out an additional step where we used a combination of the dark fibre variable and the customer name to identify dark fibre circuits sold to other telecoms providers in the dataset, which are flagged via the *dfcp* variable. These circuits appeared in our data twice: once as a passive circuit for the telecoms provider who leased the circuit, and again as an active circuit for the telecoms provider who purchased it. We therefore removed one of these from service share analysis to avoid double counting. The numbers of circuit ends removed from the inventory dataset and the connections data set are summarised in Table A12.2 below. This step does not result in any changes in the MNO inventory dataset.

**Table A12.2: Dark fibre identification**

| Circuit end observations* | Inventory | Connections |
|---|---|---|
| **CI products** | 856,285 | 161,119 |
| **Dark fibre supplied to other telecoms providers** | 4,342 (0.51%) | 387 (0.24%) |
| **CI excluding dark fibre supplied to other telecoms providers** | 851,943 (99.49%) | 160,732 (99.76%) |

*Source: Ofcom's analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices*
**At this stage of data processing, a circuit end may be captured by more than one observation where it is supplied by one telecoms provider to another. In this case, the circuit end will be classified as "on-net" for the telecoms provider who supplies it using their own network and as "off-net" for the purchasing telecoms provider.*

### On-net

A12.31 We carried out a similar exercise to standardise the on-net field: we used regular expressions to recode the variable to take on a value of one when that circuit end is on-net and zero for off-net. For circuit ends with missing on-net classification, we followed a conservative approach and included them in our service share analysis (to the extent we were able to identify their geographic location – see below). The results of this step are summarised in Table A12.3. On-net classification is not relevant for the MNO inventory dataset, which we only use to determine the locations of MNO cell sites.

**Table A12.3: On-net and off-net circuit ends**

| Circuit end observations | Inventory | Connections |
|---|---|---|
| **CI excluding dark fibre supplied to other telecoms providers** | 851,943 | 160,732 |
| **On-net** | 724,883<br>(85.09%) | 137,535<br>(85.57%) |
| **Off-net** | 85,938<br>(10.09%) | 16,517<br>(10.28%) |
| **Unclassified** | 41,122<br>(4.83%) | 6,680<br>(4.16%) |
| **CI wholesale (on-net and unclassified)** | 766,005<br>(89.91%) | 144,215<br>(89.72%) |

*Source: Ofcom's analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices*

A12.32 About 97% of the unclassified circuit ends in the inventory dataset and 99% in the connections dataset are due to Virgin Media's missing data; this represents about 26% of Virgin Media's circuit ends in the inventory dataset and 25% in the connections dataset.[173] Under our approach explained above, all of these circuit ends will be included in further analysis leading to the calculation of service shares. However, many of them may in fact be off-net and should therefore be excluded. This means there is a significant risk that Virgin Media's volumes and services shares based on the inventory dataset are materially overstated.

### Postcode

A12.33 To determine the geographic location of each circuit end, we need to have a valid postcode. Therefore, we cleaned the postcode field and validated the list of postcodes of our raw dataset by matching it with the list of postcodes provided by Miso. The objective

[173] After the application of the additional cleaning steps described below, some circuit ends with missing on-net classification as well as known on-net classification are removed from the datasets. The resulting share of Virgin Media's circuit ends with missing on-net classification decreases to about [✂]% of the connections dataset but increases to about [✂]% of the inventory dataset.

of this was to flag incorrect postcodes and postcodes that are no longer in use or outside the UK, as we are unable to allocate circuit ends with such postcodes into a geographic market. We did this both by postcode and by postcode sector, as some postcodes may be invalid but still belong to a valid postcode sector. With missing postcodes, we refer to both completely blank entries and to observations for which information was provided but did not match the UK postcode format. With invalid postcodes we refer to postcodes that matched the UK postcode format but were not matched to the Miso postcode list, while valid postcodes had both the required format, and were matched to the Miso list.

A12.34 In the connections dataset, a significant proportion of circuit ends with a missing postcode are [✂]'s circuit ends that do not represent a customer end. This is because some types of order[174] only relate to one customer end per circuit or because some products[175] only have one customer end per circuit. Circuit ends that do not represent a customer end are not relevant to our analysis of the CI Access market. To exclude them, we have applied a set of rules provided by [✂] which identifies the number of relevant customer ends per circuit based on the order type and product. This way, we removed a total of 5,444 irrelevant circuit ends with a blank postcode from the connections dataset.

A12.35 The results of postcode validation, after the removal of irrelevant circuit ends with a blank postcode from the connections dataset, are presented in Table A12.4 for our three datasets.

**Table A12.4: Missing and invalid postcodes and postcode sectors for CI wholesale circuit ends**

| | Inventory | MNO inventory | Connections |
|---|---|---|---|
| **CI wholesale (on-net and unclassified), of which:** | 766,005 | 35,737 | 138,771 |
| **Missing postcode** | 21,093 (2.75%) | 449 (1.26%) | 5,352 (3.86%) |
| **Invalid postcode** | 37,277 (4.87%) | 703 (1.97%) | 4,812 (3.47%) |
| **Valid postcode** | 707,635 (92.38%) | 34,585 (96.78%) | 128,607 (92.68%) |
| | | | |
| **Missing postcode sector** | 19,842 (2.59%) | 187 (0.52%) | 5,226 (3.77%) |
| **Invalid postcode sector** | 3,061 (0.40%) | 300 (0.84%) | 253 (0.18%) |
| **Valid postcode sector** | 743,102 (97.01%) | 35,250 (98.64%) | 133,292 (96.05%) |

*Source: Ofcom's analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices*

A12.36 About 71% of the missing and invalid postcode sectors in the connections dataset are due to Virgin Media's missing data; this represents about 22% of Virgin Media's circuit ends. With postcode sector missing or invalid, we cannot classify the circuit ends into the relevant geographic market. Given that Virgin Media is the largest rival to BT, there is a risk

[174] E.g. change of address
[175] E.g. Internet Protocol Virtual Private Network

of materially understating BT's service shares in those markets. We have sought to address this issue by assuming that Virgin Media's customer ends with missing and invalid postcode sectors follow the same distribution as Virgin Media's customer ends with valid postcode sectors, using this to apply an uplift those of Virgin Media's customer ends with valid postcode sectors (see the section "Blank postcode sector uplift" below, starting at A12.73).

### Network sites

A12.37 Another crucial step of data cleaning is to determine whether a circuit terminates at a customer or network site. This is because we only want to include circuit ends that belong to the access portion of the network for access service shares calculations. This means that we needed to identify and exclude all the circuit ends that correspond to BT exchanges, KCOM exchanges, data centres[176] and other network sites.[177]

A12.38 As we asked telecoms providers to identify whether each circuit end terminates in a customer site or network node, we first standardised their responses through the *endtype* variable.[178] We searched for key words such as "exchange", "pop", or "data centre" to generate four variables that indicate whether that circuit end is located at a BT exchange, data centre, the telecoms provider's own network site, or another telecoms provider's network site.

A12.39 However, as most telecoms providers were not able to fully answer this question or provided ambiguous classifications, we needed to find other ways of identifying network sites for blank or invalid entries. Therefore, we matched our dataset with three lists of postcodes: one containing all postcodes belonging to data centres,[179] one containing all BT exchange postcodes, and finally one containing all other network sites postcodes as identified by all the telecoms providers in our dataset.[180]

A12.40 We then combined the output of the *endtype* variable and the result of the postcode match into five single variables (*btexchange*, *kcomexchange*, *dc*, *ownnetworksite*, *othernetworksite).*[181] We assumed that a single postcode corresponds to a BT exchange or a data centre if it is identified by either the *endtype* variable or the postcode match. The approach we took for other types of network sites was slightly different. As we recognised that the list of network sites we used for matching may overstate the actual number of network sites, we only used the result of the postcode matching if the "*endtype*" variable was left blank by the telecoms provider. This ensured that whenever a circuit end is flagged as a customer site, it was treated as one regardless of whether its postcode also matches a network site.

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[176] For the reasons outlined in Section 7 we treat data centres as equivalent to network sites.
[177] MNO base stations are treated as customer sites for the purposes of the leased lines market.
[178] This variable describes whether each end is a customer site or a network node.
[179] This list was compiled based on online information via the data centre map and individual data centre websites.
[180] The lists of BT exchanges and network site postcodes were provided in response to Section B of the 1st BCMR s.135 Notice.
[181] These are indicator variables which identify whether the circuit terminates in a BT exchange, a data centre, the telecoms provider own network site, or another telecoms provider network site (respectively).

A12.41 The results of the network site identification process are provided in Table A12.5 below. This table shows that to define the CI Access market to be used for our service shares analysis we exclude around 52% of all circuit ends in the inventory data, around 27% in the MNO inventory, and around 50% in the connections dataset, as we identified these as network sites.[182]

**Table A12.5: Network sites and customer sites by dataset**

| | Inventory | MNO inventory | Connections |
|---|---|---|---|
| **CI wholesale (on-net and unclassified), of which:** | 766,005 | 35,737 | 138,771 |
| **Network sites** | 397,508 (51.89%) | 9,527 (26.7%) | 72,357 (52.14%) |
| **Customer sites** | 349,952 (45.69%) | 26,210 (73.3%) | 61,218 (44.11%) |
| **Unknown*** | 18,545 (2.42%) | - | 5,196 (3.74%) |

*Source: Ofcom's analysis of stakeholder responses the 1st and 5th BCMR s.135 Notices*
**Circuit ends with missing postcodes where the data provider has not identified the circuit end type*

A12.42 For about 2% of the circuit ends in the inventory dataset and about 4% of the circuit ends in the connections dataset, we could not apply either of the above methods of classifying them as network sites or customer sites, as both *endtype* and *postcode* are missing. Most notably, about 22% of Virgin Media's circuit ends in the connections dataset and 4% of its circuit ends in the inventory dataset cannot be classified using the above rules. Some of these circuit ends may be located at the various type of network sites that we would be able to identify if we could use a postcode match. In the absence of postcode information, for the purposes of calculating service shares, we have assumed that the distribution of network sites and customer sites is the same as for Virgin Media's circuit ends with known postcodes.

A12.43 Table A12.6 below provides the result of network site identification process by telecoms provider for the inventory and connections datasets. As seen from the table, we exclude around [✂]% of Openreach's circuit ends in the inventory data (53.11% in the connections) because these terminate in network sites.

**Table A12.6: Network sites and customer sites by telecoms provider and dataset**

| | Inventory | | | Connections | | |
|---|---|---|---|---|---|---|
| **Telecoms Provider** | **Network Sites** | **Customer Sites** | **Unknown*** | **Network Sites** | **Customer Sites** | **Unknown*** |
| **CityFibre** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |

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

| | | | | | | |
|---|---|---|---|---|---|---|
| **Colt** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **EU Networks** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Fibrespeed** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Interoute** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Kcom** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Level3** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **MS3** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Openreach** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **SSE** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Surf** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Verizon** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Virgin Media** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Vodafone** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |
| **Zayo** | [✂] | [✂] | [✂] | [✂] | [✂] | [✂] |

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

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

A12.44 Table A12.7 below shows the effect of network site exclusions to shares of circuit end supplied by each telecoms provider. [✂].

**Table A12.7: Shares before and after network site exclusion, by telecoms provider and dataset**

| | Inventory | | Connections | |
|---|---|---|---|---|
| **Telecoms Provider** | **Before exclusion of network sites** | **After exclusion of network sites** | **Before exclusion of network sites** | **After exclusion of network sites** |
| **CityFibre** | [✂] | [✂] | [✂] | [✂] |
| **Colt** | [✂] | [✂] | [✂] | [✂] |
| **Eu Networks** | [✂] | [✂] | [✂] | [✂] |
| **Fibrespeed** | [✂] | [✂] | [✂] | [✂] |
| **Interoute** | [✂] | [✂] | [✂] | [✂] |
| **Kcom** | [✂] | [✂] | [✂] | [✂] |
| **Level3** | [✂] | [✂] | [✂] | [✂] |
| **MS3** | [✂] | [✂] | [✂] | [✂] |

| | | | | |
|---|---|---|---|---|
| **Openreach** | [✂] | [✂] | [✂] | [✂] |
| **SSE** | [✂] | [✂] | [✂] | [✂] |
| **Surf** | [✂] | [✂] | [✂] | [✂] |
| **Verizon** | [✂] | [✂] | [✂] | [✂] |
| **Virgin Media** | [✂] | [✂] | [✂] | [✂] |
| **Vodafone** | [✂] | [✂] | [✂] | [✂] |
| **Zayo** | [✂] | [✂] | [✂] | [✂] |

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

A12.45 In Section 7, we set out our view that carrier neutral data centres tend towards effective competition. [✂].

**Table A12.8: Share of circuit ends terminating in data centres by telecoms provider (column totals, CI wholesale, excluding off-net ends)**

| | Inventory | | Connections | |
|---|---|---|---|---|
| **Telecoms Provider** | **Data Centres** | **Carrier Neutral Data Centres** | **Data Centres** | **Carrier Neutral Data Centres** |
| **CityFibre** | [✂] | [✂] | [✂] | [✂] |
| **Colt** | [✂] | [✂] | [✂] | [✂] |
| **Eu Networks** | [✂] | [✂] | [✂] | [✂] |
| **Fibrespeed** | [✂] | [✂] | [✂] | [✂] |
| **Interoute** | [✂] | [✂] | [✂] | [✂] |
| **Kcom** | [✂] | [✂] | [✂] | [✂] |
| **Level3** | [✂] | [✂] | [✂] | [✂] |
| **MS3** | [✂] | [✂] | [✂] | [✂] |
| **Openreach** | [✂] | [✂] | [✂] | [✂] |
| **SSE** | [✂] | [✂] | [✂] | [✂] |
| **Surf** | [✂] | [✂] | [✂] | [✂] |
| **Verizon** | [✂] | [✂] | [✂] | [✂] |
| **Virgin Media** | [✂] | [✂] | [✂] | [✂] |
| **Vodafone** | [✂] | [✂] | [✂] | [✂] |
| **Zayo** | [✂] | [✂] | [✂] | [✂] |

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

### Bandwidth

A12.46 We requested information on both the bearer bandwidth and the bandwidth sold, and while we standardised both variables, we used the bandwidth sold to define the bandwidth categories used for our service share analysis. This is because prices are typically based on the bandwidth sold rather than bearer bandwidth.[183] The process implemented to standardise these variables used regular expressions to identify the number provided in the bandwidth field. We started with the assumption that the number is provided in Mbit/s. However, when the unit of measurement is provided, we identified this and made the appropriate conversions to Mbit/s. Following these steps, there was missing bandwidth sold information for 30,485 (8.32%) customer ends in the inventory dataset, 134 (0.51%) in the MNO inventory, and 512 (0.79%) in the connections dataset for the CI access wholesale market (excluding off-net ends).

### Dig variables

A12.47 In order to inform our analysis of digging behaviour contained in Annex 11, we asked telecoms providers to indicate whether each on-net circuit end in the connections dataset was connected using existing fibre, existing duct, or if digging was required. In addition, for the connections that involved digging, we asked telecoms providers to supply a series of statistics such as the actual distance dug, the distance from the closest flexibility point, and the total cost of connecting to the building. After recording their responses, some processing was required for these variables. This derives from two issues:

- the data has been converted from circuits to circuit ends; and
- dig statistics have been provided at the circuit level.

A12.48 This means that even though we do not know which end of the circuit involved digging, the format of our dataset and the data being provided at the circuit level would lead to us finding that whenever there was digging, it always happened at both ends of the circuit. Doing so may overstate the amount of actual digging and skew the statistics around the distances dug and costs of digging. To address this issue, we generated a list of new variables (*dig1, distance1, flexdistance1, totalcost1)*[184] where we allocate all the dig statistics to the access end of the circuit. This means that whenever the circuit begins and terminates in an access site we randomly allocate the dig statistics, with a chance of doing so for the wrong end. However, we estimate that the instances of customer-to-customer digs to be less than 5% of all digs in the connections dataset, and we therefore work with the random allocation of digs.

A12.49 Using the connections dataset, we then carry out some additional steps to create a separate dataset to inform our analysis of digging behaviour contained in Annex 11. We first remove all circuit ends that do not fall within the CI Access services market. Second,

[183] In addition, most telecoms providers only supplied this information.
[184] These variables describe, respectively: whether digging was required, the actual distance dug for connections involving digging, the distance between the newly connected building and the nearest flexibility point, and the total cost of connecting to the building.

for the purposes of this analysis only, we remove all circuits ends with missing on-net classifications and recode the dig variable so that all off-net circuits with a positive dig variable are treated as connections that did not involve digging.

A12.50 We then add in the relevant geographic areas and network reach buckets, as defined below, to calculate a series of statistics related to the dig variables. In doing so, we make the assumption that all circuits classed as on-net that did not involve digging were already duct connected, regardless of whether the *existingductonly* and *existingductandfibre* variables were filled in or not. [185] Most telecoms providers did not provide complete answers regarding these variables, as they were unable to comment on the infrastructure of newly connected circuits that did not involve digging. For example, the variable *existingductonly* is missing 58,852 observations (32.96%), while the variable *existingductandfibre* has 58,423 (32.72%) missing values. [✂].[186] We therefore find it reasonable to assume that if digging was not required to connect an on-net circuit, duct was already in place. Similarly, we assume that all on-net circuits that had to be connected through digging required new duct to be put in place.

### Output datasets

A12.51 We use a combination of the circuit's contract start date and the source of the data to define our three datasets of interest - i.e. the inventory dataset, to be used for the Hull Area service shares analysis and sensitivities, the MNO inventory dataset, to be used in our network reach analysis, and the connections dataset, to be used for our service shares analysis. As we are only interested in the CI Access market, we filter these three datasets to exclude any circuit ends that are not part of the relevant product market: BT exchanges, data centres, network sites, dark fibre circuits sold to any telecoms providers in our dataset, and off-net ends. We are therefore left with 366,553 customer ends in the inventory dataset, 26,210 in the MNO inventory, and 64,789 in the connections dataset.

A12.52 After having carried out all the steps described above, some information is still missing for our key variables of interest. These are presented in Table A12.9 below.

**Table A12.9: Missing key variables**

| | Inventory | | Connections* | |
|---|---|---|---|---|
| | All | Virgin Media | All | Virgin Media |
| **CI Access, of which:** | 366,553 | [✂] | 64,789 | [✂] |
| **Unknown if on-net or off-net** | 29,842 (8.14%) | [✂] 30-40% | 765 (1.18%) | [✂] 0-10% |
| **Missing or invalid postcode** | 37,099 (10.12%) | [✂] 0-10% | 5,322 (8.21%) | [✂] 20-30% |

[185] These variables describe, respectively: whether the circuit was connected using existing duct but not fibre, and whether the circuit was connected using existing duct and fibre.
[186] [✂].

| | | | | |
|---|---|---|---|---|
| **Missing or invalid postcode sector** | 19,361 (5.28%) | [✂] 0-10% | 3,748 (5.78%) | [✂] 20-30% |
| **Missing bandwidth** | 30,485 (8.32%) | [✂] 20-30% | 512 (0.79%) | [✂] 0-10% |

*Source: Ofcom circuit data analysis*

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

A12.53 As the second largest supplier of leased lines, Virgin Media's data is key to reliably estimating service shares. However, Virgin Media has pointed out various issues affecting the accuracy of its inventory data. The data submitted by Virgin Media may include inactive circuits. [✂]. Also, the same circuit may be included more than once, [✂].[187] Overall, Virgin Media has identified about [✂].[188] We therefore have serious concerns regarding the accuracy of the inventory data and believe that using it for service shares analysis could materially overstate the number of circuit ends provided by Virgin Media.

A12.54 Virgin Media's connections dataset is not subject to the issues described above, as the data is taken from a [✂] different database. However, it contains a [✂] proportion of missing postcodes. As described above, we have addressed this issue by applying the same geographic distribution as the customer ends with known postcode information. This uplift is described in more detail below. This dataset also contains a proportion of circuit ends with missing on-net classification. For these, we took a conservative approach and included them in our analysis, as described above.

A12.55 We therefore decided to use the connections dataset for our service share analysis. However, we still use the inventory dataset for service shares analysis in the Hull Area, as Virgin Media is a smaller player in this area (it supplies [✂] CI Access circuit ends in the Hull Area, which are about [✂] 0-10% of all circuit ends terminating in the Hull Area), meaning that the quality of its data would have a negligible impact. We also use the inventory dataset for some of our sensitivity analysis (see Annex 13), though noting that it is likely to overstate Virgin Media's service share.

A12.56 The extent of missing on-net/off-net information in Virgin Media's inventory data [✂] 30-40% of their circuit ends classified as CI Access based on the above rules) means there is a risk of Virgin Media's inventory service shares being overstated and, consequently, BT's service shares understated. This is because Virgin Media's circuit ends with missing on-net/off-net classification are likely to include a proportion of circuit ends that are in fact delivered off-net and should be excluded from the CI Access market. However, based on the information provided, we are unable to identify those circuit ends. The inventory service shares provided in Annex 13 should therefore be interpreted having regard to the potential understatement of BT's service shares.

[187] Virgin Media response to 1st BCMR s.135 notice.

[188] Information provided by Virgin Media in connection with its response to the 1st BCMR s.135 notice in a meeting between Ofcom and Virgin Media on 4 April 2018.

A12.57 Another limitation is the extent of missing bandwidth information in the inventory data, which makes any analysis of VHB inventory service shares unreliable. There are 10,109 circuit ends identified as VHB, compared to 32,243 circuit ends with missing bandwidth. The latter are likely to include a proportion of VHB circuit ends that are not currently classified as such. Much of the missing bandwidth is due to Virgin Media's inventory data. However, 24,568 (76%) of the circuit ends with missing bandwidth are also missing on-net/off-net information, while 2,665 (26%) of the circuit ends identified as VHB are missing on-net/off-net information. In Virgin Media's inventory data, [✂] circuit ends are identified as VHB, of which [✂] (73%) are missing on-net/off-net information. Due to the large scope for error, we consider there is a high risk that any VHB service shares calculated based on the inventory data would be distorted.

## CI Access network reach analysis

A12.58 Business and mobile site customers require a physical network, most commonly using copper wire, optical fibre, radio or coaxial cable, to be able to receive connectivity services.

A12.59 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. We obtained business site locations from Market Location and gathered mobile site and network location information from telecoms infrastructure providers who own or have access to physical network infrastructure.

A12.60 From these sets of data, we were able to conduct our access network reach analysis which assesses the extent to which Openreach's (and KCOM's in the Hull Area) competitors have laid their own networks in different parts of the UK to serve the needs of business consumers and mobile cell sites.[189]

A12.61 In this review, the focus of our analysis in the access network is on the percentage of large businesses and mobile sites within a buffer distance of rival telecoms providers. For this measure we consider the number of rival telecoms network infrastructure within a buffer distance of 50m of each large business and mobile site. For each postcode sector, we translate this to a cumulative figure looking at the percentage of large businesses and mobile sites within a buffer distance of zero or more rival telecoms infrastructure providers, one or more rival telecoms infrastructure providers, etc. out of all large businesses and mobile sites in the postcode sector.

A12.62 For postcode sectors without any large business or MNO sites located within their boundaries (see Table A12.10 below), we nominally 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 assessment of geographic competition in the CI Access services market.

[189] In this BCMR we find that BT has SMP in the UK (excluding the CLA and Hull Area), where Openreach has access to network infrastructure such as ducts and fibre, whereas downstream BT does not.

A12.63 For example, a postcode sector with 50% of its large business and MNO sites within 50m of two or more rival telecoms infrastructure providers, 75% within 50m of one or more rival telecoms infrastructure providers, and 100% within 50m of zero or more rival telecoms infrastructure providers, will be classified as BT+1 rival telecoms infrastructure providers since at least 65%[190] of its large business and MNO sites are within one or more rival telecoms infrastructure providers.

## Geographic access market classification methodology

### UK excluding the Hull Area

A12.64 The demand and supply of leased lines in the CI Access services market is geographically diverse. In the 2016 BCMR we recognised this diversity by finding that no provider had SMP in the Central London Area (CLA), while in the Temporary Conditions we found that no provider had SMP in either the CLA or the Central Business Districts (CBDs) of Birmingham, Glasgow and Leeds.

A12.65 In this BCMR, we recognise that the CLA is different to the rest of the UK, resulting in this geographic area being separated out from the classification process.

A12.66 For the rest of the UK excluding the Hull Area, we reflect this geographic leased line diversity in the CI Access market by classifying areas, specifically postcode sectors, into varying levels of competitiveness.

A12.67 This involves applying a threshold of 65% to the cumulative percentage of large businesses and mobile sites within a buffer distance of 50m of rival telecoms infrastructure providers. Performing this process on each postcode sector in the UK excluding the Hull Area separates it into the following areas of competition:

- the CLA;
- postcode sectors where only BT is present (BT Only);
- postcode sectors where BT plus a rival telecoms infrastructure provider is present (BT+1); and
- postcode sectors where BT plus at least another two rival telecoms infrastructure providers are present, known as High Network Reach (HNR) areas.

A12.68 The distribution of this separation of postcode sectors in the UK excluding the Hull Area into areas of competition is shown in Table A12.10. Approximately 8% of postcode sectors do not have a large business or mobile site within their boundaries, with 54% of these being classified as BT Only.

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

**Table A12.10: The number of postcode sectors with no large business/mobile sites in the UK excluding the Hull Area**

| Areas of competition | Number of postcode sectors with no large business/mobile sites | Number of postcode sectors |
|---|---|---|
| CLA | 5 | 276 |
| BT Only | 433 | 5,807 |
| BT+1 | 270 | 3,569 |
| HNR areas | 87 | 318 |
| UK excluding the Hull Area | 795 | 9,970 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

A12.69 We next consider the potential for competition in metropolitan areas outside of the CLA which have been classified as HNR areas by looking at the top six postcode areas ranked by customer ends connected in 2017.

A12.70 This results in six metropolitan areas being identified as potential geographic markets: Birmingham, Bristol, Edinburgh, Glasgow, Leeds and Manchester.

**Table A12.11: The number of postcode sectors and large business/mobile sites within each geographic market in the UK excluding the Hull Area**

| Geographic Market | Number of postcode sectors | Number of large business and mobile sites |
|---|---|---|
| CLA | 276 | 4,724 |
| Birmingham | 9 | 324 |
| Bristol | 10 | 345 |
| Edinburgh | 20 | 665 |
| Glasgow | 19 | 701 |
| Leeds | 14 | 493 |
| Manchester | 33 | 704 |
| Combined metropolitan areas | 105 | 3,232 |
| HNR areas (inc. Metro Areas) | 318 | 7,182 |
| UK exc. the Hull Area BT+1 | 3,569 | 74,735 |
| UK exc. the Hull Area BT Only | 5,807 | 93,829 |
| UK exc. the Hull Area | 9,970 | 180,470 |

*Source: Ofcom analysis of Miso postcode information, Market Location business information, and stakeholder responses to the 1st and 5th BCMR s.135 notices.*

**Table A12.12: The percentage of large businesses and mobile sites within 50m of rival telecoms providers for each geographic market in the UK excluding the Hull Area**

| Geographic Market | Percentage of large businesses and mobile sites within 50m of rival telecoms infrastructure providers | | |
|---|---|---|---|
| | No rivals | 1 rival | 2 or more rivals |
| CLA | 3% | 6% | 90% |
| Birmingham | 3% | 13% | 84% |
| Bristol | 3% | 7% | 90% |
| Edinburgh | 4% | 13% | 83% |
| Glasgow | 2% | 8% | 91% |
| Leeds | 2% | 6% | 92% |
| Manchester | 3% | 5% | 91% |
| Combined metropolitan areas | 3% | 9% | 89% |
| HNR areas (inc. Metro Areas) | 3% | 13% | 83% |
| UK exc. the Hull Area BT+1 | 15% | 70% | 15% |
| UK exc. the Hull Area BT only | 78% | 19% | 4% |
| UK exc. the Hull Area | 47% | 39% | 14% |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

### The Hull Area

A12.71 The Hull Area is recognised as a separate geographic market. We do not further separate it into competitive levels but consider it as a whole.

**Table A12.13: The number of postcode sectors and large business/mobile sites within the Hull Area**

| Geographic Market | Number of postcode sectors | Number of large business and MNO sites |
|---|---|---|
| The Hull Area | 59 | 1,164 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

**Table A12.14: The percentage of large businesses and mobile sites within 50m of rival telecoms infrastructure providers for each geographic market in the UK excluding the Hull Area**

| Geographic Market | Percentage of large businesses and mobile sites within 50m of rival telecoms infrastructure providers | | |
|---|---|---|---|
| | No rivals | 1 rival | 2 or more rivals |
| The Hull Area | 80% | 17% | 3% |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

### Dark fibre adjustment

A12.72 We recognise that CityFibre's dark fibre connections are primarily used in providing circuits at 1 Gbit/s and below.[191] To cater for this when it comes to customer end volumes based on bandwidth, we assign 95% of CityFibre's dark fibre circuits to bandwidths 1 Gbit/s and below[192], and the remaining 5% are assigned to the 10 Gbit/s bandwidth.

A12.73 Other telecoms providers' dark fibre circuits are completely assigned to the 10 Gbit/s bandwidth.

### Blank postcode sector uplift

A12.74 As shown in Table A12.9 above, a material proportion of Virgin Media's new connection customer ends do not have an associated postcode or postcode sector. This means we cannot classify these customer ends into a geographic market using the above described methodology, since we do not know where in the UK these customer ends are located.

A12.75 We account for this material proportion of customer ends, which would otherwise be excluded from our subsequent analyses due to their unknown locations, by uplifting Virgin Media's customer ends with known locations (i.e. those customer ends with associated postcodes and postcode sectors).

A12.76 This uplifting process works by:

- using the ratio of customer ends to network ends in Virgin Media's new connection circuit ends with known locations, we identify the volume of circuit ends that are customer ends among those circuit ends with unknown locations; and
- we then distribute these identified customer ends with unknown locations among those customer ends with known locations based on the latter's existing geographic distribution.

A12.77 Applying this process results in the volume of Virgin Media's customer ends with known locations, uplifted using customer ends with unknown locations, to be used for subsequent analyses.

## Service share analysis

### Wholesale service shares

A12.78 Our service share analysis looks at the shares of different types of leased lines that telecoms infrastructure providers supply.

[191] See Annex 14.

[192] Split evenly between the 10 Mbit/s, 100 Mbit/s, and 1 Gbit/s bandwidths.

A12.79 The focus of our service share (market share) analysis is on the CI Access services market, so it is based on circuit ends terminating at customer sites, while those terminating at telecoms providers' network sites are excluded.

A12.80 A telecoms infrastructure provider's wholesale service share is calculated as the proportion of a telecoms infrastructure provider's customer ends of all telecoms infrastructure providers customer ends. For example, if a provider has four out of ten customer ends in an area, then that provider's service share in that area is 40%.

### UK excluding the Hull Area

A12.81 In the UK excluding the Hull Area, wholesale service shares are calculated using 2017 customer end connections.

A12.82 Table A12.15 below shows the wholesale service shares for each geographic market we identify above and for each bandwidth grouping.

**Table A12.15: Number of new customer end connections in 2017 and Openreach's wholesale market service shares (%), by geographic market**

| Geographic Market | Number of new customer end connections in 2017 | | | Openreach Wholesale Service Share (%) | | |
|---|---|---|---|---|---|---|
| | All bandwidths[193] | LB | VHB inc. DF | All | LB | VHB inc. DF[194] |
| CLA | 7,719 | 7,242 | 456 | [✂] 61% - 70% | [✂] 61% - 70% | [✂] 21% - 30% |
| Birmingham | 230 | 224 | 5 | [✂] 51% - 60% | [✂] 51% - 60% | - |
| Bristol | 268 | 263 | 4 | [✂] 61% - 70% | [✂] 61% - 70% | - |
| Edinburgh | 443 | 424 | 18 | [✂] 51% - 60% | [✂] 51% - 60% | - |
| Glasgow | 402 | 394 | 7 | [✂] 61% - 70% | [✂] 61% - 70% | - |
| Leeds | 300 | 293 | 7 | [✂] 61% - 70% | [✂] 61% - 70% | - |
| Manchester | 439 | 428 | 8 | [✂] 61% - 70% | [✂] 71% - 80% | - |
| Combined metropolitan areas | 2,082 | 2,026 | 49 | [✂] 61% - 70% | [✂] 61% - 70% | - |
| HNR areas inc. Metro Areas | 4,040 | 3,888 | 139 | [✂] 61% - 70% | [✂] 61% - 70% | [✂] 51% - 60% |
| UK exc. the Hull Area BT+1 | 21,241 | 20,636 | 520 | [✂] 61% - 70% | [✂] 71% - 80% | [✂] 51% - 60% |
| UK exc. the Hull Area BT only | 30,004 | 29,193 | 755 | [✂] 81% - 90% | [✂] 81% - 90% | [✂] 61% - 70% |
| UK exc. the Hull Area | 63,004 | 60,959 | 1,871 | [✂] 71% - 80% | [✂] 71% - 80% | [✂] 41% - 50% |

[193] This includes 2,017 new customer end connections with unknown bandwidths.

[194] Note that the VHB (inc. DF) service shares for the Metro Areas are not presented here due to the low number of VHB (inc. DF) new customer end connections in 2017.

*Source: Ofcom analysis of telecoms providers' responses to the 1st and 5th BCMR s.135 notices.*

### The Hull Area

A12.83 In the Hull Area, wholesale service shares are calculated using the inventory of customer ends.

A12.84 Table A12.16 below shows the wholesale service shares for each geographic market we identify above and for each bandwidth grouping.

**Table A12.16: Number of customer ends and KCOM's wholesale market service shares (%) in the Hull Area**

| Geographic Market | Number of customer ends | | | | KCOM Wholesale Service Share (%) | | |
|---|---|---|---|---|---|---|---|
| | All bandwidths[195] | | LB | VHB (inc. DF) | All | LB | VHB (inc. DF) |
| | The Hull Area | 1,627 | 1,541 | 32 | [✂]% | [✂]% | [✂]% |

*Source: Ofcom analysis of telecoms providers' responses to the 1st and 5th BCMR s.135 notices.*

## Retail service shares

### The Hull Area

A12.85 In the Hull Area, we also consider the service share of the retail leased lines market. This is achieved by considering the customer of a wholesale leased line, compared with the supplier as in wholesale service shares, where that customer is also a telecoms provider, and determining the share of leased lines for each.

**Table A12.17: Telecoms providers' retail market service shares (%) in the Hull Area**

| BT | CityFibre | Colt | Interoute | KCOM | Century-Link |
|---|---|---|---|---|---|
| [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| **MS3** | **Openreach** | **SSE** | **Verizon** | **Virgin** | **Vodafone** |
| [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

[195] This includes 2,017 new customer end connections with unknown bandwidths.

## Retail CI Access service shares

### The Hull Area

A12.86 In the Hull Area, we also consider the service shares of the retail CI Access services market. This is achieved by considering the retail purchases of KCOM's wholesale leased lines – a subset of those considered in retail service shares.

A12.87 In effect, service shares in the retail CI Access market measure the retail shares of telecoms providers who purchase CI access leased lines from KCOM in the Hull Area.

**Table A12.18: Telecoms providers' retail CI Access services market service shares (%) in the Hull Area**

| BT Wholesale | Colt | Interoute | KCOM | CenturyLink | SSE | Virgin | Vodafone |
|---|---|---|---|---|---|---|---|
| [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

# Distance to rival telecoms infrastructure providers' networks

## CI Inter-exchange connectivity market

A12.88 In the CI inter-exchange connectivity market, we consider the average and median distances from BT exchanges to rival telecoms infrastructure providers' networks to give an insight into the distances PCOs would potentially have to dig to connect to a BT exchange.

A12.89 Each PCO's distance to a BT exchange is ranked by their closeness, with averages and medians for these different rankings then calculated. These are shown in Table A12.19 below for each presence classification at a BT exchange.

**Table A12.19: The average and median distance from BT exchanges to PCOs for each BT exchange presence**

| Presence at BT exchange | Average distance (m) to: | | Median distance (m) to: | |
|---|---|---|---|---|
| | 1st closest rival | 2nd closest rival | 1st closest rival | 2nd closest rival |
| BT Only | 6,214 | 12,963 | 2,688 | 5,960 |
| BT+1 | 33 | 1,531 | 25 | 319 |
| BT+2 or more | 24 | 62[196] | 21 | 35 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

[196] This average excludes a single exchange to 2nd closest rival distance which is over 30km. With this outlier included, the average distance is 130m.

## CI Access services market

A12.90 In the CI Access services market, we have considered the proximity of rival telecoms infrastructure providers' networks to customer circuit ends connected in 2017 to give an insight into the distances rivals would potentially have to dig to provide leased lines to customers.

A12.91 Each rival's distance to a customer's 2017 connected circuit end is ranked by their closeness, with averages for these different rankings then calculated. The average distances to the four closest rival telecoms infrastructure providers are shown in Table A12.20 below.

**Table A12.20: The average distance from customer's circuit ends connected in 2017 to rival telecoms infrastructure providers for each geographic market in the UK excluding the Hull Area**

| Geographic Market | Average distance (m) to: | | | |
|---|---|---|---|---|
| | 1st closest rival | 2nd closest rival | 3rd closest rival | 4th closest rival |
| CLA | 16.5 | 25.6 | 34.3 | 46.6 |
| Birmingham | 17.7 | 28.1 | 51.9 | 92.6 |
| Bristol | 16.6 | 45.5 | 64.7 | 177.3 |
| Edinburgh | 19.9 | 39.3 | 134.9 | 291.8 |
| Glasgow | 13.9 | 25.0 | 56.3 | 108.4 |
| Leeds | 18.0 | 26.8 | 41.6 | 91.4 |
| Manchester | 17.2 | 29.2 | 55.7 | 92.3 |
| Combined metropolitan areas | 17.3 | 32.3 | 71.9 | 150.0 |
| HNR areas (inc. Metro Areas) | 21.6 | 42.0 | 102.2 | 266.0 |
| UK exc. the Hull Area BT+1 | 62.8 | 352.3 | 874.6 | 2,054.7 |
| UK exc. the Hull Area BT Only | 1,162.3 | 2,656.1 | 4,871.8 | 8,339.6 |
| UK exc. the Hull Area | 588.6 | 1,412.1 | 2,665.8 | 4,752.0 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

# Further access market analyses

## Average number of rival telecoms infrastructure providers

A12.92 The average number of rival telecoms infrastructure providers within a buffer distance of large businesses and mobile sites is an informative metric as it informs a large business/mobile site in an area that, on average, it will be within a buffer distance of a certain number of rival telecoms infrastructure providers.

**Table A12.21: The average number of rival telecoms infrastructure providers within a buffer distance of 50m of large businesses and mobile sites for each geographic market in the UK excluding the Hull Area**

| Geographic Market | Average number of rivals within 50m |
|---|---|
| CLA | 4.3 |
| Birmingham | 2.6 |
| Bristol | 2.8 |
| Edinburgh | 2.3 |
| Glasgow | 2.5 |
| Leeds | 2.7 |
| Manchester | 2.7 |
| Combined metropolitan areas | 2.6 |
| HNR areas (inc. Metro Areas) | 2.3 |
| UK exc. the Hull Area BT+1 | 1.0 |
| UK exc. the Hull Area BT Only | 0.3 |
| UK exc. the Hull Area | 0.8 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

**Table A12.22: The average number of rival telecoms infrastructure providers within a buffer distance of 50m of large businesses and mobile sites for each geographic market in the Hull Area**

| Geographic Market | Average number of rivals within 50m |
|---|---|
| The Hull Area | 0.2 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

## Circuit density

A12.93 As already mentioned, the demand and supply of leased lines in the UK is geographically diverse. To further highlight this, we have considered the average number of customer

ends connected in 2017 per square kilometre in each of our identified geographic markets, shown in Table A12.23 below.

**Table A12.23: The average number of customer ends connected in 2017 per square kilometre for each geographic market in the UK excluding the Hull Area**

| Geographic Market | Circuit density (per sq km) |
|---|---|
| CLA | 226.6 |
| Birmingham | 143.9 |
| Bristol | 58.2 |
| Edinburgh | 26.6 |
| Glasgow | 65.2 |
| Leeds | 130.4 |
| Manchester | 59.7 |
| Combined metropolitan areas | 53.9 |
| HNR areas (inc. Metro Areas) | 24.3 |
| UK exc. the Hull Area BT+1 | 1.5 |
| UK exc. the Hull Area BT Only | 0.2 |
| UK exc. the Hull Area | 0.3 |

*Source: Ofcom analysis of stakeholder responses to the 1st and 5th BCMR s.135 notices.*

# A13. Detailed geographic analysis

A13.1 Section 5 of Volume 1 presents our geographic analysis of the Contemporary Interface (CI) Access services market, which underpins our relevant geographic market definition. Section 6 presents our analysis of service shares for the relevant geographic markets as part of our significant market power (SMP) analysis. This annex provides the detailed results of our analyses, along with sensitivities to changes of key parameters.

## Summary of our approach to geographic analysis

### Overall approach

A13.2 Our geographic analysis starts by calculating network reach for each business site in the UK. Network reach is defined as the number of rival networks with infrastructure within a given buffer distance of a business site.[197]

A13.3 In geographic market definition, we split out the UK according to postcode sectors with similar network reach. We consider that at least two rival networks are required for an area to be potentially competitive. Having identified the postcode sectors in the BT+2 or more category (High Network Reach areas), we then proceed to examine whether they are sufficiently similar to form a single geographic market or whether one or more subsets of these postcode sectors are sufficiently different from the others to form separate markets.

A13.4 We observe that postcode sectors in the High Network Reach (HNR) category are typically clustered in cities. We also note that the Central London Area (CLA) was identified as competitive in the 2016 BCMR. We therefore compare various metrics for the HNR areas in the CLA, the largest clusters in cities (including the London area outside the CLA) and the rest of the UK. These include:

- number of postcode sectors;
- number of large business sites;
- number of customer ends connected in 2017;
- number of rival networks within the buffer distance of the average business site; and
- average distance to the 1st, 2nd etc. closest rival network in postcodes where customer ends were connected in 2017.

A13.5 Based on the above analysis, we identify which of the clusters we analysed in the HNR areas are sufficiently different from the others to constitute a separate geographic market. Our geographic market analysis is presented in Section 5 of Volume 1. Having defined the relevant geographic markets, we calculate CI Access service shares for each of the telecoms providers. These form part of our SMP analysis, presented in Section 6. The

[197] Business sites are defined as the sites of businesses with 250 or more employees. We also include mobile base stations that currently use leased lines. Each business site is assumed to be located at the centroid of its postcode.

results of our geographic market analysis and SMP analysis are presented again in this annex for comparison with the results of the sensitivity analysis.

## Sensitivities

A13.6 In this annex, we examine the impact of varying the main parameters used in the network reach analysis, on the results of our geographic analysis and CI Access service shares. In the following sections, we present the impact of varying the key parameters on:

- the size of areas with similar levels of rival network coverage;
- the average distance from leased line customer sites to rival networks in areas with similar levels of rival network coverage;
- the size of the different HNR clusters;
- the average distance from leased line customer sites to rival networks in the different HNR clusters;
- the average network reach in the different HNR clusters; and
- BT's service shares in the different HNR clusters.

A13.7 In our base case, we calculate network reach using a 50m buffer distance. This is based on our analysis of digging costs in Annex 10. In this annex, we test the sensitivity of our results by using a 100m rather than 50m buffer distance.

A13.8 In Section 5 of Volume 1, we explain that the appropriate unit of our geographic analysis is a postcode sector. We group postcode sectors with similar network reach based on the proportion of business sites having a certain number of rival networks within the buffer distance. In our base case, we set the network coverage threshold at 65%. The rationale for choosing this threshold is explained in Section 5 of Volume 1. In this annex, we test sensitivity of our results by using a 50% and an 80% network coverage threshold.

# Size of areas with similar levels of rival network coverage

A13.9 Tables A13.1, A13.2, and A13.3 show the impact of changing the buffer distance and the network coverage threshold on the size of areas with similar levels of rival network coverage, measured by the numbers of postcode sectors, large business sites and customer ends connected in 2017.

