Wholesale Local Access Market Review – Annexes

Redacted [✄] for publication

Consultation

Publication date: 31 March 2017

Closing Date for Responses: 9 June 2017

Contents

Annex 1

Responding to this consultation

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 9 June 2017**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at https://www.ofcom.org.uk/consultations-and-statements/category-1/wholesale-local-access-market-review, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.

A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please email WLA2017@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.

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

WLA team
Floor 4
Ofcom, Competition Group
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response please contact:

- Heli Frosterus (Market Review team) at heli.frosterus@ofcom.org.uk or on 020 7981 3404; or

- Melanie Everitt (Charge Control team) at melanie.everitt@ofcom.org.uk or 020 7834 4340.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/terms-of-use/

Next steps

A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in early 2018.

A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/email-updates/

Ofcom's consultation processes

A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.

A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.

A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Steve Gettings, Secretary to the Corporation, who is Ofcom's consultation champion:

A1.16 Steve Gettings
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7783 4652

Email Steve.Gettings@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation.

Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. 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

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 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 to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation response cover sheet

A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, www.ofcom.org.uk.

A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.

A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.

A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email or post you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at http://stakeholders.ofcom.org.uk/consultations/consultation-response-coversheet/.

A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

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)

Annex 4

Consultation questions

Volume 1

Question 3.1: Do you agree with our proposed product and geographic market definition? Please provide reasons and evidence in support of your views.

Question 3.2: Do you agree with our proposal that BT holds SMP in the supply of WLA products in the UK excluding the Hull Area? Please provide reasons and evidence in support of your views.

Question 5.1: Do you agree with our proposed general remedies? Please provide reasons and evidence in support of your views.

Question 6.1: Do you agree with our proposals for access regulation in respect of LLU, SLU and VULA? Please provide reasons and evidence in support of your views.

Question 7.1: Do you agree with our proposal to impose a quality of service SMP condition? Please provide reasons and evidence in support of your views.

Question 8.1: Do you agree with our proposals for the price regulation of VULA? Please provide reasons and evidence in support of your views.

Question 9.1: Do you agree with our proposals for the price regulation of LLU and SLU? Please provide reasons and evidence in support of your views

Question 10.1: Do you agree with our proposals for BT's regulatory financial reporting? Please provide reasons and evidence in support of your views.

Volume 2

Question 2.1: Do you agree with our proposal to impose an inflation indexed price cap, with CPI as the relevant measure of inflation? Please provide reasons and evidence in support of your views.

Question 2.2: Do you agree with our proposal to use CCA FAC to establish the cost base for WLA services and to use LRIC+ to estimate the costs of MPF services and 40/10 GEA services? Please provide reasons and evidence in support of your views.

Question 2.3: Do you agree with our proposal to apply the anchor pricing principle by means of an ongoing copper network with an FTTC overlay? Please provide reasons and evidence in support of your views.

Question 2.4: Do you agree with our proposal to set charge controls for MPF and 40/10 GEA services that expire on 31 March 2021? Please provide reasons and evidence in support of your views.

Question 2.5: Do you agree with our proposal to use a one-year glidepath to align charges with costs in 2019/20 for these charge controls? Please provide reasons and evidence in support of your views.

Question 3.1: Do you agree with each of our proposals in relation to the design of charge controls for BT's LLU and GEA services? Please provide reasons and evidence in support of your views.

Question 4.1 Do you agree with our proposed conceptual modelling approach? Please provide reasons and evidence to support your answer.

Question 4.2: Do you agree with our proposed approach to forecasting service volumes? Please provide reasons and evidence to support your answer.

Question 4.3: Do you agree with our proposed top-down cost modelling for MPF services? Please provide reasons and evidence to support your answer

Question 4.4: Do you agree with our proposed bottom-up cost modelling for GEA services? Please provide reasons and evidence to support your answer.

Question 4.5: Do you agree with our proposed approach to calibrating the bottom-up model? Please provide reasons and evidence to support your answer.

Question 4.6: Do you agree with our proposed approach to estimating input price inflation? If not, what alternatives would you propose and why? Please provide reasons and evidence to support your answer.

Question 4.7: Do you agree with our proposed approach to estimating AVEs and CVEs? If not, what alternatives would you propose and why? Please provide reasons and evidence to support your answer.

Question 4.8: Do you agree with our proposed approach to setting efficiency target? If not, what alternatives would you propose and why? Please provide reasons and evidence to support your answer.

Question 4.9: Do you agree with our proposed approach to forecasting and attributing BT's cumulo costs? Please provide reasons and evidence to support your answer.

Question 4.10: Do you agree with our proposed approach to the treatment of future profit and losses from the sales of copper? Please provide reasons and evidence to support your answer.

Question 4.11: Do you agree with our proposed approach to the treatment of future profit and losses from the sales of property? Please provide reasons and evidence to support your answer.

Question 5.1: Do you agree with each of our proposals in relation to the implementation of charge controls for BT's LLU and GEA services? Please provide reasons and evidence in support of your views.

Annex 5

Regulatory framework

Introduction

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 Consultation, including the draft legal instruments published in Annex 23.

A5.2 The overview in this annex identifies some of the key aspects of materials relevant to this market review, but does not purport to give a full and exhaustive account of all materials that we have considered in reaching our proposals 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 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, i.e. (CRF) – as transposed by the Act. The applicable rules[2] are contained in a package of five EC 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 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.

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

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

Market definition procedure

A5.6 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.

A5.7 The Framework Directive requires that NRAs shall, taking the utmost account of the 2014 EC Recommendation[4] and SMP Guidelines[5] published by the 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.

A5.8 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.

A5.9 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.

A5.10 The three criteria, which are cumulative, are:

- the presence of high and non-transitory structural, legal or regulatory barriers to entry;
- a market structure which does not tend towards effective competition within the relevant time horizon, 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).

A5.11 The fact that an NRA identifies the product and service markets listed in the 2014 EC Recommendation or identifies other product and service markets that meet the three-criteria test does not automatically mean that regulation is warranted. Market

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[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] EC, *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, (2007/879/EC).*

[5] EC, *Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services* (2002/C 165/03), 11 July 2002, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2002:165:0006:0031:EN:PDF.

definition is not an end in itself but rather a means of assessing effective competition.

A5.12 The relationship between the market definition(s) identified in this review and in the 2014 EC Recommendation is discussed in Section 3 of this consultation.

A5.13 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] 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.

A5.14 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.

A5.15 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[7] (relating to the application of the Chapter I or II prohibitions), Article 101 or 102 of the Treaty on the Functioning of the European Union[8] or the Enterprise Act 2002.[9]

Market analysis procedure

Effective competition

A5.16 The Act requires that we carry out market analyses of identified markets for the purpose of making or reviewing market power determinations. Such analyses are normally to be carried out within two years from the adoption of a revised recommendation on markets, where that recommendation identifies a market not previously notified to the EC, or within three years from the publication of a previous market power determination relating to that market. Exceptionally, the three-year

[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.
[7] http://www.legislation.gov.uk/ukpga/1998/41/contents.
[8] 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.
[9] http://www.legislation.gov.uk/ukpga/2002/40/contents.

period may be extended for up to three additional years where the NRA notifies the EC, and it does not object.

A5.17 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".

A5.18 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 the 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.

Sufficiency of competition law

A5.19 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 market(s) 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 market(s) 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.

A5.20 In considering this matter, we bear in mind the specific characteristics of the relevant market(s) 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.

A5.21 *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.

A5.22 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(s), or that the specific clarity and detail of regulations is required to achieve a particular result.