**Table A13.1: Postcode sectors with similar levels of rival network coverage**

| Network coverage threshold: | Number (share*) of postcode sectors | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| BT Only** | 4,910 (49%) | 5,810 (58%) | 6,918 (69%) | 3,971 (40%) | 4,575 (46%) | 5,323 (53%) |
| BT+1 rival network | 4,288 (43%) | 3,584 (36%) | 2,596 (26%) | 4,266 (43%) | 4,134 (41%) | 3,688 (37%) |
| HNR areas | 772 (8%) | 576 (6%) | 456 (5%) | 1,733 (17%) | 1,261 (13%) | 959 (10%) |
| **Total UK excl. the Hull Area** | **9,970 (100%)** | **9,970 (100%)** | **9,970 (100%)** | **9,970 (100%)** | **9,970 (100%)** | **9,970 (100%)** |

*Source: Ofcom network reach analysis*

**Percentages presented in this table may not add up to exactly 100% due to rounding.*

***Defined as postcode sectors where no more than a proportion of large business sites corresponding to the network coverage threshold have a rival network to BT within the buffer distance.*

**Table A13.2: Large business sites in postcode sectors with similar levels of rival network coverage**

| Network coverage threshold: | Number (share*) of large business sites | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| BT Only** | 74,971 (42%) | 93,918 (52%) | 119,378 (66%) | 55,718 (31%) | 66,580 (37%) | 81,065 (45%) |
| BT+1 rival network | 88,596 (49%) | 75,009 (42%) | 52,952 (29%) | 82,900 (46%) | 82,593 (46%) | 78,861 (44%) |
| HNR areas | 16,903 (9%) | 11,543 (6%) | 8,140 (5%) | 41,852 (23%) | 31,297 (17%) | 20,544 (11%) |
| **Total UK excl. the Hull Area** | **180,470 (100%)** | **180,470 (100%)** | **180,470 (100%)** | **180,470 (100%)** | **180,470 (100%)** | **180,470 (100%)** |

*Source: Ofcom network reach analysis*

**Percentages presented in this table may not add up to exactly 100% due to rounding.*

***Defined as postcode sectors where no more than a proportion of large business sites corresponding to the network coverage threshold have a rival network to BT within the buffer distance.*

**Table A13.3: Customer ends connected in 2017 in postcode sectors with similar levels of rival network coverage**

| *Network coverage threshold:* | Number (share*) of customer ends connected in 2017 | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| BT Only** | 22,673 (36%) | 30,076 (48%) | 38,972 (62%) | 14,842 (24%) | 19,326 (31%) | 25,283 (40%) |
| BT+1 rival network | 26,537 (42%) | 21,533 (34%) | 14,694 (23%) | 25,132 (40%) | 24,742 (39%) | 22,655 (36%) |
| HNR areas | 13,794 (22%) | 11,395 (18%) | 9,337 (15%) | 23,029 (37%) | 18,936 (30%) | 15,066 (24%) |
| **Total UK excl. the Hull Area** | **63,004 (100%)** | **63,004 (100%)** | **63,004 (100%)** | **63,004 (100%)** | **63,004 (100%)** | **63,004 (100%)** |

*Source: Ofcom network reach and circuit data analysis*

**Percentages presented in this table may not add up to exactly 100% due to rounding.*

***Defined as postcode sectors where no more than a proportion of large business sites corresponding to the network coverage threshold have a rival network to BT within the buffer distance.*

A13.10 As set out in Section 5 of Volume 1, we consider that a buffer distance of 50m is conservative. However, given the importance of the buffer distance as an input to our geographic analysis, we have nevertheless considered what the impact of a 100m buffer distance would be on our results.

A13.11 The analysis above shows that the geographic definition is sensitive to the choice of buffer distance used and that a wider buffer distance would result in us defining larger areas as having HNR. Widening the buffer distance from 50m to 100m means that about double the number of postcode sectors are allocated to HNR areas and fewer are allocated to BT Only areas. Similarly, the number of business sites and customer ends connected in 2017 allocated to HNR areas also increases when the buffer distance is widened. However, the impact of widening the buffer distance on the number of customer ends connected in 2017 in HNR areas is less significant than for the other two metrics. Widening the buffer distance from 50m to 100m increases the number of customer ends in HNR areas by about two-thirds for any network reach threshold.

A13.12 This result is to be expected as increasing the buffer distance means that more distant networks will be identified as sufficiently proximate to the customer. This will increase the proportion of customers with higher network reach in any given postcode sector.

A13.13 Similarly, changing the network coverage threshold also affects the geographic definition in the way we would expect. A lower network coverage threshold of 50% would increase the size of the HNR areas, while a higher network coverage threshold of 80% would reduce the size of the High Network Reach areas. This is to be expected as a lower network coverage threshold means a lower proportion of businesses need to have two proximate networks for a postcode sector to be classified as HNR. The geographic definition is not as sensitive to the choice of coverage threshold as it is to the buffer distance, but there is some impact.

A13.14 While it is clear that our geographic definitions would be materially affected by the choice of a larger buffer distance or different network coverage threshold, we note that this in itself would not directly impact our SMP findings as, with the exception of the CLA, we provisionally find BT has SMP in HNR areas as well as BT+1 and BT Only areas. We discuss the impact of these sensitivities on the CLA and on other parameters used in our SMP assessment, including service shares, in the sections below.

## Distance to rival networks in areas with similar levels of rival network coverage

A13.15 Table A13.4 shows the impact of changing the buffer distance and the network coverage threshold on the distance of the closest, second closest and third closest rival network to customer ends connected in 2017 in areas with similar levels of rival network coverage.

**Table A13.4: Average distance of the closest rival networks to customers connected in 2017 in areas with similar levels of rival network coverage**

| *Network coverage threshold:* | | Average distance of the n-th closest rival network to customers connected in 2017 | | | | | |
|---|---|---|---|---|---|---|---|
| | | Buffer distance = 50m | | | Buffer distance = 100m | | |
| | | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| BT Only* | n = 1 | 1.5km | 1.2km | 0.9km | 2.2km | 1.7km | 1.4km |
| | n = 2 | 3.4km | 2.6km | 2.1km | 4.7km | 3.8km | 3.1km |
| | n = 3 | 6.1km | 4.9km | 4.0km | 8.4km | 6.9km | 5.7km |
| BT+1 rival network | n = 1 | 79m | 62m | 47m | 109m | 83m | 66m |
| | n = 2 | 0.4km | 0.3km | 0.3km | 0.6km | 0.5km | 0.4km |
| | n = 3 | 1.0km | 0.9km | 0.8km | 1.4km | 1.2km | 0.9km |
| HNR areas | n = 1 | 21m | 18m | 17m | 33m | 27m | 22m |
| | n = 2 | 38m | 31m | 27m | 69m | 53m | 39m |
| | n = 3 | 78m | 58m | 44m | 174m | 124m | 79m |

*Source: Ofcom network reach analysis*

**Defined as postcode sectors where no more than a proportion of large business sites corresponding to the network coverage threshold have a rival network to BT within the buffer distance.*

A13.16 The analysis above supports that our identification of BT Only, BT+1 and HNR areas as geographic markets with distinct competitive conditions is insensitive to the specification of the buffer distance and network coverage threshold:

- for any combination of buffer distance and network reach coverage, the closest rival network to customers in BT Only areas is too far away to provide a credible constraint on Openreach, whereas the average distance of the closest rival network to customers in areas classified as BT+1 is broadly comparable to the buffer distance. Thus for all combinations of buffer distance and network reach threshold presented above, the conditions of competition in areas classified as BT Only are distinct from those in areas classified as BT+1; and
- the table also shows that the average distance from customers in HNR areas to the first and the second closest rival network is significantly below the relevant buffer distance

for all combinations of buffer distance and network reach threshold presented. Thus the conditions of competition in HNR areas are distinct from those in areas classified as BT+1 under all our sensitivities.

A13.17 In addition, we note that increasing the buffer distance to 100m or reducing the network coverage threshold results in a material increase in the average distances to closest rival networks. This is because the additional postcode sectors that would be identified as HNR with a larger buffer distance have less proximate rival infrastructure. As a result, the HNR areas would have less proximate rival infrastructure on average and would appear less competitive in our SMP assessment. Therefore, this would not affect our provisional finding is that BT has SMP in HNR areas, with the exception of the CLA.

## Size of High Network reach areas

A13.18 Tables A13.5 and A13.6 show the impact of changing the buffer distance and the network coverage threshold on the size of the HNR areas in the CLA, London outside the CLA, the top 10 metropolitan areas by the number of customer ends connected in 2017, and the rest of the UK excluding the Hull Area.

**Table A13.5: Customer ends connected in 2017 in High Network Reach areas**

| HNR area | Number of customer ends connected in 2017 in High Network Reach areas | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | 7,559 | 7,355 | 6,732 | 7,719 | 7,719 | 7,719 |
| London excl. CLA | 1,044 | 656 | 135 | 2,073 | 1,631 | 1,176 |
| Manchester | 543 | 439 | 388 | 1,039 | 773 | 646 |
| Edinburgh | 524 | 443 | 256 | 690 | 671 | 519 |
| Glasgow | 437 | 402 | 376 | 805 | 707 | 570 |
| Leeds | 477 | 300 | 300 | 638 | 575 | 418 |
| Bristol | 411 | 268 | 256 | 582 | 569 | 449 |
| Birmingham | 470 | 230 | 159 | 849 | 677 | 474 |
| Liverpool | 250 | 203 | 195 | 432 | 334 | 301 |
| Sheffield | 151 | 131 | 91 | n/a* | 237 | n/a* |
| Nottingham | 173 | 122 | 90 | 427 | 242 | 234 |
| Reading | n/a* | 102 | n/a* | 524 | 411 | 275 |
| Newcastle | 149 | n/a* | n/a* | n/a* | n/a* | 158 |
| Cardiff | n/a* | n/a* | 74 | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | 303 | n/a* | n/a* |
| All other HNR areas | 1,606 | 744 | 287 | 6,948 | 4,390 | 2,128 |
| **Total HNR areas** | **13,794** | **11,395** | **9,337** | **23,029** | **18,936** | **15,066** |

*Source: Ofcom network reach and circuit data analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas.*

**Table A13.6: Large business sites in High Network Reach areas**

| HNR area | Number of large business sites in High Network Reach areas | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | 4,516 | 4,361 | 3,898 | 4,724 | 4,724 | 4,724 |
| London excl. CLA | 1,702 | 1,024 | 245 | 3,689 | 2,719 | 2,012 |
| Manchester | 863 | 704 | 609 | 1,802 | 1,291 | 906 |
| Edinburgh | 907 | 665 | 404 | 1,403 | 1,314 | 890 |
| Glasgow | 852 | 701 | 619 | 1,831 | 1,561 | 1,156 |
| Leeds | 672 | 493 | 469 | 1,103 | 950 | 627 |
| Bristol | 478 | 345 | 289 | 927 | 820 | 622 |
| Birmingham | 736 | 324 | 247 | 1,578 | 1,226 | 819 |
| Liverpool | 409 | 276 | 249 | 937 | 683 | 585 |
| Sheffield | 352 | 327 | 272 | n/a* | 526 | n/a* |
| Nottingham | 345 | 260 | 241 | 864 | 605 | 548 |
| Reading | n/a* | 134 | n/a* | 974 | 821 | 601 |
| Newcastle | 252 | n/a* | n/a* | n/a* | n/a* | 273 |
| Cardiff | n/a* | n/a* | 70 | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | 819 | n/a* | n/a* |
| All other HNR areas | 4,819 | 1,929 | 528 | 21,201 | 14,057 | 6,781 |
| **Total HNR areas** | **16,903** | **11,543** | **8,140** | **41,852** | **31,297** | **20,544** |

*Source: Ofcom network reach and circuit data analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas.*

A13.19 HNR areas within the CLA represent by far the largest part of all HNR areas under all our sensitivities. The relative importance of other High Network Reach areas varies depending on the values of the two key parameters presented. The top-6 groupings of HNR areas in or around cities other than London are relatively stable in terms of their ranking for the different combinations of key parameters presented, while the other groupings show a greater variation and some of them only appear for a certain combination of buffer distance and network coverage threshold. Consequently, we believe that the HNR areas within the CLA and the top 6 cities outside London provide a robust basis for identifying relevant geographic markets where the conditions of competition are distinct from the other High Network Reach areas.

A13.20 The sensitivity analysis also shows that the geographic definition of the HNR metropolitan areas is sensitive to the choice of buffer distance and network coverage threshold, consistent with the results of our sensitivity analysis looking at the impact on the HNR areas as a whole. There is a material increase in the number of customer ends connected in 2017 and in the number of business sites in each HNR metropolitan area when the buffer distance is increased to 100m. The exception to this is the CLA, as the boundary of the CLA is limited by design.

# Distance to rival networks in High Network Reach areas

A13.21 Tables A13.7 to A13.9 show the impact of changing the buffer distance and the network coverage threshold on the distance to the closest, second closest and third closest rival network in HNR areas.

**Table A13.7: Average distance of the closest rival network to customers connected in 2017 in HNR areas**

| HNR area | Average distance (m) from customers connected in 2017 to the closest rival network | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | 16 | 16 | 16 | 16 | 16 | 16 |
| London excl. CLA | 26 | 26 | 19 | 34 | 31 | 27 |
| Manchester | 20 | 17 | 15 | 37 | 25 | 23 |
| Edinburgh | 24 | 20 | 15 | 30 | 30 | 23 |
| Glasgow | 15 | 14 | 13 | 29 | 24 | 20 |
| Leeds | 24 | 18 | 18 | 35 | 33 | 21 |
| Bristol | 23 | 17 | 16 | 24 | 24 | 22 |
| Birmingham | 23 | 18 | 17 | 35 | 35 | 23 |
| Liverpool | 27 | 27 | 26 | 38 | 30 | 28 |
| Sheffield | 28 | 22 | 20 | n/a* | 26 | n/a* |
| Nottingham | 31 | 20 | 19 | 41 | 37 | 35 |
| Reading | n/a* | 24 | n/a* | 58 | 42 | 32 |
| Newcastle | 21 | n/a* | n/a* | n/a* | n/a* | 22 |
| Cardiff | n/a* | n/a* | 30 | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | 68 | n/a* | n/a* |
| All other HNR areas | 34 | 28 | 27 | 48 | 41 | 33 |

*Source: Ofcom network reach and circuit data analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas.*

**Table A13.8: Average distance of the second closest rival network to customers connected in 2017 in HNR areas**

| HNR area | Average distance (m) from customers connected in 2017 to the 2nd closest rival network | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | 25 | 25 | 24 | 26 | 26 | 26 |
| London excl. CLA | 57 | 53 | 41 | 82 | 69 | 58 |
| Manchester | 34 | 29 | 26 | 62 | 45 | 40 |
| Edinburgh | 51 | 39 | 28 | 59 | 58 | 45 |
| Glasgow | 29 | 25 | 23 | 54 | 42 | 35 |
| Leeds | 41 | 27 | 27 | 63 | 58 | 32 |
| Bristol | 51 | 45 | 45 | 51 | 50 | 47 |
| Birmingham | 42 | 28 | 26 | 77 | 67 | 42 |
| Liverpool | 60 | 48 | 46 | 93 | 79 | 71 |
| Sheffield | 52 | 43 | 32 | n/a* | 54 | n/a* |
| Nottingham | 50 | 43 | 39 | 76 | 62 | 60 |
| Reading | n/a* | 36 | n/a* | 98 | 69 | 54 |
| Newcastle | 41 | n/a* | n/a* | n/a* | n/a* | 43 |
| Cardiff | n/a* | n/a* | 49 | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | 150 | n/a* | n/a* |
| All other HNR areas | 77 | 58 | 42 | 112 | 89 | 64 |

*Source: Ofcom network reach and circuit data analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas.*

**Table A13.9: Average distance of the third closest rival network to customers connected in 2017 in High Network Reach areas**

| HNR area | Average distance (m) from customers connected in 2017 to the 3rd closest rival network | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | 34 | 33 | 32 | 34 | 34 | 34 |
| London excl. CLA | 131 | 124 | 113 | 169 | 138 | 120 |
| Manchester | 61 | 56 | 50 | 124 | 90 | 75 |
| Edinburgh | 154 | 135 | 64 | 160 | 159 | 95 |
| Glasgow | 82 | 56 | 49 | 172 | 121 | 98 |
| Leeds | 65 | 42 | 42 | 144 | 125 | 51 |
| Bristol | 73 | 65 | 64 | 79 | 75 | 70 |
| Birmingham | 95 | 52 | 46 | 200 | 176 | 111 |
| Liverpool | 240 | 192 | 186 | 357 | 372 | 331 |
| Sheffield | 117 | 74 | 58 | n/a* | 90 | n/a* |
| Nottingham | 105 | 68 | 63 | 187 | 158 | 156 |
| Reading | n/a* | 57 | n/a* | 150 | 118 | 88 |
| Newcastle | 114 | n/a* | n/a* | n/a* | n/a* | 115 |
| Cardiff | n/a* | n/a* | 235 | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | 378 | n/a* | n/a* |
| All other HNR areas | 199 | 159 | 87 | 328 | 258 | 165 |

*Source: Ofcom network reach and circuit data analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas.*

A13.22 The analysis above supports that our identification of the CLA and top 6 Metro Areas as geographic markets with distinct competitive conditions is insensitive to the specification of the buffer distance and network coverage threshold:

- there is a consistently high proximity of rival networks to customer sites in the HNR areas within the CLA, where the distance to the first, second and third closest rival network is significantly below the buffer distance under all sensitivities. In those areas, the competitive constraint imposed by rival networks is much higher than in the other HNR areas;
- while the proximity of the closest rival network to customers in the top 6 Metro Areas is comparable to those in the CLA for the 50m buffer distance, it is much less so in the other HNR areas. This suggests that the top 6 Metro Areas may be distinct from the other HNR areas in that they face a higher competitive constraint from the closest rival network;
- the variation in the proximity of the second closest rival network is more pronounced. For some of the Metro Areas, like Glasgow or Manchester, the proximity of the second rival to customer sites is broadly comparable to that in the CLA for a 50m buffer distance, while for other areas the gap in the distance becomes more apparent. Also, there is an apparent gap between the top 6 Metro Areas and all other HNR areas. This suggests that the competitive conditions in each of the top-6 Metro Areas are distinct

from the other HNR areas and from each other. The variation in the proximity of the third rival network further highlights these differences;

- The differences in the proximity of rival networks between the HNR areas within the CLA and the other HNR area groupings become more apparent for a 100m buffer distance. At 100m buffer distance, the top 6 Metro Areas appear distinct from both the CLA and other HNR areas.

A13.23 We also note that increasing the buffer distance to 100m or reducing the network coverage threshold results in a material increase in the average distances to closest rival networks. For the reasons set out in A13.17, this would not affect our provisional finding is that BT has SMP in HNR areas, with the exception of the CLA. For the CLA, the average distances to closest rival networks is not sensitive to the buffer distance or network coverage threshold used because the CLA boundary is defined independently of the network reach in its individual postcode sectors and the vast majority of postcode sectors within that boundary are classified as HNR under all sensitivities.

## Average network reach in HNR areas

A13.24 Table A13.10 presents the impact of changing the buffer distance and the network coverage threshold on the average network reach in the HNR areas.

**Table A13.10: Average network reach in HNR areas**

| HNR area | Average network reach* | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | 4.3 | 4.3 | 4.3 | 6.3 | 6.3 | 6.3 |
| London excl. CLA | 2.1 | 2.2 | 2.5 | 2.8 | 3.1 | 3.3 |
| Manchester | 2.6 | 2.7 | 2.9 | 2.8 | 3.2 | 3.6 |
| Edinburgh | 2.1 | 2.3 | 2.5 | 2.6 | 2.6 | 2.9 |
| Glasgow | 2.3 | 2.5 | 2.6 | 2.6 | 2.8 | 3.1 |
| Leeds | 2.4 | 2.7 | 2.7 | 2.8 | 3.0 | 3.6 |
| Bristol | 2.5 | 2.8 | 2.9 | 3.0 | 3.2 | 3.4 |
| Birmingham | 2.0 | 2.6 | 2.7 | 2.4 | 2.7 | 3.0 |
| Liverpool | 1.8 | 2.0 | 2.0 | 2.1 | 2.2 | 2.3 |
| Sheffield | 2.4 | 2.4 | 2.5 | n/a** | 2.8 | n/a** |
| Nottingham | 2.1 | 2.3 | 2.3 | 2.3 | 2.6 | 2.7 |
| Reading | n/a** | 2.3 | n/a** | 2.6 | 2.8 | 3.0 |
| Newcastle | 1.9 | n/a** | n/a** | n/a** | n/a** | 2.6 |
| Cardiff | n/a** | n/a** | 1.8 | n/a** | n/a** | n/a** |
| Coventry | n/a** | n/a** | n/a** | 1.9 | n/a** | n/a** |
| All other HNR areas | 1.8 | 1.9 | 2.3 | 2.0 | 2.2 | 2.4 |

*Source: Ofcom network reach and service share analysis*

**Defined as the average number of rival networks within the buffer distance of large business sites*

***Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas.*

A13.25 The analysis above shows that the average network reach has limited sensitivity to the buffer distance used in the network reach analysis in all areas except the CLA. This is because widening the buffer distance has two effects on the average network reach of HNR metropolitan areas and these two effects largely cancel each other out. As discussed in the previous sections, it means that a greater number of postcode sectors are included in each HNR cluster and that the additional postcode sectors have more limited rival infrastructure. This reduces the average network reach. On the other hand, it measures average network reach over a larger buffer distance. This raises the average network reach.

A13.26 An exception to this is the CLA, where a larger buffer distance results in a substantially higher average network reach. This is because the definition of the CLA is bounded by design, which implies that the second effect described in the previous paragraph dominates the first.

A13.27 For most HNR clusters, the average network reach is fairly insensitive to the network coverage threshold used. The greatest impact is in Birmingham where the average network reach varies between 2 and 3 depending on the combination of buffer distance and network coverage threshold used.

A13.28 Importantly, this analysis highlights the unique position of the HNR areas within the CLA in terms of the large presence and proximity of rival networks. For all sensitivities considered, there are on average between four and five rival networks within a 50m buffer distance and between six and seven rival networks within a 100m buffer distance of a business site in the HNR areas within the CLA, compared to between two and three rival networks within a 50m buffer distance and between two and four rival networks within a 100m buffer distance of a business site in the top 6 Metro Areas outside London, and a generally lower presence of rival networks in all other HNR areas.

## BT service shares in HNR areas

A13.29 Table A13.11 presents the impact of changing the buffer distance and the network coverage threshold on BT service shares of customer ends connected in 2017 in HNR areas.

**Table A13.11: BT service shares of customer ends connected in 2017 in HNR areas**

| HNR area | BT service share of customer ends connected in 2017 | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| London excl. CLA | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Manchester | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Edinburgh | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Glasgow | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Leeds | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Bristol | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Birmingham | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Liverpool | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Sheffield | [✂]% | [✂]% | [✂]% | n/a* | [✂]% | n/a* |
| Nottingham | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Reading | n/a* | [✂]% | n/a* | [✂]% | [✂]% | [✂]% |
| Newcastle | [✂]% | n/a* | n/a* | n/a* | n/a* | [✂]% |
| Cardiff | n/a* | n/a* | [✂]% | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | [✂]% | n/a* | n/a* |
| All other HNR areas | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |

*Source: Ofcom network reach and service share analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends connected in 2017. Each set of assumptions may result in a different set of top 10 Metro Areas .*

A13.30 The above analysis shows that BT's service shares of customer ends connected in 2017 in each of the different HNR clusters are relatively insensitive to the buffer distance or network coverage threshold used. We note in particular that BT's service shares HNR are consistently high for all our sensitivities.

A13.31 We have based our service share analysis on customer ends connected in 2017, because the inventory of circuits suffers from severe data limitations. These limitations mean that, using the same methodology for calculating service shares as we have used for customer ends connected in 2017, Virgin Media's service share based on the inventory of circuits would likely be overstated and BT's service share understated.

A13.32 We have used the inventory data to calculate service shares as a sensitivity analysis, as these would provide a likely lower bound for BT's service shares. The results are presented in Table A13.12.

**Table A13.12: BT service shares of leased lines inventory in HNR areas**

| HNR area | BT service share of leased lines inventory | | | | | |
|---|---|---|---|---|---|---|
| | Buffer distance = 50m | | | Buffer distance = 100m | | |
| *Network coverage threshold:* | *50%* | *65%* | *80%* | *50%* | *65%* | *80%* |
| CLA | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| London excl. CLA | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Manchester | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Edinburgh | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Glasgow | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Leeds | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Bristol | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Birmingham | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Liverpool | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Sheffield | [✂]% | [✂]% | [✂]% | n/a* | [✂]% | n/a* |
| Nottingham | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |
| Reading | n/a* | n/a* | n/a* | [✂]% | [✂]% | [✂]% |
| Newcastle | [✂]% | n/a* | n/a* | n/a* | n/a* | [✂]% |
| Cardiff | n/a* | n/a* | [✂]% | n/a* | n/a* | n/a* |
| Coventry | n/a* | n/a* | n/a* | [✂]% | n/a* | n/a* |
| Leicester | n/a* | [✂]% | n/a* | n/a* | n/a* | n/a* |
| All other HNR areas | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% | [✂]% |

*Source: Ofcom network reach and service share analysis.*

**Results are presented for the top 10 metropolitan areas by number of customer ends in leased lines inventory. Each set of assumptions may result in a different set of top 10 Metro Areas.*

A13.33 BT's service shares of leased lines inventory are consistently somewhat lower compared to those based on customer ends connected in 2017. This may be explained, to some extent, by the poor quality of Virgin Media's inventory data which is likely to overstate Virgin Media's volumes and, consequently, understate BT's service shares in some areas (see Annex 12). Nevertheless, we find that BT's inventory service shares in the HNR areas outside the CLA are generally compatible with our findings that BT has significant market power in those areas.[198]

[198] BT's service share in the Leicester HNR area is [✂] than in the other HNR areas, mainly due to a rival network, [✂], having a large number of circuit ends terminating in a single postcode accounting for about [✂] of the total inventory of circuit ends in that area. This appears to be an exceptional data point, in the absence of which BT's service share would be broadly in line with the other HNR areas.

# A14. CI Access: hypothetical SMP assessment for VHB Access

A14.1 In Section 4 of Volume 1 we set out our proposal to define a single product market for Contemporary Interface (CI) Access services at all bandwidths. In reaching our provisional conclusions we explain why we considered that very high bandwidth (VHB) Access services were not a separate relevant product market.[199] We explained that we find the evidence ambiguous with respect to the presence of a separate VHB market from the demand side, but there is evidence from the supply side that led us to propose to define a single product market for CI Access services across all bandwidths. We explained that we considered leased line suppliers are equally able to supply all bandwidths and to switch between these at low cost and quickly, pointing to a single market on the supply side.

A14.2 This proposed finding differs from the approach we took in the Temporary Conditions. In the Temporary Conditions, we determined that BT had significant market power (SMP) in lower bandwidth Contemporary Interface Symmetric Broadband Origination (CISBO) services in certain geographic areas. We explained that in light of the exceptional circumstances and urgency we were taking a conservative approach to the market analysis.[200] We explained that for the purposes of the Temporary Conditions we were making no finding in relation to BT's SMP in VHB CISBO services,[201] but that we would consider these issues as we addressed the remitted matters.[202]

A14.3 In this annex we conduct a hypothetical SMP assessment for VHB Access circuits only as a sensitivity analysis. We examine whether BT would have SMP in the market for VHB circuits used for access, if we were to define it as a separate product market.

A14.4 We provisionally conclude that, were we to define a separate VHB Access product market, we would find BT to have SMP in the same geographic markets addressed in Section 6, (where we provisionally find BT to have SMP for CI Access Services in the whole of the UK except the Central London Area and Hull Area).

## Proposed approach to undertaking an SMP assessment in a nominal VHB Access market

A14.5 In Section 6 we set out the criteria relevant to our SMP assessment, which is based on the European Commission (EC) SMP Guidelines. Most of the assessment in Section 6 is relevant to this hypothetical assessment of SMP for VHB Access circuits. We do not repeat our

[199] We refer to circuits above 1 Gbit/s as very high bandwidth (VHB). The main VHB products in BT's leased line portfolio used for access connections are EAD 10Bit/s, OSA, OSA Filter Connect.
[200] Ofcom, 2016, *Business Connectivity Market Review Temporary Conditions*, Paragraph 2.5, https://www.ofcom.org.uk/__data/assets/pdf_file/0019/108019/BCMR-Temporary-Conditions.pdf
[201] We also made no finding on whether BT had SMP in the Central London Area. BCMR 2016 Temporary Conditions, Paragraphs 2.95-2.97.
[202] BCMR 2016 Temporary Conditions, p. 33, Paragraph 2.8.

assessment of the criteria in this annex, but only summarise the relevant arguments that inform our conclusions.

A14.6 In Section 6, we explained that:

- BT has a ubiquitous network in the UK excluding the Hull Area, whereas rival infrastructure is patchy and concentrated around some geographic areas;
- BT is at greater proximity to customer sites compared to rivals. BT had existing duct connections to [✂]% 81-90% of new customer ends it connected in 2017 in the UK excluding the Hull Area, compared to 45% across all rivals;
- greater proximity gives BT a significant cost advantage, even at short dig distances; and
- greater proximity, in particular, where BT is duct connected and rivals are not, gives BT a significant advantage due to shorter time to supply and less customer inconvenience.

A14.7 We also explained that BT benefits from economies of scale and scope from the ubiquity of its network, and that high sunk costs and switching costs (among other factors) are likely to give rise to barriers to entry and expansion in the wholesale leased lines markets, making it more difficult for rivals to compete with BT for the supply of CI Access services.

A14.8 We set out our view that there is likely to be insufficient countervailing buyer power to constrain BT's position as a supplier of CI Access services because there are limited alternative suppliers and customer volumes are not large enough.

A14.9 Additional factors that we consider in this annex when conducting our hypothetical SMP assessment with respect to VHB Access circuits are:

- service shares for VHB Access circuits by geographic market; and
- evidence on pricing and margins of VHB circuits.

A14.10 We also note that VHB circuits are currently not commonly used for access connections and therefore, the total number of VHB Access circuits under consideration in this annex is small.

A14.11 We will first consider VHB Access circuits only and then extend our analysis to include dark fibre circuits as it is reasonable to expect a proportion of these are used for VHB.

# Market context

## A very small proportion of VHB circuits are used for Access connections

A14.12 We have proposed to distinguish between access and inter-exchange CI services in our market analysis. We have also explained that in general, to aggregate data, backhaul links transport more communication services and have greater capacity than access links (see Section 3 of Volume 1).

A14.13 At present and over this review period the vast majority of VHB connections are used for backhaul, which we consider in our assessment of the inter-exchange connectivity market

in Section 7. Our analysis shows that VHB Access customer ends, which are the focus of this annex, amount to around 2% of all VHB circuit ends in the UK excluding the Hull Area.[203]

A14.14 This is consistent with the evidence from market research and from Openreach. The qualitative research undertaken for the 2018 Cartesian report showed that businesses typically used VHB connections to connect to data centres, while connections between headquarters, regional offices and local offices tended to use lower bandwidth leased lines and in the case of regional and local offices potentially business broadband products.[204] In its internal documents, Openreach noted that VHB circuits are important for mobile and fixed backhaul, but for business and corporate customers "10 Gbit/s has a restricted use case typically limited to head office locations with significant bandwidth needs."[205] This is consistent with other evidence submitted by Openreach, which explained that "in the national market we only provide a very small number of [business access] sites [✂] with 10 Gbit/s and above. These [✂] circuits are mostly driven by a small segment of VHB networks typically around [✂]. These networks are heavily data centre driven".[206] [207]

## The volume of VHB Access connections is small but growing fast

A14.15 VHB Access accounts for a small proportion of all CI Access circuits. This is shown in Table 14.1, which presents the number of customer ends for CI Access and VHB Access services. The table shows our estimates of customer ends based on new connections in 2017 and based on total circuit inventory as of December 2017. Due to data limitations from one major provider, and the very small number of VHB circuits, we have particular concerns over the reliability of the circuit inventory data for VHB (see Annex 12).[208]

[203] Ofcom analysis based on responses to 1st and 5th BCMR s.135 notices.
[204] Cartesian 2018 Study, *Business Connectivity Market Assessment,* figure 11, p23.
[205] Openreach response to Question 4 of the 8th BCMR s.135 notice dated 20 April 2018, document entitled "Ethernet & Optical Response to DF", dated 1 September 2017, p61
[206] First Witness statement, Mark Logan (BT), paragraph 53-54, p10
[207] In the case of an access connection e.g. from a head office to a data centre, the head office site would be included in our analysis of access customer ends, but the data centre end would not be as we treat it as equivalent to a network site.
[208] This is for the following reasons: Virgin Media inventory data may include inactive circuits and the same circuit may be included more than once. In addition, a large proportion of Virgin Media's inventory data has missing information for key variables. Notably, for [✂]% 20-30% of Virgin Media's customer ends classified as CI Access, there is missing information on the bandwidth supplied and for 73% of the customer ends classified as VHB Access there is no information on whether it supplied the circuit using its own network (on-net) or by purchasing a wholesale product from a third party (off-net). Our estimates are based on information for which bandwidth information was available and we assume that any circuit with missing on-net classification is provided on-net. Given the small volume of VHB Access customer ends, our estimates will be sensitive to any assumptions we make in interpreting Virgin Media's data.

**Table A14.1 Number of CI and VHB Access customer ends in the UK excluding the Hull Area (2017)**

| Customer end type | New Connections in 2017 | Circuit Inventory as of Dec. 2017* |
|---|---|---|
| Number of CI Access customer ends | 63,004 | 349,577 |
| Number of VHB Access customer ends | 1,591 | 9,138 |
| Proportion of VHB Access out of CI Access customer ends | 2.5% | 3% |

*Source: Ofcom analysis based on 1st and 5th BCMR s.135 notices.*
** Based on customer ends where bandwidth information was available and assuming customer ends with unknown "on-net" classification were provided "on-net". We have concerns around the reliability of circuit inventory data. For details see Annex 12.*

A14.16 The table shows that there are fewer than 10,000 VHB Access customer ends in the UK excluding the Hull Area, which accounts for only 3% of CI Access customer ends. Though the number of VHB Access circuits is growing, this growth is from a small base. Therefore, VHB Access circuits are expected to continue to be a small proportion of CI Access connections over this review period.

## Product dynamics

A14.17 Annex 7 sets out our view on the product dynamics in the business connectivity markets and how they affect prices and competition. We summarise our views in relation to VHB services.

A14.18 The demand for VHB services is evolving, driven by growing demand for bandwidth among leased line customers. This is consistent with an early product lifecycle where demand is low at the beginning (when early adopters take up the product) then increases as the product becomes mass-market and late adopters begin to take it up. Demand is expected to accelerate during this review period, mainly by mobile customers due to the move to fifth generation mobile technology (5G). Demand for VHB circuits from enterprises is also expected to grow, albeit it will be lower than the demand from mobile customers. This is confirmed by our recent engagement with telecoms providers and research commissioned by us on large enterprises[209], which found that:

- mobile network operators (MNOs) expect traffic to grow exponentially with 5G, and 10 Gbit/s and *n* x 10 Gbit/s links will be the norm for these customers in the next three to five years; and
- demand for 10 Gbit/s from large enterprises is growing, with some enterprises already requesting 100 Gbit/s.

A14.19 In addition to growing volumes, the prices and profit margins for VHB services are falling over time. BT has historically set prices for VHB services (which were not subject to price

[209] Cartesian, 2018. *Business Connectivity Market Assessment*.

regulation) with a greater premium above cost compared to lower bandwidth services. Over time, we find that BT's VHB prices are declining and the price gap across bandwidths is narrowing, making the bandwidth gradient flatter and more cost reflective. This is likely due to a combination of price regulation, upward migration, falling equipment costs and competition from alternative networks, see Annex 7.

A14.20 We consider that the relationship between BT's prices and competition may be circular. On one hand, a lack of competition results in the ability to charge significantly above costs. On the other, the higher BT's prices (relative to costs), the more attractive it is for alternative operators to dig and compete in the market. This means that service shares for VHB Access services may understate BT's market power.

## Assessment of SMP criteria

A14.21 In this sub-section we set out:

- service shares for VHB circuits by geographic market;
- evidence on pricing and margins of VHB circuits; and
- our extended analysis to include dark fibre.

### Service shares

**Service shares based on new customer ends connected in 2017 is the better measure for a forward looking analysis of market power**

A14.22 We do not expect historical service shares based on circuit inventory to reflect the competitive conditions over this review period. The competitive conditions for any product during an introductory phase can be materially different from those for the same product during growth or maturity stages. In this case, we consider that inventory service shares could materially understate BT's true competitive position. The low VHB Access volumes, steady migration to higher bandwidths, growing demand from mobile operators and BT's recent pricing strategies for VHB services, mean we anticipate that BT's service share for VHB Access connections will increase over this review period compared to its historical service shares.

A14.23 Evidence suggests that BT started targeting VHB services over the last few years and has radically changed its service offering, partially in response to the growing demand for these services. In particular:

- prior to September 2015, BT had a limited range of wavelength division multiplex (WDM) products for access services. In March 2015, an optical spectrum access (OSA) 10 Gbit/s circuit cost over £30,000 p.a.;[210]

[210] 2016 BCMR, Figure 4.1.

- in September 2015 BT launched the Ethernet Access Direct (EAD) 10 Gbit/s service at nearly half the wholesale charge of its previous single service 10 Gbit/s Ethernet product (c.£16,000 p.a.);[211]
- in April 2018, BT reduced the price of its leading VHB products. The price of EAD local access (EAD LA) 10 Gbit/s fell by nearly 40% to just under £7,000 p.a.; and
- BT also introduced OSA Filter Connect with around 30% discount over its standard OSA 10 Gbit/s product.[212] This product includes a 10 Gbit/s circuit, but also allows the purchaser to upgrade bandwidth at very low incremental cost.

A14.24 We consider that service shares based on new connections in 2017 are a better measure than inventory service shares for a forward-looking SMP assessment for VHB Access services.[213] As the volume of VHB Access services is growing from a small base, new connections will better reflect market dynamics compared to inventory service shares. New connections focus on the most recent activity at a time when BT is launching products which better address this market and at prices which better reflect BT's lower cost of supply. The launch of EAD 10 Gbit/s in 2015 resulted in BT having more competitive pricing. This is reflected by the fact that BT has higher service shares of new connections in 2017 compared to inventory service shares, as shown by our analysis later in this annex.

A14.25 While service shares based on 2017 new connections are a better proxy of competition going forward than inventory shares, they may still understate BT's competitive position over this review period. As our estimates are based on 2017 data, they do not reflect the impact of BT's more recent price reduction in 2018 and its launch of the Optical Filter Connect product. We would expect BT's service shares to increase during this review period in response to the price reductions and Optical Filter Connect, particularly in light of the anticipated growing future demand. Unlike BT, rivals do not have ubiquitous networks and more commonly need to extend their networks to connect a new customer. The lower charges for VHB services will make it less profitable for rivals to extend their networks and will also make the distance over which it is profitable to extend the network much shorter.

A14.26 Based on the above, our service share analysis is based on 2017 new connections, taking into consideration that they are likely to understate BT's competitive position over this review period. We also present inventory service shares for transparency but we do not put weight on them in our hypothetical SMP assessment for VHB Access services. In addition to our view that they are not a good proxy of future competitive conditions, we do not believe that results are reliable due to significant data limitations, which we discuss in more detail below when presenting the results.

[211] 2016 BCMR, page 90.
[212] Our analysis is set out below when we discuss VHB pricing.
[213] Customer ends refer to leased lines circuit ends terminating at customer premises. Our approach to estimating service shares is explained in Annex 12.

### New connections service shares

A14.27 The table below presents the number of VHB Access connections and BT's service shares based on the new customer ends connected in 2017.

**Table A14.2 Number of circuits and BT VHB service shares (2017 new connections)**[214]

| | BT Only | BT + 1 | HNR Metro Areas | Other HNR areas | CLA |
|---|---|---|---|---|---|
| Number of CI access customer ends in 2017 | 30,004 | 21,241 | 2,082 | 1,958 | 7,719 |
| Number of VHB access customer ends in 2017 | 673 | 469 | 44 | 75 | 330 |
| Proportion of VHB circuits compared to all CI access customer ends | 2% | 2% | 2% | 4% | 4% |
| BT service share CI access for all bandwidths | [✂]%<br>81%-90% | [✂]%<br>61%-70% | [✂]%<br>61%-70% | [✂]%<br>61%-70% | [✂]%<br>61%-70% |
| BT service share VHB customer ends | [✂]%<br>61%-70% | [✂]%<br>51%-60% | [✂]%<br>51%-60% | [✂]%<br>61%-70% | [✂]%<br>31%-40% |
| Share of BT's largest rival in VHB customer ends (i.e. Colt in the CLA, Virgin Media elsewhere) | [✂]%<br>11%-20% | [✂]%<br>21%-30% | [✂]%<br>21%-30% | [✂]%<br>11%-20% | [✂]%<br>41%-50% |

*Source: Ofcom analysis based on stakeholder responses to the 1st BCMR s.135 notice.*
*Note: dark fibre circuits are not included in these results but are included in Table A14.6 below.*

A14.28 The number of VHB circuits in the Metro Areas that we have defined as being separate geographic markets is very small (amounting to less than 50 customer ends in each Metro Area in 2017). The small number of circuits means that service shares by individual Metro Area would not be meaningful. Therefore, we have presented results on an aggregated basis. Even in the aggregated Metro Areas and HNR areas in the rest of the UK the total

[214] These geographic markets and resulting indicators are based on a network reach of 50m. See Section 4 of Volume 1 for an explanation of why we also consider that this is the appropriate distance for VHB circuits.

number of VHB circuits is small and therefore the evidence should be treated with some caution.

A14.29 The service share results presented in Table A14.2, support our assessment of SMP in each of the relevant geographic markets. The analysis shows that:

- BT has a high service share of over [✂]% 50% for VHB Access circuits in each of the BT Only, BT+1, Metro Areas and High Network Reach areas in the rest of the UK markets. It is also followed at a distance by Virgin Media with service share below 30%. This would support a finding of SMP in VHB Access circuits in these areas, were we to define it as a distinct market.[215] While BT's service shares are lower than that in the market for CI Access services at all bandwidths, these are still consistent with the threshold for identifying SMP. We also expect BT's service shares of new connections over this review period to be even higher following the reduction in wholesale charges for its leading VHB products in 2018; and
- BT has the second highest service share in the CLA of [✂]% 31%-40% after Colt [✂]% 41%-50%, consistent with a finding of no SMP in VHB Access circuits in this area.

### Inventory service shares

A14.30 We explained in Section 6 that we cannot present reliable estimates of service shares based on circuit inventory due to issues with Virgin Media's data. For transparency, we present the main service share results in the table below.

**Table A14.3: Number of circuits and BT VHB service shares (inventory)[216]**

| | BT Only | BT + 1 | HNR Metro Areas | Other HNR areas | CLA |
|---|---|---|---|---|---|
| Number of VHB Access customer ends in 2017 | 3,634 | 3,494 | 199 | 423 | 1,388 |
| BT service share | [✂]% 51%-60% | [✂]% 31%-40% | [✂]% 31%-40% | [✂]% 41%-50% | [✂]% 21%-30% |
| Share of BT's largest rival (i.e. Colt in the CLA, Virgin Media elsewhere) | [✂]% 31%-40% | [✂]% 41%-50% | [✂]% 41%-50% | [✂]% 21%-30% | [✂]% 21%-30% |

*Source: Ofcom analysis based on stakeholder responses to the 1st BCMR s.135 notice.*
*Note: Based on customer ends where bandwidth information was available and assuming customer ends with unknown "on-net" classification were provided "on-net". We have concerns around the reliability of circuit*

[215] We note that the number of VHB Access customer ends in the Metro Areas combined and in the HNR Areas in the rest of the UK is small (less than 80 customer ends). While service share results are only indicative due to the small volume, they look reasonable as they are broadly consistent with service share results in the other geographic markets.
[216] The geographic markets and resulting indicators, presented in Table A14.2, are based on a network reach of 50m. See Section 4 of Volume 1 for an explanation of why we consider that this is the appropriate distance for VHB circuits as well.

*inventory data. For details see Annex 12.*
*Note: dark fibre circuits are not included in these results.*

A14.31 Taken at face value, the results for inventory service shares would not be consistent with an SMP finding outside of BT Only areas. However, as set out earlier, BT's historical service shares are not a good indicator for the competitive dynamics over this review period as they would materially understate BT's competitive position.

A14.32 In addition, we consider that inventory service shares for VHB Access services are highly unreliable. The quality of Virgin Media's inventory data is particularly problematic for VHB Access services (See Annex 12 for details). Virgin Media inventory data may include both inactive circuits and planned circuits which were not ultimately installed, and the same circuit may be included more than once. Second, a large proportion of the inventory data has missing information for key variables. Notably, for [✂]% 20-30% of Virgin Media's Access customer ends, there is missing information on the bandwidth supplied and for 73% of the customer ends classified as VHB Access there is no information on whether it supplied the circuit using its own network (on-net) or by purchasing a wholesale product from a third party (off-net). Given the low volumes of VHB Access connection, the results would be overly sensitive to any assumptions we made to interpret the inventory data (i.e. the margin of error would be very high).

## Prices and margins

### Pricing of VHB services

A14.33 Under the Temporary Conditions, CI access services at 1 Gbit/s and below are regulated, whereas VHB services are not.

A14.34 The ability of BT to set prices of VHB circuits above competitive levels is an indicator of market power. In April 2018, BT reduced the price of its leading VHB products (OSA and EAD 10 Gbit/s) by 30-40%. Notwithstanding the reduction, BT's prices for VHB circuits are still substantially above BT's costs.

**Table A14.4: BT pricing for selected access connections, before and after 1 April 2018**

| Access Connection type | 3 Yr TCO (£) | |
|---|---|---|
| | Price before 1 April 2018 | Price after 1 April 2018 |
| EAD 1Gbit/s | £8,790 | £7,725* |
| EAD 10 Gbit/s 12 Month | £28,490 | £18,040 |
| OSA 12 month[217] | £70,599 | £49,453 |

[217] OSA 3000 pre April 2018 price cut compared to OSA filter connect product no mainlink.