Remedies procedure

Powers and legal tests

A5.23 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.

A5.24 NRAs have a suite of regulatory tools at their disposal, as reflected in the Act and the Access Directive. Specifically, the Access Directive specifies 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(s) identified, proportionate and justified in the light of the policy objectives as set out in Article 8 of the Framework Directive.

A5.25 Specifically, for each and every SMP obligation, we 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.

A5.26 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.

A5.27 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 (including the viability of other network access products, whether provided by the dominant provider or another person) that would make the network access unnecessary, the investment of the network operator who is required to provide access (taking account of any public investment made), and the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long term.

A5.28 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. In doing so, we also set our assessment of how, in our opinion, the performance of our general duties under section 3 of the Act will be secured or furthered by our proposed regulatory intervention, and that it is in accordance with the six 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

A5.29 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.

A5.30 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.

A5.31 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 NMR, we consider that a number of such considerations are relevant, in particular:

- the desirability of promoting competition in relevant markets; and
- the desirability of encouraging investment and innovation in relevant markets.

A5.32 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.

A5.33 Ofcom has, however, a wide measure of discretion in balancing its statutory duties and objectives. In doing so, we take into account 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

A5.34 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 European Community requirements for regulation. In summary, these six requirements are:

- to promote competition in the provision of electronic communications networks and services, associated facilities and the supply of directories;
- to contribute to the development of the European internal market;
- to promote the interests of all persons who are citizens of the EU;
- 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);

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

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

A5.35 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.

A5.36 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.

A5.37 Further, Article 3(3) of the Regulation establishing BEREC[10] requires NRAs to take utmost account of any opinion, recommendation, guidelines, advice or regulatory best practice adopted by BEREC.

A5.38 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

A5.39 The analysis presented in the whole of this document represents an impact assessment, as defined in section 7 of the Act.

A5.40 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 great majority of its policy decisions.[11]

[10] 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.

[11] 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.

A5.41 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.

A5.42 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects and practices on race, disability and gender equality. This assessment is set out in Annex 7.

Regulated entity

A5.43 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').

A5.44 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).[12]

A5.45 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.

A5.46 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".

[12] *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.

Annex 6

Approach to market definition and SMP assessment

Introduction

A6.1 This annex sets out in general terms the processes that we have followed in defining the market within this review, how and on what basis we assess whether any operator has SMP in a given market, whether SMP conditions should be imposed in a relevant market, and in what form. Volume 1, Section 3 set out in more detail how we have applied our analytical approach in the WLA market.

Overview of approach

A6.2 The market review procedure requires us to analyse markets in order to determine whether they are effectively competitive, and then to decide on appropriate remedies if necessary. Before an assessment of competitive conditions is possible it is necessary to define the relevant market.

A6.3 The definition of the relevant market does not simply entail identifying services that resemble each other in some way, but the set of services (and geographical areas) that exercise some competitive constraint on each other. It therefore has two dimensions:

- the relevant products or services to be included within the market; and
- the geographic extent of the market.

A6.4 It is often practical to define the relevant product market before exploring the geographic dimension of the market.

A6.5 The market definition exercise is not an end in itself, but a means to assessing whether there is effective competition and thus whether there is a need for *ex ante* regulation. It is in this light that we have conducted our market definitions in this review.

2014 EC Recommendation and the three-criteria test

A6.6 As explained in Annex 5, in defining the market for market review purposes, we are required to define relevant markets appropriate to national circumstances in accordance with the principles of competition law. In doing so we have taken due account of the 2014 EC Recommendation, the accompanying Explanatory Note and the EC SMP Guidelines.

A6.7 As explained in Annex 5, 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. NRAs may also identify markets that differ from those in the 2014 EC Recommendation which may be susceptible to *ex ante* regulation having regard to the three-criteria test.

A6.8 The three-criteria test is related to the assessment of SMP and involves the assessment of similar evidence, but is analytically distinct. The three-criteria test focuses on overall market characteristics and structure, for the sole purpose of identifying those markets that are susceptible to *ex ante* regulation. In contrast, assessment of SMP involves determining whether an operator active in a market that has been identified as being susceptible to *ex ante* regulation should be made subject to *ex ante* regulation.[13]

The time period under review

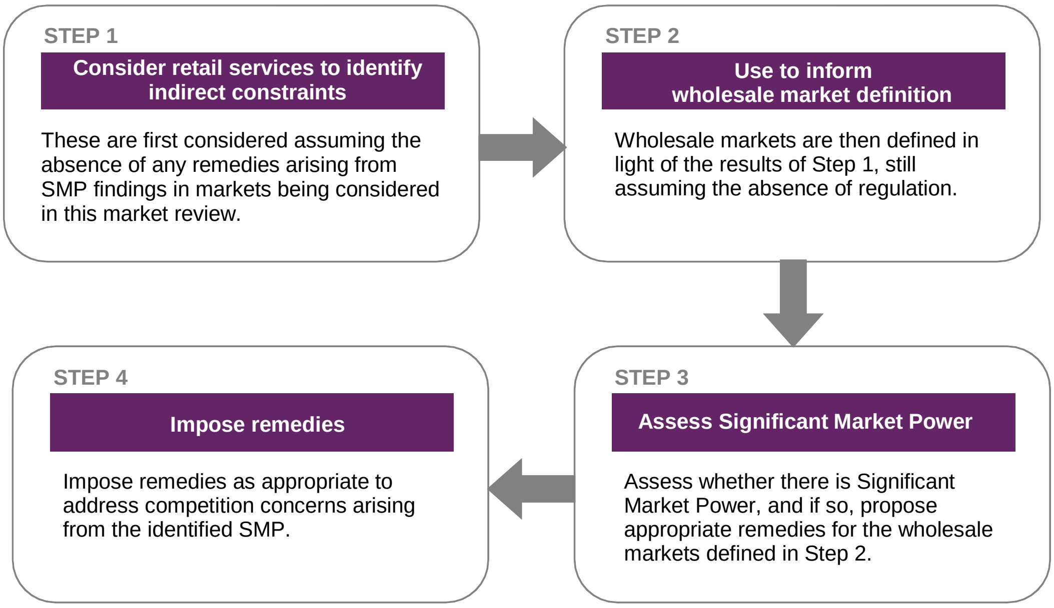
A6.9 Rather than just looking at the current position, market reviews look ahead to how competitive conditions may change in future. Our evaluation of the current market takes into account past developments and evidence, before then considering the foreseeable market changes that we expect to affect its development over the period to March 2021. This forward looking period reflects the period covered by this market review.

A6.10 The forward look period that we have used does not preclude us reviewing the market before that point should the market develop in a way we have not foreseen, to the extent that it is likely to affect the competitive conditions that are operating.

Market review process

A6.11 The market review process can be characterised as having four stages, which are shown in Figure A6.1 below.

Figure A6.1 Sequencing of market definition, SMP and remedies analysis



Source: Ofcom

A6.12 These steps are explained further in the following sub-sections.

[13] See the Commission Explanatory Note accompanying the 2014 EC Recommendation.

Market definition

A6.13 The starting point for identifying markets which may be susceptible to *ex ante* regulation is the consideration of retail services from a forward-looking perspective. The wholesale market is defined subsequent to this exercise being carried out. In relevant cases we then consider whether the wholesale market is one in which *ex ante* regulation may be appropriate (if so, we have then formally identified a relevant market).[14]

A6.14 Consideration of retail services is logically prior to wholesale market definition because the demand for the upstream wholesale service is a derived demand, meaning that the level of the demand for the upstream input depends on the demand for the retail service.