*Source: Openreach calculations set out in internal document excerpt *Ofcom analysis*[218]*
*Note: The 1 Gbit/s and 10 Gbit/s prices are based on local access variants where a mainlink circuit is not required, whereas the OSA quoted above includes a mainlink circuit.*

A14.35 We reviewed two of Openreach's internal pricing documents, which we obtained using our statutory information gathering powers. [219] The documents suggest that VHB price reductions were mainly motivated by:

- concerns that pricing of VHB was not competitive against the prices charged by other telecoms providers for similar bandwidths. Openreach was concerned that it was at risk of losing significant business if no changes were made, particularly in certain parts of the UK and in the fixed backhaul business; and
- providing a path for MNOs to upgrade their bandwidth from 10 Gbit/s to multiples of 10 Gbit/s without the high costs of additional bandwidth, and concerns about losing business to other telecoms providers and the subsequent impact on its position if this happened. In its internal documents Openreach notes "[✂]"[220] [221] Openreach states: "[✂]".[222]

A14.36 In our view, the internal pricing documents suggest that the reasons for the price reductions in part indicate that BT faced competition for VHB circuits, though some of its concerns may have related to backhaul connections (i.e. circuits falling within the inter-exchange connectivity market rather than the access market) given the volumes of VHB in inter-exchange connectivity compared to access.

A14.37 We consider that reducing prices to meet competition does not contradict a finding of BT having market power. A telecoms provider with market power would still face some level of competition and is expected to respond to it, particularly in an evolving market where customer needs are changing and demand is growing from a small base. In addition, as mentioned above in this annex, the relationship between BT's prices and competition may be circular; hence the level of competition for VHB services may have been driven by BT's high prices.

A14.38 In addition, as part of the impact assessment in these internal documents, Openreach considered that the price reductions would (i) reduce the risk of Ofcom imposing a dark

[218] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "New pricing and product launches for VHB portfolio", dated 21 January, page 21. Ofcom analysis to calculate the 3-year TCO for a EAD 1 Gbit/s for the price after April 2018 is different to other TCO prices presented elsewhere to ensure a consistent methodology with the rest of Openreach's analysis
[219] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice. The first is a document to Openreach Board entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017. The second is a document to Openreach Commercial Policy and Pricing Board (CPB) entitled "New pricing and product launches for VHB portfolio", dated 21 January.
[220] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "New pricing and product launches for VHB portfolio", dated 21 January, p6.
[221] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017, p2.
[222] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "New pricing and product launches for VHB portfolio", dated 21 January, p6.

fibre remedy; and (ii) reduce the negative financial impact to BT in the event Ofcom did impose a dark fibre remedy.

i) one of the internal documents stated "[✂]";[223] and

ii) in the financial impact assessment, Openreach considered that "[✂]". [224]

A14.39 Therefore, we consider it likely that BT's price reductions were in part driven by a desire to reduce the risk of dark fibre, or minimise its impact, in addition to being a response to competitive pressures. We consider that this is consistent with a point made in another Openreach strategy document which stated that proposals to introduce new products – which formed part of the same package of proposals as the price reductions – would [✂].[225] This further supports our view that the internal documents do not contradict our finding that BT has SMP.

A14.40 We have also compared BT's prices for VHB services across different geographic areas. The intensity of competition should be reflected in lower prices and therefore we would expect areas with more competition to have lower wholesale charges. This is reflected in Openreach's internal documents, in which it stated "[✂]".[226]

A14.41 Another internal document also suggests that Openreach [✂]. It said: "[✂]". It defines the Metro Areas as the CLA, London Periphery and the CBDs, as defined in the 2016 BCMR. In addition, the document says: "[✂]".[227]

A14.42 We recognise that competitive pressure may be higher in the Metro Areas compared to the BT Only and BT+1 access areas, though this alone is not conclusive evidence that there is no SMP in these areas.

### Margins on VHB services

A14.43 In Annex 8, Table A8.2, we presented evidence on margin by bandwidth,[228] which showed that BT earns higher margins for higher bandwidths. The estimates suggested a margin of [✂]% for 1 Gbit/s compared to [✂]% for 10 Gbit/s.

A14.44 The table below shows BT's estimates of its payback period, i.e. the time it takes for the revenue from providing a product to breakeven with the cost of providing the product, for some of its product portfolio; and the margin earned on each product.

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[223] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017, p2.
[224] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "New pricing and product launches for VHB portfolio", dated 21 January, p5. See also document entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017, p2 where Openreach states that "[✂]".
[225] Openreach stated that "[✂]". Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "Openreach Strategy – presentation to the Board", dated 14 November 2017, slide 13
[226] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017, p4
[227] Openreach response dated 20 April 2018 to Question 4 of the 8th BCMR s.135 notice, document entitled "Product Proposals: Ethernet & Optical Response to DF", dated 12 October 2017, p12.
[228] This margin refers to the difference between revenue obtained from diverted sales and the avoided costs associated with providing those sales and was used to inform our SSNIP analysis in our product market definition.

**Table A14.5: Payback period and margin for VHB products compared to 1 Gbit/s**

| Product | Payback period (months) | | 3-year margin (%)[229] | |
|---|---|---|---|---|
| | Price pre April 2018 | Price post April 2018 | Price pre April 2018 | Price post April 2018 |
| EAD 1Gbit/s | [✂] | -[230] | [✂] | - |
| EAD 10 Gbit/s 12 Month | [✂] | [✂] | [✂] | [✂] |
| EAD 10 Gbit/s 60 Month | [✂] | [✂] | [✂] | [✂] |
| OSA 12 month[231] | [✂] | [✂] | [✂] | [✂] |
| OSA 60 month | [✂] | [✂] | [✂] | [✂] |

*Source: BT calculations set out in internal document.*[232]
*Note: BT has not based this on RFS.*

A14.45 We make the following observations based on the table above, which we consider are consistent with BT having market power for VHB circuits:

- the payback period is significantly lower and the three-year margin is much higher for the VHB products (EAD 10 Gbit/s and the OSA products) compared to the regulated 1 Gbit/s product. This is also true for the prices introduced in April 2018, despite that these have decreased by 30-40%;
- before BT restructured its pricing in April 2018, the payback period of the OSA product was [✂]; and
- the payback period for BT is much shorter than both the average duration of a typical contract, and the assumptions BT makes in its analysis.[233] [✂].[234]

A14.46 We have also noted that BT may find it profitable to reduce the relative charge for VHB services if it encourages enough customers from lower bandwidths to migrate and pay higher charges. This is because the loss from lower margins from existing high bandwidth customers could be more than offset by the gain from the additional margin from customers upgrading their service, provided that customers migrate in sufficient numbers.

[229] These margins are based on Openreach's internal assessment and not based on the RFS methodology. It is not possible to do a like for like comparison with RFS margins.
[230] BT does not set out its assumptions for the payback period at the new 1 Gbit/s EAD LA price on a like for like basis. However, the reduction in the 1 Gbit/s EAD LA price resulting in the 3-year TCO falling from £8,790 to £7,725 suggests that at a minimum the payback period on a like for like basis will be the same as pre April 2018, and is more likely to be higher. Conversely the margin is likely to a minimum the same, and more likely to be lower
[231] OSA 3000 pre April 2018 price cut compared to OSA filter connect product no mainlink.
[232] Openreach response to Question 4 of the 8th BCMR s.135 notice dated 20 April 2018, document entitled "New pricing and product launches for VHB portfolio", dated 21 January, p21
[233] For example, it calculates the 3-year TCO, 3-year margin and 3-year and 5-year cash contribution, net present value and internal rate of return in its internal documents.
[234] Second Witness statement Mark Logan (BT), 16 January 2016.

This is supported by internal pricing documents from Openreach, see Annex 8. Extending the analysis to include dark fibre circuits, we provisionally find that BT would still have SMP on VHB circuits

### Service shares

A14.47 In Section 4 of Volume 1 we explained that dark fibre is likely to be a demand-side substitute for VHB Access circuits for at least some users. The largest operators, BT and Virgin Media, do not sell dark fibre to end customers. The largest suppliers of dark fibre are CityFibre and Zayo, accounting for [✂]% of all dark fibre access circuits, based on 2017 connections data.

A14.48 Telecoms providers that supply dark fibre have told us that they are unable to observe the bandwidths being used over the circuit. Therefore, to estimate VHB service shares, it is necessary to determine whether dark fibre circuits are being used as 1 Gbit/s and below active circuits or as VHB active circuits.

A14.49 Evidence shows that dark fibre use is not limited to VHB Access services. For example, for the 2016 BCMR we asked users about the types of connection speeds they have over their dark fibre. Out of a sample of 120 dark fibre circuits, 23% of circuits were used for 1 G bit/s.[235]

A14.50 Moreover, there is also evidence that CityFibre competes for customers of all bandwidths, and many of its customers are unlikely to be using VHB over dark fibre:

- CityFibre has submitted to Ofcom that "[✂]"[236];
- [✂]% of CityFibre's access customers are in the public sector, which overall use very little VHB services;[237] and
- CityFibre competes primarily in smaller cities and towns, where the use of VHB services is currently very limited.[238]

A14.51 Zayo customers are more likely to be VHB users, for example they are more likely to be located in London, more likely to be in the banking and finance sector where there is higher propensity to use VHB services.[239]

A14.52 We have conducted our sensitivity analysis assuming that 5% of CityFibre's customers use dark fibre for VHB services, [240] and all other telecoms providers using dark fibre use it for VHB circuits. Given that not all dark fibre circuits by other providers will be used for VHB, this assumption is likely to overstate true VHB usage.

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[235] Ofcom analysis 2016 based on sample of dark fibre users. See 2016 BCMR, p113.
[236] CityFibre submission to Ofcom, dated 17th March 2015, p5.
[237] Data based on 2017 new connections shows that across all providers public sector organisations typically use VHB 4%, compared to 96% for bandwidths equal to or less than 1Gbit/s.
[238] https://www.CityFibre.com/gigabit-cities/ - see list of 40 cities.
[239] Based on data in 2017 new connections
[240] As noted, CityFibre uses dark fibre to compete for all bandwidths and around 3% of CI Access circuits are VHB Access.

A14.53 Customers using dark fibre as a substitute for active WDM products may also use multiple wavelengths over a single fibre. Ideally, we should count each WDM physical fibre circuit provided from one location to another as a single circuit rather than wavelengths. However, the data we received from some telecoms providers does not distinguish between the physical bearer and where an additional wavelength had been provided. Therefore, for consistency we also adjust the dark fibre circuits where used for VHB services by the typical number of wavelengths on VHB circuits. We assume that the number of wavelengths per circuit is either one or two and we present results for both assumptions.[241]

**Table A14.6: VHB service shares including dark fibre[242]**

| | BT Only | BT + 1 | HNR Metro Areas | Other HNR Areas | CLA |
|---|---|---|---|---|---|
| Number of VHB customer ends | 755 | 520 | 49 | 90 | 456 |
| Number of CityFibre dark fibre customer ends (total) | [✂] | [✂] | [✂] | [✂] | [✂] |
| Number of dark fibre customer ends (assumed to be VHB) | [✂] | [✂] | [✂] | [✂] | [✂] |
| BT service share VHB circuits including dark fibre | [✂]% 61%-70% | [✂%] 51%-60% | [✂]% 51%-60% | [✂]% 51%-60% | [✂]% 21%-30% |
| BT service share including dark fibre and two wavelengths per circuit | [✂]% 51%-60% | [✂]% 41%-50% | [✂]% 41%-50% | [✂]% 41%-50% | [✂]% 11%-20% |

*Source: Ofcom analysis based on stakeholder responses to 1st BCMR s.135 notice*

A14.54 As shown in the table above, except for CityFibre, the use of dark fibre for VHB access circuits is very limited, and a high concentration of the use is in the CLA area.

A14.55 Including dark fibre in our service share assessments does not have a material impact on our provisional conclusions because:

- BT has a high service share for VHB circuits in each of the BT Only and BT+1 access areas, which is consistent with it having market power in VHB circuits in these areas;
- in the High Network Reach areas and the Metro Areas, the service shares are also high, potentially indicating SMP, but the low number of circuits means this evidence needs to be treated with caution; and

[241] [✂]. We note this may be an overestimate of the number of wavelengths because it assumes all dark fibre circuits use WDM technology whereas some may use Ethernet electronics, more akin to a 10 Gbit/s EAD for example. On the other hand, this may be an underestimate because the previous [✂] was not as easily scalable as dark fibre using WDM electronics.

[242] Assumes 5% CityFibre dark fibre circuits are VHB.

- BT has a service share of [✂]% less than 30% in the CLA, which is consistent with BT not having market power in VHB circuits in this area.

A14.56 In terms of inventory service shares, BT has a service share of less than 40% in each of the relevant geographic markets, which is sometimes lower than Virgin Media's service share. However, we do not place weight on these results for the same reasons set out earlier when discussing inventory service shares excluding dark fibre.

## Provisional conclusions

A14.57 On the basis of the analysis set out in this annex, we provisionally conclude that if we were to find that VHB Access circuits were in a separate market to lower bandwidth products in the CI Access market (i.e. 1 Gbit/s and below) (which is not our proposed finding for the reasons set out in Section 4 of Volume 1), we would find that BT has SMP in each of the following geographic markets:

- BT Only areas in the UK;
- BT+1 areas in the UK;
- HNR Metro Areas; and
- Other HNR areas in the rest of the UK.

A14.58 In the Metro Areas, we have not been able to supplement our SMP assessment with evidence from service shares for each Metro Area because the number of VHB circuits is very small. For the reasons set out in Section 6, the evidence on overall service shares, pricing and margins, we consider that BT would have SMP in each of the Metro Areas for a hypothetical market for VHB Access circuits. For the other geographic areas listed above, the analysis set out in this annex supports a finding that BT has SMP in VHB Access circuits.

A14.59 The analysis in this annex also suggests that we would find that BT does not have SMP in a hypothetical market for VHB Access circuits in the CLA. As set out in Section 6, the CLA is different from other geographic markets because sufficient infrastructure has been deployed to exert strong competitive constraints on BT. This is supported by the service share analysis and evidence that greater discounts on VHB prices are provided in the CLA.

# A15. Inter-exchange connectivity

A15.1 As explained in Section 7, in order to assess significant market power (SMP) in inter-exchange connectivity, we have looked at Principal Core Operator (PCO) presence at BT exchanges.

A15.2 To identify the number of PCOs present at BT exchanges we have looked at purchases of external cablelink variants at BT exchanges.

A15.3 In order to get these results, we sent two statutory information requests to relevant telecoms providers under section 135 of the Communications Act 2003. We first sent an information request to Openreach to establish which telecoms providers had bought external cablelink variants at BT exchanges.

A15.4 Having received information from Openreach, we sent a further information request to other relevant telecoms providers i.e. the main buyers and providers of inter-exchange connectivity services, to establish what each telecoms provider was doing with these external cablelink products e.g. connecting into its own or other telecoms providers' networks.

## Information request to Openreach

A15.5 On 1 February 2018, we sent a statutory information request to Openreach which requested data on sales of two products, Cablelink External and Bulk Transport Link (BTL).[243] We requested confirmation of which customer was purchasing which product, including the number of each product, at which exchange.

A15.6 On 22 February 2018, Openreach provided a response to our request. It provided a list of customers that had purchased an external cablelink variant. There were two variants included: "BT Cablelink" and "Cablelink External". Openreach also provided information on BTL purchases which demonstrated that volumes of BTL have declined to a point where it is no longer a relevant constraint on Openreach's activities in inter-exchange connectivity.[244] It also provided a list of purchases of Cablelink Internal (1-3)[245] and Cablelink Cell Sites variants.

[243] The Cablelink External product is a fibre cable connection which allows telecoms providers to connect network equipment within an exchange to fibre from outside the exchange. In contrast, BTL is a high capacity link that enables telecoms providers to transport multiple backhaul circuits from an exchange without needing to install their own equipment at the exchange.
[244] The data showed that there were [✂] BTL links nationwide.
[245] We decided not to look at these links as they helped to identify re-seller relationships but did not further help to identify fibre providers present at the BT exchange. It would also require telecoms providers to identify activity relating to approximately [✂] data points, which we considered disproportionate given that it would not enhance our analysis of presence at BT exchanges.

## Information requested from other telecoms providers

A15.7 On 13 April 2018, we sent a further 21 statutory information requests to the largest providers and buyers of inter-exchange connectivity services.

A15.8 In addition to asking questions aimed at helping us to better understand competitive conditions in inter-exchange connectivity (e.g. each telecoms provider's wholesaling policy, what factors affect their buying decisions), we also asked telecoms providers to verify the purchases of external cablelink variants provided by Openreach and confirm what it was using these products for.[246]

## Further information gathering

A15.9 In August 2018, we identified some inconsistencies in the results from the analysis we undertook on PCO presence at BT exchanges in the 2016 BCMR and our initial results from this consultation.

A15.10 The inconsistencies primarily related to Vodafone's presence at BT exchanges. Specifically, the initial results for this consultation appeared to potentially under-represent Vodafone's presence at BT exchanges. Having identified the issue, we liaised with Vodafone which confirmed its fibre presence at 114 additional exchanges.[247]

A15.11 To understand what might have caused the issue and determine whether other telecoms providers were affected, we liaised with both BT and Openreach. Openreach identified two possible reasons for the problem:

- it was possible that at some exchanges, Vodafone may have purchased another pre-Cablelink legacy product, "BT Egress" [248] [249], which may not have appeared in our initial analysis of Vodafone's presence at BT exchanges; and
- Vodafone may have received some cablelink external variants from BT. We have since established that [✂].

A15.12 On 14 September, we sent a statutory information request to BT in order to confirm which telecoms providers it was supplying with an external cablelink variant or BT Egress. The information we received showed that BT was supplying [✂] with external cablelink variants and [✂] with "BT Egress".

A15.13 Before taking final decisions in relation to this market we intend to send a further statutory information request to purchasers of "LLU Egress" and those telecoms providers that receive external cablelink variants from BT Enterprise and other non-Openreach BT

[246] As part of this request, we also asked telecoms providers about their activities at data centres.
[247] Vodafone provided this information as an update to its response to the 3rd BCMR s.135 notice.
[248] "BT Egress" is also sometimes referred to as "LLU Egress – External" https://www.openreach.co.uk/orpg/home/products/llu/downloads/RANF_Part_IV_S03.rtf [accessed 30 October 2018].
[249] On 10 September, Openreach provided an update to its response to the 2nd BCMR s.135 notice, listing its sales of BT Egress/LLU Egress – External to other telecoms providers. The volumes were relatively small, with only [✂] to a number of telecoms providers that had informed our assessment of PCOs presence at BT exchanges inclusive of [✂].

entities. We note that the evidence we receive in response to our request may change the number of BT exchanges that will be subject to regulation.

## The results of our analysis

A15.14 As in the 2016 BCMR, we have only counted presence where it is from a PCO.

A15.15 In summary, based on current evidence, we propose to not regulate 545 exchanges and to regulate 5028 exchanges. As discussed above, we note that the number of exchanges that will be subject to our regulation may change as we get greater clarity around the use of "BT Egress" and other external cablelink variant sales from BT.

A15.16 We have provided a detailed list of exchanges that we propose to regulate and not regulate in Schedule 6 to the legal instrument. In that spreadsheet, in separate worksheets, we also note the changes that have occurred since the Temporary Conditions. We do this by noting the exchanges we propose will not be subject to regulation and those we propose to re-regulate.

# A16. Dig distance cost model

A16.1 As explained in more detail in Annex 10, we have prepared an Excel model to inform our understanding of the competitive conditions in different geographic areas. This model uses a bottom up approach to estimate the maximum average route distance from a telecoms provider's nearest network flexibility point to an end-customer's premises that it would be economic for the telecom provider to serve, such that it would break even (on a net present value basis) over the average life of a leased line service contract.

A16.2 The Excel workbook used for this model can be found here: https://www.ofcom.org.uk/__data/assets/excel_doc/0015/125043/annex-16-cost-model.xlsm.

# A17. Dark fibre implementation

A17.1 In Section 12, we set out our proposal to require BT to provide dark fibre access for inter-exchange connectivity circuits from BT Only exchanges. This annex sets out our proposed timeline for implementation of the different obligations of the dark fibre remedy.

A17.2 We propose that BT should be required to publish a Reference Offer (RO) for dark fibre for inter-exchange connectivity from BT Only exchanges on the same terms set out in the 2016 BCMR.[250] The minimum requirements that we propose for this RO are set out in Section 12.

A17.3 In this annex we set out our proposed timetable for implementation obligations for dark fibre access for inter-exchange connectivity circuits from BT Only exchanges, as summarised in Table A17.1 below.

**Table A17.1: Summary of the proposed dark fibre remedy implementation obligations**

| Obligation | Summary |
|---|---|
| **Reference Offer** | Specified minimum requirements for the RO (as set out in section 12).<br>Service Level Agreements (SLAs) and Service Level Guarantees (SLGs) to be agreed and finalised as part of industry negotiations regarding product specification within the Reference Offer.<br>Publish a Reference Offer within one month of the date of the publication of the Final Statement.<br>SLAs and SLGs to enter into force three months after the launch of dark fibre. |
| **Launch** | Launch dark fibre access within one month of the date of the publication of the Final Statement. |
| **Quality of service** | QoS standards apply from year two of the market review<br>Key Performance Indicators (KPIs) defined in Direction.<br>Reporting requirements to come into effect immediately from launch (i.e. within one month of the date of the publication of the Final Statement). |

## Background

### 2016 BCMR

A17.4 In the 2016 BCMR, we concluded that BT would need some time to develop a dark fibre product and that it would need to negotiate some aspects of the product design with other telecoms providers. We therefore required BT to publish a final RO on 1 December 2016

[250] 2016 BCMR, Volume 1, paragraphs 9.177 to 9.182.

(seven months after publication of the 2016 BCMR) and to launch the dark fibre product on 1 October 2017 (17 months after publication of the 2016 BCMR).

## 2017 Dark Fibre Consultation

A17.5 In the 2017 Dark Fibre Consultation, we considered that most of the preparatory work for the launch of the dark fibre product had already been completed. In particular, industry already worked with BT for 15 months following the publication of the 2016 BCMR to develop the detailed technical and operational aspects of the dark fibre product. This included the dark fibre RO, which BT published in December 2016.[251] As a result, our view was that BT would be able to conclude those activities which it needed to undertake before launching the previously proposed dark fibre product within one month.[252]

### Stakeholder responses to the 2017 Dark Fibre Consultation

A17.6 In its response to the proposed implementation timetable set out in the 2017 Dark Fibre Consultation, Openreach commented that our proposed launch date of one month following the publication of the 2016 BCMR was "simply not achievable".[253]

A17.7 Openreach highlighted that following the Tribunal's ruling, all preparation for the original Dark Fibre Access product was suspended and up until that point there had been "very limited model office testing undertaken". Openreach outlined several tasks that would have to be completed prior to launch, such as upgrading systems to reflect changes to relevant products and retraining staff.[254]

A17.8 Openreach also commented that, while much of the RO already agreed with industry could be adopted, it cannot be simply adopted unchanged given that the remedy that was proposed by the 2017 Dark Fibre Consultation was different in scope to the dark fibre remedy imposed under the 2016 BCMR. Openreach considered that a one-month timeline would be insufficient time for negotiations with industry, which would make Openreach liable to disputes at a later stage. Openreach suggested a feasible launch date would be four months after the publication of the 2016 BCMR.[255]

A17.9 BT's response to the 2017 Dark Fibre Consultation reiterated that it would not be simple to continue with the dark fibre development that was halted in June 2017. BT noted that it had stopped preparations to consume dark fibre products in August 2017, instead deciding to work with industry and Openreach on developing the new active products. It added that "Ofcom incorrectly assumes providers are ready to sell dark fibre-based products". It also

[251] BT's dark fibre Reference Offer www.openreach.co.uk/orpg/home/products/darkfibreaccess/darkfibreaccess.do [accessed 30 October 2018].
[252] In this previous consultation we proposed that use of the dark fibre remedy would be restricted to supplying services that are at 1 Gbit/s or below. See 2017 Dark Fibre Consultation, paragraph 3.55.
[253] Openreach's response to the 2017 Dark Fibre Consultation, paragraph 490 to 500 https://www.ofcom.org.uk/__data/assets/pdf_file/0022/110659/Openreach.pdf.
[254] Openreach's response to the 2017 Dark Fibre Consultation, paragraph 496.
[255] Openreach's response to the 2017 Dark Fibre Consultation, paragraph 500 and figure 2.

remarked that the proposed timelines did not allow for a testing window between Openreach and industry, which had been previously agreed with industry.[256]

A17.10 Other telecoms providers were more supportive of the proposed implementation timeline. TalkTalk supported launch within a month of the 2016 BCMR being published (April 2018) and stated that it would seek to be using dark fibre from launch.[257] Vodafone also agreed with the proposal to require Openreach to provide the dark fibre product from April 2018. It also noted that the majority of contractual issues had already been concluded and the remaining outstanding issues could be resolved swiftly.[258]

# Implementation proposals

## Launch date and publication of the Reference Offer

A17.11 Similar to our position in the 2017 Dark Fibre Consultation, we do not consider that it would be necessary for BT to make significant amendments to the dark fibre product to reflect its implementation in the inter-exchange connectivity market.

A17.12 We acknowledge that more time has passed since July 2017, the point at which Openreach says that it abandoned its development of the dark fibre remedy, compared to our previous proposals in the 2017 Dark Fibre Consultation. Furthermore, we appreciate there may be a need for BT to carry certain product implementation activities, such as software upgrades.

A17.13 However, the dark fibre remedy we propose is much closer to the remedy originally imposed in the 2016 BCMR, given that there will not be the same usage restriction as proposed in the 2017 Dark Fibre Consultation, there will be no need to develop further processes around monitoring. As a result, there will be no need for many of the preparatory activities envisaged by Openreach in its response to the 2017 Dark Fibre Consultation, such as the need for extra training or further industry negotiations around the RO.

A17.14 Furthermore, based on the responses from Vodafone and TalkTalk, we envisage that other telecoms providers would favour a short implementation period. The RO may require limited amendments. However, given the industry's likely desire for a short implementation period and the remedy's similarity to what was imposed in the 2016 BCMR (and the variant we consulted on in 2017), there should not be a need for a longer period to provide further input on the RO.

A17.15 We therefore propose that BT should be required to launch the dark fibre product, including the publication of the RO, within one month of the publication of our final

[256] BT's response to the 2017 Dark Fibre Consultation, paragraphs 13 to 21, https://www.ofcom.org.uk/__data/assets/pdf_file/0021/110649/BT.pdf .
[257] TalkTalk's response to the 2017 Dark Fibre Consultation, paragraphs 3.61 to 3.65, https://www.ofcom.org.uk/__data/assets/pdf_file/0017/110663/TalkTalk.pdf.
[258] Vodafone's response to the 2017 Dark Fibre Consultation, page 23, https://www.ofcom.org.uk/__data/assets/pdf_file/0021/110667/Vodafone.pdf .

statement. SLAs and SLGs are to be agreed and finalised as part of industry negotiations regarding product specification within this RO. These SLAs and SLGs are to then enter into force three months after the launch of dark fibre.

## Quality of service

A17.16 As discussed in Section 15, we propose to impose a direction requiring BT to provide quality of service information in the form of KPIs in relation to Ethernet products. The KPIs required will include dark fibre provided in for inter-exchange connectivity from BT Only exchanges market once it is launched. Such information would be needed to ensure that we are able to monitor performance outcomes as between active and passive remedies and to complement our measures to address potential discriminatory behaviour.

A17.17 In the 2016 BCMR we allowed a period of six months between the introduction of dark fibre and the delivery of the KPI data for the first relevant month. We now propose that the KPI data should be made available from the launch of the dark fibre product. This is because Openreach will have already completed some of the work necessary to generate the KPIs as part of the dark fibre product development it carried out in the 15 months between April 2016 and July 2017. Openreach has therefore established systems to provide KPI data in general. We do not see any reasons why the provision of KPI data immediately from launch should pose any difficulty for Openreach.

A17.18 As discussed in Section 15, we also propose to impose QoS standards on these inter-exchange dark fibre circuits in year two of the market review, including them alongside the other Ethernet products covered by the QoS standards.

# A18. Cost modelling for active services

A18.1 As discussed in Section 2 of Volume 2, we propose to cap prices for CI access and inter-exchange services at 1 Gbit/s and below with a flat nominal (i.e. CPI-CPI) control starting with average prices as set in the final year of the current control. We have carried out some analysis to understand how this scenario compares with a cost-based charge control, similar to the one currently in place for these services, which would normally require prices to align with fully allocated costs (FAC) by the end of the review period.

A18.2 As well as maintaining price stability, we also seek to strike an appropriate balance between protecting downstream customers from excessive pricing and ensuring BT has a fair opportunity to recover efficiently incurred costs. The modelling presented in this annex allows us to better understand the potential effects of a flat nominal control on these two objectives.

A18.3 Using the 2016 LLCC top-down model as a starting point and largely following forecasting methodologies established in previous leased lines and the 2018 WLA charge controls, we have undertaken some modelling to understand the likely evolution of efficient costs of the relevant services over this review period. We refer to this as the 'CI model'.

A18.4 Our analysis shows that we expect prices to be broadly aligned to cost by the end of the current control period. Further, our modelling suggests that a CPI-CPI charge control could be expected to lead to BT recovering around £50 to £65m more over the review period than if we set the control on a FAC basis.

A18.5 If we consider a reasonable range for key input parameters (as we normally would if we were consulting on a range for the X), then the value of 'X' could be in the range of between -9.75% and -1.25%. This would imply greater over-recovery of anything up to £135m or some under-recovery of up to £10m as being possible.

A18.6 A control at CPI-CPI is therefore most likely to result in higher prices than would a cost-based control to align with FAC, but it falls within the range of reasonably possible outcomes. As explained in Section 2 of Volume 2, we do not consider that any potential over-recovery of costs by BT will outweigh the benefits of pricing stability or that the risks of under-recovery are significant.

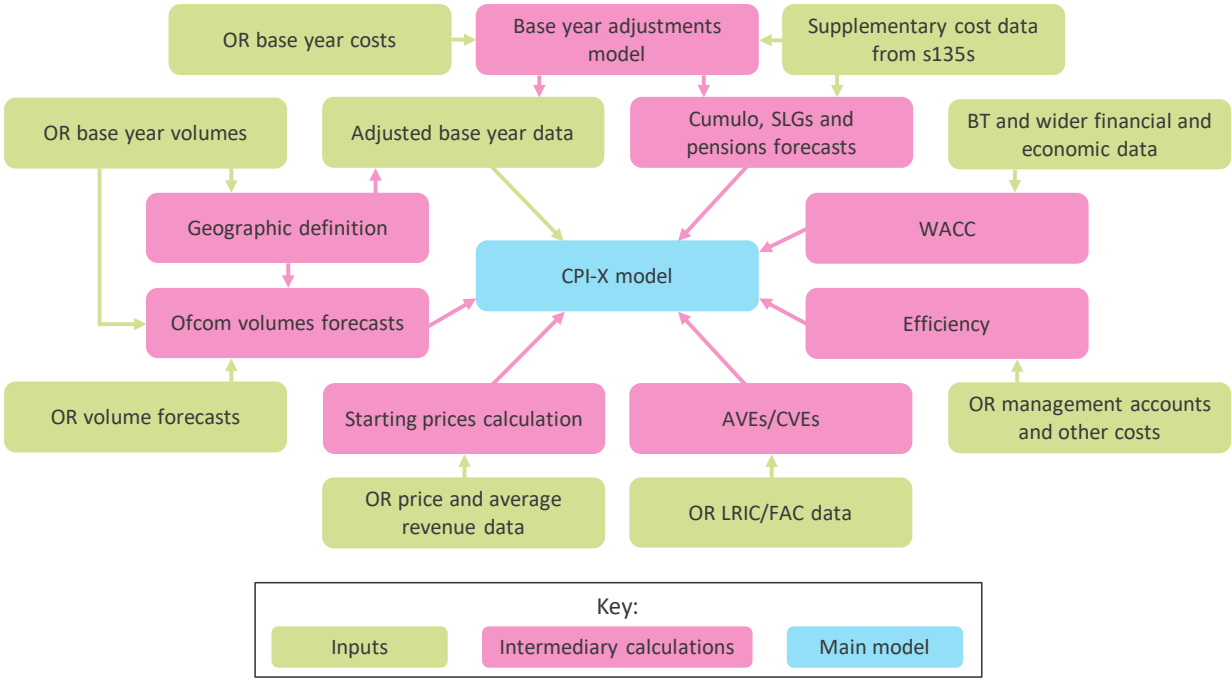
A18.7 In this annex we set out:

- 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

A18.8 The objective of our modelling exercise is to forecast how the efficient costs of providing the active services at 1 Gbit/s and below might evolve over the charge control period. We have structured our model as illustrated in Figure A18.1 below.

**Figure A18.1: The model structure**




*Note: in this Figure 'OR' refers to Openreach. Other acronyms are described later in this section.*

## Approach to modelling

A18.9 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 2016 LLCC 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

A18.10 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.[259] This is based on forward-looking costs plus some relevant sunk costs, such as the cost of duct.

A18.11 As in previous business connectivity market reviews (in 2004, 2009, 2013 and 2016) and other charge controls using top-down models (WLA and, until recently, WBA)[260], we

[259] 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.
[260] Ofcom, 2014. *Wholesale broadband access market review,* Section 7. https://www.ofcom.org.uk/__data/assets/pdf_file/0021/57810/WBA-Final-statement.pdf; Ofcom, 2018. *Wholesale local access market review,* Volume 2, Section 2. https://www.ofcom.org.uk/__data/assets/pdf_file/0023/112487/wla-statement-vol-2.pdf.

consider Current Cost Accounting (CCA) Fully Allocated Cost (FAC) as the most appropriate standard for estimating the cost of providing leased line services.

A18.12 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 current costs give better signals for efficient investment and entry than historic 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

A18.13 In summary, our modelling approach consists of four key steps:

a) First, we calculate the base year costs for the relevant services. These costs are based on 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. 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 latest view of the appropriate forward-looking weighted average cost of capital (WACC).

c) Third, we forecast revenues in each year until the end of the charge control, absent a charge control over the forecast period.

d) Finally, we compare revenues and costs for the 1 Gbit/s and below active services basket[261] to assess the effect of setting a CPI-CPI control rather than a CCA-FAC-based charge control.

A18.14 We describe each of the steps and key assumptions used in more detail below.

## Base year costs

A18.15 The first step of a top-down model is to establish the relevant costs in the base year for the charge control. These base year costs are based on regulatory accounting data provided by BT. To make them suitable to use as the starting point of our forecasts, we then adjust the data to reflect our view of BT's efficiently-incurred costs. These adjustments are discussed in detail in Annex 19.

A18.16 We have used BT's 2016/17 costs as our base year. We are aware that BT has published its 2017/18 costs as part of its 2017/18 RFS[262], but have not had sufficient time since the publication of the 2017/18 RFS to gather additional data from BT to inform our

[261] Please note, in the draft legal instrument we refer to this basket as the 'Ethernet (1 Gbit/s and below) Services Basket'.
[262] BT 2017/18 RFS.
https://www.btplc.com/Thegroup/Policyandregulation/Governance/Financialstatements/2018/index.htm.

adjustments and to perform the necessary checks on these costs to make them suitable for use as our base year. We intend to update the model to use 2017/18 for the base year prior to publishing our statement.

A18.17 We consider our adjusted 2016/17 data (with several adjustments intended to bring costs more in line with the 2017/18 position) provides a reasonable basis for the purposes of consulting on our modelling. We are satisfied, on the basis of our initial checks, that updating the model to use 2017/18 for the base year on the basis of the 2017/18 RFS should not cause a significant shift in the overall results of the model.

A18.18 Table A18.2 below shows the costs and revenues in the recent RFS alongside our base year assumptions, for context.

**Table A18.2: Comparison of BT's currently-regulated CI service costs and revenues**

| Year | Total revenue | Total CCA opex | Return | MCE |
|---|---|---|---|---|
| 2016/17 | £803m | £492m | £311m | £2,055m |
| 2016/17 restated | £638m | £395m | £243m | £1,831m |
| 2016/17 Ofcom-adjusted | £633m | £424m | £209m | £1,483m |
| 2017/18 | £609m | £410m | £199m | £1,932m |

*Source: 2016/17 and 2017/18 BT RFS and Ofcom analysis. Data for CISBO Rest of UK plus CISBO London Periphery used for 2016/17, and CISBO Rest of UK and CISBO Combined Geographic used for 2017/18.*

*Note: In each RFS BT provides data for the previous year restated on the same basis of preparation as the main publication year. As the basis of preparation for CISBO costs has changed quite significantly between 2016/17 and 2017/18, in part due to the publication of the Temporary Conditions and due to some major cost changes being identified by BT, we have presented both the original and restated 2016/17 data.*

*Note: 2016/17 RFS data include services at 1 Gbit/s and below and services above 1 Gbit/s aggregated together, and so are not strictly comparable to the following rows. For reference, the total FAC of these separate bandwidths are £506m and £148m respectively across the CISBO Rest of UK and CISBO London Periphery geographic areas.*

*Note: Ofcom-adjusted base year data is presented based on the geographic definitions in the Temporary Conditions. A discussion of the update to the geographic definitions in this market review is presented later in this Annex.*

# Forecasting costs

## Overall approach

A18.19 BT's efficiently-incurred costs consist of operating and capital costs (opex and capex, respectively). We forecast each of these cost types separately. We have taken a similar approach to forecasting costs as in the 2016 BCMR.[263]

[263] 2016 BCMR, Volume 2, paragraphs A26.26-49.

A18.20 While we are interested ultimately in service-level costs, our cost forecasts are calculated at a network component level. We consider this provides greater robustness 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 or Ethernet electronics costs. By forecasting how the costs of these 'building blocks' are expected to change, we can then 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 from every other.

A18.21 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 as a starting point:

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. The volume changes are combined with the AVEs and CVEs to estimate the impact on costs.

## Geographic definition

A18.22 In Section 5 of Volume 1 we set out our geographic market definitions. These do not align precisely with the current geographic definitions as set out in the Temporary Conditions, which were themselves different to those in the 2016 BCMR. Generally, we have separated Central London Area from the rest of the UK, but the exact boundaries used and any other definitions such as the central business districts of other major cities have changed between publications.

A18.23 For the purposes of setting a charge control, we are most concerned with the boundary between areas where the charge control is in force (regardless of whether this is further subdivided in the SMP market assessment) and areas that are not charge controlled. Table A18.3 below shows changes in these areas since 2016.

**Table A18.3: Summary of the proposed and previous geographic market definitions**

| | 2016 BCMR Statement | Temporary Conditions | 2018 BCMR Consultation |
|---|---|---|---|
| Charge-controlled areas | London Periphery<br>Rest of UK | London Periphery<br>The CBDs of Bristol and Manchester<br>Rest of UK | BT Only areas in the UK<br>BT+1 areas in the UK |
| Non-charge-controlled areas | Central London Area | Central London Area<br>The CBDs of Birmingham, Leeds and Glasgow | BT+2 areas:<br>- each of the Metro Areas<br>- other High Network Reach areas<br>- Central London Area |

*Note: in the 2017/18 RFS, costs are reported separately for two areas: 'Rest of the UK' and 'Combined Geographic' (which includes London Periphery and the CBDs of Bristol and Manchester). While the name 'Central London Area' is used both in the 2016 BCMR Statement and this consultation, the exact set of postal sectors covered in this document for this area is slightly changed from the set in 2016. See Section 5 of Volume 1 for further details.*

A18.24 To ensure our modelling is consistent with our latest definitions, we have adjusted base year costs and volumes to reflect only those circuits in relevant geographic areas.

A18.25 We have approached this adjustment in five steps:

- **Step 1:** We have identified circuits by geography under each of the geographic definitions in the Temporary Conditions and under the definitions in Section 5 of Volume 1. We have done this by using the Openreach Circuit Inventory Database which contains geographic data for all Openreach leased lines.

- **Step 2:** We have identified those circuits in areas where we are proposing any change in geographic definition whether that circuit is or is not in a charge-controlled area. These are:
  - the circuits which were in the Rest of UK, the London Periphery or the CBDs of Bristol and Manchester which are now in BT+2 areas – these are circuits that are currently charge controlled but will not be under our proposed definitions; and
  - the circuits which were in the Central London Area or the CBDs of Birmingham, Leeds and Glasgow which are now in BT Only or BT+1 areas – these are circuits that are not currently charge controlled but will be under our proposed definitions.

- **Step 3:** We have calculated the proportion of circuits that have been reclassified (i.e. number of reclassified circuits in an area divided by total circuits in that area). We have done this for each of the areas for which we have aggregated data from BT: the Combined Geographic Area (comprising the London Periphery and the CBDs of Bristol and Manchester); the Rest of UK; and CISBO Residual (comprising the Central London Area and the CBDs of Birmingham, Leeds and Glasgow).[264] These three areas are the areas we use in our base year data, with each service having a variant with its own costs, volumes and revenues for each of these areas.

- **Step 4:** To represent the reclassification of whether or not a circuit is charge controlled in our modelling, we move circuit volumes between the CISBO Residual (which includes all circuits that are not charge controlled) and the Rest of UK (which includes all circuits which are charge controlled). We have moved all volumes out of the Combined Geographic Area, with around a third moving into CISBO Residual and the remainder moving into the Rest of UK. For each service, this results in up to three net movements:
  - from the Combined Geographic area into the Central London Area;
  - from the Combined Geographic Area into the Rest of UK; and

[264] We do not hold data disaggregated at the level of each of the individual geographic markets listed in Table A18.3. We have therefore performed our analysis at the greatest level of disaggregation available to us, which are the data split as shown in the 2018 RFS.

- between the Central London Area and the Rest of UK.

**Step 5:** In moving volumes between areas, we need to assume the associated costs of the reclassified circuits. BT does not hold data on a more granular basis than the three areas we have used, so we are not able to identify the actual costs of the circuits we are reclassifying. For the purposes of this analysis, we have assumed that the average unit cost of service volumes moving from the Central London Area and the Combined Geographic Area is equal to the average unit cost of the service in the original area. This may be different from the average unit cost of the equivalent service in the destination area.

We consider this assumption is appropriate because the Combined Geographic Area and Central London Area are smaller areas with greater homogeneity than the Rest of UK, which covers a high proportion of the country with a range of business densities from large towns to rural areas. Furthermore, the areas that are being redefined are likely to be parts of the country with greater business density, either being in areas which have seen greater competition in the last few years or that were previously defined as competitive (and are now at the more competitive end of the spectrum in the Rest of UK). Therefore, we consider that using the unit costs of circuits in these smaller and more homogenous areas is a better proxy for the unit costs of circuits in redefined areas than are the unit costs of circuits in the Rest of UK.

# Key modelling assumptions

## Volume forecasts

A18.26 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 with an inverse relationship between the two.

A18.27 As we are forecasting the costs and revenues of BT's regulated CI services, on a service-by-service basis, we have based our volume forecasts initially on BT's own forecasts. We consider that BT's forecasts of service volumes provide the best starting point for our forecasts. We have checked these forecasts against those of other telecoms providers and adjusted them where necessary, primarily to allocate them across services and geographies.

A18.28 We have received forecast volume data from Openreach.[265] These provide us with two sets of volumes forecasts:

a) a short-run forecast covering 2017/18 and 2018/19, broken down by individual service; and

b) a long-run forecast covering 2019/20 to 2021/22, broken down only by broad bandwidth categories and technology.

[265] Openreach response dated 2 March 2018 to question 11 of the 1st LLCC s.135 notice.

A18.29 Neither forecast breaks services down by geography with both sets of data providing forecasts across all geographic areas.

## Adjustments to Openreach's forecasts

A18.30 We have identified some areas where we consider adjustments are needed to Openreach's forecasts to make them appropriate for use in our CI model:

- an adjustment to account for volumes in Northern Ireland;
- adjustments to convert the more aggregated long-run forecasts into suitable service-level growth rates;
- a bespoke forecast of main links;
- an adjustment to reflect our new geographic definitions; and
- an adjustment to reflect the potential impact on volumes of the mixed-usage PIA remedy we introduced in 2018 WLA.[266]

*Northern Ireland adjustment*

A18.31 While the base year volumes data from BT's RFS do include Northern Ireland volumes, Openreach's volume forecasts do not. We have accounted for this in our modelling to avoid inconsistencies between the base year data and the forecast series.

*Converting the more aggregated long-run forecasts into suitable service-level growth rates*

A18.32 Openreach's long-run forecast aggregates services into quite 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 category:

- 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 than compared to their non-LA equivalents, consistent with historical trends.

A18.33 In each case, we change the growth rates of both the adjusted services and the remaining services such that the total volume growth of each broad service category remains in line with Openreach's original forecast.

*Main links forecast*

A18.34 Openreach's forecasts do not include forecasts for main link services. We have set these to grow at the same rate as the overall growth rate of the services which use them. We have

[266] In paragraph 2.222, Volume 3 of the 2018 WLA Statement, we signalled our intention to consider the potential impact of the mixed-usage PIA remedy on BT's cost recovery.

based this on a mapping of such services provided by Openreach. We consider this is a reasonable predictor for main link growth as main link services are 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*

A18.35 In the 2018 WLA we relaxed usage restrictions on BT's PIA product to allow 'mixed usage'. Our relaxation of the usage restrictions allowed telecoms providers to use BT's ducts and poles (through the PIA remedy) to deploy local access networks offering both broadband and non-broadband services, provided the primary purpose of the network deployment is the delivery of broadband services. Furthermore, in parallel with this consultation we have published a consultation on the Physical Infrastructure Market Review, setting out our proposals to give unrestricted access to Openreach's network of underground 'ducts' and telegraph poles.

A18.36 Unrestricted access will allow telecoms providers to use PIA to provide business connectivity in more circumstances than with the current mixed usage arrangements, which 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.

A18.37 We consider that only new external connections, as opposed to existing circuits, may move to the use of 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 (for example the cost of blowing fibre), and non-financial (for example end customers would likely face service downtime when switching to the new service).

A18.38 We consider that if a telecoms provider did try to migrate an existing customer, the disruption that migration could cause may result in the customer switching provider. Moreover, even if an existing customer was prepared to consider the migration of an existing service, it may do so only where it would obtain a large cost reduction. This would limit telecoms providers' incentives to seek to migrate existing active services to services deployed used 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.

A18.39 We have considered a range for the volumes of circuits that could be cannibalised in 2019/2020 and 2020/21. At the lower bound of our range, no Openreach new connections would be lost to other telecoms providers in either year. At the higher bound of our range, 20% to 25% of Openreach's external 100 Mbit/s and 1 Gbit/s EAD LA connections would be cannibalised by PIA and almost all of its external 10 Gbit/s EAD LA connections. This reflects the likelihood that it will be more economically viable to use PIA over shorter distances and for higher-bandwidth circuits. Overall, we expect that this will amount to c.12,000 connections each year. We consider this gives a wide enough range to capture all reasonable possible volume losses.

A18.40 We note that PIA will also be available for inter-exchange connectivity. However, our initial view is that any take-up of PIA is likely to be limited to local access circuits, at least for this market review period. This is because the cost of using PIA for inter-exchange connectivity is materially higher than for local access segments.

### Bandwidth-level rentals forecasts

A18.41 Having made the above adjustments to Openreach's service-level volume forecasts, we have constructed two scenarios to represent our upper- and lower-bound volume forecasts. In producing these we have represented two factors that we believe could affect the growth of volumes in the basket of active services at 1 Gbit/s or lower in a way that would affect the output value of X from our model:

- 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.

A18.42 Greater exogenous volumes growth would tend to decrease unit costs as fixed and common costs are spread over a wider base. This would then produce a larger (absolute) value of X as prices would need to fall faster to be in line with costs at the end of the period. The reverse is true for lower exogenous volumes growth.

A18.43 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.

A18.44 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. These forecasts are shown in Figures A18.4 and A18.5 below.

**Figure A18.4: Ofcom's high and low volume forecasts, by bandwidth**

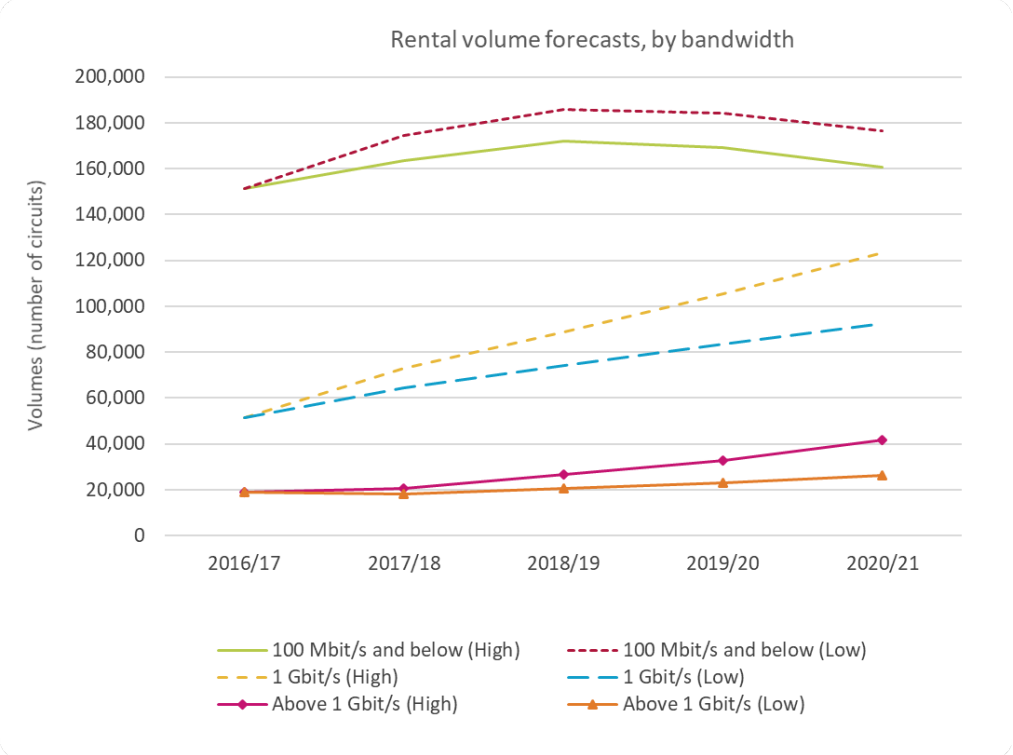
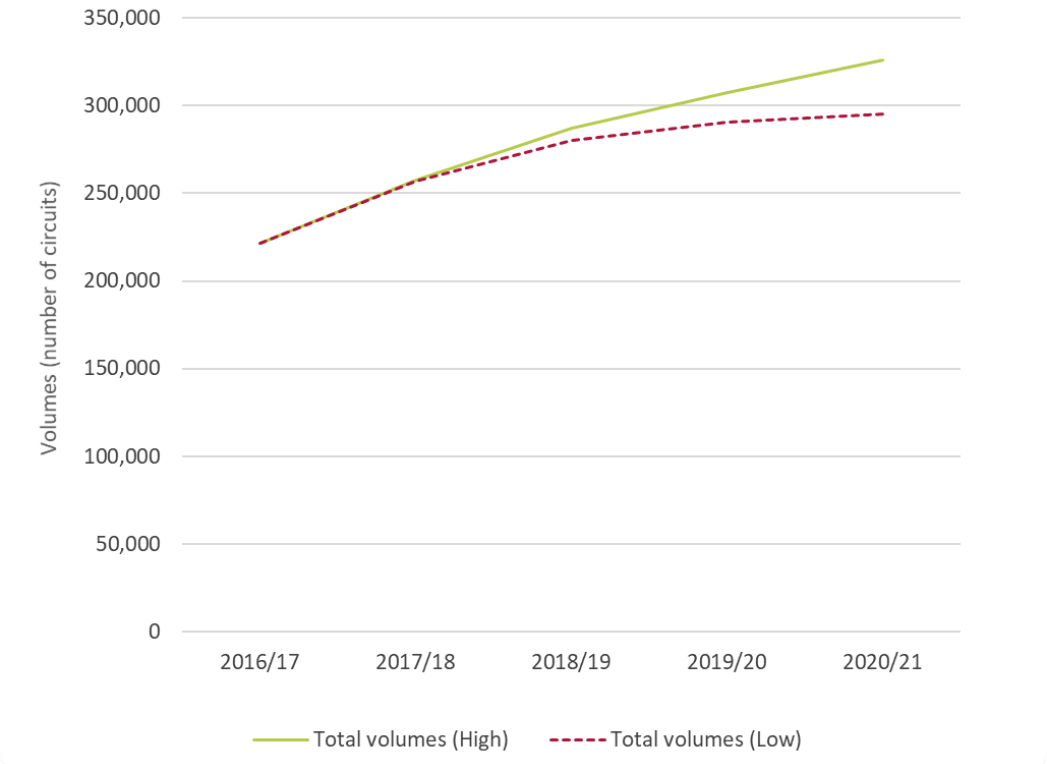



**Figure A18.5: Ofcom's high and low volume forecasts, total**




A18.45 Overall, we forecast the bulk of circuits to remain as 100 Mbit/s and 1 Gbit/s over the forecast period, with the former experiencing lower growth from a higher starting volume

and the latter experiencing higher growth from a lower starting volume. We forecast strong growth in circuits above 1 Gbit/s, though as the starting volume of these circuits is much lower in the base year, they will remain a minority of circuits over the forecast period. In our low-case scenario, circuits up to 100 Mbit/s are forecast to be higher than in our high-volumes scenario because the effect of there being greater demand for lower bandwidth services dominates the generalised lower demand for leased lines.

A18.46 We have also checked these forecasts against forecasts provided by other telecoms providers for their own use of leased lines. We are satisfied that our forecasts sit within the range of these forecasts, though towards the lower end. We consider this is reasonable as, being the largest provider of leased lines, we would expect lower growth rates for Openreach than we might for a smaller telecoms provider simply due to scale or the maturity of its market position.

## Efficiency

A18.47 As part of our cost forecasting we take a view on the cost savings (efficiency) we expect BT to achieve over the review period. To support this judgment, we have considered several sources of evidence in the round.

A18.48 Historical trends are useful only to the extent they can be repeated in future and can be calculated on a basis that is consistent with our modelling approach. Forecast data sources might be more relevant but may be less reliable because, in the case of BT's divisional forecasts, they do not represent an independent view.

A18.49 Our chosen efficiency assumptions reflect the different weights we give to each source of evidence that we have reviewed, as explained in more detail below.

### Operating costs

A18.50 Consistent with the methodology described in the 2016 BCMR Statement and 2018 WLA Statement, to arrive at our operating cost efficiency targets we have:

- Analysed changes in component costs via sets of 'pairwise' comparisons over the historic period 2013/14 to 2017/18 using BT regulatory accounting information from Openreach.[267] Consistent with how we have modelled costs, cumulo and Service Level Guarantee (SLG) costs have been removed from this analysis.
- Analysed both historical and forecast BT divisional management accounting information for the relevant BT divisions[268] over the historic period 2013/14 to 2017/18 and forecast period up to 2020/21.[269] Consistent with how we have modelled costs, cumulo and SLG costs have been removed from this analysis.

[267] Openreach response dated 9 May 2018 to question 2 of the 3rd LLCCs.135 notice.
[268] The relevant BT divisions for this charge control are Openreach and BT Technology.
[269] Openreach response dated 9 May 2018 to section 2 of the 3rd LLCC s.135 notice; Openreach response dated 2 July 2018 to section 3 of the 7th LLCC s.135 notice; Openreach response dated 23 May 2018 to question 14 of the 3rd LLCC s.135 notice. The methodology for this analysis is the same as described in the 2018 WLA Statement, paragraphs A17.48-78.

- Reviewed information originating from outside BT. This included various benchmarking studies undertaken for BT[270] together with various telecoms specific and economy wide studies.[271]
- Reviewed other public information about BT's cost performance such as public statements made by BT.

A18.51 We continue to consider that our regulatory cost analysis provides an important source of evidence[272] and attach a relatively high weight to it in forming our efficiency assumptions. This analysis is consistent with the way we model costs and covers the same services. We estimate the average annual cost saving achieved between 2012/13 and 2016/17 was a compound annual growth rate (CAGR) of 7.2%.

A18.52 We consider our analysis of Openreach and BT Technology's historical and forecast internal management accounting data should also provide relevant and reliable evidence for forming our efficiency assumptions for this review period. This analysis provides a view of both the relevant divisions recent past efficiency achievements and its forecast internal efficiency and cost transformation targets out to 2020/21. This analysis suggested CAGR efficiency of 5.7% p.a. has been achieved historically for our Relevant Services and forecast CAGR efficiencies of 5.1% p.a. are expected. When adjusted to look over a consistent time period, the results are similar to those from our regulatory cost analysis, and again we attach a relatively high weight to this analysis in forming our efficiency assumptions.

A18.53 In recent charge controls we have taken the view that benchmarking data and other external studies can provide a potentially informative source of evidence. However, we have had concerns about all the studies we considered. These generally related to consistency with our modelling approach, notably the treatment of changes in volumes, and consistency with the range of costs to which we apply our efficiency estimates. We continue to have these concerns and so currently give these studies no weight in our analysis.

A18.54 Our review of public statements by BT confirmed that it has reduced costs through its cost transformation programmes and it believes there are still significant opportunities to do so going forward, at a similar rate to those achieved in the past. Identified cost transformation initiatives include activities that span the Relevant Services. These statements provide qualitative evidence that cost savings will continue to materialise in relation to the Relevant Services. This gives us more confidence in using evidence from historical data for BT as an indication of what rates may be achievable in the future.

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[270] Two separate benchmarking studies were provided by Openreach both related to very niche parts of the BT business and the costs from which made up a very small portion of our base data cost pool. Openreach response dated 9 May 2018 to question 15 of the 3rd LLCC s.135 notice.

[271] ONS, April 2017. *Multi-factor productivity estimates: Experimental estimates to 2015*; IMF 2016, Country Report No. 16/58, United Kingdom: Selected Issues. https://www.imf.org/external/pubs/ft/scr/2016/cr1658.pdf; OBR, Economic and fiscal outlook supplementary economy tables – November 2017, Table 1.6. http://budgetresponsibility.org.uk/efo/economic-fiscal-outlook-november-2017/ [accessed 31 January 2018].

[272] 2018 WLA Statement, paragraph A19.119.

A18.55 Having considered all the evidence in the round, we use a range of 4% to 7% per annum for our operating cost efficiency target within the model and our analysis indicates that BT can achieve the higher end of this range. We have sought to identify a challenging but achievable target, which while not easy to meet, is nevertheless capable of being exceeded.

### Capital costs

A18.56 We have assessed efficiency on capital expenditure separately from that on operating costs. Consistent with the methodologies described in the 2018 WLA Statement, for each different capital cost category, for both Openreach and TSO, we have calculated historical cost saving rates and then combined these together based on the relevant weights for our Relevant Services. The distinct categories we have considered are:

- Capitalised pay [✂]% (30% to 40%) in 2016/17[273] – the capitalisation of pay costs for BT employees.[274]
- Civil engineering [✂]% (0% to 10%) in 2016/17[275] – costs for work undertaken by external third parties to complete civil engineering activity.[276]
- Contract equipment, Stores and other [✂]% (50% to 60%) in 2016/17[277] – we understand that these cost categories contain the electronics equipment along with other costs which cannot be mapped onto one of the previous categories.

A18.57 Our analysis of these categories suggests historical annual average cost savings of 3% to 6% between 2014/15 and 2016/17 with a CAGR in the middle of this range. Our cost savings estimates for different types of capital expenditure are weighted to reflect both the mix of capital expenditure for the Relevant Services and the relative contribution of each Relevant Division to capital expenditure on the Relevant Services.

## Asset volume elasticities (AVEs) and cost volume elasticities (CVEs)

A18.58 We would expect changes in the volume of a service provided to impact the costs and assets 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.

A18.59 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

[273] Openreach response dated 3 August 2018 to question 1 of the 8th s.135 notice.
[274] The methodology for this analysis is the same as described in the 2018 WLA Statement, paragraphs A19.149-152.
[275] Openreach response dated 3 August 2018 to question 1 of the 8th s.135 notice.
[276] The methodology for this analysis is the same as described in the 2018 WLA statement, paragraphs A19.153-156.
[277] Openreach response dated 3 August 2018 to question 1 of the 8th s.135 notice.

volumes have on forecast costs (before considering the impact of inflation or cost savings) is determined by AVEs and CVEs.

### Overall approach to calculating AVEs/CVEs

A18.60 In general, we have adopted the same methodology as in the 2016 BCMR Statement and 2018 WLA Statement.[278]

A18.61 We have used LRIC to FAC ratios as a proxy for AVEs and CVEs based on BT's LRIC model outputs. In the short run, marginal costs can be lumpy, but in the long run, marginal costs are less lumpy; many inputs that in the short run may have been fixed for certain output ranges are treated as fully variable and scalable in the long run. For the purposes of charge controls, we focus on the long-run marginal costs, which thus abstract from a degree of the lumpiness that may be observed in the short run.[279]

A18.62 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.[280] This is consistent with the approach we adopted in the 2014 FAMR, 2016 BCMR and 2018 WLA.

A18.63 AVEs can be calculated in the same manner as CVEs (i.e. separately for each component). We propose to calculate AVEs using the same approach that we adopted in the 2016 BCMR and 2018 WLA 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.[281] 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 CI model.

### Cross checks and adjustments

A18.64 We 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 of a 10% increase 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 cost for that component). We have therefore checked that all the estimated CVEs and AVEs are between zero and one. In previous charge controls we had identified some ratios

[278] See Annex 18 of the 2018 WLA Statement.
[279] While this long-run approach may imply that, for certain points in time and levels of volume, the modelled marginal cost exceeds the likely short-run marginal costs relevant to the control period, at other times the converse will be true. Therefore, these impacts should, to some extent, offset each other over time.
[280] 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.
[281] 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.

that lay slightly outside this range. However, our checks on the ratios using 2016/17 data identified no exceptions.

*Adjustment to non-pay CVE for Openreach Admin Fee component*

A18.65 As in the 2018 WLA Statement, we propose to 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[282] 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 for Access Fibre cost category*

A18.66 We propose to make an adjustment to the AVE for access fibre similar to, and for the same reasons as, the one we made in the 2016 BCMR Statement.[283] Access fibre costs are used by a number of Ethernet components and are an important element of the Ethernet basket cost stack. Using BT's LRIC model outputs and the methodology described above, the estimated AVE for access fibre costs used by the EAD Fibre component is very low ([✂]), representing very little volume elasticity of costs. Our adjustment raises this AVE to between 0.6 and 0.8.

A18.67 We consider that our standard approach of using BT's LRIC model outputs is likely to understate the AVE in this case, 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, because 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 removed. Instead, we would expect less intensive use of existing assets.

*Dynamic AVEs/CVEs*

A18.68 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 charge control 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.

A18.69 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 abd maintain a fixed level of fixed and common costs across all years. This is the same approach taken in the 2016 LLCC model. 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.

[282] See the description of the base LICENCEFEE in BT's 2017 AMD, page 47.
[283] See paragraphs A32.119-136 of the 2016 BCMR Statement.

## Input price inflation

A18.70 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.

A18.71 Our proposed approach to forecasting inflation is consistent with that adopted in both the 2016 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 propose to adopt a pay cost inflation rate within our forecasts of 2.8% (geometric mean 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 propose to adopt a non-pay cost inflation rate within our forecasts of 2.1% (geometric mean per annum across the forecast period).
- **Asset price inflation.** We propose to 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 Regulatory Financial Statements (RFS) (i.e. an indexed historic methodology using the Retail Price Index (RPI)). The geometric mean of the OBR's RPI forecast between 2017/18 and the final year of the charge control period, 2020/21, is 3.3% per annum. We propose to assume that all other asset prices, including those for fibre assets, stay constant in nominal terms. We explain our rationale for the indexation of fibre assets in Annex 19.

## WACC

A18.72 Our model also requires an estimate of the appropriate forward-looking cost of capital for leased lines services. We have estimated a range of 7% to 9% to be appropriate for the purposes of this model. We explain our estimation of WACC in Annex 21.

## Costs forecast separately

### Cumulo

A18.73 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'.[284]

A18.74 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 will take place in 2020 in Northern Ireland, 2021 in England and Wales and 2022 in Scotland.[285]

A18.75 Within our model we include recovery of an appropriate share of BT's forward looking cumulo costs. From 1 April 2017 the rating authorities reassessed BT's cumulo RVs at a significantly higher level. These RVs will remain in place until the end of the charge control period, except in Northern Ireland, and will increase BT's cumulo costs significantly from 2017/18. Our standard approach to modelling operating costs would not capture these large increases and so we have forecast them separately.

A18.76 We have adopted the same two step approach to forecasting these costs as in the 2018 WLA Statement. We forecast BT's total cumulo costs and then we attribute these across all BT's services.[286] The only change we have made for our model compared to the WLA Statement has been our approach to net replacement costs (NRCs) when attributing cumulo costs to TI and Ethernet services. We describe this change below.

*Forecasts of BT's cumulo rates costs*

A18.77 As in the 2018 WLA Statement, we have forecast BT's cumulo rates costs by taking BT's latest published RVs, forecasting them forward by estimating the impact of two material changes in circumstances[287] (for MPF growth and VULA rollout), applying assumptions about rates in the pound, and estimating the impact of the English transition scheme.[288]

A18.78 BT's RVs have not changed since those we reported in the 2018 WLA Statement. As a result of the 2017 revaluation in England, Wales and Scotland they increased from £201m as at 31 March 2017 to £602m from 1 April 2017.[289]

A18.79 We understand from BT that the material changes in circumstance (MCC) regime has not yet been agreed between BT and the rating authorities.[290] We have therefore forecast BT's RVs over the charge control period using the same assumptions as we used in the 2018 WLA Statement. We have again assumed that BT's future RVs will not be reduced because

[284] 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.
[285] Openreach response dated 10 September 2018 to question 13 of the 10th LLCC s.135 notice.
[286] See Annex 21 of the 2018 WLA Statement.
[287] 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.
[288] *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.
[289] See Table A21.1 in the 2018 WLA Statement.
[290] Openreach response dated 10 September 2018 to question 13 of the 10th LLCC s.135 notice.

of the UK Government's recent legislation that grants 100% business rate relief on new full-fibre infrastructure for a 5-year period from 1 April 2017. Overall, we expect that BT's cumulo RV will increase by c.£70m by the end of 2020/21.

A18.80 We have used the rates in the pound published for 2017/18 and 2018/19 and have forecast them forward as we did in the 2018 WLA Statement by indexing by CPI, consistent with recent government announcements in England, Scotland and Wales. The resulting forecast rates in the pound are again very similar to those we presented in Table A21.4 of the WLA Statement.

A18.81 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.

A18.82 Overall, we have forecast BT's cumulo costs almost to quadruple from around £96m in 2016/17 to around £349m in 2020/21, in a profile that is very similar to the forecasts in the 2018 WLA Statement.

*Attributions of BT's cumulo costs*

A18.83 Our proposed approach to the attribution of BT's cumulo costs is the same as that in the 2018 WLA Statement. We consider that this approach is reasonable and note that the core methodological approach of profit weighted net replacement costs (PWNRC) was defended successfully at appeal to the Competition Commission in 2012/13.[291] The only change we have made in this control is that we have included forecasts of NRCs of rateable assets for leased line services, both Ethernet and TI.

A18.84 The three steps in our attribution method are:

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.

b) Attribute the cumulo costs apportioned to GEA services across relevant GEA components using the PWNRC methodology.

c) Attribute the cumulo costs apportioned to non-GEA services across relevant non-GEA components using the PWNRC methodology.

[291] Competition Commission, 2013, *British Telecommunications Plc v Office of Communications Case 1193/3/3/12 British Sky Broadcasting Limited and TalkTalk Telecom Group Plc v Office of Communications Case 1192/3/3/12 Determinations,* paragraphs 11.97-98, and 11.112. https://www.catribunal.org.uk/sites/default/files/1192-93_BSkyB_CC_Determination_270313.pdf. Under the PWNRC methodology BT's cumulo costs are attributed across the rateable assets in proportion to the share of the net replacement costs (NRC) of the asset multiplied by the return for that asset (the profit weight).

A18.85 In implementing this methodology, we have again started from BT's 2016/17 cumulo attribution model. We plan to use BT's 2017/18 cumulo attribution model for our statement.

A18.86 We have made changes to the approach we used in the 2018 WLA statement when generating NRCs for the rateable assets for some components. We do this to better forecast the split between TI and Ethernet services, which we had held constant as a simplifying assumption in the WLA Statement.

A18.87 For Ethernet services we have used the forecast growth in component NRCs from the CI model in the same way we used forecast growth in component NRCs from the 2018 WLA charge control model to drive attributions to non-GEA WLA services. For TI services we have assumed component NRCs reduce at a rate consistent with the average reduction in these NRCs over the last four years.

A18.88 Lastly, we have identified some components that are shared to a significant extent between different markets – notably Sales and Product Management, Ofcom Licence Fee and Openreach Project Services. We have forecast NRCs for these components by weighting the forecast NRC growth rate for each component across the markets that it is shared between. We have then attributed a proportion of the forecast cumulo for each of these components to Ethernet services, based on the split of the component's NRC between Ethernet and other services.

### Service Level Guarantee (SLG) costs

A18.89 We have removed SLG costs from the 2016/17 base data and then added our forecasts of SLG costs back into our total operating cost forecasts. We propose to treat SLG costs in the same way when we update our base year for the 2017/18 RFS. Our proposed treatment of SLG costs is similar to our proposed treatment of BT's cumulo costs, except that SLG costs also form part of the costs for dark fibre services.

A18.90 We have adopted the following approach to calculating SLGs:

a) As discussed in Annex 19, we note that the 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.[292] Due to this, we have not relied on 2016/17 RFS data and instead estimated a steady-state level of SLGs costs in 2016/17 and 2017/18 from recent payment levels and used that as the base from which we forecast payments in the future.[293]

b) We then forecast this base cost forward using:

   i) Our forecast growth rate for connections volumes, as in general with more connections we would expect more connections that incur an SLG payment;

[292] Openreach response dated 3 July 2018 to question 14 of 7th LLCC s.135 notice.
[293] Openreach response dated 17 September 2018 to question 17 of 7th LLCC s.135 notice.

ii) An assumption of rental price changes, as SLG payments are a function of monthly rental prices[294]; and

iii) The expected impact from the year two change in the Certainty QoS standard, as with higher Certainty QoS standards, we would expect fewer connections to incur an SLG payment and so lower total SLG payments to be made. We consider that the QoS standards that are proposed to be in place over the charge control period are achievable.

# Revenue forecasting

A18.91 We need to forecast revenues in each year until the end of the charge control period. These forecasts are based on two inputs: the charges for each service that we expect to be in place during the control; and the volumes of each service.

A18.92 We have explained how we have produced our volume forecasts above. Our approach to forecasting service level prices is described below.

## Prices

A18.93 For service level prices, we have collected data on Openreach's average list prices by service for the beginning of years one (2016/2017) and two (2017/2018) of the current charge control as well as expected price changes post 2017/2018.[295]

A18.94 To forecast revenues during the review period, we need the progression of prices from 2016/17 to the start of the period (i.e. at the end of 2018/19). We then project revenues to the final year of the period (2020/21) 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). We then compare the projected revenues and costs in the final year of the period to work out the value of X.

A18.95 In the 2016 BCMR we decided to allow BT to include certain types of discounts to reach compliance.[296] We therefore need to account for the level of discounts offered to each service when calculating our starting prices. We are aware that this information will not be reflected by the data we received from Openreach, as this related to the prices listed in Openreach's official price list which does not include the net effect of any relevant discounts. We have taken the following approach to calculate the discount for each service until the beginning of 2018/19.

A18.96 We use additional information we received from Openreach in relation to discounts for some services which will continue to apply from October 2018. For services that

[294] We note that this introduces an endogenous element to our calculations, as forecast rental prices are an output of the model. We have run the model once 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.
[295] Openreach responses dated 7 March 2018 to question 2 of the 1st s.135 LLCC notice and 25 June 2018 to question 34 of the 7th LLCC s.135 notice; and email from Openreach to Ofcom dated 28 August 2018.
[296] As discussed in Section 5 of Volume 2, in this review we are proposing not to allow these discounts for measuring compliance.

Openreach did not provide additional discount information for, we compare the list price of each service with its corresponding average revenue from BT's regulatory financial statement (RFS) for 2016/2017. We then use the percentage difference between each service's average revenue and list price as its corresponding discount rate and we project this forward until the beginning of 2018/19. We also introduce an adjustment to prices of services included in the current ethernet basket to ensure that the total revenue for each period satisfies compliance with our current charge control.

## Outputs of the model

A18.97 First, our analysis shows that we expect prices to be broadly aligned to cost by the end of the current control period. Table A18.6 below shows that returns in this market have declined significantly (broadly consistent with the trajectory forecast in the 2016 LLCC) and we are not expecting a material gap between returns and the cost of capital by the end of the current control period. The forecast ROCE for the final year of the current control is slightly below the WACC of 9.8% assumed in the 2016 BCMR Statement, but is above our proposed estimate for the current WACC of 8.0%.

**Table A18.6: Outturn and forecast revenues, costs and ROCE, 2016/17 to 2018/19**

| Parameter | 2016/17 | 2017/18 | 2018/19 |
|---|---|---|---|
| Revenue | £581.6m | £555.7m | £531.2m |
| Total CCA operating costs | £361.4m | £381.5m | £384.9m |
| Return | £220.2m | £174.2m | £146.3m |
| MCE | £1,384.8m | £1,490.4m | £1,628.7m |
| ROCE | 15.9% | 11.7% | 9.0% |

*Note: This table shows the outputs of our model based on the proposed geographic and product definitions for the CI Ethernet and WDM services up to and including 1 Gbit/s in charge-controlled areas and include the adjustments we have made to the base year costs. This is a different basis of preparation to the definitions on which BT's 2016/17 and 2017/18 RFS have been prepared. The ROCEs presented are slightly higher than those presented in BT's RFS as our adjustments to reduce MCE outstrip those that increase costs.*

A18.98 Our modelling allows us to assess the potential implications of our proposed CPI-CPI control for active services at 1Gbit/s and below on BT's cost-recovery. The assumptions we have made in each of these scenarios are provided in Table A18.7 below. If we consider a reasonably wide range for key input parameters (as we normally would if we were consulting on a range for the X for a cost-based control), then our modelling suggests that the value of 'X' could in the range of between -9.75% and -1.25%. For comparison, the near-term forecast from the OBR is of CPI between 1.8% and 2.2%.[297]

[297] OBR, *Economic and Fiscal Outlook March 2018,* Table 4.1. http://obr.uk/efo/economic-fiscal-outlook-march-2018/ [accessed 26 September 2018].

**Table A18.7: Low- and high-cost scenario parameters assumed**

| Parameter | Low-cost assumption | High-cost assumption |
|---|---|---|
| Volumes | Higher exogenous growth<br>Greater demand for higher bandwidth services<br>Low impact of PIA | Lower exogenous growth<br>Greater demand for lower-bandwidth services<br>High impact of PIA |
| Efficiency | Opex: 7.0%<br>Capex: 6.0% | Opex: 4.0%<br>Capex: 3.0% |
| WACC | 7.0% | 9.0% |
| Impact of dark fibre | No impact modelled | No impact modelled |
| Resulting value of '-X' for the CPI-X formula | **-9.75%** | **-1.25%** |

A18.99 We have calculated this range without modelling any migration from active circuits to the proposed inter-exchange dark fibre remedy. This is because the impact, and particularly the speed and scale of take-up, is uncertain. However, as the proposed dark fibre remedy only covers inter-exchange circuits from BT Only exchanges, it is likely to affect only a small proportion of total Openreach circuits even if take-up is high in those areas. As such, we would expect any impact on the value of X to be small and would not change any of the conclusions we have drawn from this modelling.

A18.100 Were we setting a cost-based CPI-X control, we would expect values of X closer to the middle of the range to be more likely than those close to the limits of the range. This is because the limits of the range are produced by applying the effects of multiple changes in input assumptions which all work in tandem to produce a more extreme result. If two such assumptions were to move in opposite directions, their effects would to some extent offset and the result would remain towards the middle of the range.

A18.101 Therefore, we expect that, compared to a cost-based CPI-X control, a flat nominal CPI-CPI cap is most likely to lead to some over-recovery to BT (of around £50 to £65m), with over-recovery of up to £135m or under-recovery of up to £10m being plausible but less likely. As noted above, we do not expect the impact of dark fibre on this result to be large, though it would tend to reduce the scale of this likely over-recovery to some extent.

A18.102 We are comfortable with this as a likely outcome of our policy decision to ensure pricing stability over the next few years as we transition to the introduction of new, long-term downstream regulation for business and residential markets.

# A19. Base year adjustments

A19.1 In Section 4 of Volume 2 we set out our proposed approach to setting the price for inter-exchange dark fibre services and in Annex 18 we set out details of the model that we have used to estimate the evolution of efficient costs of the relevant active services. In this annex, we set out the adjustments we have made to our base year data used as the input for inter-exchange dark fibre prices and for our cost modelling of active services.

A19.2 We use BT's 2016/17 costs as a starting point for our base year. We then make several adjustments to ensure that those costs form an appropriate base which can be used to estimate the dark fibre prices and as an input into our forecasting model.

A19.3 BT has published its 2017/18 costs as part of its 2017/18 RFS. We have had insufficient time since the publication of the 2017/18 RFS to gather additional data from BT to inform our adjustments and to perform the necessary checks on these costs to ensure they are suitable for use in the analysis in this consultation. However, we plan to use BT's 2017/18 data as the base year, with appropriate adjustments, for our statement.

A19.4 In considering whether to adjust the base year data, we must exercise regulatory judgement based on our understanding of BT's accounting data. Specifically, we have reviewed the 2016/17 base year cost data provided by BT and considered whether it:

- contains any identifiable errors or inappropriate accounting methodologies;
- includes any 'one off' costs that should be excluded; and
- is likely to reflect BT's efficiently incurred costs which will be present in the 2017/18 base year.[298]

A19.5 We have also considered known changes to future costs post 2017/18 and made adjustments where the changes reflect our expectation of actual efficiently incurred costs that BT faces.

A19.6 Table A19.1 below sets out the changes that we propose to make to BT's 2016/17 base year data. Some of these adjustments may not be required for our statement as they reflect changes that BT has now implemented in its 2017/18 RFS. The impacts reflect changes to costs of a subset of CISBO services at 1 Gbit/s and below in the revised 'Rest of UK' and 'Combined Geographic' markets as defined in the Temporary Conditions (these services are referred to as the 'Relevant Services').[299] In Annex 18 we describe our approach to adjusting base year data to reflect the new geographic market definitions proposed in Volume 1.

[298] In the past we would have also needed to check that previous regulatory decisions had been implemented. However, the change control process now ensures that this is done annually.
[299] Ofcom, 2017. *Business Connectivity Markets: Temporary SMP conditions in relation to business connectivity services*. https://www.ofcom.org.uk/__data/assets/pdf_file/0019/108019/BCMR-Temporary-Conditions.pdf.

**Table A19.1 Summary of adjustments to our base year model on Relevant Services (£m)[300]**

| | Opex[301] impact (£m) | CCA Depreciation (£m) | Mean Capital Employed (MCE) impact (£m) |
|---|---|---|---|
| 2016/17 RFS total unadjusted | 183.3 | 172.8 | 1,482.5 |
| Remove cumulo costs[302] | -5.6 | - | - |
| Increase restructuring charges and property provision costs for smoothed 3-year average | 2.3 | - | - |
| Remove EE integration costs | [✂] | - | - |
| Increase pensions service costs | [✂] | - | - |
| BT CCN adjustments[303] | -15.1 | -2.4 | -23.0 |
| Replace Excess Construction Charges (ECCSs) | 29.6 | -2.6 | -60.3 |
| Fibre CCA revaluation | 0.3 | 23.5 | 33.8 |
| Increase ethernet electronics costs | 13.2 | 17.1 | 44.3 |
| Remove service level guarantee (SLG) payments | -20.9 | - | - |
| Remove Openreach repayment works | - | -1.1 | -29.1 |
| 2016/17 revised total | 188.1 | 207.4 | 1,448.0 |

*Source: Ofcom analysis of BT data*

A19.7 In the remainder of this annex we set out the details of each of the proposed base year adjustments that feed into our active services cost model and dark fibre prices. For each adjustment, we set out an explanation and the associated calculation.

[300] See relevant sections below for detail of from where information has been obtained.
[301] For all operating costs numbers disclosed within this document they do not include costs relating to Other CCA adjustments, CCA depreciation or holding gains/losses.
[302] The removal of all cumulo costs is the first adjustment made to our 2016/17 base data. All other adjustments below have been made excluding cumulo.
[303] BT proposes changes to ECCs in its 2018 CCN. However, we do not agree with the way BT accounts for ECCs in 2016/17 or under its revised methodology in the CCN (see below) and thus have proposed a separate adjustment for ECCs. As BT was not able to identify the impact of just the ECC methodology change separately, we have assumed it to be all costs captured in the excess construction components.

# Removal of cumulo costs

## Explanation of the adjustment

A19.8 BT's cumulo rate costs are the non-domestic rating costs BT pays on its rateable network assets. As explained in Annex 18, the rating authorities increased BT's cumulo rating assessment significantly, with effect from 1 April 2017. This has resulted in BT facing significantly higher cumulo costs going forward compared to the costs BT incurred in our base year, 2016/17.

A19.9 Due to the large increase in BT's rates bill, we propose to forecast cumulo costs separately in our actives services cost model. This is consistent with the approach taken in the 2018 WLA Statement. Our proposed approach to the treatment of BT's cumulo rates is described in Annex 18, where we also explain that our efficiency assumption is not applied to these costs. To avoid the double-counting of cumulo costs, we have also removed all cumulo costs from our base year data before adding back our forecasts of cumulo costs for the Relevant Services within the CI model. The treatment of cumulo costs in calculating the base year dark fibre prices is explained in more detail in Annex 20.

## Calculation of the adjustment

A19.10 BT's cumulo costs amounted to a £5.6m impact on operating expenditure (opex) for the Relevant Services in 2016/17.[304] We have removed these costs from the base year.

# Adjustments arising from the review of BT's Annual Reports

A19.11 We have reviewed both the attribution and magnitude of the specific items BT records within its annual report and accounts to determine whether adjustments to our base data are required.[305] We are proposing to make base data adjustments for three of these items:

- restructuring charges;
- property rationalisation provision; and
- EE acquisition and integration costs.

A19.12 Below, we consider the restructuring charges and property rationalisation together, and then EE acquisition and integration costs.

[304] Openreach response dated 7 March 2018 to question 5 of 1st LLCC s.135 notice.
[305] BT Group plc 2018 Annual Report and Form 20F, page 222, note 8.
https://www.btplc.com/Sharesandperformance/Annualreportandreview/pdf/2018_BT_Annual_Report.pdf.

## Inclusion and smoothing of restructuring charges and property rationalisation provision costs

### Explanation of the adjustment

A19.13 Restructuring costs are associated with changes in BT's organisational structure that result in employee redundancies (with costs from redundancies known as leaver payments).

A19.14 Property rationalisation provision costs relate to BT's strategy of consolidating its office space to enable the mothballing and subletting of buildings. The cost associated with this rationalisation is treated as a provision. BT makes an annual assessment of the size of the balance sheet provision and its net movement. This assessment includes an element of judgement with regard to the level of future costs and savings.

A19.15 As part of our review of BT's 2016/17 Statutory Financial Statements for 'one off' items, we identified that BT incurred no costs in relation to property rationalisation and restructuring.[306] Both types of cost display a high level of volatility. In particular, the 2016/17 restructuring cost appears low in comparison to previous years, as shown in Table A19.2 below.

**Table A19.2 Restructuring and property rationalisation provision costs (£m)**

| Adjustment | 2014/15 | 2015/16 | 2016/17 |
|---|---|---|---|
| Restructuring costs | 315 | - | - |
| Leaver costs[307] | 8 | 109 | 86 |
| Property rationalisation costs | 45 | 29 | - |

*Source: BT Group Plc Annual report & Form 20-F 2016, 20-F 2017 and 20-F 2018*

A19.16 In the 2018 WLA Statement, we considered that leavers costs, 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). We therefore propose to include these costs in the base year.

### Calculation of the adjustment

**A19.17** For the purposes of modelling our base year costs, we smoothed these costs over a three-year period. This is due to the continued variability of these costs, the amount of discretion that BT has in this process and the lack of transparency of the calculation. This is consistent with the approach taken in 2018 WLA Statement.

[306] BT Group plc 2017 Annual Report and Form 20F, page 189.
[307] Included in operating expenditure before specific items.

A19.18 We asked BT to provide a breakdown for the Relevant Services for the restructuring and property rationalisation provision costs for[308]:

- 2014/15 and 2015/16 for each historic RFS CISBO market as published in BT's 2015/16 RFS;
- 2015/16 and 2016/17 for each historic RFS CISBO market as published in BT's 2016/17 RFS; and
- 2016/17 for each Revised RFS CISBO Market.

A19.19 BT also provided network component costs for both the restructuring costs and property rationalisation provision cost for each service and network component within each of the Revised RFS CISBO Markets for 2016/17.[309] We combine the three years data, using both the published and restated numbers in each year's RFS to ensure that we reflect changes in market definitions, to produce a smoothed three-year average. We then replace the 2016/17 base year opex data with our smoothed calculation. The impact on our base year data amounts to a £2.3m increase in respect to operating costs for the Relevant Services in 2016/17.

## Adjustment for EE integration costs

### Explanation of the adjustment

A19.20 On investigating EE integration costs, identified as a specific item within BT's annual report and accounts, we identified that some of these costs were being allocated to the Relevant Services. However, we do not consider that any costs associated with EE should be included in our base data and therefore propose to remove them. We intend to make a similar adjustment for our statement.

### Calculation of the adjustment

A19.21 BT provided us with its estimate of the EE integration costs by service and component that had been allocated to the Relevant Services. These costs amounted to £[✂] of operating expenditure (opex) for the Relevant Services in 2016/17.[310] We have removed these costs from the base year.

# Adjustment reflecting the increase in pension service costs

## Explanation of the adjustment

A19.22 In the 2018 WLA Statement, our base year data reflected that the pension service charge within the 2016/17 RFS was significantly different from that which BT was expected to

[308] Openreach response dated 6 June 2018 to question 11a of the 5th LLCC s.135 notice.
[309] Openreach response dated 6 June 2018 to question 11b of the 5th LLCC s.135 notice.
[310] Openreach response dated 10 September 2018 to question 4 of 10th LLCC s.135 notice.

incur in the future.[311] This difference was due to BT entering new agreements with the trade unions on pension arrangements in early 2018.

A19.23 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).[312]

A19.24 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.[313] In addition, BT stated that it would:

- continue to work with the CWU to introduce a 'hybrid' pension scheme that includes defined benefit and defined contribution elements, with an aim to have this set up by 1 April 2019; and
- be improving the BTRSS for all members, beyond the current level.

A19.25 In light of these changes to BT's pension schemes, we do not consider it is appropriate to use the 2016/17 pension costs as a basis for the charge control. This is consistent with our decision in the 2018 WLA Statement.

A19.26 We anticipate that we will be making an adjustment to the 2017/18 pension costs in our statement, although the size of this adjustment is likely to be smaller given that BT's pensions costs in 2017/18 will reflect new pension arrangements for at least part of the year.

## Calculation of the adjustment

A19.27 To assess what BT's actual pension service costs may be for the charge control period, and what is an appropriate level for the base year, we have obtained BT's estimates of the ongoing pensions service charge for the three years 2018/19 to 2020/21 which covers the period up to the end of the charge control.[314]

A19.28 Given that the BTRSS and BTPS schemes closed on 1 June 2018 and 30 June 2018 respectively, the costs provided by BT for 2018/19 include an element of the costs of the old arrangements. As we do not consider that these costs are an appropriate basis for determining the ongoing costs of the scheme, we are not including any costs from the previous scheme in our forecasts. We propose to use the 2019/20 pension expense amount as that will be the first full year under the new deal.

A19.29 The ongoing pension charges, provided by BT under s.135, include an element of transition costs that it estimates will account for £[✂] or [✂]% of the annual P&L charge for BT

[311] 2018 WLA Statement, paragraphs A12.30-46.
[312] https://www.btplc.com/News/#/pressreleases/bt-to-close-defined-benefit-pension-scheme-for-10000-managers-2405030.
[313] https://www.btplc.com/News/#/pressreleases/bt-announces-closure-of-its-defined-benefit-pension-scheme-2451910.
[314] Openreach response dated 22 May 2018 to questions 5 of the 4th LLCC s.135 notice.

Group in 2019/20.[315] Our adjustment should include these costs as they are necessary to implement the new scheme.

A19.30 The costs provided by BT do not make allowances for some recent developments, i.e. BT's announcement relating to the removal of [✂][316] (c.13,000) roles or the hiring of [✂][317] (c.6,000) employees across engineering, customer service and cyber security areas. As BT was unable to provide updated information on pensions for this consultation in relation to these developments, we are reducing the 2019/20 future pension cost of £[✂] by the proportion [✂] (c.7,000/105,800) to reflect these developments.[318]

A19.31 BT provided us with the 2016/17 pension costs[319] within BT as a whole, and for each service and network component combination separately.[320]

A19.32 We have adjusted the pension costs within the base year data of [✂] by uplifting the cost for each Relevant Service and network component combination. We have uplifted the cost by the ratio between BT's forecast 2019/20 pension expense, adjusted for the developments above [✂], and the 2016/17 current pension expense £[✂].

A19.33 Table A19.3 below sets out the 2016/17 ongoing pension charge, alongside the cost we are including within our base year.

**Table A19.3 Estimated P&L costs of the pension deal for BT Group**

| | Total BT pensions service charge (£m)[321] | Relevant Services pensions operating charge (£m) |
|---|---|---|
| 2016/17 Cost[322] | [✂] | [✂] |
| BT forecast 2019/20 pension expense | [✂] | [✂] |
| BT forecast 2019/20 pension expense adjusted for 'recent developments' | [✂] | [✂] |

*Source: Ofcom analysis of BT data*

A19.34 We propose to make an adjustment to the 2016/17 base year costs to increase the pension costs by the difference between the costs currently in the base year £[✂] and the forecast

[315] Openreach response dated 20 July 2018 to questions 7 of the 8th LLCC s.135 notice.
[316] Openreach response dated 17 May 2018 to questions 5 of the 4th LLCC s.135 notice, Openreach response dated 25 June 2018 to questions 43 of the 7th LLCC s.135 notice.
[317] Openreach response dated 10 September 2018 to questions 9 of the 10th LLCC s.135 notice.
[318] BT annual accounts page 43, full time equivalent employees.
[319] Excluding member contributions to be consistent with the forecast pension costs provided by BT
[320] Openreach response dated 25 June 2018 to question 42 of the 7th LLCC s.135 notice.
[321] Service charge relating to employees who currently receive benefits in the BTPS and BTRSS and excluding employee contributions paid through salary sacrifice arrangements.
[322] Openreach response dated 25 June 2018 to question 42 of the 7th LLCC s.135 notice.

pension expense in 2019/20 for our relevant services, adjusted for 'recent developments' £[✂] this results in an increase in the pension costs of £[✂].