A6.15 This link between the retail and wholesale level means that the range of available substitutes at the downstream (e.g. retail) level will inform the likely range of competitive constraints acting at the upstream (e.g. wholesale) level. This is because a rise in the price of a wholesale service which is passed through to the price retail services may cause retail customers to switch to substitute retail services, reducing demand for the wholesale input. We refer to this as an indirect constraint.

A6.16 Consequently, the analysis of the retail and wholesale levels of the supply-chain should be regarded as one exercise, the ultimate purpose of which is to define those wholesale markets in the UK where there may be a requirement for the imposition of *ex ante* regulation.[15]

Demand-side and supply-side substitution

A6.17 The boundaries between markets are determined by identifying competitive constraints on the price setting behaviour of firms. There are two main constraints to consider:[16]

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

- to what extent suppliers can switch, or increase, production to supply the relevant products or services in response to a relative price increase (supply-side substitution).

A6.18 The hypothetical monopolist test (HMT) is a tool which can be used to identify close demand-side and supply-side substitutes.[17] In this test, a product is considered to constitute a separate market if the hypothetical monopolist supplier could impose a

[14] See recital 5 and point 2 of the 20014 EC Recommendation.

[15] See, in this respect, recital 7 of the 2014 EC Recommendation which states that "*the starting point for the identification of wholesale markets susceptible to ex ante regulation is the analysis of corresponding retail markets*". See also section 2.1 of the Explanatory Note to the 2014 EC Recommendation and paragraph 44 of the SMP Guidelines.

[16] See paragraph 38 of the SMP Guidelines, which also notes that potential competition also acts as a third source of competitive constraint on an operator's behaviour, but is taken into account in the SMP assessment.

[17] See paragraph 40 of the SMP Guidelines.

small but significant non-transitory increase in price (SSNIP) above the competitive level without losing sales to such a degree as to make this price rise unprofitable. If such a price rise would be unprofitable, because consumers would switch to other products or because suppliers of other products would begin to compete with the hypothetical monopolist, then the market definition should be expanded to include the substitute products.

A6.19 We must first therefore address the issue of which product(s) should form the starting point for the application of the HMT. This starting point can be referred to as the 'focal product'[18], and typically starts from the narrowest potential market definition.[19]

A6.20 Having considered demand-side substitution we then, where relevant, assess supply-side substitution possibilities to consider whether they provide any additional constraints on the pricing behaviour of the hypothetical monopolist which have not been captured by the demand-side analysis. In this assessment, supply-side substitution is considered to be a low-cost form of entry which can take place within a reasonable timeframe (e.g. up to 12 months).

A6.21 For supply-side substitution to be relevant not only must suppliers be able, in theory, to enter the market quickly and at low cost by virtue of their existing position in the supply of other products or geographic areas, but there must also be an additional competitive constraint arising from such entry into the supply of the service in question.

A6.22 Therefore, in identifying potential supply-side substitutes, it is important that providers of these services have not already been taken into consideration. There might be suppliers who provide other services but who might also be materially present in the provision of demand-side substitutes to the service for which the hypothetical monopolist has raised its price. Such suppliers are not relevant to supply-side substitution since they supply services already identified as demand-side substitutes. However, the impact of expansion by such suppliers can be taken into account in the assessment of market power.

Relevance of existing regulation – the modified Greenfield approach

A6.23 When we conduct our analysis we use the modified Greenfield approach.[20] This requires us to assess whether markets are effectively competitive from a forward-looking perspective in the absence of any regulation that would result from a finding of SMP. To do otherwise would be circular.

A6.24 However, it remains appropriate to take into account *ex ante* regulation arising from SMP findings in markets either upstream from, or horizontally related to, the services of interest.

[18] This reflects the terminology used by the OFT (OFT, *Market definition*, December 2004, OFT403, www.oft.gov.uk/shared_oft/business_leaflets/ca98_guidelines/oft403.pdf).

[19] Paragraph 3.2 of the OFT Market Definition Guidelines explains that 'previous experience and common sense will normally indicate the narrowest potential market definition, which will be taken as the starting point for the analysis'.

[20] See also Section 2.5 of the Explanatory Note to the 2014 EC Recommendation.

Bundling

A6.25 A common feature of the retail telecoms sector is the supply of bundles of different services. However, the Explanatory Note explains that the fact that bundling is a trend observed at the retail level does not require the definition of retail market(s) for bundles. This is because evidence to date has not indicated that there is a need for *ex ante* regulation of bundles, which may contain a previously regulated input.[21]

A6.26 The Explanatory Note goes on to explain that what matters in this regard is that:

> "NRAs are able to ensure that the vertically integrated SMP operator's regulated elements of the bundle can be effectively replicated (in terms of both technical and economic replicability) at the retail level, without an implicit extension of regulation to other components which are available under competitive conditions".

Aggregating markets

A6.27 In certain circumstances, it may also be appropriate to define a product or geographic market by grouping together services despite the absence of demand- and supply-side substitutability.

<u>Homogeneity of competitive conditions</u>

A6.28 Aggregating markets on the basis of the homogeneity of competitive conditions can help streamline the subsequent market power analysis by reducing the need to review multiple markets for products, the provision of which is subject to homogeneous competitive conditions.

A6.29 However, combining products and services based on homogenous competitive conditions, is – by definition – only appropriate where this would not substantively alter any subsequent findings of SMP (relative to defining those markets separately).

A6.30 Our approach also takes into account the SMP Guidelines. In particular, in the context of geographic market analysis, the SMP Guidelines state that:

> "According to established case-law, the relevant geographic market comprises an area in which the undertakings concerned are involved in the supply and demand of the relevant products or services, in which area the conditions of competition are similar or sufficiently homogeneous and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different. […]"[22]

A6.31 Hence, subject to the relevant caveats above, where there are products (or geographic areas) where competitive conditions are sufficiently homogeneous, the definition of the relevant market will include all of those products (or geographic areas) within one market.

[21] See Section 3.2 of the Explanatory Note to the 2014 EC Recommendation.

[22] See paragraph 56 of the SMP Guidelines.

Common pricing constraints

A6.32 Another factor that is sometimes considered in setting market boundaries is whether there exist common pricing constraints across customers, services or geographic areas (for example, areas in which a firm voluntarily offers its services at a uniform price). Where common pricing constraints exist, the products or geographic areas in which they apply could be included within the same relevant market even if demand-side and supply-side substitution is limited (or absent). Failure to consider the existence of a common pricing constraint could lead to unduly narrow markets being defined.

Geographic market

A6.33 In addition to the product(s) to be included within a market, market definition requires us to specify the geographic extent of the market in which conditions of competition are sufficiently similar.

A6.34 One approach would be to begin with a narrowly defined geographic area and then consider whether a price increase by a hypothetical monopolist in that area would encourage customers to switch to suppliers located outside the area (demand-side substitution) or telecoms providers outside the area to begin to offer services in the area (supply-side substitution). If demand- and/or supply-side substitution is sufficient to constrain prices, then it is appropriate to expand the geographic market boundary.

A6.35 We recognise that in certain communications (product) markets, there may be different competitive conditions in different geographic areas. In this case, we therefore have to consider whether it is appropriate to identify separate geographic markets for some services. Defining separate markets by geographic area may be problematic because, due to the dynamic nature of communications markets, the boundary between areas where there are different competitive pressures may be unstable and change over time.

A6.36 An alternative approach is to define geographic markets in a broader sense. This involves defining a single geographic market but recognising that this single market has local geographic characteristics. That is to say, recognising that within the single market there are geographic areas where competition is more developed than in other geographic areas. This avoids the difficulties of defining and remedying large numbers of markets and instability in the definition over time. Such an approach may also include the aggregation of markets as discussed above.