# Adjustments for changes proposed by BT in its 2018 Change Control Notice (CCN)

## Explanation of the adjustment

A19.35 BT has proposed several changes for the 2017/18 RFS within its 2018 Change Control Notification. The changes that will affect the business connectivity markets within the 2018 CCN are[323]:

- 3.01 – change of market structure for CISBO markets;
- 3.06 – access fibre allocation to SMP markets;
- 3.08 – ECCs;
- 3.10 – fibre CCA indexation;
- 3.12 – ethernet electronics;
- 3.13 – remote testing platform;
- 3.14 – Ethernet Backhaul Direct (EBD) component to service;
- 3.15 – removal of rule type 4, 6 and 12 apportionments and associated inclusion lists;
- 3.16 – removal of activity groups; and
- 3.17 – working capital.

A19.36 The changes identified in the 2018 CCN will be applied in BTs 2017/18 RFS. In producing our statement, we propose to use the 2017/18 RFS to calculate base data costs and will therefore not need to make these adjustments.

## Calculation of the adjustment

A19.37 BT provided us with the combined impact of the changes (excluding the fibre CCA indexation and the ethernet electronics adjustments[324]) on operating costs and MCE by business connectivity service, for each service and network component combination separately. The net impact was to reduce HCA operating expenditure (excluding depreciation) by £15.1m, CCA depreciation by £2.4m and MCE by £23.0m impact of MCE for our Relevant Services.[325]

[323] Terms and associated reference numbers are as used and defined in BT's 2018 CCN.
[324] These adjustments have been discussed separately and so excluded from this total CCN adjustments as they are significant in size.
[325] We note that these adjustments affect SLG costs. Since we deal with SLGs in a separate adjustment (as outlined below) any impact on the non-pay SLG costs is excluded from these figures.

# Adjustment for fibre CCA indexation

## Explanation of the adjustment

### Background

A19.38 As set out in Annex 18 and Section 4 of Volume 2, we consider that estimating the cost of both active and inter-exchange dark fibre services based on BT's CCA costs is transparent and practicable to implement, and provides better signals for efficient investment than historic costs. We do not believe that BT's current approach to calculating the CCA value of its fibre assets is appropriate and hence are proposing to make an adjustment to the value of these assets.

A19.39 Up to 2016/17, BT valued its fibre assets within its RFS using an absolute valuation methodology.[326] However, within its 2017/18 RFS, BT changed the methodology to an indexed historic approach, using CPI as the inflation index.

A19.40 In the 2016/17 RFS, within our statement on BTs Regulatory Financial Statements 2017, we noted that the valuation of fibre required further review ahead of the next year's RFS. Having reviewed the results of BT's analysis into the previous methodology, we agree that there were issues with the previous absolute valuation methodology, both in 2016/17 and potentially in earlier years.

A19.41 BT proposed the change in the 2018 CCN Notice where it noted: "Historically the valuation of Fibre assets was based on an absolute valuation. We have performed a review of the methodology due to the historically high level of 'Other CCA adjustments', which highlighted that the increasing complexity of the Fibre network is not fully reflected in the absolute valuation model".[327]

### Our review of the evidence

A19.42 We obtained the analysis BT performed to come to support its move to a historic indexed approach using CPI[328] and have used this as a starting point for our own analysis into the appropriate methodology for the CCA valuation for fibre assets.

A19.43 BT's analysis examined a range of scenarios using different indexes and concluded that indexing by CPI produced NRC estimates that were in the middle of the range of NRC values produced by the different scenarios.

A19.44 We accept that an indexed historic approach is a reasonable approach for estimating the CAA value of BT's fibre assets. Compared to the absolute valuation methodology it has some advantages in terms of reducing complexity and increasing stability, and it is unlikely to lead to a major loss of reliability.

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[326] See BT's AMD 2016/17. https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2017/AMD2016-17.pdf.
[327] BTs 2018 CCN, Section 3.10, page 23.
[328] Openreach response dated 17 May 2018 to questions 2 of the 4th LLCC s.135 notice.

A19.45 However, we are not persuaded that CPI is the right index to use for indexing fibre assets. We have considered the supporting analysis provided by BT, as well as other evidence, and on balance, we consider that keeping valuations flat in nominal terms (i.e. indexing by 0%) is more consistent with this evidence. We explain our reasoning below.

A19.46 BT's analysis sought to answer what the best index might be by considering several different options for indexing. It indexed historical capex for these different cost categories. Most options resulted in NRCs close to the value under a 'flat nominal' approach (i.e. HCA cost). However, indexing all capex components (pay, stores and other) by the General Buildings Cost Index (GBCI) produced noticeably higher values. Indexing all cost components by CPI produced a value between HCA and the value indexed by GBCI, which was a key justification used by BT for choosing CPI.

A19.47 We believe that GBCI is not an appropriate index for revaluing fibre assets. This is for two main reasons.

A19.48 First, when considering the use of GBCI for revaluing ducts and copper in the 2014 FAMR (see Annex 5), we noted that there would be cost savings that would be achieved if the network was to be rebuilt on a planned basis over a short period. We referred to this as the 'national discount' principle. We consider such a discount would apply also in the case of rebuilding BT's fibre network. However, this discount is not reflected in the GBCI index, so an indexed historic valuation approach that used GBCI would overvalue the fibre assets.

A19.49 Second, the GBCI index is based on a cost model of an average building and reflects changes in the costs of labour, materials and plant costs. We consider it likely that the mix of costs reflected in this index will be very different to that required to install fibre. As we explain below, this is predominantly labour costs in some form and the fibre itself, with, for example, no civil engineering activity and little plant costs.

A19.50 As such, we do not consider that indexation by GBCI would provide a good basis for indexation. Removing this from BT's results significantly weakens the case for adopting CPI as the index. Openreach analysis of the direct costs included in BT's Access Fibre shows that pay makes up c.44%, stores c.24% and other c.33% of the relevant capital expenditure.[329] We understand that stores relate mainly to the costs of fibre and that other is primarily contractors and third-party costs. If we assume that the bulk of the other costs are also labour or stores costs then this suggests that BT's capitalised fibre costs are predominantly a mix of pay and stores, say c.65% pay and c.35% stores.

A19.51 BT's analysis referred to two indices on fibre cable costs: a UK and a US index. We consider that both provide relevant evidence on stores costs. In the UK, the ONS publishes a 'Fibre Optic Cables' index on the costs required to manufacture (but not install) fibre back to 2011.[330] There has only been a very small increase of just 3.3% in the index over the last six years. In the US, a 'Fibre Optic Cable Manufacturing' index goes back to 2004 and shows a

[329] Openreach response dated 17 May 2018 to question 2 of the 4th LLCC s.135 notice.
[330] ONS Fibre Optic Cables index. https://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/jv7b [accessed 13/09/2018].

reduction in fibre prices, with these remaining quite flat since 2014.[331] As fibre costs have remained fairly stable since 2004, it suggests there is little reason to index this element of BT's historical capex.

A19.52 BT's analysis used various indices for capitalised pay costs. However, when not using a general index such as CPI or GBCI, it usually applied a UK index of average earnings with 2% efficiency, consistent with how it had revalued fibre planning costs in the past.[332] BT did not justify the use of 2% efficiency. Our efficiency analysis, discussed in more detail in Annex 18, has estimated savings in pay costs, after considering the impact of inflation and changes in volumes, to be much higher at around 6% per annum. It therefore seems likely that efficiency gains would more than offset the effects of pay inflation, again suggesting little justification to index the capitalised pay element of this capex.

A19.53 There may be some fibre installation costs that have risen in recent times. We have identified two potential areas: the time that it takes engineers to travel to and from fibre installation jobs may have increased because of increased traffic congestion; and traffic management costs. However, we do not consider that either of these should make up a significant proportion of the cost base. Furthermore, any increase in travel times will have been captured as part of our efficiency analysis of pay costs.

### Our proposed approach

A19.54 On balance, we do not consider the evidence supports an upwards revaluation of fibre assets to arrive at a reasonable proxy for their CCA valuation. We note that this is consistent with our approach to forecasting fibre asset values in previous leased lines charge controls.[333] It is also consistent with the assumptions used in the 2018 WLA bottom-up model used to estimate the cost of GEA services.[334]

A19.55 Given this conclusion, we do not consider it appropriate to revalue BT's fibre assets in the 2016/17 base year using a CPI indexation approach. Nor do we consider the 2016/17 RFS fibre asset value (based on the old absolute valuation methodology) to be appropriate, given BT's own concerns about the old methodology and its decision to abandon it from 2017/18.

A19.56 Since the evidence we have does not support an upward revaluation of fibre assets, we propose to use an opening value consistent with HCA valuation. We consider that this would be a better proxy for CCA valuation and therefore would be a more appropriate basis on which to estimate dark fibre costs and to forecast fibre costs in the CI model.

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[331] Federal Reserve Bank of St. Louis Fiber Optic Cable Manufacturing index. https://fred.stlouisfed.org/series/PCU3359213359210 [accessed 13/09/2018].
[332] See BT's 2016/17 AMD.
[333] 2016 BCMR and 2018 WLA.
[334] 2018 WLA, Annex 29, page 29, Figure 27. This assumption was based on BT's Chief Engineers model where BT was assuming fibre costs would increase at 0% p.a.

### Calculation of the adjustment

A19.57 BT provided us with the impact of using HCA valuation instead of an absolute valuation on the 2016/17 operating costs and MCE for each service and Network component combination separately.[335] This increased HCA operating expenditure (excluding depreciation) by £0.3m, CCA depreciation by £23.5m and MCE by £33.8m for the Relevant Services.

A19.58 Given that fibre is valued using the CPI indexation approach in the 2017/18 RFS, we will also need to make a base year adjustment for our statement. Again, we propose to set the opening CCA asset value based on the HCA valuation.

## Adjustment for a change in methodology for the network component ethernet electronics

### Explanation of the adjustment

A19.59 Within the 2018 CNN, BT proposed to split costs which were previously collectively recorded for all bandwidths and services under one single network component 'ethernet electronics'. The proposed change is to record these costs under three separate network components based on the different services bandwidths.

A19.60 The costs recorded by the ethernet electronics component can be split into two categories: pay and electronics. The pay costs relate to installation costs which, across EAD bandwidths, are relatively similar. However, under the old methodology, proportionately more pay costs were being allocated to the services with the more expensive equipment as costs were distributed to services based on the electronics cost and volumes.[336]

A19.61 The new methodology allows more accurate usage factors to be used for the allocation of pay costs. It results in pay costs which were previously over allocated to high bandwidth services being reallocated to the lower bandwidth services.

### Calculation of the adjustment

A19.62 BT provided us with the impact of this change on operating expenditure and MCE for each service and network component combination separately. This increased HCA operating expenditure (excluding depreciation) by £13.2m, CCA depreciation by £17.1m and MCE by £44.3m for the Relevant Services.[337] As the methodology change is already reflected in BT's 2017/18 RFS, this adjustment will not be required for our statement.

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[335] Openreach response dated 27 June 2018 to question 1 of 4th LLCC s.135 notice.
[336] E.g. there are little pay costs relating to optical products as these are mainly installed by BT's suppliers, however under the old methodology, large pay costs were being allocated to optical products due to the more expensive equipment used.
[337] Openreach response dated 27 June 2018 to question 1 of 4th LLCC s.135 notice.

# Adjustment for ECCs

## Explanation of the adjustment

A19.63 BT's current treatment of ECCs within the 2016/17 RFS is to capitalise all costs relating to both the fixed fee ECC cost recovered from connection services and the ECC costs recovered against the separate additional ECCs.[338]

A19.64 We do not agree with capitalising ECC costs. Instead, we consider that the costs should be recovered 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, the costs should be recognised as an operating cost in the year they are incurred.

## Calculation of the adjustment

A19.65 All costs included in our starting base year data that relate to ECCs are captured by BT's network component CE104 'CISBO Excess Construction'.[339] We have removed all costs within this component relating to MCE and the associated depreciation from the base year data. This part of the adjustment has been done as the final adjustment to the base year data to ensure any MCE or depreciation costs from adjustments that flow through to component CE104 are removed.[340]

A19.66 BT provided us with estimates of the capital expenditure attributable to ECC fixed fee revenues and capital expenditure attributable to other ECCs for 2016/17. This information was provided for each of the revised CISBO RFS markets, broken down by capitalised pay and other capital expenditure.[341]

A19.67 BT also provided a breakdown of its ECC revenues in 2016/17, split by fixed fee and other, in each of the revised CISBO RFS markets.[342]

A19.68 We have allocated the estimates of capital expenditure by market to the ECC services based on the ECC revenue by service in 2016/17.

A19.69 We have treated all capitalised pay in BT's estimates as pay operating costs and all other capitalised costs as non-pay operating costs in our adjusted base year data.

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[338] Openreach response dated 4 June 2018 Question 12 of the 5th LLCC s.135 notice.
[339] We note that in BT's 2018 CCN a new component for 2017/18 and restated 2016/17 was introduced, CE106. This component captured the direct capex from ECCs. We have combined component CE104 and CE106 within our base year model.
[340] We have not removed overhead operating costs that are allocated to ECCs as consider these costs are appropriate to be recovered.
[341] Openreach response dated 13 June 2018 to question 17 of the 5th LLCC s.135 notice.
[342] Openreach response dated 13 June 2018 to question 16 of the 5th LLCC s.135 notice.

A19.70 The impact of the above adjustments is to increase HCA operating expenditure (excluding depreciation) by £29.6m, but decrease CCA depreciation by £2.6m and MCE by £60.3m for the Relevant Services.[343]

# Adjustment for SLG Payments

## Explanation of the adjustment

A19.71 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.[344] These SLG payments are part of BT's operating costs.

A19.72 In previous leased line charge controls we have allowed BT to recover an appropriate forward-looking estimate of these costs. We propose to continue to include these costs in the base year, but to adjust 2016/17 base year provision SLG costs as we do not consider them to be reflective of the efficient level of cost.[345] We discuss our proposed base year adjustment below. We discuss how SLG costs have been forecast in Annex 18.

A19.73 In the 2016 LLCC we also did not rely on SLG costs in either of the base years (2013/14 for the Consultation and 2014/15 for the Statement). This is because they represented a period of poor performance and we expected BT's QoS to improve over the period of the charge control.[346] In the 2016 BCMR Statement, we used BT's actual cash SLG payments in 2011 as a proxy for the efficient level of SLG payments.[347] However, we do not consider the 2011 costs to be an appropriate basis for estimating the base year SLG costs in this review period. We do not think it is appropriate to rely on data that relates to demand levels, procedures and rental prices from seven years ago.

A19.74 SLG costs were significantly higher in 2016/17 than in previous years and they remained at a similar level in 2017/18. BT has told us that the increase in 2016/17 resulted from two factors. The first was an accounting change under which SLG payments for circuit provisions, where the customer completion date had not yet been achieved but known payments under the SLG terms and conditions were already due, were accrued in 2016/17. Previously these SLG costs had only been booked to the general ledger as they came through for payment. The second and larger change was because Openreach worked on a large tail of older provision orders in 2016/17 which had been in Openreach's work stack for a long time. These tended to be more complex jobs to fulfil and increased the risk of missing delivery dates and hence incurred higher SLG payments.[348] We therefore consider

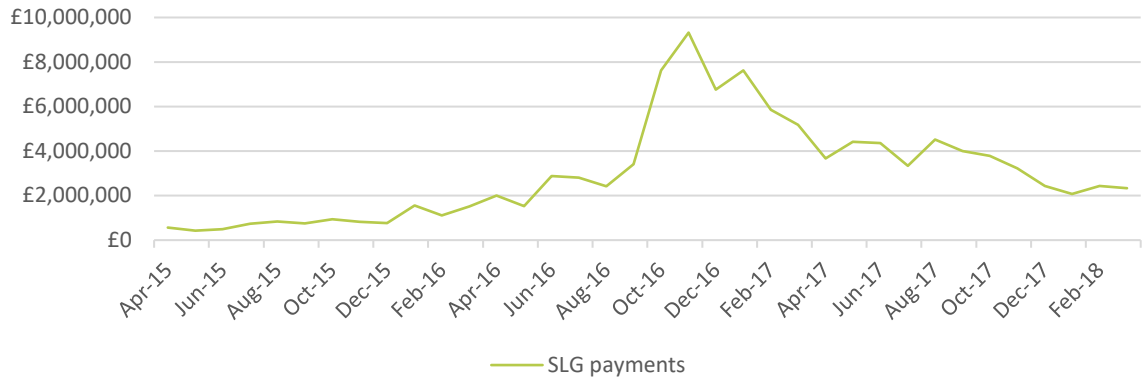
[343] Before the 2017/18 RFS, costs for ECCs were set equal to the revenue for ECCs. As such, removing this MCE does not prevent BT from recovering its costs as these have already previously been recovered.
[344] For example, see page 85 of BT's 2016/17 AMD.
[345] We have reviewed the repair SLG costs post the impact of the 2018 CCN adjustments and do not consider there to be an issue with the level of repair SLG costs.
[346] 2016 BCMR Statement, Annex 27, paragraph A27.100.
[347] 2016 BCMR Statement, Annex 27, paragraph A27.109.
[348] Openreach response dated 3 July 2018 to question 14 of 7th LLCC s.135 notice.

that SLG costs in 2016/17 and the early parts of 2017/18 are atypical. The analysis below confirms this to be the case.

A19.75 As part of its RFS restatement of 2016/17 costs, BT has identified that nearly all of its SLG costs are associated with provision and not repair. As there are no major issues with repair SLG costs and these are minimal, we propose to keep the level of these the same as in 2016/17 (post CCN adjustments). We plan to update using 2017/18 costs for our statement.

A19.76 The starting point of our analysis for provision SLG costs is data from BT that splits Ethernet SLG costs incurred on provision services by month, in the years 2015/16, 2016/17 and 2017/18.[349] This data is summarised in Figure A19.4 below.

**Figure A19.4: SLG payments by month over the last 3 years**




A19.77 Figure A19.4 shows that payments increased rapidly from June 2016 to a peak in December 2016, before reducing slowly with some evidence that they started to level off from December 2017. This is also consistent with QoS data that suggests performance has started to stabilise. The current level of payments will also reflect revised Openreach procedures following the 2017 deemed consent investigation.

A19.78 However, there are certain other factors that need to be considered when coming to a final view of what provision SLG payments might be.

A19.79 First, we note that there are unresolved negotiations between Openreach and industry, regarding both what the level of SLG reimbursements should be in the future[350] and contract changes proposed by Openreach as part of a broader package of changes to Ethernet provision.[351] We propose not to make any adjustments to reflect these discussions until they are finalised. If negotiations are completed prior to publication of our

[349] Openreach revised response dated 17 September 2018 to question 17 of 7th LLCC s.135 notice.
[350] http://www.offta.org.uk/updates/otaupdate2018July.htm [accessed 1 November 2018].
[351] https://www.openreach.co.uk/orpg/home/updates/briefings/ethernetservicesbriefings/ethernetservicesbriefingsarticles/eth05518.do [accessed 1 November 2018].

statement, we propose to reflect the outcome of those negotiations in our final SLG cost forecasts.

A19.80 Second, there are changes that we are proposing to QoS standards in Section 15 of Volume 1. These would come into force next year and therefore may affect the level of SLG payments over the review period.

A19.81 We have considered the possible impacts, both direct and indirect, that each of the proposed QoS standard changes may have and adjusted our base SLG cost for the certainty standard.[352] We are assuming that the net impact of the proposed changes to the other QoS standards on future SLG costs will be minimal. We do not consider that this is unreasonable as we believe that the impacts of these other changes would be small and would offset each other.

### Calculation of the adjustment

A19.82 There are several factors that could affect SLG payments going forward and SLG costs in 2016/17 and in 2017/18 will not necessarily be a good reflection of what they should be in the future, consistent with our revised QoS standards. We have therefore:

- Estimated the current annual run rate in 2017/18 using the cash payments made over the last 4 months of 2017/18.
- Scaled this annualised number down by a ratio of 15/17[353] to reflect the actual change on the Certainty standard. This adjustment has been made to reflect the quality level, in relation to the certainty standard, which should be present at the start of the charge control.[354]

A19.83 We are proposing to include an operating cost of £19.5m as the 2016/17 base efficient level of SLG costs to be forecast forward over the charge control period. This reduces operating expenditure by £20.9m for the Relevant Services.[355] We plan to update our analysis for our statement with more recent data on SLG payments.

## Adjustment for Openreach repayment works

### Explanation of the adjustment

A19.84 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.

[352] The required percentage of orders to be provided on time based on the actual completion date quoted.
[353] The actual percentage of orders provided on time for the last 4 months of 2017/18 averaged 83%. The new certainty standard proposed by Ofcom requires the year 1 average to be 85%.
[354] The most up to date information we have, covering the 4-month period to August 2018, shows that Openreach has achieved an average of 86%. Given this, we do not think adjusting to a starting position of 85% is unrealistic.
[355] Total SLG costs for our Relevant Services amount to £40.4m.

Repayment damages relate to the repair of the Openreach network caused by third party damage and reported via the Openreach damage control unit.[356] The charges billed for these two programmes are made up of the direct cost of the damage or alteration works and the relevant overheads.[357]

A19.85 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.[358] The revenues are however wholly attributed to the Openreach residual market. We believe that revenues should be matched to costs and therefore propose to reattribute any capitalised repayment work costs previously attributed to regulated markets to the Openreach residual market.

A19.86 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 need to consider the cumulative impact back to 2006.

## Calculation of the adjustment

A19.87 BT provided information which showed the gross book value (GBV) and the associated full year depreciation of repayment assets that have been added to the fixed asset register by class of work (CoW) for each year since 2012/13. BT also provided the accumulated depreciation for the repayment assets and associated GBV by network component and CoW that were added to the fixed asset register from 2012/13.[359]

A19.88 We have calculated the average in-year depreciation and GBV additions over the period 2012/13 to 2016/17 and assumed that these will provide a reasonable proxy for the annual in-year depreciation and GBV additions over the period 2006/07 to 2011/12.

A19.89 We need to make three adjustments to remove the appropriate share of repayment works costs from the relevant regulated services. We need to adjust GRCs, NRCs, and the 2016/17 in-year depreciation. We assume for simplicity that there is no difference between GRC and GBV, and so there is also no difference between NRC and NBV.[360]

A19.90 For each of these three adjustments, we first calculate the total impact for each network component. We then identify what proportion is relevant to the Relevant Services by using component volumes data.[361] We explain each of the adjustments in turn.

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[356] Openreach response dated 3 August 2018 to question 13 of the 8th LLCC s.135 notice.
[357] For the avoidance of doubt, the overheads do not include items that previous court decisions have ruled as too remote from Repayment works such as corporate overheads and senior management costs.
[358] 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.
[359] Openreach response dated 3 August 2018 to question 13 of the 8th LLCC s.135 notice.
[360] This will slightly the adjustment as some repayments works activity is associated with duct, which would be revalued each year in BT's RFS using RPI as the measure of asset price inflation.
[361] Openreach response dated 9 May 2018 to question 1 of the 3rd LLCC s.135 notice. This data shows total volumes by component and what proportion relate to the Relevant services.

A19.91 We have adjusted the accumulated GRC by removing the total additions as provided by BT over the period 2012/13 to 2016/17 and our estimate (as calculated above) of the additions over the period 20006 to 2011/12. We have attributed the GRC (or GBV) additions over the years 2006/07 to 2011/12 period to network components in the same way that total GBV additions over the period 2012/13 to 2016/17 have been attributed.

A19.92 We have adjusted the accumulated NRC by firstly removing the total accumulated depreciation as provided by BT over the period 2012/13 to 2016/17. We have calculated the accumulated depreciation associated with assets added over the period 2006/07 to 2011/12 using our estimates of the GBV additions over this period and by assuming that these have been depreciated on the same basis as the 2012/13 to 2016/17 additions.[362] We have attributed the accumulated depreciation for assets pre-2012/13 to network components in the same way that total accumulated depreciation over the period 2012/13 to 2016/17 has been attributed.

A19.93 Finally, we have adjusted the 2016/17 depreciation to remove the in-year depreciation associated with all of the additions going back to 2006/07 to 2016/17. This total depreciation by CoW has been assigned to components using the same ratio as the accumulated depreciation by component for each CoW.

A19.94 This has reduced CCA depreciation by £1.1m and MCE by £29.1m for the Relevant Services.

# BT head office move

## Explanation

A19.95 On the 10 May 2018 BT announced plans to vacate and sell its head office 'BT Centre'.[363] BT provided its latest forecasts for profits and losses from sales of property over the period 2017/18 to 2020/21.[364] [✂].

A19.96 BT also provided information relating to property replacement costs and the impact of the wider UK office restructuring strategy.[365] [✂].

A19.97 Given this, we do not propose to make any adjustments to our base data in relation to the sale of BT Centre.

[362] We assume that assets are on average added to the fixed assert register mid-year, i.e. they only incur half of the annual depreciation charge in the year they are added.
[363] https://www.btplc.com/Sharesandperformance/Financialreportingandnews/Quarterlyresults/2017-2018/Q4/Downloads/Newsrelease/DC18-136BTANNOUNCESSTRATEGYUPDATE.pdf [accessed 2 October 2018].
[364] Openreach response dated 17 May 2018 to question 6 of the 4th LLCC s.135 notice.
[365] Openreach response dated 20 July 2018 to question 8 of the 8th LLCC s.135 notice.

# A20. Inter-exchange dark fibre pricing

A20.1 In Section 4 of Volume 2 we provide an overview of how we propose to set starting charges for inter-exchange dark fibre services. This includes a description of the cost standard that we intend to use (forward looking fully allocated costs), and the services that we intend to set starting charges for (connection, rental and main link services and selected ancillary services). We also set out an overview of our methodology, which is:

- to estimate the costs of the main inter-exchange dark fibre services by estimating the costs of each of the following elements:
  - costs relating to the passive infrastructure required for an inter-exchange dark fibre circuit, such as duct and fibre ('element A');
  - other costs required for, but not specific to, an inter-exchange dark fibre circuit, such as costs associated with staff working in customer contact centres handling provision and repair enquiries ('element B'); and
  - costs that are specific to an inter-exchange dark fibre circuit, such as those relating to its unique network terminating equipment ('element C').
- to calculate the costs of elements A and B with reference to the relevant costs for EAD 1 Gbit/s services as reported in BT's RFS, and the costs of element C using a similar methodology to that Openreach used when preparing its final Reference Offer for dark fibre services in 2016.

A20.2 In this annex we explain in detail our approach to estimating each of elements A, B and C, including how we propose to:

- classify the costs of the network components[366] within the cost stack for EAD services as being either active, passive or shared;
- use the costs of passive components to estimate element A;
- use the costs of shared components to estimate element B;
- use alternative data on costs specific to inter-exchange dark fibre services to estimate element C; and
- not include the costs of non-domestic rates (NDRs) in elements A, B or C as these will be paid by the telecoms provider that lights the fibre.

A20.3 We then provide our proposed starting charges for the main inter-exchange dark fibre services based on costs from BT's 2016/17 RFS (using our calculation of WACC as set out in Annex 21 and after making the cost adjustments outlined in Section 4 of Volume 2 and Annex 19). We plan to update our analysis for our statement so that the starting charges reflect cost data from BT's 2017/18 RFS as well as in response to comments and inputs from stakeholders.

[366] BT allocates costs to components which represent 'discrete parts of [its] network' such as Ethernet Electronics, Ethernet Access Direct Fibre and Sales Product Management. Component costs are then attributed to services using usage factors. See page 201 of BT's 2018 AMD.

A20.4 Finally, we set out our proposals for the pricing of two ancillary services that are specific to inter-exchange dark fibre services: a cessation charge and a right when tested (RWT) charge.

## Classification of components

A20.5 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.

A20.6 Below we set out our proposed classification for the components used to provide EAD services in BT's 2016/17 RFS (which serves as the input for the indicative starting charges presented in this consultation). We then discuss our proposals in relation to the slightly revised set of components used to provide EAD services in BT's 2017/18 RFS (which we plan to use as the input for the starting charges for our statement).

### BT's 2016/17 RFS

A20.7 The table below summarises our proposed classifications for the components used to provide EAD services in BT's 2016/17 RFS.

**Table A20.1: Proposed classification of components used to provide EAD services in BT's 2016/17 RFS**

| Component | Classification | Component used by: | | |
|---|---|---|---|---|
| | | EAD Connections | EAD Rentals | EAD Main Link Rentals |
| Ethernet Electronics | Active | | ✓ | |
| Ethernet main links | Passive | | | ✓ |
| Routing & Records | Passive | ✓ | | |
| Ethernet Access Direct Fibre | Passive | | ✓ | |
| Ethernet Excess Construction | Passive | ✓ | | |
| Openreach sales product management | Shared | ✓ | ✓ | ✓ |
| OR Systems & Development - Ethernet | Shared | ✓ | ✓ | ✓ |
| OR Service Centre - Assurance Ethernet | Shared | | ✓ | |
| OR Service Centre - Provision Ethernet | Shared | ✓ | | |

| Component | Classification | Component used by: | | |
|---|---|---|---|---|
| | | EAD Connections | EAD Rentals | EAD Main Link Rentals |
| Ofcom Administration Fee - Openreach | Shared | ✓ | ✓ | ✓ |
| Revenue Receivables | Shared | ✓ | ✓ | ✓ |

A20.8 Active components relate to the active elements of an EAD circuit and do not appear to include any costs relevant to an inter-exchange dark fibre circuit. These include:

- Ethernet Electronics, which covers costs associated with operating and maintaining active equipment, including the capital costs of that equipment.

A20.9 Passive components relate to the passive elements of an EAD circuit and so may include costs that are relevant to an inter-exchange dark fibre circuit. These include:

- 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 duct and 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. As discussed in Section 3 of Volume 2, we have, since 2014, 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.

A20.10 Shared components relate to both the active and passive elements of an EAD circuit and so may include costs that are relevant to an inter-exchange 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;

- 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. Revenue Receivables 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.

## BT's 2017/18 RFS

A20.11 In BT's 2017/18 RFS it introduced some new components and removed others. Table A20.2 below shows how we propose to classify the revised set of components used to provide EAD services in the event we update our cost estimates for our statement using BT's 2017/18 RFS.

A20.12 The new components that BT introduced were:

- SLG Ethernet Provision and SLG Ethernet Assurance, which cover costs associated with Service Level Guarantee (SLG) payments made to customers if Openreach fails to meet contractually agreed timescales for provision or repair activities. These costs were included within the OR Service Centre – Assurance Ethernet and OR Service Centre – Provision Ethernet components in BT's 2016/17 RFS.
- Ethernet Monitoring Platform, which covers costs associated with a platform that performs remote diagnostic testing and reconfigurations of EAD and OSA circuits. These costs were included within the costs of the Ethernet Electronics component in BT's 2016/17 RFS.[367]
- EAD Electronics Capital, which covers the direct costs associated with the dedicated electronic equipment supporting an EAD service. These costs were included in the costs of the Ethernet Electronics component in BT's 2016/17 RFS.
- Ethernet Electronics Current, which covers the overheads associated with the electronic equipment used to provide various Ethernet services including EAD. These costs were also part of the costs for the Ethernet Electronics component in BT's 2016/17 RFS.
- Ethernet Excess Construction, which appeared in BT's 2016/17 RFS but now only covers the capital employed (except in-year capital expenditure) and depreciation relating to ECCs incurred on Ethernet services.
- Ethernet Excess Construction Capital, which covers in-year capital expenditure relating to ECCs incurred on Ethernet services. These costs were part of the costs of the Ethernet Excess Construction component in BT's 2016/17 RFS.

[367] Openreach response dated 31 July 2018 to question 1 of the 4th LLCC s.135 notice.

**Table A20.2: Proposed classification of components used to provide EAD services in BT's 2017/18 RFS**

| Component | Classification | Component used by: | | |
|---|---|---|---|---|
| | | EAD Connections | EAD Rentals | EAD Main Link Rentals |
| Ethernet Electronics Current | Active | | ✓ | |
| EAD Electronics Capital | Active | | ✓ | |
| Ethernet Monitoring Platform | Active | | ✓ | |
| SLG Ethernet Provision | Active | ✓ | | |
| Ethernet main links | Passive | | | ✓ |
| Routing and Records | Passive | ✓ | | |
| Ethernet Access Direct Fibre | Passive | | ✓ | |
| Ethernet Excess Construction | Passive | ✓ | | |
| Ethernet Excess Construction Capex | Passive | ✓ | | |
| Openreach sales product management | Shared | ✓ | ✓ | ✓ |
| OR Systems & Development - Ethernet | Shared | ✓ | ✓ | ✓ |
| OR Service Centre - Assurance Ethernet | Shared | | | |
| OR Service Centre - Provision Ethernet | Shared | ✓ | | |
| SLG Ethernet Assurance | Shared | | ✓ | |
| Ofcom Administration Fee - Openreach | Shared | ✓ | ✓ | ✓ |
| Revenue Receivables | Shared | ✓ | ✓ | ✓ |

## Passive infrastructure costs ('element A')

A20.13 For each inter-exchange dark fibre service (i.e. connection, rental and 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 that we consider would also be required to

provide inter-exchange dark fibre services. We do not consider that the unit FAC of any of the elements we include would vary with the number of fibres provided, i.e. the unit cost for a two fibre dark fibre circuit would be twice that of a one fibre dark fibre circuit.

## Ethernet Main Links

A20.14 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 that is attributed to the EAD main link service.

## Routing and Records

A20.15 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 service.

## EAD Fibre

A20.16 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 duct and fibre other than that required to connect the circuit between the two BT exchanges. The costs of that duct and fibre are included in element A of the cost stack within the Ethernet Main Links component. This contrasts with most EAD circuits where one or more of the ends will be in a customer premises, and so duct and fibre is required to connect the customer premises to its local BT exchange.

## Ethernet Excess Construction

A20.17 We propose not to include the costs of the Ethernet Excess Construction component that are attributed to the EAD connection service in element A of the inter-exchange dark fibre connection service. We consider that, for most inter-exchange dark fibre circuits, little (if any) extra construction work will be required as the infrastructure supporting connectivity between BT exchanges is already in place.

A20.18 We acknowledge that in some instances there may be capacity constraints that require Openreach to install a new fibre cable to fulfil an inter-exchange dark fibre order. However, any other fibres within the new cable could then be used by both Openreach and other telecoms providers. It would therefore not seem appropriate to load costs of installing the new fibre cable on the telecoms provider placing the first order.

A20.19 We consider that most orders will not require any new construction work and so we do not think it is appropriate to include an ECC balancing charge in element A of the cost stack for the inter-exchange dark fibre connection service.

### New passive components in 2017/18 RFS

A20.20 With respect to the new components that BT introduced in its 2017/18 RFS, we propose not to include any costs attributed to the re-defined Ethernet Excess Construction component or to the newly introduced Ethernet Excess Construction Capex component for the reasons outlined above.

## Other costs not specific to inter-exchange dark fibre services ('element B')

A20.21 For each inter-exchange dark fibre service, 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 service. In this annex we discuss our proposed treatment of the costs for each of the following components:

- Systems and Development (Ethernet);
- Service Centre – Assurance (Ethernet);
- Service Centre – Provision (Ethernet);
- Openreach Sales and Product Management;
- Ofcom Administration Fee; and
- Revenue Receivables.

A20.22 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. We acknowledge that our proposed treatment of these costs could be taken to imply a reattribution of common costs and this may lead to lower costs in the long run for active Ethernet services. However, we consider that the impact of any such implicit reattribution would be relatively low over the short period during which the proposed charge control will operate.

A20.23 As for the passive components we have discussed above, we do not consider that the unit FAC of any of these shared components would vary with the number of fibres provided, i.e. the unit cost for a two fibre dark fibre circuit would be twice that of a one fibre dark fibre circuit.

### Openreach Systems and Development – Ethernet

A20.24 In BT's RFS, Openreach Systems and Development (Ethernet) costs are attributed to Ethernet connection, rental and main link services based on service volumes.[368]

A20.25 We asked Openreach to explain how it estimated the proportion of Openreach Systems and Development (Ethernet) costs that should be removed under the 'active minus' pricing approach that we set out in the 2016 BCMR Statement when setting prices for dark fibre

[368] 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).

services within its DFA Final Reference Offer. We also asked for any updated analysis Openreach had undertaken on this proportion since publishing its DFA Final Reference Offer.

A20.26 Openreach explained that, for its DFA Final Reference Offer pricing, it conducted a review of expenditure by system by the Openreach Sales and Product Management team between 2014/15 and 2016/17. Openreach proposed to exclude the costs of systems specific to EAD services (such as its 'E-co' ordering system used to order electronic equipment). It estimated that 19% of expenditure was specific to EAD services.[369]

A20.27 Openreach updated its analysis in August 2017 in preparation for publishing launch prices for DFA services. The update used the same methodology, but instead covered expenditure between 2015/16 and 2017/18 and estimated that the proportion of system costs specific to EAD services was now lower at 9%.[370]

A20.28 Under BT's current attribution approach, it is likely that any attribution of Openreach Systems and Development (Ethernet) costs would result in similar attributions, in terms of unit costs, to both active ethernet and dark fibre services. However, we consider it appropriate to exclude that spend which is specific to active Ethernet services from the attribution to inter-exchange dark fibre. We propose to adopt Openreach's approach to estimating the proportion of Openreach Systems and Development (Ethernet) costs that is specific to active Ethernet services. We therefore propose to include 91% of the unit FAC of the Openreach Systems and Development (Ethernet) component that is attributed to each EAD service within the unit FAC of element B of its corresponding inter-exchange dark fibre service.

## Openreach Service Centre – Assurance Ethernet

A20.29 In BT's RFS, Openreach Service Centre – Assurance Ethernet costs are attributed to Ethernet rental services based on service volumes. As in the 2016 BCMR statement, we propose to estimate the unit FAC of this component for inter-exchange dark fibre rental services by considering the relative number of faults per circuit likely to be incurred on a dark fibre service compared to those on an active EAD circuit.[371]

A20.30 We asked Openreach for data on the number of EAD faults reported between April 2016 and March 2018 split by the clear code submitted by the Openreach engineer upon handling the fault.[372] We then classified these clear codes as relating either directly to the passive or active elements of an EAD circuit or as not relating directly to either ('other'). We propose to assume that if BT provided inter-exchange dark fibre services:

- the number of active faults per circuit would be zero by definition; and
- the frequency of passive faults per circuit would be equal to that for EAD services.

[369] Openreach response dated 14 September 2018 to question 19a of the 10th LLCC s.135 notice.
[370] Openreach response dated 14 September 2018 to question 19b of the 10th LLCC s.135 notice.
[371] See paragraphs A23.72-81 of the 2016 BCMR Statement.
[372] Openreach response dated 14 September 2018 to question 22 of the 10th LLCC s.135 notice.

A20.31 A relatively large proportion ([✂]%) of reported EAD faults are classified as right when tested (RWT). For EAD services, we understand that this relates primarily to instances where BT's remote diagnostic testing using the EAD electronic equipment indicates that there is no apparent fault relating to BT's EAD service and that the fault may be the telecoms provider's responsibility (e.g. related to the telecoms provider's network or the electronic equipment that the telecoms provider has connected to the EAD electronic equipment). If a telecoms provider purchases an inter-exchange dark fibre circuit, it can carry out this remote diagnostic testing itself (Openreach will not be able to undertake any remote diagnostic tests). As a result, we assume that most faults on dark fibre services that might otherwise have been cleared as RWT (had Openreach provided an EAD service) will no longer be reported to Openreach. Consistent with our proposal for the RWT charge, discussed in the ancillary services section below, we have assumed that 6% of previously reported RWT faults will still be reported to Openreach, i.e. for the purposes of this analysis we classify 94% of RWT faults as active.

A20.32 Our proposed classification of all clear codes is shown in the table below, alongside the proportion of EAD faults accounted for by each clear code.[373]

**Table A20.3: Split of reported EAD faults by clear code (April 2016 to March 2018)**

| Clear code | Classification | % of EAD faults |
|---|---|---|
| Card replaced / reseat | Active | [✂]% |
| Chassis change / reseat | Active | [✂]% |
| Customer kit / customer damage | Active | [✂]% |
| Customer kit no engineers dispatched | Active | [✂]% |
| Right when tested (RWT) | 94% active: 6% passive | [✂]% |
| External fibre | Passive | [✂]% |
| Internal Fibre | Passive | [✂]% |
| Fault not found | Other | [✂]% |
| Cancelled | Other | [✂]% |
| Matters beyond our reasonable control (MBORC) | Other | [✂]% |
| Provision fault | Other | [✂]% |

A20.33 The data suggests that [✂]% of reported EAD faults related to active elements of the service, [✂]% to passive elements and that [✂]% did not directly relate to either. It is unclear how many of these 'other' faults would continue to be reported if BT provided inter-exchange dark fibre circuits in place of EAD circuits. We propose to attribute these

[373] Data refers to faults for standard (i.e. non-Local Access) EAD circuits.

faults between active and passive elements pro-rata to the split of active and passive faults. This approach suggests that 74% of reported EAD faults are related to active elements of the service while 26% are related to passive elements.

A20.34 We therefore propose to include 26% of the unit FAC of the Openreach Service Centre - Assurance Ethernet component that is attributed to the EAD rental service within the unit FAC of element B of the inter-exchange dark fibre rental service.

## OR Service Centre – Provision Ethernet

A20.35 In BT's RFS, Openreach Service Centre – Provision Ethernet costs are attributed to Ethernet connection services based on service volumes. We consider that the unit FAC of element B of the inter-exchange dark fibre connection service should include the unit FAC of the Openreach Service Centre – Provision Ethernet component that is attributed to the EAD connection service. This is because we do not consider that the activities performed by staff in customer contact centres in relation to provisions are likely to differ materially depending on whether a customer orders an EAD or an inter-exchange dark fibre circuit.[374]

## Openreach Sales Product Management

A20.36 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.[375]

A20.37 We asked Openreach to explain how it estimated the proportion of Openreach Sales Product Management costs that should be removed under the 'active minus' pricing approach that we proposed in the 2016 BCMR Statement when setting prices for dark fibre services within its DFA Final Reference Offer. We also asked for any updated analysis BT had undertaken on this proportion since publishing its DFA Final Reference Offer.

A20.38 We propose not to use the approach used by Openreach to support its DFA Final Reference Offer pricing and launch pricing.[376] We propose instead to estimate the unit FAC of the Openreach Sales Product Management component to be included within element B of each inter-exchange dark fibre service by using the same approach that is used to attribute

[374] This is consistent with the discussion of these costs in the 2016 BCMR Statement as part of our guidance for how dark fibre prices should be set. See paragraphs A23.70-71.
[375] See page 246 of BT's 2017 AMD.
[376] Openreach explained that it had asked the Directors in the Openreach Sales Product Management team to estimate the split of resources allocated to Ethernet services between active Ethernet services and dark fibre services in a world where the latter were also offered. This analysis suggested that [✂]% of the FTE relating to active Ethernet services in 2015/16 might instead relate to dark fibre services or [✂]% in 2016/17 (from Openreach responses dated 4 September 2018 to questions 20a and 20b of the 10th LLCC s.135 notice). These estimates were however conjectures assuming the introduction of the 2016 BCMR Statement dark fibre remedy. This is not the same as the inter-exchange dark fibre remedy we propose in Volume 1.

these costs between Ethernet services in BT's RFS. As outlined above, this attribution is based on revenues and volumes, so we have estimated the relative contribution by considering the likely price differences between each inter-exchange dark fibre service and its corresponding EAD service.

A20.39 We estimate these price differences by comparing the ratios of unit costs i.e. we assume the ratio of unit costs will be a good proxy for the ratio of prices. The unit costs we have compared are the total unit FAC of each inter-exchange dark fibre service and the corresponding EAD service, but excluding Openreach Sales Product Management costs as well as other costs that we propose to allocate in this manner (such as the costs of the Ofcom Administration Fee and Revenue Receivables components as discussed below).

A20.40 Following this approach, we propose to include 50% of the Openreach Sales Product Management EAD unit costs for connection services, 2% for rental services and 97% for main link services.

## Ofcom Administration Fee – Openreach

A20.41 In BT's RFS, the cost of the Ofcom Administration Fee is attributed to connection, rental and main link services based on revenue. We propose that the unit FAC of element B of each inter-exchange dark fibre service should include an amount that is based on the unit FAC of the Ofcom Administration Fee – Openreach component that is attributed to the corresponding EAD service, adjusted to reflect price differences. We use the same approach to reflecting price differences as described above for the Openreach Sales Product Management component.

## Revenue Receivables

A20.42 In BT's RFS, Revenue Receivables costs are attributed to connection, rental and main link services based on revenue. As above, we propose that the unit FAC of element B of each inter-exchange dark fibre service should include an amount that is based on the unit FAC of the Revenue Receivables component that is attributed to the corresponding EAD service, adjusted to reflect price differences. This approach will appropriately reflect the relatively lower debtors on dark fibre services compared to EAD services due to the lower price. We use the same approach to reflecting price differences as described above for the Openreach Sales Product Management component.

## Other (non-passive) components introduced in BT's 2017/18 RFS

A20.43 With respect to the new components that BT introduced in its 2017/18 RFS, we propose not to include any costs attributed to the Ethernet Monitoring Platform and EAD Electronics Capital and Current components as these relate exclusively to active elements of EAD services. Finally, we intend to include SLG Ethernet Provision and SLG Ethernet Assurance costs albeit at levels in line with our proposed treatment of SLG costs explained in Annex 19.

# Costs specific to inter-exchange dark fibre services ('element C')

A20.44 For each inter-exchange dark fibre service, we propose to include in element C of the cost stack an estimate of the unit FAC of any costs that are specific to inter-exchange dark fibre services (i.e. costs not incurred when providing EAD services).

A20.45 As explained in Section 4 of Volume 2, Openreach identified costs specific to dark fibre services in its DFA Final Reference Offer published in December 2016 and when reviewing the launch pricing for DFA in August 2017, covering:

- patch panel costs; and
- birth certificate / initial testing costs.

A20.46 In this annex, we first discuss the labour rates we propose to use which are common to our estimation of both patch panel and initial testing costs. We then discuss the specific assumptions for each cost in turn.

## Labour rates

A20.47 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. We also apply these assumptions when estimating ancillary charges specific to dark fibre services later in this annex.

A20.48 Openreach explained that, when it estimated costs specific to dark fibre services in its DFA Final Reference Offer, it used LRIC labour rates for two engineering grades with different skillsets: we refer to these as 'less qualified' and 'more qualified' engineers.

A20.49 We therefore need two labour rates, corresponding to more and less qualified engineers, to use in our calculations below. We consider that there are two possible sources for these labour rates: those used by Openreach in support of its DFA Final Reference Offer pricing (which are confidential) and those published in BT's RFS for TRCs. For reasons of transparency we propose to use the latter rather than the confidential labour rates provided by Openreach. These rates are described as Total Direct Costs per hour. We propose to 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. In 2016/17 this was £38.22 per hour.[377] Similarly, we propose to use the TRC Total Direct Cost per hour for Ethernet TRCs as the proxy for the more qualified pay rates. In 2016/17 this was £51.08.[378] We propose to use the analogous published 2017/18 rates when updating our calculations for our statement.

A20.50 As we are proposing to adopt a FAC cost standard, we consider it reasonable that the labour rates that we use should include contributions to indirect and support costs. We have estimated FAC labour rates by applying an uplift to the 2016/17 TRC costs. The uplift

[377] See: Appendix 4.1 of 2016/17 RFS. https://www.btplc.com/Thegroup/Policyandregulation/Governance/Financialstatements/2017/RRD2017Final.pdf. [✂]
[378] See: Appendix 4.5 of 2016/17 RFS. [✂]

we have applied is the 37% that we adopted in the 2016 BCMR Statement when estimating overheads for Ethernet TRCs.[379] This produces FAC pay rates in 2016/17 of £52.36 per hour (which in these calculations we have rounded to £52.40) for the less qualified engineer and £69.98 per hour (which we have rounded to £70 per hour) for the more qualified engineer. We plan to review these rates and the mark-up for our statement. We propose to estimate the uplift based on an analysis of the differences between the FAC costs for TRC services and the above TRC Total Direct Costs. We expect the uplift to relate primarily to corporate overheads.

## Patch panel costs

A20.51 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.[380] 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.

A20.52 To provide inter-exchange dark fibre services BT would need to install some form of passive NTE to hand over the service to the purchasing telecoms provider. We propose to include the unit FAC associated with this NTE in element C of the cost stack for the inter-exchange dark fibre rental service.

A20.53 Openreach's DFA Final Reference Offer specified that NTE for the DFA service would be an optical patch panel installed at each of the served locations. It specified that Openreach would connect the unlit fibre to a port on the patch panel using an optical interface and that the purchasing telecoms provider would then connect its own equipment to the other side of this port using an optical interface. The DFA Final Reference Offer noted that four variants of patch panel would be available depending on the served location.[381]

A20.54 We asked Openreach to explain how it estimated the incremental costs of installing patch panels within its DFA Final Reference Offer. We also asked for any updated analysis it had undertaken on these costs since publishing its DFA Final Reference Offer.

A20.55 Openreach explained that its DFA Final Reference Offer pricing was based on a blended cost of patch panels across access and backhaul circuits. The access circuit was assumed to have one end located in a BT exchange and one at a customer premises. The backhaul circuit was assumed to have both ends located in BT exchanges. The installation time, type of patch panel and long-term port utilization assumption (used to convert the cost to a per

[379] See paragraph 8.96 of 2016 BCMR Statement, Volume 2, where we discuss our approach to estimating overheads for Ethernet TRCs as BT was not able to provide sufficiently granular data.
[380] The NTE installed by BT at each of the served locations as part of the EAD service is available in two variants. If the served location is a BT exchange, then the NTE is likely to be a modular chassis capable of supporting multiple circuits (this will be located within the telecoms provider's cabinet located in a Licensed Area within the BT Exchange). If the served location is a customer premises, then the NTE is likely to be a standalone unit to support a single circuit.
[381] Pages 11-14 of DFA Final Reference Offer: Technical Specification, 2016. https://www.openreach.co.uk/orpg/home/products/darkfibreaccess/darkfibreaccess/downloads/DFAfinalreferenceoffertechnicalspecifications011216.pdf.

circuit cost) differed between whether the patch panel was installed at a BT exchange or at a customer premises. Openreach assumed the installation would be performed by a less qualified engineer and that the resulting installation costs would be capitalised, depreciated over an assumed life of [✂] years and recovered from the dark fibre rental service.[382]

A20.56 Openreach prepared updated prices in August 2017 for the expected launch of dark fibre services. It used 2016/17 (as opposed to 2015/16) labour rates, updated its patch panel equipment cost assumption and assumed an asset life of [✂] (five to ten years). It used a similar methodology to that within its DFA Final Reference Offer. However, Openreach noted that its previous patch panel estimates did not include any incremental costs associated with indirect or support functions, whereas the incremental Ethernet Electronics costs that had been removed did include contributions from these costs. Openreach therefore planned to include some indirect and support costs within its final pricing, basing these estimates on a proportion of the incremental costs for the Ethernet Electronics component.[383]

A20.57 We propose to assume that an inter-exchange dark fibre circuit requires the installation of a 24-port patch panel in the telecoms provider's racks located within each of the BT exchanges. We have assumed the patch panel costs £120[384] and that it would take 3 hours to install, which includes splicing work.[385] We have used our estimate of the FAC labour rate for a less qualified engineer of £52.40 per hour.

A20.58 We consider that this pay rate includes contributions to all material overheads that would be attributed to patch panels with the possible exception of accommodation costs. We understand the patch panel will however be installed in the telecoms provider's rack within the BT exchange, the space for which the provider would pay for separately via the co-mingling charge. We therefore do not consider that the patch panel should trigger any incremental accommodation costs and propose not to include any specific contribution for these within our patch panel cost estimates. We do not consider this to be a critical assumption as Openreach [✂].[386]

A20.59 The above assumptions generate a FAC of installing two patch panels. We have converted this to a cost per circuit by assuming a long-term port utilisation rate of 50%. We propose, consistent with Openreach's pricing proposals, that these costs would be recovered within the dark fibre rental service. We assume these costs would be capitalised and depreciated over an assumed life of seven years. We believe that these port utilisation assumptions

[382] Openreach response dated 14 September 2018 to question 18a of the 10th LLCC s.135 notice.
[383] Openreach response dated 14 September 2018 to question 18b of the 10th LLCC s.135 notice.
[384] Prices of patch panels similar to those we believe Openreach would install are generally around £160. For example, see Huber & Suhner 24 Port SC Single Mode Simplex Fibre Optic Patch Panel available from RS at https://uk.rs-online.com/web/p/fibre-optic-patch-panels/1442457/ [accessed 5 October 2018]. We assume that Openreach will be able to negotiate lower costs than this because of its buying power resulting in an assumption of £120 per unit. The assumption we have made here is [✂].
[385] [✂]
[386] Openreach response dated 14 September 2018 to question 18b of the 10th LLCC s.135 notice.

imply that the unit patch panel costs of a two fibre dark fibre circuit would be twice those of a one fibre dark fibre circuit.

A20.60 The above assumptions result in a cost of £8.69 per fibre per annum. The table below outlines the derivation of this cost, which we have included in element C of the cost stack for the inter-exchange dark fibre rental service.

**Table A20.4: Calculation of per circuit unit FAC for patch panels**

| Item | Assumption |
|---|---|
| Cost of 24 port patch panel | £120 |
| Number of patch panels | 2 |
| Installation time per patch panel | 3 hours |
| Installation resource cost (FAC) | £52.40 per hour |
| Long-term port utilisation assumption | 50% |
| **FAC per circuit** | £46.20 |
| Asset life of 24 port patch panel | 7 years |
| WACC | 8.0% |
| **FAC per circuit per year** | £8.71 per year |

## Birth certificate / initial testing costs

A20.61 Openreach's DFA Final Reference Offer specified that a dark fibre circuit needs to be tested on installation by an engineer to confirm the performance of the line before handover, as well as to generate a record to which future repair tests for that circuit could be compared. Openreach referred to this as a birth certificate. The equivalent test within the installation process for an EAD circuit can be performed using the electronic equipment.

A20.62 We asked Openreach to explain how it estimated the incremental costs associated with this initial testing in its DFA Final Reference Offer pricing. We also asked for any updated analysis it had undertaken on the costs associated with initial testing since publishing its DFA Final Reference Offer.

A20.63 Openreach explained that its DFA Final Reference Offer pricing assumed that a dark fibre circuit would require an additional [✂] (two to four) hours of installation time by a less qualified engineer compared to that required for an active EAD circuit. The tasks involved were as follows[387]:

- switch on a light source at one end of the circuit;
- travel to other end of circuit;
- perform an Optical Time Domain Reflectometer (OTDR) test; and

[387] Openreach response dated 14 September 2018 to question 18a of the 10th LLCC s.135 notice.

- travel back to first end of circuit and remove the light source.

A20.64 Openreach assumed that the labour costs associated with these activities would be capitalised, depreciated over [✂] years and recovered from the dark fibre rental service. In preparing updated prices in August 2017 for the expected launch of dark fibre services, Openreach updated its analysis to reflect 2016/17 rather than 2015/16 labour rates but did not make any changes to the installation time assumptions.[388]

A20.65 We consider that this initial testing is a legitimate additional cost specific to a dark fibre circuit. We also consider that the activities and timings provided by Openreach are reasonable. However, we propose that the costs would be more appropriately recovered from the connection service rather than being capitalised and recovered from the rental service. We understand that the activities identified above are required for each circuit that is installed. The circuit will be broken at the end of its life – we discuss cessation costs in more detail below – and so could then not be used by anyone else. We therefore do not believe that an asset is being created by these activities and therefore the costs should not be capitalised.

A20.66 We propose to assume that initial testing takes 2.5 hours and to use our estimate of the FAC labour rate for a less qualified engineer of £52.40 per hour. We therefore propose that the unit FAC of element C of the inter-exchange dark fibre connection service should include £131 to reflect the activities associated with the initial testing required for a dark fibre circuit.

A20.67 We do not believe that this cost varies with the number of fibres provided. There should be no need for an engineer to undertake two different journeys for the two different fibres as both ends of each fibre will be at the same location. £131 is therefore our estimate of the FAC of the cost of initial testing of both a one and two fibre dark fibre circuit.

A20.68 Finally, Section 4.1 of the EAD Product description explains that "[Openreach] fibre engineers will splice a fibre 'pigtail' onto the network fibre in the optical splice tray" at each end of the EAD circuit. These fibre pigtails then connect to the Openreach Network Terminating Equipment (NTE) at each end of the circuit. We understand that a pigtail may be required to connect the dark fibre inter-exchange circuit to the patch panel and it is not clear to us whether the costs of these have been included within the patch panel, initial testing or RFS costs above.

A20.69 We asked BT to explain where the costs of fibre pigtails are captured within its RFS. BT explained that the pigtail costs were relatively small (£[✂]) and were attributed "across a number of components in the RFS". Some pigtail costs have been capitalised and "a small minority of capitalised costs were booked directly across fibre Classes of Work LFSC and LFDC and spread across a number of components including CW609, Ethernet Access Direct Fibre". BT also explained that fibre pigtail costs "are not attributed directly to services" and

[388] Openreach response dated 14 September 2018 to question 18b of the 10th LLCC s.135 notice.

that they had "no relative contribution (i.e. no impact)" to any of the component usage factors for the [EAD and EAD LA 1 Gbit] services listed".[389]

A20.70 Through our approach to RFS passive component costs described above, we will have included any pigtail costs within the Ethernet Main Links component but will have excluded those within the EAD Fibre component. However, our analysis suggests that any pigtail contribution to the costs of the EAD Fibre component are, as BT suggested, minimal. We therefore propose not to make any further adjustments for the costs of pigtails.

## Treatment of non-domestic rates costs

A20.71 Non-domestic rates (NDRs) are a form of property tax. Ratepayers pay NDRs on their rateable assets, which include telecoms assets such as fibre and duct. In general, the 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. We provide more background on NDRs in Annex 18 when discussing our approach to forecasting BT's cumulo costs.

A20.72 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.[390] 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.

A20.73 Prices for inter-exchange dark fibre services should therefore not include any contribution to BT's NDR costs. As we are proposing to adopt a cost-based approach to setting dark fibre prices in this control, we therefore propose not to include BT's attribution of its cumulo rates costs to EAD services in the cost stack for inter-exchange dark fibre services. This primarily affects rental services because relatively little of BT's cumulo costs are attributed to connection services.

A20.74 This proposal is different to the final treatment of NDRs when issuing guidance on dark fibre pricing within the 2016 BCMR Statement. As part of our original decision to introduce a dark fibre remedy, we issued guidance that dark fibre prices should be set by subtracting an 'active differential' from the price of the stated active reference service (BT's EAD 1 Gbit/s service). The 'Second Component' of this active differential covered NDR costs. Our guidance was that this should be calculated using BT's attribution of its cumulo rates costs to the reference service. In an appeal lodged by TalkTalk the Competition and

[389] Openreach response dated 10 September 2018 to question 17 of the 10th LLCC s.135 notice.
[390] Paragraph 5.2 of Section 871 of the VOA's 2017 Rating Manual: https://www.gov.uk/guidance/rating-manual-section-6-part-3-valuation-of-all-property-classes/section-871-telecommunications-fibre-optic-networks.

Markets Authority found that Ofcom was wrong to use BT's attribution of its cumulo rates costs when calculating the costs of the Second Component.[391]

A20.75 We amended our guidance with respect to the treatment of NDR costs in the 2017 NDR Statement we published on 30 June 2017.[392] Under the revised guidance we said there were two separate ways in which the Second Component of the active differential was to be calculated, depending on whether the NDRs for the telecom provider renting the dark fibre service would be assessed using the Direct Rental Comparison (DRC) method or the Receipts and Expenditure (R&E) method.[393] The latter was to be estimated using BT's attribution of its cumulo rates costs as in our original decision.

A20.76 In this control we could therefore have followed the decision within the 2017 NDR Statement and proposed to exclude an amount for NDRs based on the NDRs likely to be incurred by the telecoms provider renting the circuit. For those providers whose networks are assessed under the DRC method, this would have resulted in a price below the FAC for inter-exchange dark fibre services and therefore, contrary to our cost-based approach to dark fibre pricing. Further, it could be argued that this would have led to BT subsidising other telecoms providers' NDRs. We do not consider that this would be appropriate, and we would also have to consider how and from which services we should recover this subsidy.

## Proposals

A20.77 The table below shows indicative starting charges for each inter-exchange dark fibre service. These are based on costs from BT's 2016/17 RFS after making the adjustments outlined in Annex 19. We plan to update our analysis for our statement using costs from BT's 2017/18 RFS, as well as to take account of stakeholder comments.

A20.78 We have undertaken some initial analysis of the costs reported within BT's published 2017/18 RFS and believe that our estimates of charges may reduce slightly if we update

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[391] The CMA's determination is available at: https://www.catribunal.org.uk/sites/default/files/1259%3B1261_BCMR_CMA_Final_Determination_100417.pdf [accessed 25 October 2018].

[392] Ofcom, 2017. *Non-domestic rates and the price for regulated Dark Fibre*. https://www.ofcom.org.uk/__data/assets/pdf_file/0021/103647/statement-non-domestic-rates-dark-fibre.pdf.

[393] The VOA explains its approach to rating fibre optic networks in Section 871 of its rating manual. This is referred to above. Most telecoms providers fibre optic networks are valued using the Direct Rental Comparison method. Under this method telecoms providers are required to pay NDRs for each fibre that they use (light). There are several factors that determine the rating liability for any given fibre cable. These factors include: the size of the telecom provider's existing fibre network to which it attaches the cable, the length of the route of the fibre cable, and the number of fibres the telecoms provider has lit on the route. However, the VOA values fibre optic networks for some other telecoms including BT, KCOM, and Virgin Media using the Receipts and Expenditure (R&E) method. This method values all contiguous rateable assets together in a single assessment (a 'cumulo' assessment). For example, the assessment of BT's RV covers all of BT's rateable assets including its copper, duct and fibre assets (including those fibres that are used to supply services outside the scope of the BCMR). Under the R&E method, RVs are assessed by considering a set of forecast cash flows across all the rateable assets. It is therefore not possible to estimate how much NDRs BT pays on its leased lines, or indeed on any of its individual services, and so in designing regulatory controls on BT's charges we use an attribution of BT's cumulo rates costs. We explain our approach to attribution of BT's cumulo costs in Annex 18.

our analysis as we plan to do. Main link rental charges and per circuit rental charges might reduce with perhaps some slight increases to connection charges.

**Table A20.5: Indicative starting charges for inter-exchange dark fibre services – detailed breakdown**[394]

| | | Connection (per circuit) | Rental (per circuit per year) | Main Link (per metre per year) |
|---|---|---|---|---|
| **A: passive infrastructure costs** | Routing and records | £2.68 | £0.00 | £0.000 |
| | Ethernet Main Links | £0.00 | £0.00 | £0.140 |
| **B: other costs not specific to dark fibre** | Systems and Development (Ethernet) | £40.61 | £40.60 | £0.006 |
| | Service Centre – Assurance Ethernet | £0.00 | £0.54 | £0.000 |
| | Service Centre – Provision Ethernet | £543.60 | £0.00 | £0.000 |
| | Openreach Sales Product Management | £8.87 | £0.63 | £0.003 |
| | Ofcom Administration Fee - Openreach | £0.53 | £0.04 | £0.000 |
| | Revenue Receivables | £5.23 | £0.37 | £0.002 |
| **C: costs specific to dark fibre** | Patch panel | £0.00 | £8.71 | £0.000 |
| | Initial testing | £131.00 | £0.00 | £0.000 |
| **Total**[395] | | **£732.52** | **£50.90** | **£0.150** |

## Charges for ancillary services

A20.79 For BT to provide inter-exchange dark fibre services, it would also need to provide a number of ancillary services. These ancillary services can be divided into two groups:

- those that are equivalent to services that BT already offers to provide active services (e.g. TRCs); and

[394] These are estimates of the charges for a one fibre dark fibre service. The charges for a two fibre dark fibre service would be twice those above with the exception of the initial testing costs included in the connection charge. As we explain above we propose that these costs should be the same as those for a one fibre circuit. Our indicative connection charge for a two fibre dark fibre circuit would therefore be £1,334.04.

[395] Note that in Section 4 of Volume 2 and in the draft legal instrument, we have rounded rental and connection charges to the nearest pound and main link charges to the nearest penny.

- those that BT does not currently offer, which would be specific to inter-exchange dark fibre services.

A20.80 In Section 12 of Volume 1 we propose that ancillary services in the former group should be offered and charged for on the same basis as for active services. We identify two new ancillary services specific to the provision of inter-exchange dark fibre services and propose to set cost-based prices for these services, namely:

- a cessation charge; and
- a right when tested (RWT) charge.

A20.81 In this annex, we set out our pricing proposals for these last two services.

## Cessation charge

A20.82 A dark fibre circuit needs to be physically broken by an engineer to prevent it from being used when it is no longer being charged for. This contrasts with the cessation process for an active service such as EAD that can be switched off remotely using the electronic NTE.

A20.83 We asked Openreach to explain how it reflected the costs associated with the cessation of dark fibre circuits within its DFA Final Reference Offer pricing. We also asked for any updated analysis that Openreach had undertaken on the costs associated with ceasing dark fibre services since publishing its DFA Final Reference Offer.

A20.84 Openreach explained that in its DFA Final Reference Offer pricing it assumed that the cessation of a dark fibre circuit would require: [396]

- a desk-based engineer to plan the activity and raise it on the system [✂] (one to three) hours; and
- a field engineer to travel to the site, access the site and locate, break and un-label the fibre before closing the job on the system. [✂] (one to three) hours.

A20.85 Openreach proposed to capitalise the cost of these activities, depreciate it over an assumed median circuit life of [✂] and recover it from the dark fibre rental service.

A20.86 In preparing updated prices in August 2017 for the expected launch of dark fibre services Openreach updated its analysis by[397]:

- using 2016/17 rather than 2015/16 labour rates; and,
- reducing the field engineer task time in hours from [✂] to [✂], on the assumption that the cease would always be performed at a BT exchange, which would reduce travel time and site access time.

A20.87 We consider that extra activities will need to be undertaken to cease an inter-exchange dark fibre circuit and that Openreach's updated estimates of the time required to perform these activities are reasonable. However, our view is that these costs are most appropriately recovered from a charge levied at the time of cessation rather than from the

[396] Openreach response dated 14 September 2018 to question 18a of the 10th LLCC s.135 notice.
[397] Openreach response dated 14 September 2018 to question 18b of the 10th LLCC s.135 notice.

rental service. It does not seem reasonable that telecoms providers should pay for the cessation in advance when the average life of an inter-exchange dark fibre circuit is unknown and may differ significantly from available proxies such as the average survival life for EAD circuits. Furthermore, we expect relatively few cessations over the charge control period. Having a cessation charge avoids these uncertainties and the subsequent under-or-over recovery of cessation costs. It is also consistent with our proposed approach to birth certificate costs discussed above.

A20.88 We propose to assume that a cessation requires two hours of time from a more qualified engineer and one hour of time from a less qualified engineer, with estimated FAC labour rates of £70 and £52.40 respectively. This results in an estimated FAC per cessation of £192.40.

A20.89 As for initial testing costs we do not believe that this estimated FAC per cessation request varies with the number of fibres that are ceased. There should be no need for an engineer to undertake two different journeys to break both fibres on a two fibre circuit (if that is what is requested) as both can be broken at the same location. Therefore, our estimate of the FAC of the cost of each cessation request for either a one or two fibre dark fibre circuit is £192.40.

## Right when tested charge

A20.90 Openreach's DFA Final Reference Offer proposed that faults reported to Openreach that were ultimately cleared as right when tested (RWT) by an Openreach engineer may be subject to a charge. The RWT charge was intended to encourage telecoms providers to carry out diagnostic testing before reporting a fault. This increases the likelihood that reported faults on dark fibre circuits relate to Openreach's passive infrastructure, rather than to the purchasing telecoms provider's electronic equipment or network.

A20.91 Openreach's DFA Final Reference Offer specified that a RWT charge of £599 would apply only to RWT faults exceeding 6% of the overall fault volumes reported by a telecoms provider (assessed on a quarterly basis). Openreach stated that any RWT faults within this threshold would be charged using TRCs in line with the contract.[398]

A20.92 In Volume 1 we propose that Openreach should be able to levy a RWT charge subject to the thresholds described above and to set a cost-based price for a RWT charge.

A20.93 We asked Openreach to explain how it set the RWT charge within its DFA Final Reference Offer. We also asked for any updated analysis that Openreach had undertaken on the costs associated with a RWT fault on a dark fibre circuit since publishing its DFA Final Reference Offer.

[398] Page 8 of Openreach DFA Final Reference Offer Pricing, 2016. https://www.openreach.co.uk/orpg/home/products/darkfibreaccess/darkfibreaccess/downloads/DFAfinalreferenceofferpricing011216.pdf.

A20.94 Openreach explained that in both its DFA Final Reference Offer pricing and its updated launch pricing analysis in August 2017 that it assumed the following activities would be required for a RWT fault[399]:

- A desk-based (more qualified) engineer would:
  - validate the fault, review telecoms provider diagnostic data and create a task; and
  - locate a precision test officer (PTO), a more qualified engineer, assign them the task and arrange site access before finally closing the task.
- The PTO would:
  - travel to the site and conduct an OTDR test;
  - if the test at a wavelength of 1,250nm proved correct as 'Right When Tested' (RWT) then attach a light source at the site, travel to the other end where they would test the circuit at wavelengths of 1,310nm and 1,550nm;
  - travel back to the initial site, remove the light source and communicate back to the operations centre; and
  - travel back to the previous job.

A20.95 To its estimates of the time taken on these activities – [✂] (0.5 to 1.5) hours for the desk-based engineer and [✂] (4 to 6) hours for the PTO – Openreach applied a fully allocated pay cost "blended to create a 24 hour cost".[400]

A20.96 We broadly agree with the activities and timings provided by Openreach for handling a RWT fault, but we do not consider the costs should include [✂] (0.5 to 1.5) hours of time for the PTO to travel back to the previous job.[401] This travel time would have been required regardless of whether the PTO cleared the reported fault as RWT or diagnosed a genuine fault relating to BT's passive infrastructure. We therefore propose to set a RWT charge based on a RWT fault requiring 0.75 hours of work for a staff member in BT's AOC and 4.25 hours of work for a PTO. We have used our estimate of the FAC labour rate for more qualified engineers of £70 per hour. This results in an estimated FAC per RWT fault of £350.

[399] Openreach response dated 14 September 2018 to question 21 of the 10th LLCC s.135 notice. In Openreach's DFA Final Reference Offer pricing for the RWT charge it also included costs relating to tri-band testers required to perform the ODTR tests specified above. It converted the total cost of a tri-band tester to an hourly recovery charge over an assumed [✂] year asset life of £[✂]. When reviewing the launch pricing for DFA in August 2017, Openreach excluded the cost of tri-band testers from the RWT charge as there was a possibility that this handset type would be ordered for all engineers as standard.

[400] Openreach response dated 14 September to question 21 of the 10th LLCC s.135 notice.

[401] Openreach response dated 14 September to question 21 of the 10th LLCC s.135 notice.

# A21. Cost of capital

A21.1 In Section 2 of Volume 2 we set out our rationale for proposing to keep prices flat in nominal terms (i.e. to set a CPI-CPI control) for active services at 1 Gbit/s and below. We also explain that we have modelled the likely evolution of efficient costs to understand how a CPI-CPI control compares with a cost-based charge control.

A21.2 Our modelling, discussed in Annex 18, requires an estimate of the target return on mean capital employed (MCE), which should reflect our latest view of the appropriate forward-looking weighted average cost of capital (WACC) for active leased lines services. In addition, as explained in Section 4 of Volume 2, our proposed approach to estimating inter-exchange dark fibre prices also requires an estimate of the appropriate forward-looking WACC.

A21.3 In both cases, the modelling is done in nominal terms without explicit modelling of tax, and so we require a forecast of the pre-tax nominal WACC.

A21.4 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 is denoted by g below and the rate of corporation tax is denoted by t.

$$WACC = \frac{Ke * (1 - g)}{1 - t} + Kd * g$$

## Framework for estimating an appropriate rate of return

A21.5 We have followed a broadly similar approach to setting the target rate of return in recent charge controls for regulated telecoms services.

- **The cost of equity** is calculated 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):

  $$Ke = RFR + ERP * \beta e$$

  Under our approach, the equity beta is estimated by first undertaking a three-way disaggregation of the BT Group asset beta (into Openreach copper access, 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.

- **The cost of debt** is calculated by combining the RFR with a debt premium (dp), i.e. the corporate debt rate above benchmark risk-free assets, such that:

  $$Kd = RFR + dp$$

  In deciding on the appropriate estimate for the cost of debt, we have placed some weight on the cost of BT's existing (or embedded) debt.

A21.6 The approaches used by regulators to set the cost of capital in charge controls have been explored in several recent publications. For example:

- in July 2018, the EC published a consultation on guidance to European regulators on cost of capital estimation in the electronic communications sector (2018 EC Consultation)[402];
- a March 2018 report by Wright et al commissioned by the UK Regulators Network (UKRN) considered approaches used by UK economic regulators to estimate the cost of capital and made ten recommendations (2018 UKRN Report)[403]; and
- Ofgem[404], Ofwat[405] and CAA[406] have recently set out their initial views on the cost of capital for the next round of price controls in the energy, water and aviation sectors.

A21.7 We have had due regard to these publications when formulating our proposals in this consultation.

A21.8 Before setting out our WACC estimate, we explain our proposed framework for identifying an appropriate rate of return in regulated markets.[407]

- **Efficient price and investment signals** – the WACC 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 (not only those in the regulated firm, but also those in competing infrastructure providers and access seekers) to be able to commit risky capital in the knowledge that we design our price regulation not to undermine the viability of their investments in future periods.
- **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.

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[402] EC, 2018. *Targeted consultation on guidance on cost of capital for EU electronic communications regulators*. https://ec.europa.eu/digital-single-market/en/news/targeted-consultation-guidance-cost-capital-eu-electronic-communications-regulators. This consultation followed a 2016 report by Brattle for the EC which considered approaches used by European telecoms regulators to estimate the cost of capital (see https://publications.europa.eu/en/publication-detail/-/publication/da1cbe44-4a4e-11e6-9c64-01aa75ed71a1/language-en/format-PDF/source-search).
[403] Wright, S. Burns, P., Mason, R., Pickford, D., 2018. *Estimating the cost of capital for implementation of price controls by UK regulators* http://www.bbk.ac.uk/ems/faculty/wright/wrightburnsmasonpickford2018.pdf.
[404] Ofgem, 2018. *RIIO-2 Framework Decision*, Section 6, pages 49-57. https://www.ofgem.gov.uk/system/files/docs/2018/07/riio-2_july_decision_document_final_300718.pdf.
[405] Ofwat, 2017. *Delivering Water 2020: Our final methodology for the 2019 price review*, pages 172-180. https://www.ofwat.gov.uk/wp-content/uploads/2017/12/Final-methodology-1.pdf.
[406] CAA, 2018. *Economic regulation of capacity expansion at Heathrow: policy update and consultation*, pages 55-57. http://publicapps.caa.co.uk/docs/33/CAP1658EconomicregulationofcapacityexpansionatHeathrow.pdf.
[407] This framework embodies principles similar to those proposed in the 2018 EC Consultation.

A21.9 We consider that our WACC proposals in this consultation strike a reasonable balance between these objectives.

## Proposed approach in this review

A21.10 In the interests of stability and consistency – particularly as this is a relatively short, two-year review – we propose to continue using the same three-way disaggregation of the BT Group WACC used in the 2018 WLA Statement and the preceding 2016 BCMR Statement.

A21.11 We propose that the Other UK Telecoms WACC continues to be the relevant WACC for active leased lines services. We also propose to use the Other UK Telecoms WACC in estimating the efficient costs of providing inter-exchange dark fibre services.

A21.12 In the interests of sending efficient price and investment signals, we have reviewed our approach to setting the market parameters – i.e. the RFR and the total market return (TMR, which is the sum of the RFR and the ERP) – and propose some reductions.

A21.13 We propose to place greater weight than in past decisions on more recent data to estimate the RFR. We consider that this approach better reflects the impact that the prolonged period of low interest rates has had on the forward-looking cost of equity and the forward-looking cost of debt. However, as we explain below, we do not propose moving to spot rates – or a short averaging window – to estimate the RFR.

A21.14 We also propose to reduce slightly our estimate of the TMR relative to previous decisions. While we continue to place weight on historical returns to inform our assessment, we consider there is a case for placing more weight on forward-looking methods.

A21.15 While we propose to base our RFR on more recent data, we consider it is appropriate to continue to place some weight on BT's existing debt obligations when estimating the overall cost of debt for the purposes of setting charge controls. We remain of the view, as expressed in our recent decisions, that 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, and that 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.[408] Therefore, the overall cost of debt is estimated by reference to both the forward-looking cost of debt (informed by our revised estimate of the RFR and the debt premium) and the cost of BT's existing debt.

## WACC proposals

A21.16 Our proposed values for the BT Group WACC and its three constituent parts (Openreach copper access, Other UK Telecoms and Rest of BT) are shown in Table A21.1 below.

[408] 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, with broadly similar probabilities of over- or under-recovery against the regulatory allowances over the longer-term.

A21.17 We propose to apply the Other UK Telecoms WACC to dark fibre and active leased lines services.

A21.18 We summarise below how the key parameter values compare to those set out in the 2018 WLA Statement:

- a reduction in the real (RPI-deflated) RFR from 0.0% to -1.25% (equivalent to a reduction in the nominal RFR from 2.9% to 1.6%), reflecting the fact that interest rates remain at historically low levels and our proposal to place more weight on recent data;
- a proposal to adopt a real (CPI-deflated) TMR of 6.7%, reflecting our revised assessment of the available evidence. This is equivalent to a nominal TMR of 8.8% and a real (RPI-deflated) TMR of 5.8% (which compares to a value of 6.1% used in the 2018 WLA Statement);
- combining the reductions in the RFR and the TMR implies an increase in the nominal ERP from 6.3% to 7.2%;
- a decrease in the Openreach copper access asset beta from 0.59 to 0.56, reflecting updated estimates of the BT Group asset beta and the utility asset betas (coupled with a cross-check on other telecoms asset betas);
- a reduction in the Other UK Telecoms asset beta from 0.73 to 0.65, reflecting updated evidence on asset betas for telecoms comparators ICT companies; and
- no change in the cost of debt, reflecting updated evidence on corporate debt costs.

### Table A21.1: BT WACC, 2018 LLCC Consultation (2020/21)

| WACC component | BT Group | Openreach copper access[409] | Other UK Telecoms | RoBT | Source |
|---|---|---|---|---|---|
| Real (RPI-deflated) RFR | -1.25% | -1.25% | -1.25% | -1.25% | Ofcom estimate |
| RPI inflation forecast | 2.9% | 2.9% | 2.9% | 2.9% | OBR |
| Nominal RFR | 1.6% | 1.6% | 1.6% | 1.6% | = (1+real RFR)*(1+RPI inflation)-1 |
| Real (CPI-deflated) TMR | 6.7% | 6.7% | 6.7% | 6.7% | Ofcom estimate |
| CPI inflation forecast | 2.0% | 2.0% | 2.0% | 2.0% | OBR |
| Nominal TMR[410] | 8.8% | 8.8% | 8.8% | 8.8% | = (1+real TMR)*(1+CPI inflation)-1 |
| Nominal ERP | 7.2% | 7.2% | 7.2% | 7.2% | = Nominal TMR – Nominal RFR |
| Debt beta (βd) | 0.10 | 0.10 | 0.10 | 0.10 | Ofcom estimate |
| Asset beta (βa) | 0.71 | 0.56 | 0.65 | 1.17 | Ofcom estimate |
| Asset beta weight | 100% | 20% | 65% | 15% | Ofcom estimate |
| Gearing (forward looking) (g) | 35% | 35% | 35% | 35% | Ofcom estimate |
| Equity Beta (βe) | 1.04 | 0.81 | 0.95 | 1.75 | = (βa - βd*g)/(1-g) |
| Cost of equity (post-tax) (Ke) | 9.1% | 7.4% | 8.4% | 14.2% | = Nominal RFR + ERP *βe |
| Cost of equity (pre-tax) | 11.0% | 9.0% | 10.2% | 17.1% | = Ke / (1-t) |
| Corporate tax rate (t) | 17% | 17% | 17% | 17% | HMRC |
| Cost of debt (pre-tax) (Kd)[411] | 4.0% | 3.9% | 4.0% | 4.1% | Ofcom estimate |
| **WACC (pre-tax nominal)** | 8.5% | 7.2% | 8.0% | 12.6% | =(Ke*(1-g))/(1-t)+(Kd*g) |
| *2018 WLA Statement* | *9.3%* | *7.9%* | *8.9%* | *12.9%* | |

*Source: Ofcom*[412]

[409] In the 2018 WLA Statement we also used the Openreach copper access WACC in the calculation of PIA rental charges as part of the remedy introduced in the 2018 WLA, as well as LLU services (Volume 3, page 146, paragraph 5.6).
[410] This is equivalent to a real (RPI-deflated) TMR of 5.8% using the Fisher equation, i.e. (1+nominal TMR)/(1+ RPI inflation) = real (RPI-deflated) TMR.
[411] We propose to set the cost of debt based on the weighted average cost of existing and new debt.
[412] For comparison purposes, the UKRN annual update has previously reported real vanilla WACCs for 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 2.9%) is 4.3%, 3.2%, 3.9% and 7.6% for BT Group, Openreach

A21.19 Our proposed pre-tax nominal WACC for Other UK Telecoms is 8.0%. For the purposes of our modelling of active costs (described in Annex 18), we propose a range of 7 and 9% (one percentage point lower and higher than our point estimate). Our estimates of efficient costs of providing inter-exchange dark fibre (described in Section 4 of Volume 2 and Annex 20) reflect our latest view of the Other UK Telecoms WACC of 8.0%.

A21.20 In the remainder of this annex we set out our estimation of the BT Group WACC before explaining our approach to disaggregating the BT Group WACC between Openreach copper access, Other UK Telecoms and the RoBT.

## BT Group WACC

A21.21 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.[413] We therefore want any disaggregated WACC for the regulated lines of business to be commensurate with the overall WACC for BT Group.

A21.22 We need to estimate several parameters to calculate a WACC for BT Group as shown in Table A21.1. The rest of this annex sets out our proposals on each of these parameters.

## RFR

A21.23 The RFR in the economy is not directly observable. Instead, it must be approximated by finding an established and (as far as possible) riskless asset which is highly liquid (i.e. regularly traded). Typically, government bonds (known in the UK as 'gilts') are used as a proxy for the RFR.

A21.24 In recent regulatory decisions we have estimated the real (RPI-deflated) RFR by reference to average yields on index-linked gilts rather than current (spot) yields. Reasons for this include:

- by using index-linked gilts we observe the yield net of compensation for (RPI) inflation – itself a form of risk; and
- using averages avoids putting too much weight on spot rates which may be volatile and avoids large swings from one regulatory decision to the next.[414]

A21.25 However, a key question is how long a period should be used for averaging. Given that the same RFR underpinned both the cost of equity and the overall cost of debt in previous decisions, we tended to use longer averaging periods to inform our RFR estimate. This recognised that firms issue debt over several years and at various points through the

copper access, Other UK Telecoms and RoBT respectively. Note: the pre-tax nominal WACC is rounded to one decimal place, but all intermediate calculations are unrounded.

[413] According to the 2018 RFS, markets in which BT was found to have SMP represented 63% of returns and 42% of MCE.

[414] 2018 WLA Statement, paragraph A20.32.

economic cycle.[415] We did not mechanistically follow a single averaging period but, in practice, our estimates have been between the five- and 15-year averages of yields on ten-year gilts (as shown in Figure A21.2).

A21.26 Using longer term averages helps ensure that the cost of debt estimated by combining a RFR with a debt premium is reasonable when compared to estimates of the weighted average cost of existing and new debt.[416] We considered that this cross-check against the overall average cost of debt was reasonable because even an efficiently financed firm might not have anticipated the length and scale of QE coupled with an extended period of low interest rates.

A21.27 However, taking a particularly long averaging period for gilt yields means the RFR underpinning the cost of equity is slow to adjust to current market data. Given the fact that low gilts yields have persisted for so long (and therefore it seems unlikely rates will revert to pre-crisis levels for the foreseeable future) and concerns over the overall cost of debt can be addressed by other means, we have reviewed our approach.

A21.28 While the principle of stability referred to in the framework section above could support the use of longer averaging periods, we consider that placing greater weight on more recent yields would help ensure that our estimates of the cost of equity provide more efficient price and investment signals, i.e. they would more closely reflect the current financial market conditions facing investors.

A21.29 As explained in more detail in the cost of debt subsection, to ensure our projected cost of debt continues to provide adequate remuneration for efficiently incurred debt costs, our overall cost of debt is derived by combining:

- the evidence on the forward-looking cost of debt (which we continue to estimate by reference to the RFR and the debt premium); with
- the evidence on the cost of BT's existing debt.

A21.30 In considering the weight to put on current and forward gilt yields, we have had regard to our principles of stability and consistency in setting the WACC. We remain of the view that placing too much weight on the very latest yields could lead to decisions which are unduly affected by 'noise' in the data (i.e. short-term movements in the gilt market that are not representative of the underlying forward trend).

A21.31 Based on the available market evidence and the considerations set out in this annex, we propose to reduce our estimate of the RPI-deflated RFR from the 0.0% used in the 2018 WLA Statement to -1.25%. The overall impact on the WACC from the proposed reduction in the RFR is moderated by our approach to the cost of equity (in which the ERP increases) and our approach to the cost of debt (in which we make an allowance for embedded debt).

[415] 2018 WLA Statement, paragraph A20.33.
[416] 2018 WLA Statement, paragraph A20.48.

## Yields on index-linked gilts

A21.32 When estimating the real RFR (RPI-deflated) from index-linked gilt yields, two relevant considerations are the bond maturity and, as explained above, the averaging period.

A21.33 In terms of bond maturity, telecoms investments have relatively long asset lives and an efficient network operator would be expected to finance investments (whether network renewals or enhancements) steadily through time. For example:

- BT's network infrastructure assets have asset lives of between two and 40 years, while the main assets used to deliver business connectivity services (fibre and ducts) have asset lives between five and 40 years[417];
- the average remaining maturity on BT's debt is currently around six to eight years; and
- the average maturity from issuance on BT's debt is currently around 12 to 14 years.

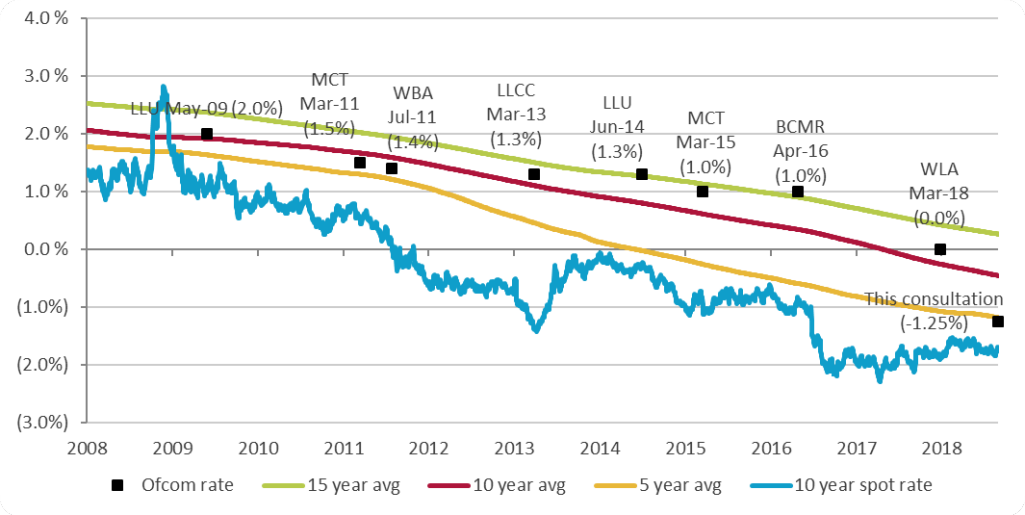
A21.34 In previous decisions we have considered yields on five-, ten- and 20-year index-linked gilts, but have tended to place most weight on ten-year gilts as a reasonable estimate of the relevant time horizon for telecoms investments. We propose to continue placing most weight on ten-year gilts.

A21.35 Index-linked gilt yields averaged over different periods (between five and 15 years) are currently in the range of around -1.25% to 0.25%, while spot rates are around -1.7%. We propose to reduce our estimate of the real (RPI-deflated) RFR from 0% used in the 2018 WLA Statement to -1.25% because:

- we consider there is a case for placing greater weight on more recent evidence on gilt yields when estimating the forward-looking expected return (i.e. WACC);
- while the spot rate has shown signs of increasing at times in the last year, it remains close to some of the lowest levels seen in the last decade and significantly below the real (RPI-deflated) RFR of 0% used in the 2018 WLA Statement; and
- forward rates on five- and ten-year gilts are currently in the region of -1.5%[418], as shown in Figure A.21.3, suggesting that it would not be appropriate to use a RFR as low as indicated by current spot rates.

[417] Page 211 of BT's 2018 annual report shows the asset lives used by BT for network infrastructure assets. Page 91 of the 2018 Regulatory Financial statements shows that fibre and duct represent the majority of assets used to provide business connectivity services.
[418] The end of the charge control is in 2020/21, which is in two and a half years' time. Forward rates shown in Figure A21.3 represent the expected yields on five- and ten-year gilts three years from the date shown on the x-axis (i.e. recent data is representative of expected yields at the end of the charge control given the analysis cut-off date of 31 August 2018).

**Figure A21.2: Yields on ten-year gilts and Ofcom decisions on real RFR**




*Source: Bank of England, Ofcom analysis. Data as at 31 August 2018.*

**Figure A21.3: Forward rates on five- and ten-year gilts taken out in three years' time**


*Source: Bank of England, Ofcom analysis. Data as at 31 August 2018.*

A21.36 Combined with our proposed RPI inflation forecast for 2020/21 of 2.9% (see below), the proposed nominal RFR is 1.6%.

## TMR and ERP

A21.37 The TMR represents the sum of the RFR and the ERP. While the expected TMR and expected ERP are not directly observable, in recent decisions we have placed more weight on estimates of the TMR because historically it has been less volatile than the ERP[419], with the ERP estimated by subtracting the RFR estimate from the TMR estimate.