Market power assessment

A6.37 Having identified the relevant product and geographic market(s) and, where relevant having identified the market as susceptible to *ex ante* regulation, we go on to analyse each market in order to assess whether any person or persons have SMP as defined in section 78 of the Act (construed in accordance with Article 14 of the Framework Directive). Section 78 of the Act provides that SMP is defined as being equivalent to the competition law concept of dominance in accordance with Article 14(2) of the Framework Directive which provides:

> "An undertaking shall be deemed to have significant market power if, either individually or jointly with others, it enjoys a position equivalent to dominance, that is to say a position of economic strength affording

> it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers."

A6.38 Further, Article 14(3) of the Framework Directive states that:

> "Where an undertaking has significant market power on a specific market, it may also be deemed to have significant market power on a closely related market, where the links between the two markets are such as to allow the market power held in one market to be leveraged into the other market, thereby strengthening the market power of the undertaking."

A6.39 Therefore, in the relevant market, one or more undertakings may be designated as having SMP where that undertaking or undertakings enjoy a position of dominance. Also, an undertaking may be designated as having SMP where it could lever its market power from a closely related market into the relevant market, thereby strengthening its market power.

A6.40 In assessing whether an undertaking has SMP, we take due account of the SMP Guidelines as we are required to do under section 79 of the Act.

The criteria for assessing SMP

A6.41 The SMP Guidelines require NRAs to assess whether competition in a market is effective. This assessment is undertaken through a forward-looking evaluation of the market (i.e. determining whether the market is prospectively competitive), taking into account foreseeable developments and a number of relevant criteria.[23]

A6.42 Our assessments of SMP are concerned with the prospects for competition over the review period of three years. Ultimately, we want to understand how the markets are likely to develop, and whether competition is likely to be, or become, effective during this review period. Below we set out certain key factors that we are likely to consider when assessing SMP.[24]

A6.43 Where a market is found to be competitive then no SMP conditions can be imposed. Section 84(4) of the Act requires that any SMP condition in that market, applying to a person by reference to a market power determination made on the basis of an earlier analysis, must be revoked.

Market shares

A6.44 In the SMP Guidelines, the EC discusses market shares as being an indicator of (although not sufficient to establish) market power:

> "…Market shares are often used as a proxy for market power. Although a high market share alone is not sufficient to establish the possession of significant market power (dominance), it is unlikely that a firm without a significant share of the relevant market would be in a dominant position. Thus, undertakings with market shares of no more than 25% are not likely to enjoy a (single) dominant position on

[23] See, for example, paragraphs 19 and 20, and the opening words of paragraph 75, of the SMP Guidelines.

[24] The factors listed in this annex are not intended to be exhaustive and other evidence may be relevant.

> the market concerned. In the Commission's decision making practice, single dominance concerns normally arise in the case of undertakings with market shares of over 40%, although the Commission may in some cases have concerns about dominance even with lower market shares, as dominance may occur without the existence of a large market share. According to established case-law, very large market shares — in excess of 50% — are in themselves, save in exceptional circumstances, evidence of the existence of a dominant position…"[25]

A6.45 Market shares and market share trends provide an indication of how competitive a market has been in the past. If a firm has a persistently high market share, then that in itself gives rise to a presumption of SMP. However, changes in market share are also relevant to our assessment of prospects for competition. For example, a market share trend which shows a decline may suggest that competition will provide an effective constraint within the time period over which the SMP assessment is being conducted, although it does not preclude the finding of SMP.[26]

Other factors affecting competitive constraints

A6.46 In addition to market shares, the SMP Guidelines set out 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:[27]

- the overall size of the undertaking;
- control of infrastructure not easily duplicated;
- technological advantages or superiority;
- easy or privileged access to capital markets/financial resources;
- product/services diversification (e.g. bundled products or services);
- economies of scale;
- economies of scope;
- vertical integration;
- highly developed distribution and sales network;
- absence of potential competition; and
- barriers to expansion.

A6.47 A dominant position can derive from a combination of these criteria, which when taken separately may not necessarily be determinative.

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[25] Paragraph 75 of the SMP Guidelines.
[26] Paragraph 75 of the SMP Guidelines.
[27] SMP Guidelines, paragraph 78.

A6.48 An SMP analysis may also take into account the extent to which products or services within the market are differentiated. The constraint from products or services outside the relevant market may also be a relevant factor.

Excessive pricing and profitability

A6.49 In a competitive market, individual firms should not be able to persistently raise prices above costs and sustain excess profits.

A6.50 The ability, therefore, to price at a level that keeps profits persistently and significantly above the competitive level is an important indicator of market power. The SMP Guidelines refer to the importance, when assessing market power on an *ex ante* basis, of considering the power of undertakings to raise prices without incurring a significant loss of sales or revenue. [28] Factors that may explain excess profits in the short term, such as greater innovation and efficiency, or unexpected changes in demand, should however be considered in interpreting high profit figures.

A6.51 However, consistently low profits, i.e. profits at or below the cost of capital, cannot be taken as evidence of an absence of market power. It may simply be evidence of inefficiency or other factors such as predatory pricing. For example, if a firm with SMP were to have inefficiently high costs, it may charge a price above the level we would expect to see in a competitive market but this would not result in high profits. In addition, price regulation exists in many of the wholesale markets considered, and therefore low profits may simply be the result of existing regulation rather than a reflection of the underlying competitive conditions.

Barriers to entry and expansion

A6.52 Entry barriers are important in the assessment of potential competition.[29] The lower entry barriers are, the more likely it is that potential competition will prevent undertakings already within a market from profitably sustaining prices above competitive levels. Moreover, the competitive constraint imposed by potential entrants is not simply about introducing a new product to the market. To be an effective competitive constraint, a new entrant must be able to attain a large enough scale to have a competitive impact on undertakings already in the market. This may entail entry on a small scale, followed by growth. Accordingly, whether there are barriers to expansion is also relevant to an SMP assessment. Many of the factors that may make entry harder might also make it harder for undertakings that have recently entered the market to expand their market shares and hence their competitive impact.

A6.53 A related factor is the growth in demand in the market. In general, telecoms providers are more willing to invest in a growing market (and less willing in a declining market). As a result, barriers to entry and expansion tend to be less of an impediment to competition in rapidly growing markets.

Countervailing buyer power

A6.54 A concentrated market need not lead to harmful outcomes if buyers have sufficient countervailing buyer power to curtail the exercise of market power. In general, purchasers may have a degree of buyer power where they purchase large volumes

[28] Paragraph 73 of the SMP Guidelines.
[29] Paragraph 80 of the SMP Guidelines.

and can make a credible threat to switch supplier or to meet their requirements through self-supply to a significant degree. It is important to note, however, that the volumes involved must be large enough to make a material difference to the profitability of the current supplier. That is, an individual wholesale customer must represent a significant proportion of the total volume supplied by the relevant telecoms provider.

Annex 7

Equality impact assessment

Introduction

A7.1 Ofcom[30] is required by statute to assess the potential impact of all our functions, policies, projects and practices on equality.[31] 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.

A7.2 Unless we state otherwise in this document, it is not apparent to us that our proposed remedies will have a differential impact on any equality group.

A7.3 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 regulatory intervention will not have a differential impact on people of different sexes or ethnicities, consumers with protected characteristics in Northern Ireland[32] or disabled consumers compared to consumers in general.

Equality impact assessment

A7.4 We have considered whether the proposed remedies would have an adverse impact on promoting equality. In particular, we have considered whether the remedies would 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.

A7.5 The intention behind our approach to regulating the WLA markets is to promote competition to the ultimate benefit of end consumers by, for example, requiring any telecoms provider with Significant Market Power (SMP) to provide access to their networks on regulated terms (including charging).

A7.6 To understand how our proposals may affect equality groups, we have considered how different groups in society engage with communications services. In particular, we conducted market research that enabled us to assess the potential impact of future regulation on certain equality groups, particularly older consumers.[33] While our research identifies differences in take-up and use of fixed line services by different groups within society our proposed regulation is aimed at promoting competition across the range of services that rely on WLA.

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[30] We explain why we undertake an Equality Impact Assessment (EIA) and how we have done it in Volume 1, Section 2 of this consultation.

[31] 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.

[32] 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.

[33] https://www.ofcom.org.uk/consultations-and-statements/category-1/wholesale-local-access-market-review/.

A7.7 We consider that our proposals will not have a detrimental impact on any defined equality group. Further, we do not propose to carry out separate EIAs in relation to race, gender equality or equality schemes under the Northern Ireland and Disability Equality Schemes. This is because we anticipate that our proposed regulatory intervention would not have a differential impact on people of different genders or ethnicities, consumers with protected characteristics in Northern Ireland or on disabled consumers compared to consumers in general. Therefore, we do not propose to carry out separate EIAs in relation to race or gender equality or equality schemes under the Northern Ireland Disability Equality Schemes.

A7.8 Rather, we consider that our proposals will further the aim of advancing equality of opportunity between different groups in society by furthering the interest of all consumers that use retail services reliant on WLA.

Annex 8

Further supporting analysis of the 'fair bet'

Introduction

A8.1 In Volume 1 Section 8, we have set out our provisional judgement that BT has had a fair opportunity to make a return on its original investment in SFBB and that a charge control, as proposed for VULA, would be consistent with the fair bet principle. In reaching this provisional judgement we have considered:

- how much time has elapsed compared to the expected payback period at the time the investment was committed;
- the perceived riskiness of the initial investment;
- the performance of the investment against initial expectations; and
- the level of returns.

A8.2 In order to give some insight into the risks and expectations at the time, we have reviewed internal documents provided by BT in response to a request made using our statutory information gathering powers relating to the original investment case for fibre. The most relevant documents are a paper presented to the BT Group Board in June 2008 and a slide presentation to Ofcom shortly afterwards.[34]

A8.3 In this annex, we provide further details of our analysis.

Our definition of a fair bet

A8.4 For the purposes of this assessment, we consider that an investment is a "fair bet" if, at the time of investment, expected return is equal to the cost of capital. This means that, in order for an investment to be a fair bet, the firm should be allowed to enjoy some of the upside risk when demand turns out to be high (i.e. allow returns higher than the cost of capital) to balance the fact that the firm will earn returns below the cost of capital if demand turns out to be low.[35] Equivalently, the expected Net Present Value (NPV) of the investment, after having taken account of the risks, including assumptions of future regulation, would be equal to zero.

A8.5 The expected discounted payback period – that is, that length of time that BT originally expected it would take to break even on the investment (in NPV terms) in

[34] Of the relevant documents provided to Ofcom, the most detailed description of the investment position at the time of the July 2008 announcement is found in a paper presented to the BT Group Board in June 2008, which sets out proposals for the first tranche of investment in NGA and includes an indicative scenario for the payback period. BT Group plc Board, NGA Strategy, (BT's NGA strategy), June 2008. A subsequent slide presentation to Ofcom shortly after the Board provides further detail.

[35] Ofcom, January 2011. *Proposals for WBA charge control: Consultation document and draft notification of*
decisions on charge control in WBA Market 1, Annex 8, para A8.27. https://www.ofcom.org.uk/__data/assets/pdf_file/0021/34239/condoc.pdf.

the absence of regulation - serves as a useful reference point for assessing whether a period of pricing flexibility has been sufficient.[36] If BT knew that it would not be subject to price regulation in the expected payback period, then it would expect to earn an NPV of at least zero and would therefore choose to invest.

A8.6 Moreover, if a charge control allowed for continued returns on capital, BT would expect to gain additional returns throughout the remaining lives of assets.[37] If we were to impose a charge control at the point in time at which the original expected payback is reached, the expected NPV at the time the investment was committed, across the period of pricing flexibility and the subsequent period of charge control, would therefore be significantly positive. Allowing pricing flexibility until the point of expected payback is therefore generous to BT.

A8.7 It therefore follows that regulating before expected payback can be consistent with a fair bet. However, if we were to regulate before this point we would want to check that this was consistent with the fair bet.

A8.8 Performance against expectations and, in particular, the level of returns, provide a useful indicator of whether it is appropriate to intervene. Although it is consistent with the fair bet principle to allow BT the opportunity to earn returns above cost, if the level of returns becomes very high it could be appropriate to impose a charge control, even if expected payback has not been met. The fair bet would still be met if we intervened before expected payback, but only when returns are significantly above the benchmark cost of capital. We would have a greater tolerance for higher returns where the downside risk is greater.

A8.9 We recognise that an assessment of whether the fair bet has been met is not straightforward, and we cannot precisely understand now what investors perceived about the risks they faced at the time the investment was made. We also recognise that the effects of regulatory error are likely to be asymmetric in this case: in that if we intervene too early the harm caused by deterring future investment in UFBB may be greater than the harm caused by intervening too late. Therefore, as we set out in our Strategic Review, in determining whether returns are appropriate, we will tend to err on the side of caution with respect to investment incentives in the case of fibre networks.[38]

Expected payback date for BT's initial investment

A8.10 BT announced its first major tranche of investment in SFBB in July 2008, with a plan to deliver SFBB to 10 million homes – around 40% of UK premises - by 2012.[39] In March 2010, BT announced that it was extending the rollout to around two thirds of the country. At this stage, BT's contemporaneous documents indicate that it envisaged that 75% of the deployment would be based on fibre to the cabinet (FTTC) with the remaining 25% delivered using fibre to the premises (FTTP).[40] The

[36] 2016 Strategic Review, paragraph 4.51.

[37] Our standard approach to setting a cost based charge control includes an allowance for the cost of capital.

[38] 2016 DCR Statement, paragraph 4.52.

[39] BT plans UK's largest ever investment in super-fast broadband, http://www.btplc.com/superfastbroadband/ [accessed 9 March 2017].

[40] BT, 13 May 2010, Q4 and Full Year Results, page 22, http://www.btplc.com/Sharesandperformance/downloads/PDFdownloads/q410transcript.pdf.

projected incremental cost of the first tranche was around £1 billion[41] and the second was around £0.5 billion.[42] BT also began investing outside of the commercial footprint in 2013/14, primarily with the help of government funding through the Broadband Delivery UK (BDUK) subsidy programme.

A8.11 We have considered the payback period for FTTC in isolation, rather than the payback period for the initial FTTC/FTTP mix. This is because the contemporaneous documents indicate that BT appeared to have flexibility over the extent of FTTP deployment and ultimately chose to deploy almost exclusively FTTC. We understand that about 1% of GEA lines were using FTTP at the end of 2016.[43] BT therefore did not incur any significant degree of risk associated with FTTP investments.