[419] From Table 71 of the 2018 Yearbook the ratio of standard deviation to arithmetic mean for the nominal TMR is 1.9, which is lower than the equivalent ratio for the nominal ERP calculated for equities against bonds (3.4) and equities against bills (3.1).

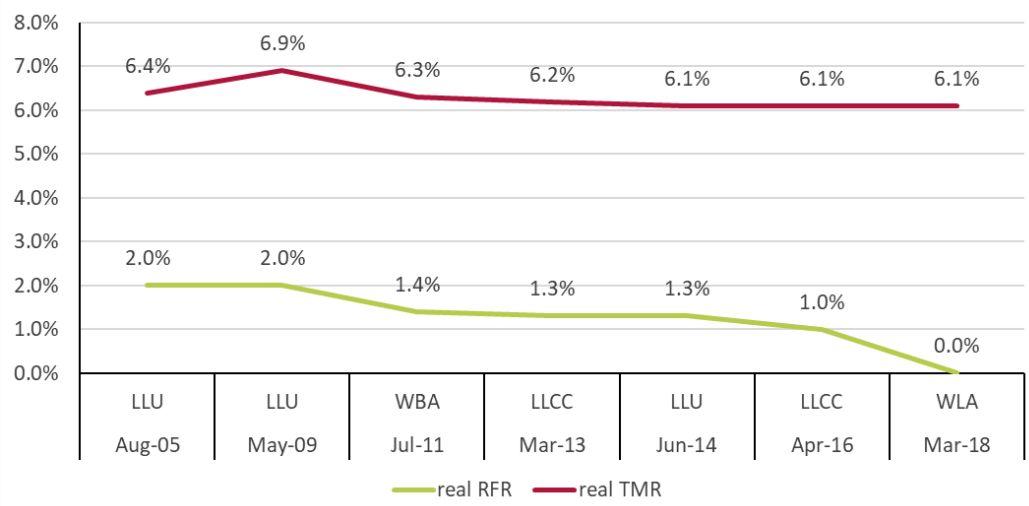
A21.38 We recognise that the views of experts and practitioners can differ when it comes to estimating the level of the TMR and the relationship between the RFR, ERP and TMR. We commissioned Europe Economics to help us consider these issues. The report from Europe Economics is published alongside this consultation.[420]

## Our previous decisions

A21.39 In the 2018 WLA Statement we used a real (RPI-deflated) TMR of 6.1% informed by historical *ex post* and *ex ante* estimates of the TMR using data from Dimson, Marsh and Staunton (DMS) in the Credit Suisse 2017 Yearbook (2017 Yearbook) and the 2017 Barclays Equity Gilt Study (2017 EGS).

A21.40 Between 2005 and 2018, our decisions on the real (RPI-deflated) RFR estimates fell by two percentage points and we now propose a further reduction (as discussed above). Over the same period, our real TMR estimates also reduced, though at a much slower rate. We have used a real (RPI-deflated) TMR of 6.1% for the last three fixed telecoms market reviews (starting with the 2014 FAMR Statement), during which time we reduced the real RFR by 1.3 percentage points up to the 2018 WLA Statement. These decisions are shown in Figure A21.4.

**Figure A21.4: Real RFR and real TMR decisions in charge controls on BT (RPI-deflated)**




*Source: Ofcom decisions. Note that real TMR estimates for 2005 to 2014 have been estimated by adding the real RFR rate to the real ERP used in our decisions because the TMR was not directly estimated and reported in those decisions.*

A21.41 Given the sustained period of very low gilt yields, we now revisit the evidence on the TMR, including more recent studies.

[420] Europe Economics, 2018. *Cost of Capital: Total Market Return*. https://www.ofcom.org.uk/_resources/documents/consultations/category-1/124718-bcmr/associated-documents/secondary-documents/europe-economics-wacc-report.pdf.

## Historical *ex post* evidence

A21.42 Historical *ex post* approaches assume that realised equity returns are a good proxy for the forward-looking expected TMR. Since asset returns, especially equity returns are very volatile, it is reasonable to consider long periods of history (if data permits).

A21.43 Indeed, the 2018 UKRN report recommends that regulators base their estimate of the TMR on historical averages calculated over a very long period.[421] While the authors of that report do not dispute the fact that actual returns may deviate from the long-run historical average, they suggest that regulators cannot do better when forecasting the TMR than to assume that the TMR is stable over time.

A21.44 The 2018 UKRN report proposes a real (CPI-deflated) TMR range of 6% to 7%.[422] The report uses the Bank of England's long-term CPI measure to calculate the real CPI-based historic return for the UK[423], and supplements it with evidence on international returns (which it notes are CPI-based)[424], to derive a range.

A21.45 The 6% to 7% UKRN range is estimated by adding a volatility adjustment to the historic geometric return to arrive at an arithmetic average return, with the size of the adjustment reflecting the extent to which serial correlation in returns is taken into account.[425]

A21.46 In considering different sources of evidence on the TMR, the Europe Economics report estimates that average historical returns imply a real TMR of 7.0%, using the Bank of England's CPI series to deflate historical nominal returns or 7.3% using the real DMS data directly.[426] In contrast to the 2018 UKRN report, the Europe Economics report takes the arithmetic averages of historic returns directly from the DMS dataset.

A21.47 It is difficult to assess the impact of changes in measuring inflation on real realised returns over such a long horizon. In 2013, the ONS declassified the UK RPI index as a national statistic and has recently concluded that RPI is an upwardly biased measure of inflation[427];

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[421] 2018 UKRN report, page 47. This is consistent with the recommendation in the 2003 report by Wright et al, February 2003. *A Study into Certain Aspects of the Cost of Capital for Regulated Utilities in the UK*, page 48.
[422] UKRN report, Appendix E.
[423] In comparison, the 2018 Yearbook (page 210) reports UK real returns using a cost of living index until 1947, RPI from 1947 until 1988, and CPI from 1988 onwards to deflate UK nominal returns.
[424] Appendix D of the UKRN report discusses the issues relating to inflation measurement in interpreting historical returns data. For example, on page 117, the UKRN report sets out the reasons why the authors recommend estimating the real cost of equity in CPI terms. One of the reasons given is that "we can calculate a CPI based historic real return on a consistent basis, and then augment this with evidence on international returns which are essentially CPI based real returns".
[425] UKRN report, Appendix E.
[426] See Europe Economics, 2018. *Cost of Capital: Total Market Return,* (Europe Economics' report), pages 14-15. Based on the DMS nominal dataset and deflated with the Bank of England's long-term CPI measure.
[427] The debate about the appropriateness of RPI as an inflation measure has largely been triggered by the ONS methodology changes introduced in 2010. See ONS's latest discussion on the shortcomings of RPI: https://www.ons.gov.uk/economy/inflationandpriceindices/articles/shortcomingsoftheretailpricesindexasameasureofinflation/2018-03-08.

while the 2015 Johnson Review of price indices explored the shortcomings of RPI and noted that CPI was the headline measure of inflation in the economy.[428]

A21.48 Over the 20th century, the estimated difference between the UK CPI and UK RPI has been relatively modest (0.14%)[429], suggesting that the choice of inflation index used to deflate nominal returns may not be that significant, at least for the first century of data reported in the DMS dataset. The wedge between RPI and CPI has been more significant in recent years.[430] However, the DMS dataset uses CPI to deflate historical returns from 1988 onwards, implying that their real estimates are not too affected by recent changes to RPI and that at least the last quarter of their real data sample is CPI-based. Therefore, we consider that the evidence presented above (from the 2018 UKRN report, Europe Economics report, as well as from the DMS dataset directly) could be used to provide reasonable estimates of real *ex post* returns to inform future expectations.

A21.49 It is harder to assess the impact of changes in inflation measurement on how investors form their return expectations. However, as explained above, the ONS has recently established that RPI is a flawed and upwardly biased measure of inflation.[431] Hence, assuming investors target real returns, it seems plausible that expected returns would be shaped by an expectation that nominal returns would compensate investors for CPI (currently the headline measure of inflation[432]) rather than RPI inflation. As such, using historical evidence on real returns as a guide for forward-looking real (CPI-deflated) returns is reasonable in our view.

## Historical *ex ante* evidence

A21.50 In previous charge controls we have also considered two historical *ex ante* approaches to estimating the real TMR.

A21.51 First, we have considered Fama and French's approach of estimating the real TMR from the sum of average dividend yields and the average real rate of dividend growth.[433] Data from the 2018 Barclays EGS suggests that the average dividend yield has been 4.5% over the period 1900 to 2017 in the UK[434], with dividend yields in recent years below the long-run average (around 3.5% since 2010). Both the Barclays and DMS datasets suggest average

[428] Johnson, P., 2015. *UK Consumer Price Statistics: A Review*. https://www.statisticsauthority.gov.uk/archive/reports---correspondence/current-reviews/uk-consumer-price-statistics---a-review.pdf. The Review also recommends that the ONS should work towards making CPIH (a variant of CPI which includes a measure of housing costs) the headline measure of inflation, after certain shortcomings in its composition are resolved.
[429] UKRN report, page 122.
[430] The wedge between RPI and CPI has increased in recent years and averaged at 0.7% over the 2000-16 period (UKRN report, page 122).
[431] See ONS's discussion on the shortcomings of RPI: https://www.ons.gov.uk/economy/inflationandpriceindices/articles/shortcomingsoftheretailpricesindexasameasureofinflation/2018-03-08.
[432] CPI is not without its shortcomings, and there is a debate whether CPIH would become the headline measure of inflation in the future.
[433] Fama, E. F. and French, K. R., April 2002. *The Equity Premium*, Journal of Finance Vol. LVII, No. 2.
[434] DMS reports an average dividend yield of 4.6% for the UK market over the same time period. However, the DMS dataset does not provide data on dividend yields by year.

real dividend growth rates of around 1.2%. These numbers would imply a real TMR of 5.7% (based on long-run average dividend yields) or lower (based on current dividend yields). Given our earlier discussion around the interpretation of the DMS real dataset, we consider that these estimates could reasonably be used to inform expectations of future (CPI-based) returns.

A21.52 As discussed in some detail by the CMA in its 2014 decision on the Northern Ireland Electricity appeal[435], part of the difference between expected returns under a dividend yield approach (such as the one described above) and historical (arithmetic) averages could be due to historically lower volatility of dividend growth relative to capital (equity price) growth. However, part of the difference is also attributed to relatively high realised returns in the second half of the 20th century, which might be due to unrepeatable factors or good luck. This would suggest that TMR estimates based on historical *ex post* evidence could overstate future expected returns.

A21.53 This conclusion is similar to findings of the DMS, most recently described in the 2018 Yearbook. The authors infer what returns investors may have been expecting in the past by separating the historical equity risk premium into elements that correspond to investor expectations and those that relate to non-repeatable good or bad luck. DMS considers dividend income, real dividend growth, expansion of valuation ratios and changes in the real exchange rate.[436] DMS infers that going forward, once they adjust for non-repeatable factors of the past, globally diversified investors might expect an arithmetic average ERP over treasury bills of around 5.0%.[437] Given the average long run real return on US treasury bills (which is the DMS preferred measure of risk-free returns[438]) is 0.9%[439], this implies an expected real TMR of around 5.9% (or lower if based on current treasury bill rates rather than long-run averages[440]). As the DMS estimates are for a global investor, we consider it is appropriate to consider these estimates as an indication of the expected real (CPI-based) return.[441] The DMS evidence is consistent with the analysis from Fama and French that historical returns may overstate future returns.

## Other evidence

A21.54 The Europe Economics report included forward-looking TMR estimates using three variants of the dividend growth model (DGM). Its DGM analysis implies a real (CPI-based) TMR of

[435] See the discussion by the CMA in its 2014 NIE Determination, Section 13 and Appendix 13.2. https://assets.publishing.service.gov.uk/media/535a5768ed915d0fdb000003/NIE_Final_determination.pdf; https://assets.publishing.service.gov.uk/media/534cd4b4ed915d630e000041/appendices-glossary.pdf.
[436] See for example pages 31-34 of the 2018 Yearbook.
[437] 2018 Yearbook, page 36.
[438] See page 26 of the 2017 Yearbook.
[439] See page 225 of the 2018 Yearbook. The equivalent long run real return on UK treasury bills is 1.2% from page 209 of the 2018 Yearbook.
[440] For example, yields on US 6-month treasury bills are currently around 2.5% (nominal), which, assuming expected CPI inflation in the US is greater than 1.6%, would imply a real rate of less 0.9%. UK treasury bills are trading at significantly lower yields (less than 1% nominal). Sources: US Treasury, Bank of England.
[441] Appendix D of the UKRN report notes that international price indices tend to be more comparable to CPI (or CPIH).

6.4% to 6.7%.[442] Together with the other evidence considered in the report (historical *ex post* estimates, which we have summarised above, and regulatory precedent), it recommends a range of 6.25% to 7.0% for the real (CPI-based) TMR.[443]

A21.55 The Europe Economics report also investigated the empirical relationship between the RFR and TMR over time. Using outputs from its DGM models, the report finds that, when deflating modelled equity returns and nominal gilt yields by CPI, there is a statistically significant relationship between the real TMR and the real RFR, with the coefficient ranging from around 0.3 to 0.6.[444] When deflating returns by RPI however, there is a less clear relationship between the TMR and RFR, with some coefficients not significantly different from zero.[445]

A21.56 We note that the 2018 Yearbook examines the empirical relationship between real interest rates and subsequent real returns for equities and concludes that "when real interest rates are low, expected future returns on all risky assets are also lower"[446], consistent with DMS finding a positive relationship between real interest rates and real returns on equity.

## Our proposal

A21.57 In real (CPI-deflated) terms, the 2018 WLA TMR was implicitly 7.1% (although it was not expressed in these CPI-deflated terms in that statement).[447] Considering the available evidence on equity returns together with the sustained and substantial reduction in gilt yields over the last decade (and our proposal to further reduce the RFR from the 2018 WLA statement), we consider that a reduction in the forward-looking TMR is appropriate.

A21.58 Taking all the evidence together, we note that:

- historical *ex post* approaches suggest a real (CPI-deflated) TMR of around 6% to a little over 7%;
- historical *ex ante* approaches generally suggest lower numbers, potentially below 6%;
- forward-looking evidence (based on the DGM in the Europe Economics report) implies a range of 6.4% to 6.7%; and
- there is empirical evidence (albeit mixed) of a positive relationship between the RFR and the TMR.

[442] The three DGM models considered by Europe Economics make different assumptions for short-term and long-term dividend growth rates. See section 2.5.2 and Table 2.3 of the Europe Economics report.
[443] Europe Economics report, page 15.
[444] Europe Economics report, page 15. Europe Economics also notes that PwC also studied this relationship for Ofwat. PwC's analysis found a negative correlation between the real RFR and the real ERP, with a coefficient of -0.62 (using data from 2000-17). This coefficient corresponds to a coefficient of 0.38 between the real RFR and TMR, which is at the lower end of the range of statistically significant coefficients estimated by Europe Economics when deflating returns by CPI. See PwC's report, *Updated analysis on cost of equity for PR19*. https://www.ofwat.gov.uk/wp-content/uploads/2017/12/PwC-Updated-analysis-on-cost-of-equity-for-PR19-Dec-2017.pdf.
[445] Europe Economics report, page 15.
[446] 2018 Yearbook, page 20.
[447] Given the nominal TMR of 9.2% and CPI forecast of 2% (for 2020/21).

A21.59 In light of the empirical evidence and preceding discussion, we consider that the range suggested by the Europe Economics report of 6.25% to 7.0% for the CPI-deflated real TMR is reasonable. Within that range, we propose to use a CPI-deflated TMR of 6.7% as this seems most compatible with the various methodologies considered in this consultation and sits close to the middle of the range recommended in the Europe Economics report.

A21.60 Using our forecast of CPI inflation for 2020/21 of 2.0% (see below), a real (CPI-deflated) TMR of 6.7% implies a nominal TMR of 8.8%. Consistent with forecast RPI inflation for 2020/21, this is equivalent to a real (RPI-deflated) TMR of 5.8%, although it would be compatible with lower values for the real (RPI-deflated) TMR, if the wedge between RPI and CPI is greater than 0.9%.[448]

## ERP

A21.61 Based on a nominal TMR of 8.8% and a nominal RFR of 1.6%, the implied nominal ERP is 7.2%. Based on forecast RPI of 2.9%, this implies a real (RPI-deflated) ERP of 7.0%.

A21.62 We have cross-checked these estimates of the ERP against:

- historical premiums of UK equities over UK gilts; and
- the Bank of England's DGM model.

### Historical premia of UK equities over gilts

A21.63 The 2018 Yearbook reports that the average (arithmetic mean) equity risk premium over bonds for the UK between 1900 and 2017 was 5.0%[449] while the Barclays 2018 EGS indicates it was 5.1%.[450]

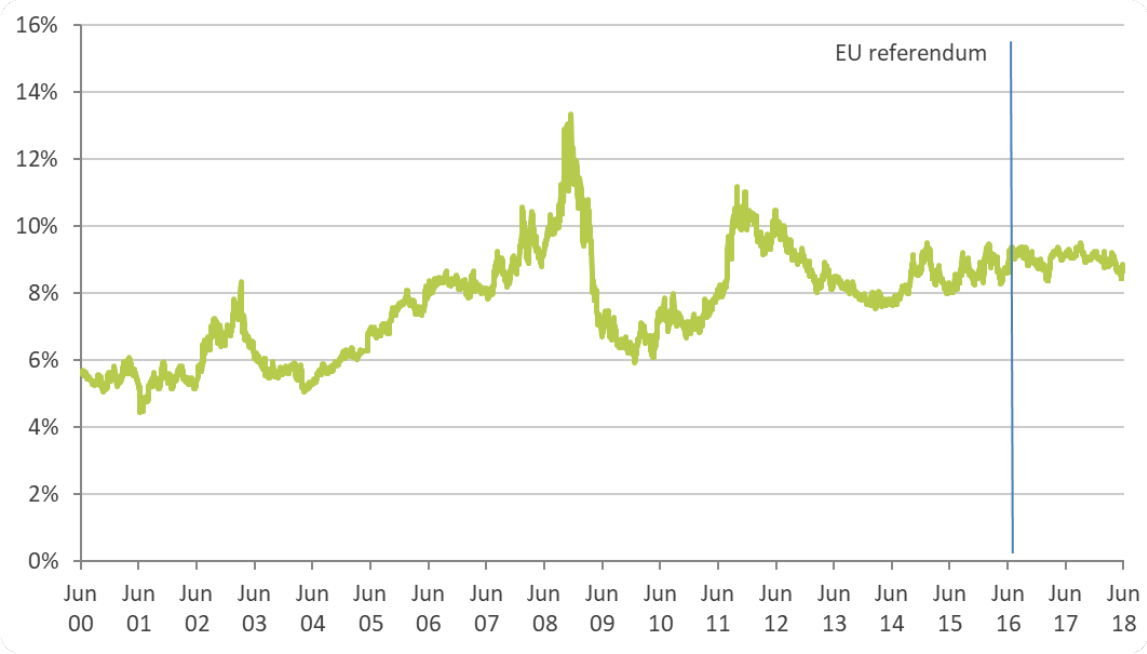
### DGM estimates of the ERP

A21.64 Figure A21.5 below shows the Bank of England's estimates of the nominal ERP derived using a DGM.[451] The Bank of England's November 2017 Financial Stability Report indicates that UK equity risk premiums have increased since January 2016, unlike in the US and euro-area where equity risk premiums have fallen.[452]

A21.65 The chart below shows that the ERP estimates obtained from a DGM can vary widely depending on the time when the estimation is made. Broadly speaking, the ERP appears to range from around 5% to 13% over the period shown in the chart. However, in the last five years shown in the chart, the ERP estimates have tended to fall within a narrower range of around 7.5% to 9.5%.

[448] The OBR estimates the long-run RPI-CPI wedge at 1%; the Bank of England estimates the long-run wedge at 1.3%.
[449] 2018 Yearbook, page 209, Table 71.
[450] Derived from tables on page 106 (inflation) and page 118 (real equity and gilt returns) of the Barclays 2018 EGS.
[451] The ERP derived from the BoE DGM is nominal because it has been estimated by reference to nominal gilts.
[452] November 2017 FSR, Chart A.20.

**Figure A21.5: Bank of England ERP estimates derived from a DGM**




*Source: Bank of England. Data to 7 June 2018. The above ERP estimates are taken from the Bank of England's DGM model.*

### Our proposal

A21.66 We consider our nominal ERP estimate of 7.2% is reasonable since it lies between historical *ex post* estimates of the ERP (around 5%) and the ERP derived from the Bank of England's DGM model (7.5% to 9.5%). We consider it reasonable that our ERP estimate lies closer to the lower end of the ERP derived from the Bank of England DGM model since our estimate of the RFR, from which our ERP is derived, is informed by more recent evidence on government gilts. This means we would expect the resulting ERP to be closer to the ERP derived from current market data (such as DGM models) compared to the ERP derived solely from an average of historical data over a longer period.

## Cost of debt

A21.67 In previous decisions we have estimated the cost of debt by adding an estimate of the debt premium to the estimated nominal RFR. This approach meant that we took a consistent view of components that were common to different elements of the WACC (i.e. the same RFR underpinned both the cost of debt and the cost of equity). We also checked that our estimated cost of debt was reasonable when compared to estimates of the weighted average cost of BT's existing debt and new debt which might be expected to be issued during the charge control period.[453]

[453] As noted in the RFR subsection, we undertook this cross-check because even an efficiently financed firm might not have anticipated the length and scale of QE and the long period of very low interest rates, meaning it would not be given the opportunity to recover efficiently incurred finance costs if regulated charges only reflected the current cost of debt.

A21.68 We propose to continue placing some weight on BT's existing debt costs. We consider it appropriate to recognise the potential impact that QE and the prolonged period of low interest rates may have had on a firm's ability to recover efficiently incurred debt costs. However, as explained above, we propose to set the RFR to better reflect the forward-looking cost of equity.

A21.69 We therefore propose a slightly modified approach to estimating the cost of debt:

a) we first derive a forward-looking cost of debt based on our chosen RFR assumption plus a debt premium: this estimate reflects our view of the efficient cost of new debt;

b) second, we estimate the cost of BT's existing debt;

c) the cost of new and existing debt is then weighted based on how much new debt BT might be expected to issue during the charge control period to derive a range for the cost of debt; and

d) we then choose a point estimate within the range calculated.

A21.70 As explained below, we propose to use a cost of debt of 4.0% (pre-tax nominal).

## Cost of new debt

### Debt premium

A21.71 As at 31 August 2018, we estimate that BT's fixed rate listed debt (all currencies) had an outstanding tenor of around [✂] (six to eight) years[454], while for sterling denominated debt it was higher at around [✂] (10 to 12) years.[455] The tenor on sterling debt has increased recently since BT issued some long-dated sterling debt in June 2018. Prior to the issuance of these bonds, its sterling tenor was around nine years as shown in Table A21.6.[456]

A21.72 We previously placed more weight on the observed spreads on sterling denominated debt over government bonds for BT Group because the tenor on sterling bonds was similar to the tenor of all BT's debt.[457] However, as the average tenor of all BT's debt is below the tenor on its sterling bonds and the majority of BT's debt is non-sterling denominated[458], we are minded to place more weight on spreads on an index of BBB bonds over government gilts with a maturity of five to ten years. This is consistent with the rating on BT's debt (BBB)[459] and the weighted average maturity of BT's debt across all currencies.

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[454] Derived from Openreach response dated 23 July 2018 to question 1 of the 9th LLCC s.135 notice.
[455] Derived from Openreach response dated 23 July 2018 to question 1 of the 9th LLCC s.135 notice.
[456] This table excludes the sterling bonds BT issued in June 2018 since one- and two-year average spreads are unavailable. Tenor is the term used to describe the length of time until a bond matures.
[457] We have focused on the spreads of BT's sterling denominated bonds to inform our debt premium estimate. While we could also take account of the spreads of bonds denominated in other currencies, this would involve taking account of expectations of future exchange rates. We would not expect the currency denomination of the debt to have a material impact on the total cost of BT's bonds because of the opportunity for arbitrage.
[458] Approximately 54% of BT's outstanding fixed rate listed debt is euro denominated, with 19% dollar denominated and the remaining 26% sterling denominated based on Ofcom analysis using S&P Capital IQ, data as at 31 August 2018.
[459] This is the Bloomberg composite rating which is a blend of the ratings from Moody's, S&P, Fitch and DBRS.

A21.73 For the purposes of determining a range for the debt premium, we have considered debt spreads over a one- and two-year period.

*Sterling debt*

A21.74 We have considered the sterling denominated debt of BT Group with both short-term and long-term maturity dates because we would expect BT to raise debt of varying maturities when considering its future financing requirements. Table A21.6 below lists the sterling debt we have considered alongside the average, minimum, maximum and upper and lower quartile spread of this debt in the last one and two years.

**Table A21.6: Spread of BT's sterling denominated debt over UK gilts**

| Maturity | Tenor (years) | 1 year | | | | | 2 year | | | | | Current |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Avg | Min | Max | Lower quartile | Upper quartile | Avg | Min | Max | Lower quartile | Upper quartile | 31 Aug 2018 |
| Mar-19 | 0.6 | 0.6% | 0.5% | 0.8% | 0.6% | 0.7% | 0.7% | 0.5% | 0.9% | 0.6% | 0.8% | 0.6% |
| Mar-20 | 1.6 | 0.7% | 0.6% | 0.8% | 0.6% | 0.7% | 0.7% | 0.6% | 0.8% | 0.7% | 0.8% | 0.7% |
| Dec-28 | 10.3 | 1.5% | 1.2% | 1.7% | 1.3% | 1.6% | 1.3% | 0.9% | 1.7% | 1.2% | 1.5% | 1.6% |
| Jun-37 | 18.8 | 1.6% | 1.3% | 2.0% | 1.4% | 1.9% | 1.4% | 0.9% | 2.0% | 1.2% | 1.6% | 1.9% |
| Nov-31 | 13.2 | 1.6% | 1.3% | 1.9% | 1.5% | 1.8% | | | | | | 1.8% |
| Nov-47 | 29.2 | 1.8% | 1.5% | 2.1% | 1.7% | 2.0% | | | | | | 1.9% |
| **Average** | **8.8** | **1.2%** | **1.0%** | **1.5%** | **1.1%** | **1.4%** | **1.1%** | **0.8%** | **1.5%** | **1.0%** | **1.3%** | **1.4%** |

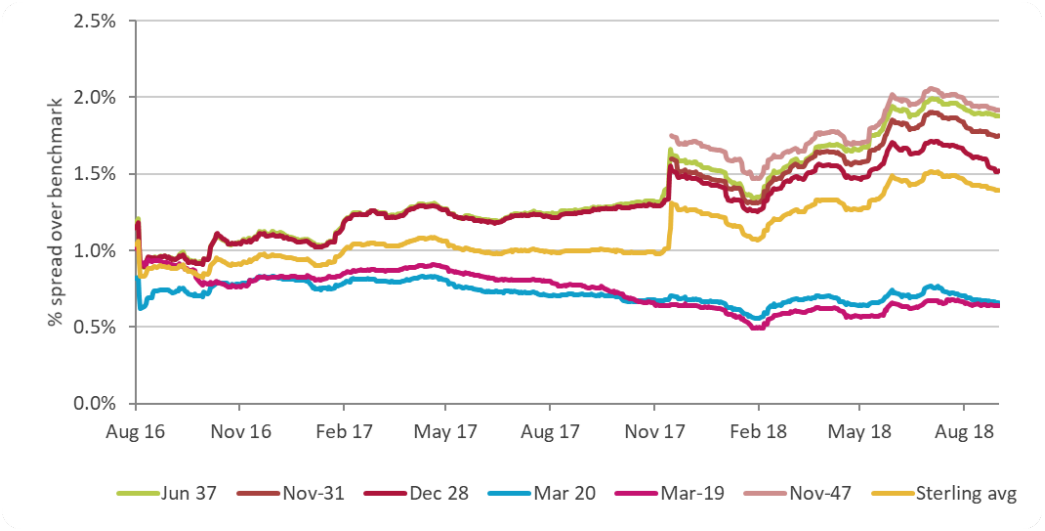
*Source: Bloomberg, Ofcom analysis. Data to 31 August 2018.*[460]

A21.75 Table A21.7 charts the spread of BT's sterling debt over the last two years. BT's debt premium has increased over the last few months, particularly since March 2018 when Moody's downgraded BT's credit rating from Baa1 to Baa2[461] (followed in June 2018 by S&P who downgraded BT from BBB+ to BBB), giving BT a Bloomberg composite rating of BBB. Since March 2018, the average debt premium on sterling debt has been 1.4%.

[460] Spread over nominal gilt yields. Average maturity is a weighted average and average spreads are simple averages. These bonds have a Bloomberg Composite credit rating of BBB. The table does not include sterling debt issued by BT in June 2018 since one- and two-year average spreads are unavailable. Also note, the November bonds in the table above do not have two-year averages as they have traded for less than two years.

[461] https://www.moodys.com/research/Moodys-downgrades-BTs-and-EEs-ratings-to-Baa2-stable-outlook--PR_380805.

**Figure A21.7: Spread of BT's sterling denominated debt over UK gilts**

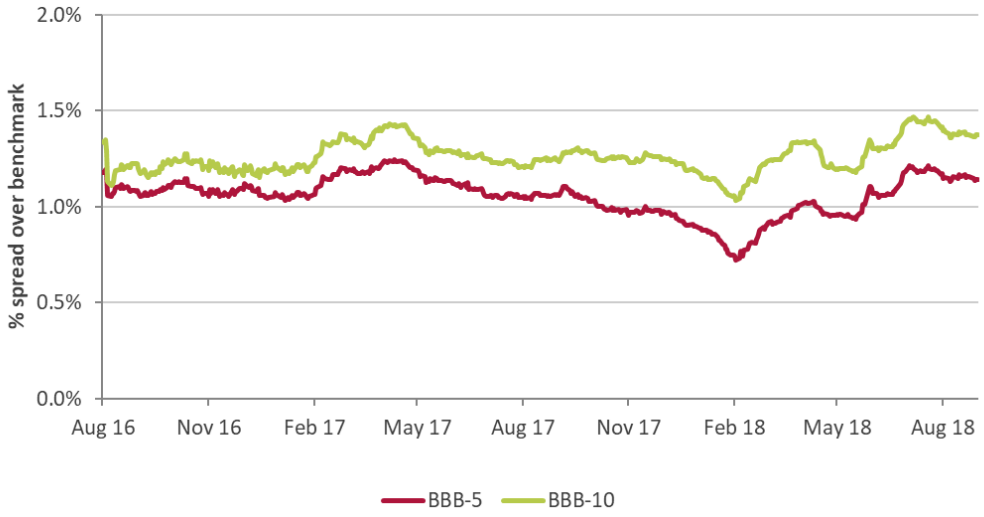



*Source: Bloomberg, Ofcom analysis. Data to 31 August 2018. Sterling average is a simple average of the spread of BT's sterling denominated debt over UK gilts. This figure does not include sterling debt issued by BT in June 2018.*

*Spreads derived from a BBB Index*

A21.76 Figure A21.8 shows the spread of an index of BBB bonds over UK gilts with maturities of five and ten years. More recently, the BBB index spreads have been broadly in line with BT's sterling debt spreads over the same period.[462]

**Figure A21.8: Spread over nominal gilts of an index of five and ten-year BBB bonds**




*Source: Bloomberg, Ofcom analysis. Data to 31 August 2018.*

[462] The BBB index includes bonds with ratings of BBB-, BBB and BBB+. BT's debt has had a composite rating of BBB on Bloomberg since March 2018, so we would expect its recent average debt spreads to be in line with the spreads for the index.

A21.77 The above bond data indicates a range for the debt premium of 0.9% to 1.4%. This captures the interquartile range of the average spread on BT's sterling denominated debt over the last one and two years (1.1% to 1.4% and 1.0% to 1.3%, respectively), and the interquartile ranges of the spread on five- and ten-year BBB corporate bonds over the last one and two years (0.9% to 1.3% over the last year and 1.0% to 1.3% over the last two years).[463] The mid-point of this range is 1.2%, but we consider it appropriate to use a point estimate slightly higher than this to reflect the increase in current spreads on BBB-rated debt and the fact sterling spreads on BT's debt have been above this rate in recent months (potentially reflecting the downgrades in BT's credit rating). We propose a debt premium of 1.3% for BT Group.

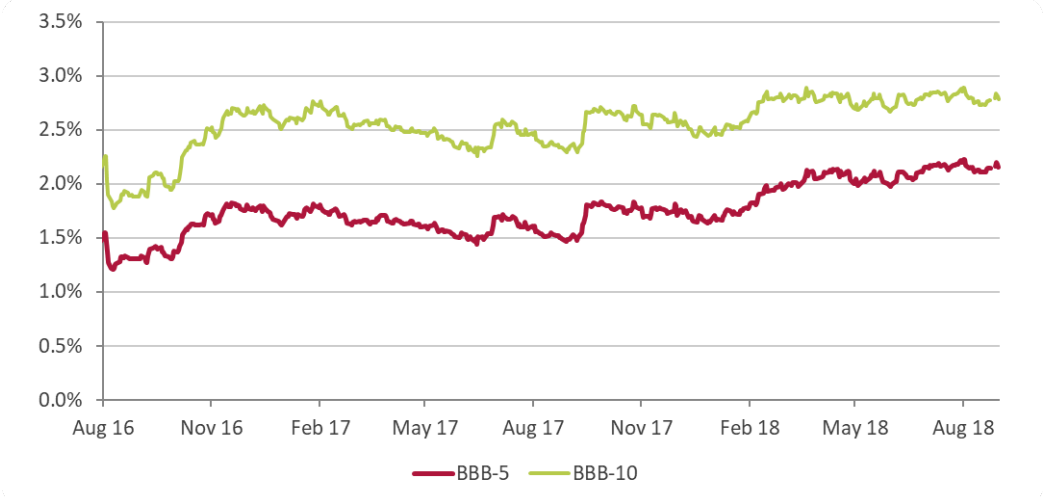
A21.78 Given the nominal RFR of 1.6%, this implies a cost of new debt of 2.9% (pre-tax nominal). We have compared this estimate against current and forward yields on BBB debt.

### BBB yields

A21.79 As BT's listed debt is currently rated BBB, we have cross-checked our estimate of the cost of new debt by considering historic and forward yields on an index of BBB rated debt. We have considered bonds with maturities of around five to ten years because, as noted above, BT's average tenor is around six to eight years across all currency denominations, although we recognize that BT could issue new debt with longer maturities.[464]

A21.80 Figure A21.9 shows yields over the last two years for an index of BBB bonds with five- and ten-year maturities. The average yield over the last year was 1.9% and 2.7% respectively, while over two years the average was 1.8% and 2.6% respectively.

**Figure A21.9: Yields on indices of five- and ten-year BBB bonds**

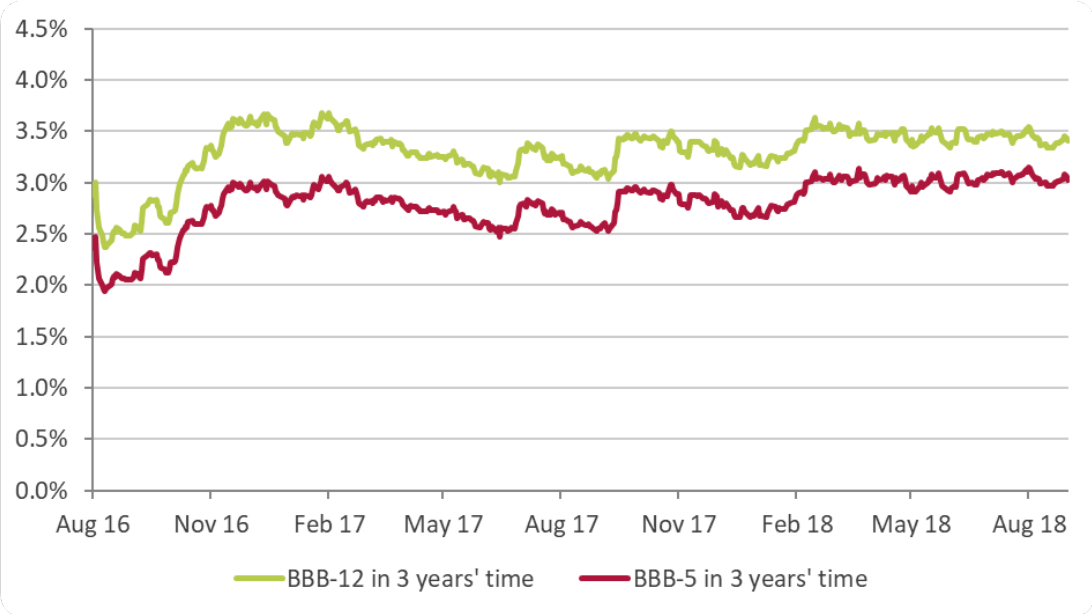



*Source: Bloomberg, Ofcom analysis. Data to 31 August 2018.*

[463] Referencing inter quartile ranges avoids placing weight on the highest and lowest spreads over the period.
[464] For example, in June 2017 BT issued three tranches of debt with maturities of five, seven and ten years while in November 2017 BT issued three tranches of debt with maturities of seven, 14 and 30 years. In June 2018 BT issued three further tranches of fixed rate debt with maturities of 15, 20 and 24 years.

A21.81 We have also calculated forward rates on BBB bonds. Figure A21.10 shows forward rates on five- and 12-year BBB bonds for the final year of the charge control.[465] As at 31 August 2018, forward rates were between 3.0% to 3.4%, and so higher than spot yields observed over the last two years.

**Figure A21.10: Three-year forward yields on indices of five- and twelve-year BBB bonds**




*Source: Bloomberg, Ofcom analysis. Data to 31 August 2018. In June 2018, the lines represent forward rates on five- and 12-year BBB bonds in June 2021. The 12-year line represents the forward rate implied by the Bloomberg three-year and 15-year BBB indices.*

A21.82 Based on the evidence presented above we consider that a range of 2.5% to 3.5% would reasonably reflect the cost of new debt.[466] Our proposed cost of new debt of 2.9% sits comfortably within this range.

## Cost of existing debt

A21.83 As we explained earlier, we consider it is appropriate to give some recognition to the fact that, in the current environment, an efficiently financed firm may not be given a fair opportunity to recover efficiency incurred costs if the cost of debt allowance reflects forward-looking debt costs only. We therefore also consider evidence on BT's existing debt

[465] The end of the charge control is in 2020/21, which is in two and a half years' time. On Bloomberg, information on BBB indices exist for three-year, eight-year and 15-year periods. A forward rate can therefore be estimated for five-year and 12-year periods where the five-year forward rate is estimated from the three-year and eight-year indices. Ideally, we would estimate a ten-year forward rate from a three-year and 13-year bond. However, this information is not available in Bloomberg and therefore we estimate a 12-year rate from the three-year and 15-year indices.

[466] We note that, given our estimated debt premium of 1.3% and the inflation forecasts set out above, a new debt range of 2.5-3.5% would indicate a real (RPI-deflated) RFR rate in the range -1.7% to -0.7%. Our proposed real RFR of -1.25% sits close to the mid-point of this range.

costs. This allows us to derive a plausible range for the weighted average cost of debt faced by an efficiently financed firm.

A21.84 We asked BT to provide a breakdown of the interest rate on its fixed and floating rate debt, taking account of any hedging effects, to help us calculate the cost of its existing debt.

A21.85 As at August 2018, fixed rate debt represented around [✂]% of BT's total debt, with floating rate debt the remainder.[467]

A21.86 The relevant cost of existing fixed debt is uncertain and could be estimated in several ways, for example: i) as of today; ii) as at the end of the charge control period (2020/21); or iii) as a weighted average over that period. In addition, while the interest rate may currently be fixed, BT's future hedging strategy could see it swap fixed debt for floating debt.[468]

A21.87 We estimate that the interest on BT's existing fixed debt is between [✂]% and [✂]%.[469]

A21.88 The cost of floating rate debt is also uncertain, although it represents a smaller amount of total debt than fixed rate debt. We estimate that the interest on BT's floating rate debt was around [✂]% as at August 2018.

A21.89 Combining these estimates and weighting by the estimated relative amounts of fixed and floating debt as at August 2018, we estimate that the cost of BT's existing debt is between [✂]% and [✂]%.[470]

## Weighting of existing debt and new debt

A21.90 Approximately 15% of BT's listed debt is due to mature before the end of the charge control. If BT were to replace all the debt that is due to mature we might therefore expect around 15% of its debt to be 'new debt' by the end of the charge control. Alternatively, given that the average maturity of BT's listed debt is around six to eight years and this is a short charge control ending in 2020/21, we might expect up to 35% of debt to be new. However, we are not certain how much of its existing debt BT will refinance.[471] To allow for this uncertainty, we have assumed that new debt could represent between 15% to 35% of debt by the end of the charge control period.

## Proposed cost of debt

A21.91 Combining the above weightings with our estimate for the cost of new debt of 2.9% and the cost of existing debt range of [✂]% to [✂]% indicates that the weighted average cost of new and existing debt lies in the range of [✂]% to [✂]% (3.4% to 4.4%). As might be expected in the current low interest rate environment, this weighted average range is

[467] Openreach response dated 23 July 2018 to question 1 of the 9th LLCC s.135 notice.
[468] Openreach response dated 26 September 2017 to question B9d of the 12th WLA s.135 notice.
[469] The higher number is the rate as at 29 June 2018 and the lower number is the estimated rate in 2020/2021, taking account of debt that is due to mature over this period (where more recent debt has been issued at a lower interest rate).
[470] We have assumed that the amount of floating debt as a proportion of total debt remains at estimated June 2018 levels.
[471] For example, while BT's 2017 Annual Report included an objective to reduce net debt (page 26), its 2018 Annual Report did not.

higher than our estimates of the cost of new debt, reflecting the fact that firms issue debt at various points through the economic cycle.

A21.92 As noted in the 2018 WLA Statement, when estimating the weighted average cost of existing and new 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.[472] We asked Openreach for details of the issuance costs associated with the six tranches of debt BT issued between June 2017 and November 2017 and on an annualised basis these ranged from [✂]% to [✂]% with an average of [✂]%.[473]

A21.93 In its Bristol Water decision, the CMA allowed for a 10 basis points uplift in the cost of debt for a notional company.[474] Taking account of this and the evidence on BT's actual debt issuance costs, we consider it appropriate to include an allowance of ten basis points for debt issuance. This means that our estimate for the cost of new and existing debt for BT under a weighted cost of debt approach is between [✂]% to [✂]% (3.5% to 4.5%).

A21.94 To reflect the cost of BT's existing debt, we propose to use the midpoint of this range. We therefore propose a pre-tax nominal cost of debt for BT Group of 4.0%.[475]

## Inflation assumptions

A21.95 We propose using RPI and CPI forecasts from the OBR consistent with other parts of our cost modelling. The OBR's March 2018 forecast of RPI in 2020/21 is 2.9% and for CPI it is 2.0%.[476] In this consultation, we propose to use these RPI and CPI forecasts in our WACC calculation for 2020/21. We note that the OBR released updated inflation forecasts on 29 October 2018 as part of the Autumn Budget.[477] All else being equal, the revised RPI and CPI forecasts would imply a slightly higher nominal WACC. We plan to update our WACC estimates for our statement using the latest available OBR forecasts at the time, alongside other evidence.

## Equity beta and asset beta – BT Group

A21.96 In the 2018 WLA Statement we used an asset beta for BT Group of 0.78, which was based on the two-year asset beta against the FTSE All Share calculated by NERA. We commissioned NERA to estimate the equity and asset betas for BT and comparator

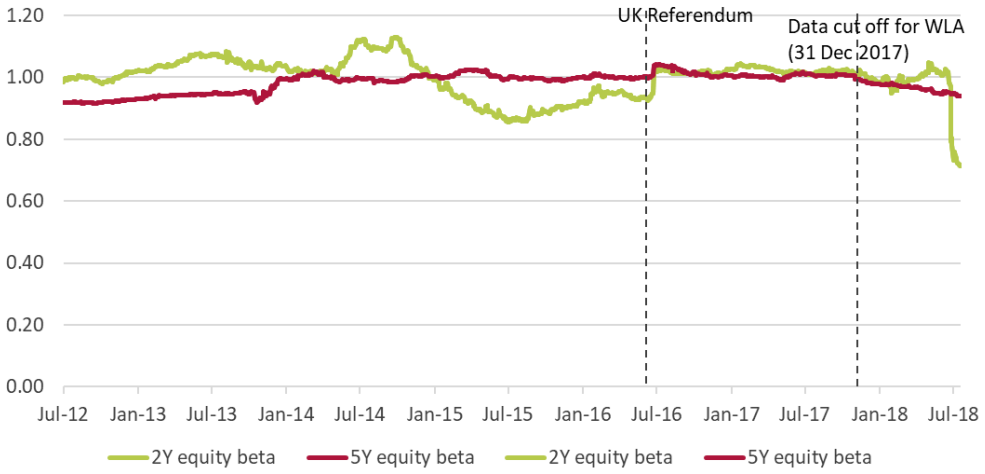
[472] See paragraph A20.71 of the 2018 WLA Statement.
[473] Openreach response dated 20 June 2018 to question 5 of the 6th LLCC s.135 notice.
[474] See Appendix 10, paragraphs 48-53, CMA Bristol Water (October 2015). https://assets.digital.cabinet-office.gov.uk/media/5627997640f0b60368000001/Appendices_5.1_-_11.1_and_glossary.pdf.
[475] We have rounded the midpoint of the [✂]% to [✂]% (3.5% to 4.5%) range to 4.0%.
[476] OBR, 2018. *Economic and Fiscal Outlook*, tab T3.10. http://cdn.obr.uk/Charts_and_tables_chapters_1-3_March_2018_EFO-v2.xlsx.
[477] https://obr.uk/efo/economic-fiscal-outlook-october-2018/ [accessed 1 November 2018].

companies as at 20 July 2018. NERA's report has been published alongside this consultation.[478]

## Equity beta estimates

A21.97 Figure A21.11 below shows the two-year and five-year daily equity beta for BT Group measured against the FTSE All Share index. It illustrates that BT's two-year equity beta fell significantly in July 2018, whereas the five-year equity beta has been relatively stable over the period shown.