A8.12 In an "indicative scenario" in BT's Board Paper, BT Group's payback period associated with this scenario is [✂] (double digit years) for the FTTC component and [✂] (double digit years) for the whole "mixed economy rollout".[44] The payback period subsequently presented to Ofcom was slightly different – [✂] (double digit years) for the FTTC component, [✂] (double digit years) for FTTP and [✂] (double digit years) for the mixed rollout. A presentation to Ofcom also indicated the business case was based on a [✂] (double digit return).[45]

A8.13 This suggests an expected payback period in the region of [✂] (double digit years) for the FTTC component of its first major tranche of investment. On this basis, BT would have expected payback on this first tranche to occur within period spanned by this review (2018/19 to 2020/21). As set out above setting a cost-based charge control at, or after, the original expected payback period for an investment should in general be sufficient to ensure a fair bet.

A8.14 In our view, it is the first tranche that is most relevant to our assessment of the fair bet. We recognise that BT has continued to invest beyond its initial £1 billion tranche, in order to extend the footprint of the network and that the expected payback period for this subsequent investment may extend beyond 2020/21. However, the fact that BT was able to stagger the rollout to some degree means the risk of subsequent tranches of investment would have declined significantly over time as demand and costs became better understood.

[41] Total projected capital spend for this tranche was £1.5 billion of which £1 billion was incremental to pre-existing plans.

[42] BT estimated spend of £2.5 billion for the entire commercial deployment but we understand from BT (Response to CAR s135, 2nd February 2016) that figure included £0.5 billion of opex as well as the £0.5 billion of capex from pre-existing plans referred to above, with fibre-specific capex making up the remaining £1.5 billion.

[43] Data from Openreach mandatory non-discrimination KPIs. Correct to January 2016.

[44] BT's indicative scenario for its initial investment included the following assumptions: 10 million homes passed by December 2012; 20% take-up of services within homes passed; incremental capital expenditure of £1.0bn; premium on existing SMPF price of £[✂] per month; premium on existing £18 price charged by retail SPs of £[✂] per month. Source: BT's NGA strategy and BT Group Plc, Q1 2015/16 Results Call Transcript, page 3, http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/Q1/Downloads/Webcast/Results_transcript_Q1_15-16.pdf.

[45] BT, Superfast Broadband: Summary of commercials, (BT's SFBB slide presentation to Ofcom), slide 2.

Perceived riskiness of the initial investment

A8.15 We recognise that BT has invested substantial amounts in its FTTC network and that uncertainty surrounding costs and demand for superfast services meant that there was a risk that the project may have failed to recover its cost of capital. As we said in 2009 "super-fast broadband requires major new investment, carrying with it uncertainty and risk".[46]

A8.16 However, BT's fibre investments were planned and implemented in stages. As we noted above, BT planned to undertake its investment in two tranches, and we consider that the risk associated with subsequent tranches is significantly reduced. The risk of the first tranche was also mitigated to some extent as BT would have had flexibility to halt the project before the full £1 billion had been spent, if conditions had turned out to be worse than expected, mitigating the potential losses and reducing the riskiness of their investment. BT's investment case for the first tranche notes that the "*proposal will start with an operational trial before moving to a geographically targeted market deployment and then a national deployment"* and that at each stage it would "*assess if conditions are right to continue.*"[47]

A8.17 Further, BT was also able to draw on evidence from fibre deployments in Europe and the US, observing that "*there seems to be a broad acceptance of premium pricing for a very high speed broadband product.*"[48] It seemed that demand risk was primarily driven by uncertainty around the timing of growth in demand for higher bandwidths, rather than the question of whether it would materialise at all. The June 2008 Board paper did note that *"Fibre is highly likely to be the future of high speed access. The issue is timing. Whilst there is insufficient current market demand or services that can use the speeds fibre will offer, this position will change in the future.*"[49] This suggests that, from BT's perspective, the demand risk was primarily driven by uncertainty around the timing of growth in demand for higher bandwidths, rather than the question of whether it would materialise at all. The alternative strategy of waiting would, "*run the risk of losing broadband share to Virgin in the areas that they serve.*"[50]

A8.18 Thus while we do believe that BT's investment in fibre was risky, the risk was mitigated to some extent by the investment being split into tranches and expectations about the eventual evolution of demand.

Performance of the investment against initial expectations

A8.19 We have looked in detail at the actual performance of Openreach's commercial investment in fibre relative to initial expectations. This provides some insight into how much upside Openreach has achieved, and hence, whether introducing a cost-based charge control at this stage would be consistent with the fair bet principle.

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[46] Ofcom, March 2009. *Delivering super-fast broadband in the UK: Promoting investment and competition,* https://www.ofcom.org.uk/__data/assets/pdf_file/0018/59121/statement.pdf, para 19.8.

[47] BT's NGA strategy, page 1.

[48] BT's NGA Strategy, page 13.

[49] BT's NGA Strategy, page 2.

[50] BT's NGA Strategy, page 6.

A8.20 FTTC has outperformed BT's initial assumptions (as evidenced by its contemporaneous documents) in several important areas. While the cost of BT's fibre investment appears broadly in line with expectations[51]:

- take-up within the superfast coverage area has significantly surpassed initial expectations;[52] and
- Openreach's FTTC rental charges are higher than it originally expected.[53]

Level of returns

A8.21 BT has now had pricing flexibility on VULA for a period of 10 years. This has given it significant opportunity to earn returns above the cost of capital.

A8.22 The strong demand for fibre suggests that BT should indeed have been able to earn such returns. Although BT's return on capital employed (ROCE) was initially negative, reflecting the high up-front capital costs and low initial take-up volumes, it then grew quickly with take-up. As we set out in Volume 1 Section 3, ROCE now appears to be well above the cost of capital. In the absence of regulation, we would expect the ROCE to continue to rise as demand for higher bandwidths continues to grow.

A8.23 If we were to continue to allow pricing flexibility across VULA services and then impose a cost based charge control in 2020/21, we estimate the IRR at the Openreach level on BT's commercial investment over 20 years (including the period subject to a cost based charge control), could exceed 15%,[54] well above BT's cost of capital.

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[51] According to actual expenditure data provided to Ofcom by BT, Openreach invested around £[✂] in the commercial rollout of its fibre network between 2009/10 and 2012/13 and had passed around 13 million homes, or 45% of UK premises by the end of this period. BT invested a further £[✂] in fibre in 2013/14 to extend the commercial footprint to around 18.5m – roughly the 2/3 coverage targeted in the 2010 announcement. Thus the total capital spend by this stage appears to have been slightly lower than initially expected, at £[✂] compared to a planned spend of £[✂]. Capex estimate from BT's response to WLA s.135 request, tranche 2, question 2.3 (WBA/WLA tranche 2); Footprint estimate based on BT Group PLC, Results for the fourth quarter and year to 31 March 2014, http://www.btplc.com/News/ResultsPDF/q414-release.pdf.

[52] Two years into the programme BT noted that it seemed "to be doing a little bit better than the original plan for fibre", and by the end of the first quarter of 2015/16, take-up within footprint had exceeded BT's original assumption of 20%, to the extent that BT then updated its take-up assumption to 28% across the network and 30% in BDUK areas. BT Group Plc, Q1 2015/16 Results Call Transcript, page 3, http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/Q1/Downloads/Webcast/Results_transcript_Q1_15-16.pdf.

[53] Openreach offered a single 40/2 Mbit/s service at launch, which was priced at £6.90 per line per month. Openreach has subsequently introduced higher bandwidth services, with progressively higher rental charges, with the highest speed service – 80/20 Mbit/s – priced at £9.95. All of these charges are above the wholesale premium of £[✂] assumed in the indicative scenario presented to the Board in June 2008 board paper. Based on revenues and volumes data presented in BT's 2015/16 Additional Financial Information (this information is requested by Ofcom and provided privately to Ofcom), the current weighted average charge for GEA is £7.75 per calendar month.

[54] Ofcom estimate of 20-year IRR at the Openreach level on BT's commercial investment (including the period subject to a cost based charge control) assuming BT were to maintain its current prices for

VULA throughout the review period and we only then imposed a cost based charge control from 2020/21. We believe this represents a conservative estimate of the performance of BT's investment because the analysis assumes no impact on the volume of lines or profits from services other than VULA whereas the decision to invest may have likely considered the impact of the investment on the volume of lines as well as profits of services other than VULA. The IRR analysis also covers a 20-year period. Returns during the period subject to a cost based charge control are constrained to WACC and thus have a dilutive impact on the 20 returns relative to the returns over the period before charge controls are applied.

Annex 9

Diagrams of service

Introduction

A9.1 This annex provides a brief description of the exchange and street cabinet wiring arrangements associated with the provision of core WLR, LLU and GEA-FTTC Rental services. Understanding these wiring arrangements is necessary to understand the engineering activity that is required at the exchange and street cabinet to migrate a customer from one telecoms provider to another, and between services with the same telecoms provider. This activity is one of the main drivers of migration costs.

Wiring arrangements for core WLR, LLU and GEA-FTTC rental services

A9.2 There are five means the WLR, LLU and GEA-FTTC services can be used to provide voice and voice + broadband services, namely:

- for voice only, WLR; and
- for voice + broadband:
- WLR+SMPF;
- MPF;
- WLR+FTTC; or
- MPF+FTTC[55].

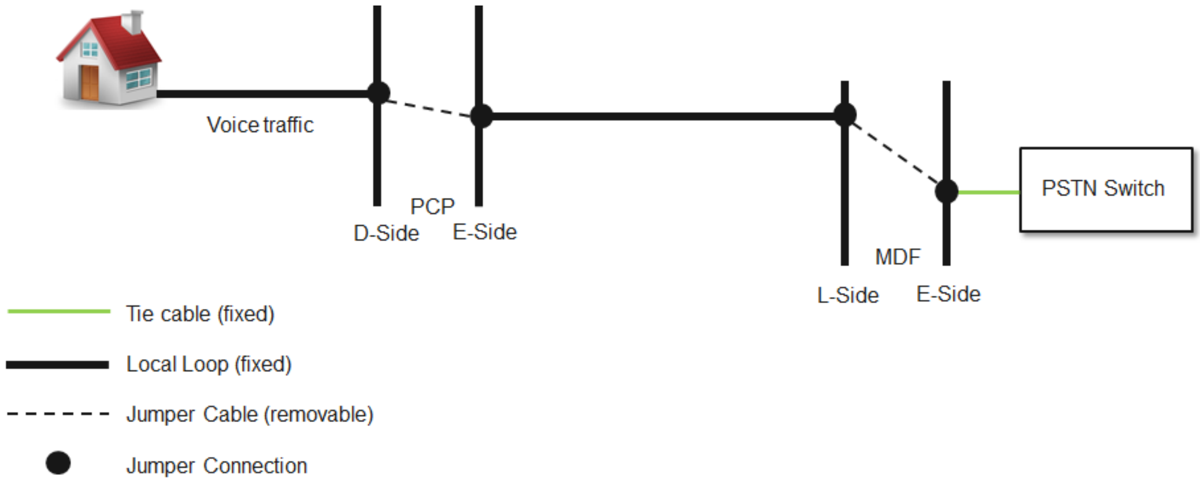
A9.3 Each of these five means require different wiring on the Main Distribution Frame (MDF) at the exchange and in the copper street cabinet (also referred to as the Primary Cross-connect Point, (PCP), and distinct from the street cabinet housing the FTTC DSLAM[56]). The MDF is the termination point of the local loops of the telecommunications network (all copper telephone lines used to provide telecommunications services are terminated here). The MDF is then used to connect these local loops to additional equipment located at the exchange using

[55] SOGEA and Single Order G.fast (SOG.fast) have been excluded from this analysis as at the time of writing they are not commercially available. SOGEA refers to Single Order GEA, a proposed variant of the GEA-FTTC service (based on VDSL2 technology) that does not require an underlying WLR or MPF service, and can therefore be provided as a ‘single order’. SOG.fast refers to Single Order G.fast, a proposed variant of the GEA-FTTC service (based on G.fast technology) that does not require an underlying WLR or MPF service, and can therefore be provided as a ‘single order’.
[56] ‘DSLAM’ refers to a DSL Access Multiplexer, typically located in a telephone exchange building or a street cabinet, that provides broadband services to multiple premises over the copper access network using DSL technologies (‘DSL’ refers to Digital Subscriber Line, a family of technologies that provide broadband internet access over traditional copper telephone lines between an end-customer’s premises and a street cabinet or telephone exchange building).

jumper wires. A jumper is a copper cable that provides a flexible connection between two terminal ends, commonly used in an exchange to connect the Line-Side (L-Side) to the Exchange-Side (E-side) of the MDF, and in a PCP to connect the Distribution-Side (D-Side) to the Exchange-Side (E-Side) of the PCP.

A9.4 When migrating a customer from one telecoms provider to another, or between services with the same telecoms provider, the number of jumper movements needed varies according to the service required by the customer and the technology used by the gaining and losing providers. To explain this, we provide stylised representations of the wiring arrangements at the PCP and MDF for the various WLR, LLU and GEA-FTTC services, and their interactions with DSLAM, MSAN[57], TAM[58] and PSTN[59] switch equipment, as shown in the diagrams below.