**Figure A21.11: BT Group two-year and five-year daily equity betas against the FTSE All Share**




*Source: NERA*

A21.98 As at 20 July 2018, BT's two-year equity beta was 0.72, a 30% reduction from the equity beta of 1.03 at the time of the 2018 WLA Statement. NERA explains that the sharp decline in the two-year equity beta is due to the European referendum in June 2016 falling out of the two-year estimation window (the 'referendum effect').

A21.99 We have previously placed weight on two-year betas as a trade-off between recent beta estimates on the one hand (which may better reflect current views of systematic risk but can be volatile and less statistically robust) and on the other hand, average betas over a longer period (which can be less volatile and more statistically robust but may be less reflective of current views of systematic risk). The referendum effect has clearly had a significant impact on BT's two-year equity beta (as well as other UK focused companies', as shown in the NERA report).[479] As well as the decline shown in Figure A21.11, confidence

[478] NERA, 2018. *Cost of Capital: Beta and Gearing for the 2019 BCMR*. https://www.ofcom.org.uk/_resources/documents/consultations/category-1/124718-bcmr/associated-documents/secondary-documents/nera-wacc-report.pdf.
[479] NERA Report, Appendix A.

intervals on two-year betas have also increased since the referendum, reducing the statistical reliability of the estimates.[480]

A21.100 We agree with NERA that the high degree of uncertainty around the referendum and how it will affect UK companies going forward supports placing greater weight on five-year betas.[481] We do not consider it is appropriate to ignore the referendum effect, but rather to give it due weight in our analysis. Placing weight on five-year betas captures the time before and after the referendum and, given current uncertainties, we consider it would strike a better balance between regulatory stability and efficient price and investment signals.

A21.101 We therefore propose to estimate BT's beta by reference to its five-year daily betas. BT's five-year daily equity beta as at 20 July 2018 was 0.94.

## Asset beta

A21.102 The asset beta is calculated from the equity beta using average gearing over the same period used to estimate the equity beta and assuming a debt beta of 0.10 (consistent with our proposal on the debt beta below).

A21.103 BT's average gearing in the five years to 20 July 2018 was 27%, with gearing measured using the gross value of short-term debt and long-term debt as a proportion of enterprise value.[482]

A21.104 De-levering the BT Group five-year equity beta of 0.94 using average gearing of 27% gives an asset beta of 0.71.[483]

## Forward-looking gearing-

A21.105 Our forward-looking gearing estimate considers short-term and long-term debt as a proportion of enterprise value, consistent with previous market reviews.

A21.106 As can be seen in Figure A21.12 below, BT's gearing increased in January 2016 following its acquisition of EE. Since then, while BT's debt levels have been relatively stable, its gearing has increased as its market capitalisation has reduced (especially following the EU referendum). As at 20 July 2018, BT's gearing stands at around 40%.

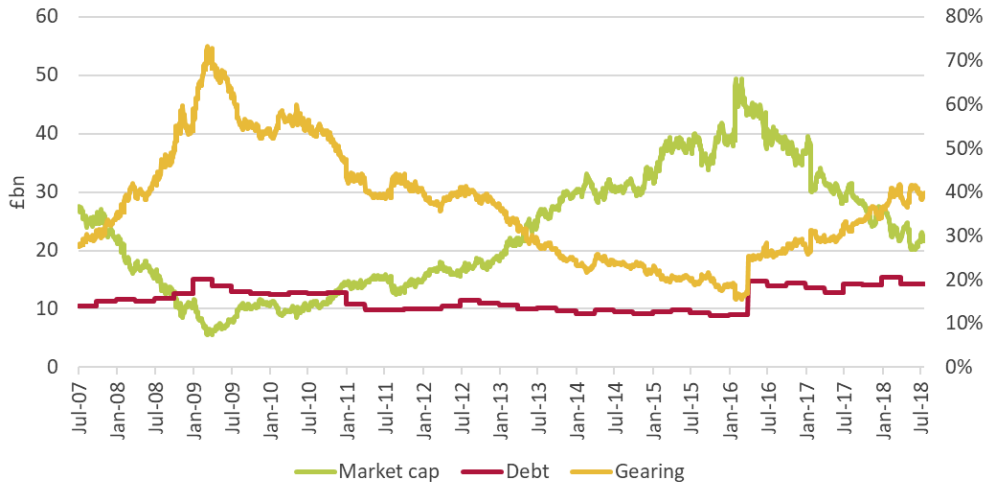
A21.107 We consider that a reasonable forward-looking gearing level for BT Group would lie between 25 to 50%. The lower end of this range approximately reflects the average gearing for BT over the last five years. The upper end of the range is around the average gearing for UK listed utilities[484] and the maximum level proposed in the 2016 Brattle Report for the

[480] See page 67 of the NERA Report, Appendix B. For example, the BT two-year asset beta had a 95% confidence interval of 0.62 to 0.94 as at September 2017, yet at July 2018 this had increased by around 50% to a 95% confidence interval of 0.28 to 0.75. Similar results are observed for TalkTalk and Sky.
[481] NERA Report, page 4.
[482] NERA Report, Table 3.4 (page 16).
[483] NERA Report, Table 3.3 (page 11), Table 3.4 (page 16).
[484] NERA Report, Table 3.4 (page 16).

European Commission.[485] Over the last one and two years, the average gearing of most UK and European telecoms operators has fallen within this range, with the average across all these operators around 35% to 39%.[486]

A21.108 We consider that forward gearing of 35% is reasonable since it is similar to BT's current and longer-term gearing averages and falls within a credible range based on comparator companies.

**Figure A21.12 BT Group gearing, market cap and total debt**




*Source: Bloomberg (debt = short-term + long-term debt; gearing = debt/(Market cap + debt)), data to 20 July 2018.*

## Forward-looking equity beta

A21.109 Combining an asset beta of 0.71, a forward-looking gearing of 35% and a debt beta of 0.10 (see the next subsection) we derive a forward-looking equity beta for BT Group of 1.04.

# Debt beta

A21.110 In the 2018 WLA Statement we used a debt beta of 0.1 following consideration of a range of sources. We propose to maintain that assumption for this review given the uncertainty associated with debt beta estimation and the relatively modest change in gearing and debt premium range compared to the WLA statement.

A21.111 NERA also concluded that a debt beta of 0.10 would be consistent with the upper end of recent regulatory determinations in the UK and with the more recent evidence provided by academics and practitioners.[487]

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[485] On 18 July 2016 the European Commission published a report from Brattle reviewing approaches to estimating the WACC across European telecoms regulators ('2016 Brattle Report') in which Brattle recommends a maximum forward-looking gearing rate for telecoms operators of 50% to 55%. https://publications.europa.eu/en/publication-detail/-/publication/da1cbe44-4a4e-11e6-9c64-01aa75ed71a1/language-en.

[486] NERA Report, Table 3.4 (page 16), Table 3.5 (page 17) and Table 3.9 (page 32).

[487] NERA Report, page 44.

A21.112 Our debt premium and gearing proposals for this decision are set alongside those used in the 2018 WLA statement and previous BT charge control decisions, in Table A21.13.

**Table A21.13: Ofcom's recent debt beta, debt premium and gearing decisions**

| Year | Publication | Debt beta | Gearing | Debt premium range |
|---|---|---|---|---|
| **2018** | **BCMR Consultation** | **0.10** | **35%** | **0.9% - 1.4%** |
| 2018 | WLA Statement | 0.10 | 30% | 1.0% - 1.5% |
| 2016 | BCMR Statement | 0.10 | 30% | 1.1% – 1.5% |
| 2014 | FAMR Statement | 0.10 | 32% | 1.0% - 1.5% |
| 2013 | LLCC Statement | 0.15 | 40% | 1.7% - 2.3% |
| 2011 | MCT Statement | 0.10 | 30% | 1.0% – 2.0% |

*Source: Ofcom*[488]

# Corporate tax rate

A21.113 We propose to use a corporate tax rate of 17% for 2020/21.[489]

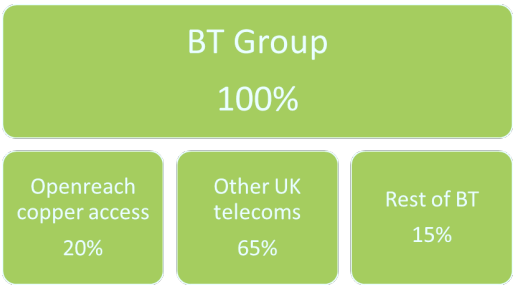
# Disaggregation of BT Group asset beta

## Our proposals

A21.114 In our last two fixed telecoms reviews we split the BT Group asset beta between: Openreach copper access[490], Other UK Telecoms[491] and the Rest of BT (RoBT - this primarily included BT's ICT operations from its Global Services and Business and Public Sector divisions).[492] This is illustrated in Figure A21.14, which shows the relative weights put on each disaggregated part of BT in the 2018 WLA Statement (so that the weighted sum of the disaggregated asset betas equals the BT Group asset beta).

[488] 2011 MCT Statement, 2015 MCT Statement (Table A10.1), 2013 LLCC Statement, and 2014 FAMR Statement (Table A16.1 and Table A16.2), 2016 BCMR Statement (Table A30.1), 2018 WLA Statement (Table A20.1).
[489] https://www.gov.uk/government/publications/rates-and-allowances-corporation-tax/rates-and-allowances-corporation-tax [accessed September 2018].
[490] Since 2005 we have distinguished BT's copper access services from other services it provides because we consider that the copper access lines to customer premises have a lower systematic risk than other services such as those delivered over those lines (i.e. usage services such as voice and broadband). In the 2018 WLA Statement we also used the Openreach copper access WACC to derive PIA rental charges.
[491] Other UK Telecoms included BT's wholesale and retail leased lines, fixed voice, broadband and bundled services.
[492] 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. Other changes included EE's business division moving into the new 'Business and Public Sector' division. See BT press release dated 1 February 2016: http://www.btplc.com/news/#/pressreleases/bt-announces-new-structure-1304769 [accessed 20 February 2018].

**Figure A21.14: Weights used in the 2018 WLA Statement**




*Source: Ofcom*

A21.115 In estimating asset betas for the disaggregated parts of BT we need to exercise judgement, considering evidence from benchmark operators similar to each disaggregated part (albeit not pure-play comparators) and taking account of the overall BT Group asset beta. In the rest of this subsection we set out our proposals on disaggregating the BT Group asset beta as follows:

- approach to estimating a beta for active leased lines;
- approach to estimating a beta for dark fibre services;
- asset beta weightings;
- comparator company asset betas;
- Openreach copper access asset beta; and
- Other UK Telecoms and RoBT asset beta.

## Asset beta for active leased lines services

A21.116 In the 2016 BCMR Statement we considered that a leased lines business would face higher systematic risk than wholesale fixed line access services (which we include within Openreach copper access) and was instead, likely to share similar characteristics to other telecoms usage services. We therefore applied the Other UK Telecoms asset beta to active leased lines services.

A21.117 We propose to continue applying the Other UK Telecoms asset beta (and WACC) to active leased lines for the following reasons:

- **The systematic risk for active leased lines services is likely to be greater than that for copper access services included in Openreach copper access**. We consider that demand for wholesale leased lines is likely to be more closely correlated with general economic activity than copper access services (and hence have a somewhat higher asset beta) since the downstream leased lines services, from which the demand for wholesale services is derived, are used in part by corporate customers.[493] Wholesale leased lines revenue is also likely to be more variable due to volume changes, whereas revenues from local access connections – particularly to residential properties – will

[493] We consider that business customers are more likely to reduce their consumption of bandwidth or number of lines in the event of a downturn.

typically vary less with the economic cycle. Data from BT on the monthly volume variability and forecast accuracy of different types of products also supports this view, showing that leased lines experience greater volume variability than copper access and are more difficult to forecast.[494] Higher operational leverage (i.e. extent of fixed costs within total costs) can also imply higher systematic risk. Analysis by NERA suggests that on this basis leased lines may be somewhat more risky than copper access, although there are limitations in this analysis.[495]

- **The systematic risk faced by the telecoms activities included in Other UK Telecoms is likely to be reasonably similar**. In the 2018 WLA Statement we considered it would be reasonable to assume that the systematic risk faced by the telecoms activities included within Other UK Telecoms is likely to be reasonably similar since they are characterised by: (a) using a fixed telecoms network, which often involves shared or similar infrastructure and hence, similar degrees of operational gearing; and (b) involves sales to customers who are able to scale demand in response to changes in the macro-economic cycle to a greater extent than for basic access connections.[496]

A21.118 Data from BT on the monthly volume variability and forecast accuracy of different types of products supports this view, showing that the variability and forecast accuracy of services included in Other UK Telecoms is broadly similar.[497]

A21.119 In addition, previous work by NERA did not find evidence that pay TV or mobile activities included in Other UK Telecoms were associated with higher levels of systematic risk than other telecoms services included in Other UK Telecoms.[498]

A21.120 We therefore propose to continue to apply the Other UK Telecoms asset beta to active leased lines services.

## Asset beta for dark fibre services

A21.121 In determining an asset beta for inter-exchange dark fibre services, we need to assess whether Openreach would face similar risk in providing these services relative to active leased lines or whether the risk characteristics are sufficiently different to warrant a different asset beta and hence cost of capital.

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[494] NERA Report, Section 5.3 and Appendix C.2. We would expect services with lower demand risk to be associated with lower volume variability and be easier to forecast (which is the case for copper lines).
[495] NERA Report, Section 5.3.
[496] 2018 WLA Statement, paragraph A20.203.
[497] 2018 WLA Statement, paragraph A20.204 and NERA Report, Appendix C.2. NERA also compares the operational leverage of leased lines to BT Group overall, noting that it has "no reason to conclude that leased lines have a lower or higher operational leverage than BT as a whole or OUKT (Other UK Telecoms)" (see Appendix C.1).
[498] NERA Report, page 48. In the 2016 BCMR Statement, we considered the systematic risk of ICT services and pay TV, concluding that, while there was sufficient evidence to suggest ICT activities will tend to be associated with higher systematic risk than standard telecoms (a conclusion we consider remains valid), it was less clear cut that a vertically integrated pay TV business would be associated with higher systematic risk (see paragraph A30.233). Also, in the 2018 WLA Statement, we asked NERA to consider whether there was evidence that mobile asset betas were materially different from fixed telecoms asset betas; NERA concluded that there was no evidence of a statistically significant difference in the betas of fixed versus mobile telecoms operators (see paragraph A20.202).

A21.122 Much of the underlying infrastructure for dark fibre circuits is shared with active leased lines and the customers (i.e. downstream telecoms providers) are also likely to be the same, with dark fibre being substitutable for active leased lines for those telecoms providers prepared to make the necessary investment in using dark fibre. These considerations alone would point to limited differences in systematic risk between dark fibre and active leased lines.

A21.123 Nevertheless, a potential driver of the differences in systematic risk between active leased lines and inter-exchange dark fibre is differences in exposure to demand risk, even if the wholesale customers were often the same. There are two factors which could contribute to these differences.

A21.124 First, since the scope of our dark fibre remedy is limited to a subset of the CI Inter-exchange market (i.e. it does not include access connections), demand for dark fibre is likely to be less sensitive to demand from individual end-users (i.e. business sites) in the access part of the network compared to active leased lines. Therefore, it is likely to be less correlated with the economic cycle. However, the significance of this effect is difficult to estimate *ex ante*, and demand for dark fibre will still depend on traffic aggregation and connectivity requirements of telecoms providers serving end users. Furthermore, as noted above, dark fibre services will compete with active leased lines services.

A21.125 Second, there are differences in charging structure. Active leased lines services offered by Openreach are specified by bandwidth (e.g. 100 Mbit/s, 1 Gbit/s, or 10 Gbit/s). A dark fibre service is essentially agnostic to bandwidth, with the user of dark fibre in control over the bandwidth the line is used for. This means that from the perspective of Openreach, once a wholesale customer has purchased a dark fibre connection, revenue will be less dependent on bandwidth compared to active services. To the extent that demand for bandwidth is correlated with the economic cycle, this might suggest a lower exposure to systematic risk compared to active services.

A21.126 However, it is difficult to assess if any difference in demand risk would be significant in practice, as there is uncertainty around how dark fibre will be used and there is no existing service for which we might analyse volumes. Even if dark fibre were lower risk than active leased lines, it seems unlikely that the provision of dark fibre would be as low risk as providing local access connections to primarily residential premises (i.e. such that the Openreach copper access WACC would be appropriate).

A21.127 Therefore, we propose using the Other UK Telecoms asset beta (and WACC) in capping inter-exchange dark fibre prices.

## Asset beta weightings

A21.128 Table A21.15 below reports weightings based on EBITDA and the ratio of net replacement cost to enterprise value (NRC/EV) for Openreach copper access as a proportion of BT Group.

**Table A21.15: Weightings for Openreach copper access**

| | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 5Y Average |
|---|---|---|---|---|---|---|
| EBITDA | 25% | 24% | 22% | 24% | 22% | 24% |
| Regulatory NRC/EV | 25% | 22% | 17% | 15% | 20% | 20% |

*Source: Ofcom*[499]

A21.129 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.

A21.130 We therefore propose to apply a weighting of 20% to Openreach copper access.

A21.131 To estimate the weightings of Other UK Telecoms and RoBT, we have considered the proportion of BT Group EBITDA that relates to each division. This is shown in Table A21.16 below.

**Table A21.16 Proportion of total EBITDA represented by each BT division**

| | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 | 5Y Average |
|---|---|---|---|---|---|---|
| Global Services | 17% | 17% | 13% | 6% | 6% | 15% |
| Openreach | 43% | 41% | 34% | 34% | 34% | 37% |
| BT Consumer | 14% | 16% | 13% | 13% | 14% | 15% |
| BT Business and Public Sector | 16% | 17% | 14% | 20% | 19% | 18% |
| BT Wholesale | 10% | 9% | 7% | 11% | 10% | 10% |
| EE | 0% | 0% | 20% | 15% | 18% | 10% |
| Other | 0% | 0% | (1%) | 0% | 0% | 0% |
| **Total** | 100% | 100% | 100% | 100% | 100% | 100% |

*Source: 2015/16 data from pro-forma results published by BT on 29 June 2016.*[500] *All other data taken from BT's annual reports. Note that the Openreach division reported here includes wholesale copper access, wholesale Ethernet leased lines and wholesale fibre broadband products and is therefore broader than the Openreach copper access business described earlier.*

[499] 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 copper access' includes EBITDA associated with WLR and WLA (excluding fibre) markets and a proportion of 'Other Openreach markets and activities' that we estimate relates to internal SMPF. Total EBITDA is equal to that reported in BT's annual report but prior to 2015/16 the EBITDA percentage assumes that EE was owned for the full year. NRC is taken from the cost model supporting the 2018 WLA Statement divided by BT's average enterprise value for the year, derived from Bloomberg. Note that in the 2016 BCMR Statement enterprise value was taken at the end of the financial year but we consider that an average for the year better matches the NRC (which is an average of the opening and closing balances for the year).

[500] See http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/RestatedhistoricalfinancialinformationJune2016/Downloads/Proforma/ProformahistoricalfinancialsJune2016.pdf.

A21.132 We note that the proportion of EBITDA represented by Global Services reduced in 2016/17 due to issues in its Italian business[501] and the 2016 reorganisation noted above. Since BT's ICT operations (which are captured in our RoBT disaggregated asset beta) are spread across its Global Services and Business and Public Sector divisions in 2016/17 and 2017/18, we asked BT to provide EBITDA figures for UK-focused ICT services in Business and Public Sector and internationally focused ICT services in Global Services in these years.

A21.133 Our analysis suggests that in 2016/17 and 2017/18, EBITDA for ICT services across these two divisions represented around [✂]% (10-15%) of BT Group EBITDA[502], a percentage comparable to the 2015/16 percentage for Global Services in Table A21.16. As such we propose to apply a weighting of 15% to the RoBT, which captures BT's ICT operations.

A21.134 Based on the analysis set out above, Openreach copper access would receive a weighting of 20% and the RoBT would receive a weighting of 15%, which implies a weighting for Other UK Telecoms of 65%. These proposed weightings are the same as those used in the 2018 WLA Statement.

## Comparator company asset betas

A21.135 Our disaggregation of the BT Group asset beta is informed by the asset betas for comparator companies. In the 2018 WLA Statement we estimated asset betas for the following comparators: UK network utilities, UK telecoms operators, European telecoms operators, and international ICT companies.[503] We commissioned NERA to provide estimates of the asset betas for these. Consistent with our approach to the BT Group asset beta, we propose to place more weight on five-year asset betas for comparator companies to inform the disaggregation.

A21.136 Table A21.17 below summarises the five-year asset beta averages and min-max ranges for these comparators. The UK utility comparators shown in this table omit SSE as compared to the comparators in the 2018 WLA Statement. This is because a large portion of SSE's revenues do not relate to regulated network assets and it is therefore less close to a traditional network utility.[504]

A21.137 The table shows average asset betas for UK telecoms both including and excluding Sky since Sky has experienced a significant period of M&A speculation which could have affected its beta.[505]

[501] See page 6 of BT's 2017 Annual Report.
[502] 2018 WLA Statement, paragraph A20.163 (for 2016/17); Openreach response dated 20 June 2018 to question 3 of the 6th LLCC s.135 notice (for 2017/18).
[503] In the 2018 WLA Statement we also included asset betas for US telecoms comparators, but did not place any weight on these in our decision due to the different regulatory regime applying in the US. We have not included US telecoms comparators in this consultation.
[504] NERA Report, page 13.
[505] NERA Report, Tables 5.2 and 5.3 (page 51).

**Table A21.17 Five-year daily asset beta ranges and averages for comparator groups**

| | Home index | | World index | |
|---|---|---|---|---|
| | Range | Average | Range | Average |
| UK utilities | 0.38 to 0.41 | 0.40 | 0.32to 0.35 | 0.33 |
| UK telecoms excluding Sky | 0.63 to 0.68 | 0.66 | 0.59 to 0.64 | 0.62 |
| UK telecoms including Sky | 0.56 to 0.68 | 0.62 | 0.55 to 0.64 | 0.59 |
| European telecoms | 0.39 to 0.66 | 0.53 | 0.43 to 0.74 | 0.62 |
| ICT (Tier 1 and Tier 2) | 0.57 to 1.15 | 0.77 | 0.61 to 1.25 | 0.87 |
| ICT (Tier 1) | 0.64 to 0.95 | 0.80 | 0.77 to 1.22 | 0.92 |
| **BT Group** | **0.71** | | **0.68** | |

*Source: NERA, 5- year asset betas with a cut-off date of 20 July 2018.*

A21.138 In line with our approach in the 2018 WLA Statement, we propose to base the disaggregated asset beta for each part of BT on the following comparators.

- **Openreach copper access –** this refers to the line of business which provides wholesale access to copper-based fixed connections used to provide voice and broadband services to end customers, and which also sells access to BT's network of ducts and poles. We would expect this line of business to face lower systematic risk than BT Group, but to face greater systematic risk than UK network utilities.[506] When considering the Openreach copper access asset beta, we also take account of the asset betas for UK telecoms operators. In general, we would expect the systematic risk facing Openreach copper access to be lower than that facing UK telecoms operators since they sell more usage-dependent services downstream from Openreach.
- **Other UK Telecoms** – this includes BT's wholesale and retail leased lines, mobile, fixed voice, broadband and bundled services (in other words it includes all activities not captured by Openreach copper access or the RoBT). To estimate the beta for Other UK Telecoms, we generally take account of the asset betas of UK and European telecoms operators as comparators. We would expect Other UK Telecoms to face greater systematic risk than Openreach copper access but less systematic risk compared to the ICT activities included in RoBT.
- **RoBT** – this primarily represents BT's ICT operations.[507] NERA identifies that BT's ICT activities provide services in three main areas: i) managed networked IT services and security; ii) unified communications and IT infrastructure; and iii) professional services and IT consulting. NERA identifies two tiers of comparators: 'Tier 1' comparators that are active across all three main business areas and 'Tier 2' comparators that are active

[506] Although we consider that systematic demand risk is likely to be lower than BT Group, we do not consider it is clear that systematic demand would be as low as that for products provided by pure network utility operators (such as water and electricity networks).
[507] Since BT's 2016 reorganisation, its ICT services are spread between Business and Public Sector (UK ICT Services) and Global Services (International ICT Services), as noted above.

in two of the three main business areas. The asset betas shown in Table A21.17 illustrate that, as in the 2018 WLA Statement, a telecoms operator is likely to exhibit a lower asset beta than an ICT business, on average.[508] We take account of the asset betas for Tier 1 and Tier 2 ICT comparators when proposing an asset beta for RoBT.

## Openreach copper access asset beta

A21.139 As in previous reviews, while we would expect Openreach copper access to face lower systematic risk than BT Group, we consider that it is likely to face greater systematic risk than UK network utilities such as water companies and energy networks. Therefore, much as in previous decisions we have started by looking at the mid-point between the BT Group (0.71) and network utility asset betas[509] (0.40), i.e. around 0.56. We have then considered whether it would be appropriate to shade this asset beta of 0.56 up or down by reference to other relevant factors to estimate an asset beta for Openreach copper access:

- **Comparison with asset betas for UK telecoms providers** – an Openreach copper access asset beta of 0.56 against the FTSE All Share index would be at the bottom end of the five-year asset beta range for UK telecoms comparators (including Sky) of 0.56 to 0.68 (average 0.62), and below the range if we exclude Sky (0.63 to 0.68 with an average of 0.66). In light of this comparison against UK telecoms comparators, we consider that the Openreach copper access beta should be no higher than 0.6 and that 0.56 looks reasonable against these comparators, since these operators might be expected to face somewhat higher systematic risk (since they sell more usage dependent services downstream from Openreach).
- **Comparison with asset betas of European telecoms** – an Openreach copper access asset beta of 0.56 would be slightly higher than the average European telecoms asset beta against the home index (0.53), but below the average European telecoms asset beta against the World index (0.62). Given that the average asset betas for European telecoms comparators are above or below 0.56 depending on the reference index, taken in isolation, these comparators provide little evidence as to whether it is appropriate to shade an asset beta of 0.56 up or down.
- **BT pension scheme effect** – allowing for the effect of BT's defined benefit pension scheme means that we might expect the Openreach asset beta to be somewhat higher than that of a comparator company without such a defined benefit pension scheme. This would apply for all lines of business within BT Group, including Openreach copper access.
- **Asset beta for other disaggregated parts of BT Group** – in determining the asset beta for each disaggregated part of BT Group, we need to take account of the relevant weightings and comparator asset beta evidence since we require the weighted sum of

[508] The average five-year asset beta for UK and European telecoms operators is around 0.62 against the FTSE All World index whereas for ICT businesses the average asset beta is between 0.87 and 0.92 (depending on whether we include all ICT comparators or just Tier 1 ICT comparators) and all of the ICT comparators have an asset beta above or equal to 0.61 against the FTSE All World index. While the ranges overlap to some extent, the range for the ICT comparators is wide, which implies some uncertainty in coming to a point estimate for these companies.
[509] As estimated by NERA on a consistent basis to BT.

disaggregated betas to reconcile to that of BT Group. Any reduction in the Openreach asset beta from 0.56 implies that one (or both) of the Other UK Telecoms and RoBT asset betas would need to increase so that the weighted sum of asset betas remains consistent with the BT Group asset beta. Given the limitations on increasing the RoBT or Other UK Telecoms asset betas when considering external benchmarks for these lines of business, we do not consider that a reduction in the Openreach copper access asset beta below 0.56 would be appropriate.

A21.140 Consequently, we do not consider that it would be appropriate to shade up or down the asset beta estimate of 0.56 for Openreach copper access. We therefore propose to use an asset beta of 0.56 for Openreach copper access.

## Other UK Telecoms and RoBT asset beta

A21.141 In this subsection, we first set out our proposed asset beta ranges for Other UK Telecoms and RoBT before proposing point estimates within these ranges.

### Asset beta range for Other UK Telecoms

A21.142 Based on evidence from telecoms comparators, we have considered whether the asset beta range of 0.55 to 0.75 used in the 2018 WLA Statement for Other UK Telecoms remains appropriate.

A21.143 The 0.55 to 0.75 range captures the five-year asset betas of UK telecoms comparators measured against the FTSE All Share (which range from 0.56 to 0.68) and the mid-point of the 0.55 to 0.75 range (0.65) is slightly higher than the average UK telecoms asset beta of 0.62. However, the average UK telecoms asset beta of 0.62 is weighted down by Sky which has been the subject of bid speculation for an extended period (as discussed above) and which has led to a significant fall in its beta. Excluding Sky, the average UK telecoms asset beta is 0.66 – close to the mid-point of the 0.55 to 0.75 range. In addition, the 0.55 to 0.75 range largely captures the 95% confidence intervals for the UK telecoms asset betas, with confidence intervals for TalkTalk, Sky and Vodafone being at 0.48 to 0.77, 0.47 to 0.66, and 0.62 to 0.75 respectively.[510]

A21.144 Since the 2018 WLA Statement, the five-year average UK telecoms asset beta has been relatively flat, although we recognise that the two-year average has come down mainly due to the referendum effect.[511] We recognise that none of the UK telecoms comparators are perfect comparators for BT's Other UK Telecoms activities; for example, TalkTalk has fewer infrastructure assets and focuses on retail customers and Vodafone is predominantly focused on mobile services and only generates a minority of its revenue from the UK.

A21.145 It is difficult to determine the appropriate market index when estimating asset betas for European telecoms comparators when seeking to inform our Other UK Telecoms range. Against the FTSE All Europe index the five-year asset betas range from 0.39 to 0.66 while

[510] NERA Report, Appendix B.
[511] NERA Report, Figure 3.7.

against the FTSE All World they range from 0.43 to 0.74. On this evidence, 0.75 could represent a reasonable upper end for the Other UK Telecoms range since it captures the upper end of the European telecoms asset betas against the All World index, although it also suggests the lower end of the Other UK Telecoms range could be less than 0.55. Similar to UK telecoms asset betas, since the 2018 WLA Statement, the five-year average European telecoms asset beta has been relatively flat, though the two-year average asset beta has trended down slightly.[512]

A21.146 On balance, we propose that an asset beta range of 0.55 to 0.75 remains appropriate for Other UK Telecoms. This range is compatible with the five-year asset beta averages of UK telecoms comparators (0.56 to 0.68 when including Sky, 0.63 to 0.68 when excluding Sky); it overlaps with most (if not all) of the 95% confidence intervals for each of the UK telecoms comparators' five-year asset betas and spans much of the five-year asset beta averages for European telecoms (0.43 to 0.74 against the FTSE All World).

A21.147 While the lower end of some of the UK telecoms comparators' 95% confidence intervals and the lowest asset betas for European telecoms might support a wider range for Other UK Telecoms with a low-end asset beta below 0.55, we do not consider it appropriate for the lower end to be less than the asset beta we might typically set for Openreach copper access (which is informed by both the asset beta for BT Group and the asset betas of UK network utilities).

A21.148 Nevertheless, when identifying a point estimate, we have taken account of the fact that the current five-year asset betas for many UK and European telecoms operators are below the top end of this range and also the reduction in the two-year telecoms asset betas, as explained below.

### Asset beta range for RoBT

A21.149 In the 2018 WLA Statement we used an ICT range of 0.70 to 1.25. We consider that the ICT asset betas presented in Table A21.14 would continue to support this range. The highest five-year asset betas for the Tier 1 and Tier 2 ICT comparators are between 0.95 and 1.25 depending on whether the home or World index is used as the reference index. While there could be scope to reduce the lower end of the range based on the ICT ranges from Table A21.14 (the lower end now being nearer 0.60), given that the evidence supports an ICT asset beta above a telecoms asset beta, we consider that 0.70 remains a reasonable lower end of the range as it sits above the midpoint of our proposed 0.55 to 0.75 range for the Other UK Telecoms asset beta. We therefore propose that an ICT range of 0.70 to 1.25 remains reasonable to apply to RoBT.

### Asset beta for Other UK Telecoms and RoBT

A21.150 When selecting a point estimate for the Other UK Telecoms and RoBT asset betas, we need to consider evidence from comparator companies as well as the weightings and implications for the asset beta for the other parts of BT. The UK telecoms asset beta range

[512] See Figure 3.15, NERA Report.

(0.56 to 0.68, including Sky) would support a value towards the middle to lower part of the 0.55 to 0.75 range, while the European asset betas are quite wide and could imply values anywhere in the 0.55 to 0.75 range (against the FTSE All Europe index five-year asset betas are 0.39 to 0.66 and against the FTSE All World are 0.43 to 0.74).[513]

A21.151 As we are placing weight on five-year estimates of beta, the above analysis supports a figure in the middle of the 0.55 to 0.75 range. A lower than midpoint Other UK Telecoms asset beta would also imply an increase in the Openreach copper access or RoBT asset beta, neither of which is easily justified given the asset betas of network utilities and ICT companies, respectively. As such we propose an Other UK Telecoms asset beta of 0.65 which is consistent with a RoBT asset beta of 1.17[514] when the Openreach copper access beta is 0.56. [515]

## Disaggregation of BT Group cost of debt

A21.152 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 businesses with lower systematic risk (i.e. Openreach copper access) would face a lower cost of debt than Other UK Telecoms or the RoBT (at the same level of gearing).

A21.153 The credit ratings of UK utilities currently generally range from BBB to A- compared to BT Group at BBB.[516] While on the face of this evidence BT Group's rating (BBB) sits within the range of UK utilities, the utilities are all more highly geared than BT Group.

A21.154 To estimate the potential difference in the cost of debt for Openreach copper access, we have compared the spreads between BBB-rated debt and A-rated debt with maturities of ten years (as at 31 August 2018), which is shown in Table A21.18 below.[517] This suggests that the spread between A-rated debt and BBB-rated debt is between 0.13% and 0.38%; the lower spread reflecting a comparison with UK utilities and the higher spread reflecting a comparison against BBB and A-rated companies in general. Assuming a one notch uplift to Openreach copper access from the BT Group rating, Openreach copper access might be able to reduce its cost of debt by around 0.04% to 0.13% relative to BT Group.[518]

[513] While the top end of the European telecoms asset beta range against the FTSE All World is 0.74, the majority of these asset betas are lower than 0.65 (7 out of 11 observations).
[514] 1.17 is within the RoBT asset beta range proposed above.
[515] This is based on weightings of 20%, 65% and 15% for Openreach copper access, Other UK Telecoms and RoBT respectively.
[516] Long-term credit ratings from S&P: Severn Trent (BBB), United Utilities (BBB+) and National Grid (A-).
[517] There are effectively three ratings notches between BBB rated debt and A rated debt.
[518] One-notch estimates have been derived by dividing the figures in the table by three.

**Table A21.18: Spread between BBB and A-rated benchmark indices (10 years)**

| | One-year average | Two-year average |
|---|---|---|
| BBB vs A ratings | 0.32% | 0.38% |
| UK Utilities BBB vs A ratings | 0.15% | 0.13% |

*Source: Bloomberg, Ofcom analysis using data to 31 August 2018. BBB index is the BVCSGU10 Index from Bloomberg. 'A' index is the BVCSGK10 Index from Bloomberg. UK Utilities BBB index is the BVGBUB10 Index from Bloomberg. UK Utilities A index is the BVGBUA10 Index from Bloomberg.*

A21.155 Any adjustment based on this approach is approximate as it depends on the extent to which Openreach copper access is perceived as utility-like and the assumed level of gearing, among many factors. As in the 2018 WLA Statement, we consider that an adjustment somewhere between the utility range and that for other companies might imply a cost of debt for Openreach copper access around 0.1% lower than for BT Group, i.e. around 3.9% compared to BT Group's 4.0%.

A21.156 It is similarly difficult to assess precisely what rating the Other UK Telecoms activities would achieve. However, we note that many of the UK and European telecoms comparators described above have similar credit ratings to BT Group implying that the Other UK Telecoms activities might have a cost of debt similar to that of BT Group, i.e. the 4.0% cost of debt estimated above.[519]

A21.157 To estimate the cost of debt for the RoBT under a three-way disaggregation, we use the weightings from the asset beta disaggregation. On this basis, the weightings imply a RoBT cost of debt of 4.1%.[520]

A21.158 We propose to use a cost of debt of 3.9% for Openreach copper access and 4.0% for Other UK Telecoms. For presentation purposes (since we do not regulate services supplied within what we describe as RoBT), we have used a cost of debt of 4.1% in calculating the WACC for the RoBT.

## Our proposal on the disaggregated WACC

A21.159 Table A21.19 summarises the pre-tax nominal WACC we propose for BT Group and the three-way disaggregation.

**Table A21.19: BT pre-tax nominal WACC for BT Group and disaggregated lines of business**

| | BT Group | Openreach copper access | Other UK Telecoms | RoBT |
|---|---|---|---|---|
| Pre-tax nominal WACC | 8.5% | 7.2% | 8.0% | 12.6% |

*Source: Ofcom*

[519] S&P rates 11 of the 14 UK and European telecoms comparators. Six of these have BBB ratings (similar to BT), three have A ratings and two have BB ratings. Orange Belgium is owned by Orange S.A and does not have a separate credit rating. S&P does not rate Iliad or Tele2.

[520] 3.9% x 20% [Openreach copper access] + 4.0% x 65% [Other UK Telecoms] + 4.1% x 15% [RoBT] = 4.0% [BT Group].

# A22. Glossary

| | |
|---|---|
| **2013 BCMR** | The business connectivity market review (BCMR) for the period 1 April 2013 to 31 March 2016. |
| **2014 EC Recommendation** | The 2014 EC Recommendation on relevant product and service markets. |
| **2014 FAMR** | The fixed access market review (FAMR) for the period 1 April 2014 to 31 March 2017. |
| **2016 BCMR** | The BCMR for the period 1 April 2016 to 31 March 2019. |
| **2016 LLCC** | The leased line charge controls imposed by the 2016 BCMR. |
| **2017 Dark Fibre Consultation** | The November 2017 Dark Fibre Consultation on adding dark fibre to the remedies for business connectivity markets. |
| **2019 BCMR** | The BCMR for the period 1 April 2019 to 31 March 2021. |
| **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. |
| **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. Now referred to as Contemporary Interface (CI). |
| **AISBO** (Alternative Interface Symmetric Broadband Origination) | Leased line terminating segment typically using an Ethernet interface. Now referred to as Contemporary Interface Symmetric Broadband Origination (CISBO). |
| **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. |
| **ATM** (Asynchronous Transfer Mode) | A network technology that uses asynchronous time division multiplexing techniques and which supports data transmissions at up to 622 Mbit/s. |
| **AVE** (Asset Volume Elasticity) | The percentage increase in capital costs required for a 1% increase in volume. |

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| **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. |
| **BCMR** | Business Connectivity Market Review. |
| **BCMR Judgment** | The Competition Appeal Tribunal judgment of 10 November 2017. |
| **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 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 = $\left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\text{number of years}}\right)}$-1. |

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| **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 in Birmingham, Bristol, Glasgow, Leeds and Manchester. |
| **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. |
| **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 a 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. |
| **CPI** (Consumer Price Index) | The 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) | An interconnection between BT and another telecoms provider where the BT handover circuit terminates at the telecoms provider's premises. |

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| **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** | The business (non-domestic) rates paid by BT on the rateable network assets within its cumulo rating assessment. |
| **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. (See the June 2015 Cost Attribution Review). |
| **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 passive remedy which allows telecoms providers to lease only the fibre element of the leased lines from BT, 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. Also referred to as DFA (Dark Fibre Access). |
| **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. |

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| **DP** (Duct and Pole) | A wholesale access service allowing a telecoms provider to make use of the underground duct network and the poles of another telecoms provider. Also referred to as Duct and Pole Access (DPA). |
| **DPCN** (Digital Private Circuit Network) | A BT network that is used to provide very low bandwidth TI leased lines services (services at bandwidths below 2 Mbit/s). |
| **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 premises. 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 |

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| | 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. |
| **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 CI 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. |

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| **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 license 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 where the handover takes place at collocation space rented by a telecoms provider in a BT local 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. |

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| **ISH** (In Span Handover) | An interconnection between BT and another telecoms provider where the BT handover circuit terminates at a point between BT's premises and the telecoms provider's premises. |
| **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. |
| **Leased line** | A permanently connected communications link between two premises 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. |
| **LP** (London Periphery) | A proposed geographic market set out in the 2015 BCMR Consultation and adjacent to the CLA. |
| **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. |
| **MCC** | Material changes in circumstance. |

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| **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 to provide connectivity from multiple mobile base station sites back to a mobile core network. |
| **MI** (Multiple Interface) **leased lines** | Leased line services with bandwidths greater than 1 Gbit/s and leased lines services of any bandwidth delivered using WDM equipment. |
| **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. |
| **MPF** (Metallic Path Facility) | The provision of access to the copper wires from the customer premises 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. |
| **MSC** (Mobile Switching Centre) | A component of a mobile telephone network that switches voice calls between mobile users. |
| **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 |

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| | 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. |
| **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. |
| **ONBS** (Openreach Network Backhaul Services) | An Openreach Ethernet backhaul service providing high bandwidth inter-exchange connectivity. |
| **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. |

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| **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 (see Section 5 of the June 2015 Cost Attribution Review) 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 as shown in the following formula $x =$ $\mathbf{OUC\ costs\ X}\ [\frac{\mathbf{Previously\ allocated\ total\ costs\ at\ level\ x}}{\mathbf{Total\ previously\ allocated\ total\ costs\ within\ BT}}]$, where x = allocation of the OUC (Operational Unit Costs) at a specific level of BT's cost exhaustion system. |
| **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. |
| **PDH** (Plesiochronous Digital Hierarchy) | An older TI digital transmission technology that uses TDM. Although PDH systems are still widely used, they are being replaced by SDH and increasingly Ethernet services. |
| **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. |
| **PPC** (Partial Private Circuit) | A TI leased line which provides the connection between an end-user site and a point of handover with a telecoms provider's network. |
| **PTO** (Precision Test Officer) | An Openreach technician who undertakes optical fibre testing and fault diagnosis. |

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| **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.[521] |
| **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. |
| **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 and is made up of leased line access and 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.[522] |
| **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. |

[521] See: https://www.openreach.co.uk/orpg/home/products/llu/contracts/contracts.do [accessed 30 October 2018].
[522] Available at: http://www.btplc.com/thegroup/RegulatoryandPublicaffairs/Financialstatements/index.htm [accessed 30 October 2018].

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| **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. |
| **SAC** (Stand Alone Cost) | An accounting approach under which the total cost incurred in providing a product is allocated to that product. |
| **SBO** (Symmetric Broadband Origination) | A symmetric broadband origination service provides symmetric capacity from a customer's premises to an appropriate point of aggregation, generally referred to as a node, in the network hierarchy. In this context, a customer refers to any public electronic communications network provider or end-user. |
| **SDH** (Synchronous Digital Hierarchy) | A TI digital transmission standard that is widely used in communications networks and for leased lines. |
| **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 must meet additional obligations 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) | Usually considered to be 5 to 10 per cent, which is part of the hypothetical monopolist test used in market definition analysis. |
| **Sub-basket** | A sub-basket refers to a control on a group of two or more charges. |

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| **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. |
| **TI** (Traditional Interface) | Leased lines services with an ITU G.703 Interface. |
| **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.' |
| **TISBO** (Traditional Interface Symmetric Broadband Origination) | Leased line terminating segment with an ITU G.703 interface. Referred to in the 2016 BCMR. |
| **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. |

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| **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. |
| **Upper percentile** | A QoS standard intended to protect customers whose orders fall into the tail of complex orders from suffering excessively long lead times for Ethernet provisioning. |
| **VHB** (Very High Bandwidth) | Bandwidths above 1 Gbit/s, normally used when referring to CI services. |
| **VLB** (Very Low Bandwidth) | Bandwidth below 2 Mbit/s, normally used when referring to TI services. |
| **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 premises to a node in a communications network, superseded by Openreach's EAD product. |

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| **WEES** (Wholesale end-to-end service) | A legacy Openreach Ethernet service that can be used to provide a point-to-point connection between two customer's sites, superseded by Openreach's EAD product. |
| **WDM** (Wavelength Division Multiplex) | An optical frequency division multiplexing transmission technology that enables multiple high capacity circuits, to share an optical fibre pair by modulating each on a different optical wavelength. |
| **WLA** (Wholesale Local Access) **market** | The market that covers fixed telecommunications infrastructure, specifically the physical connection between customers' premises and a local exchange. |
| **WLR** (Wholesale Line Rental) | The service offered by Openreach to other telecoms providers to enable them to offer retail line rental services in competition with BT's own retail services. |