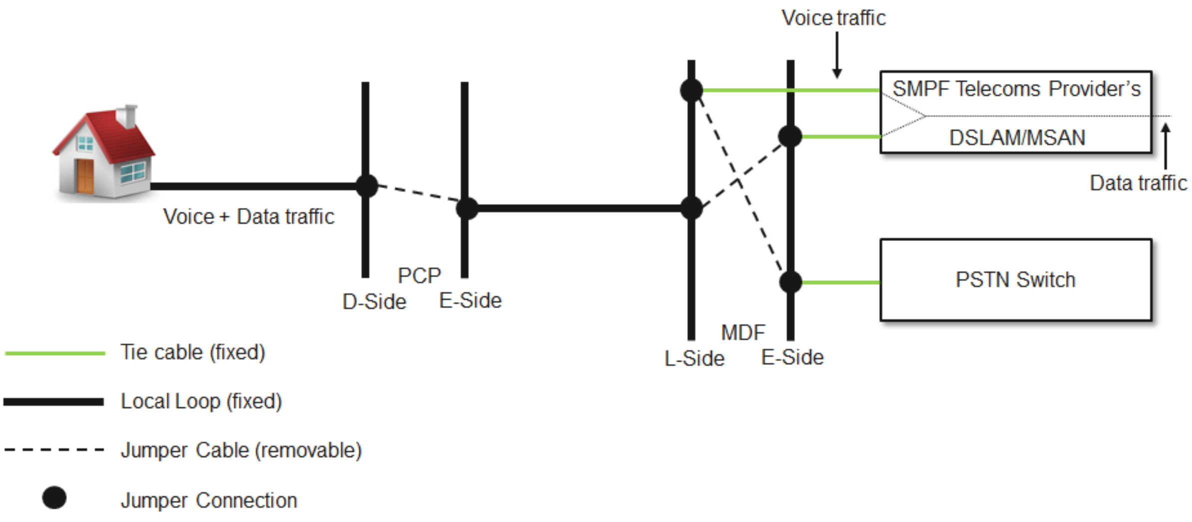
Figure A9.1: WLR Wiring



Source: Ofcom

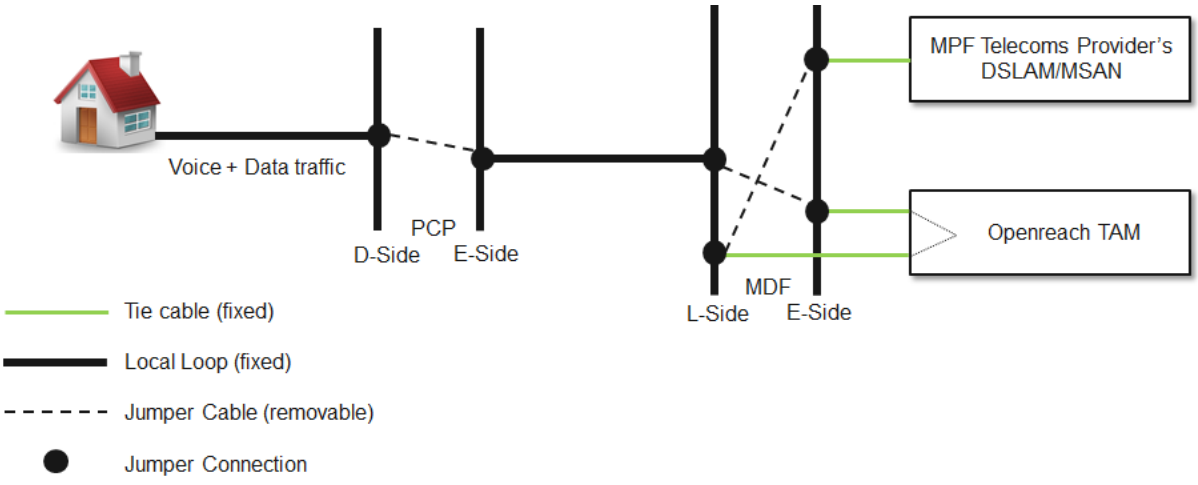
[57] 'MSAN' refers to a Multi-Service Access Node, typically located in a telephone exchange or a street cabinet, that provides a range of services, including DSL-based broadband and voice, to multiple premises over the copper access network.
[58] 'TAM' refers to a Test Access Matrix, typically located in a telephone exchange building, that provides on-demand test signals and measurement capabilities for end-customer telephone lines so that a telecoms provider can remotely identify and diagnose potential faults.
[59] 'PSTN' refers to the Public Switched Telephone Network, a telecommunications network that uses circuit-switched technology to provide voice telephony services.

Figure A9.2: WLR + SMPF Wiring



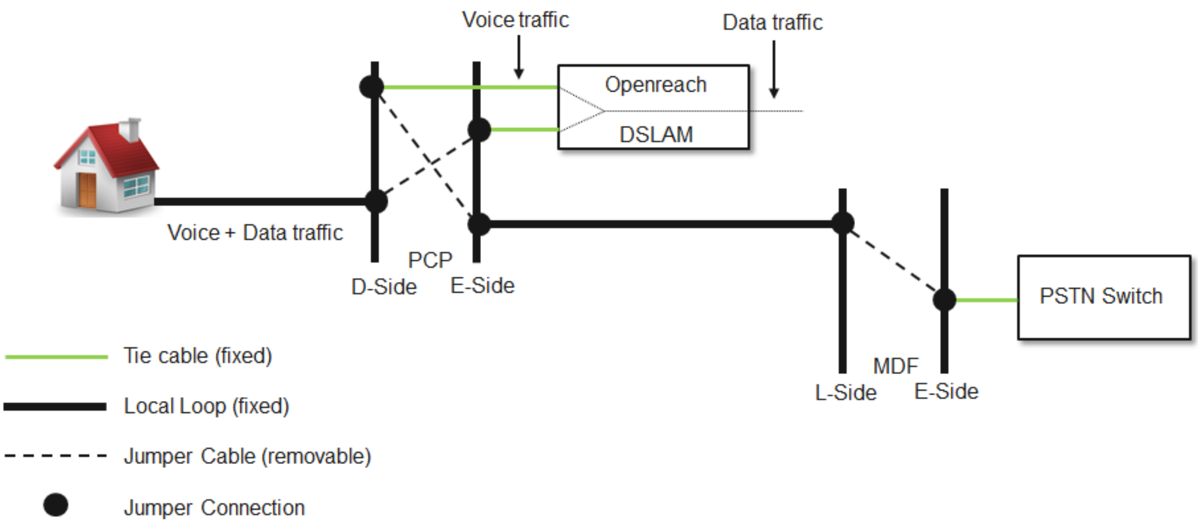
Source: Ofcom

Figure A9.3: MPF Wiring



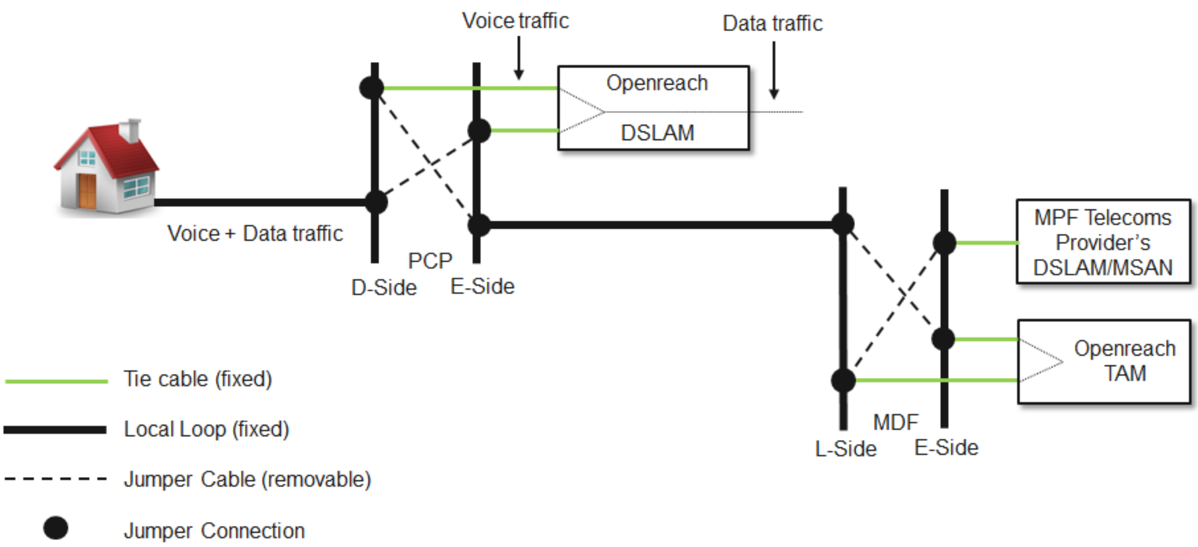
Source: Ofcom

Figure A9.4: WLR + FTTC Wiring



Source: Ofcom

Figure A9.5: MPF + FTTC Wiring



Source: Ofcom

A9.5 The above diagrams show the MDF and PCP jumpering configuration (including the number of jumpers) and tie cable configuration (including the number of tie cables) that applies to each rental service. Each rental service relates to a different set up and must be changed where a customer switches telecoms provider or otherwise requires a change in service or services.

A9.6 The provision of WLR involves one tie cable at the MDF, whilst both the WLR+SMPF and MPF services involve three tie cables at the MDF. The provision of WLR+FTTC involves a total of three tie cables, two at the PCP and one at the

MDF. The provision of MPF+FTTC involves a total of five tie cables, two at the PCP and three at the MDF.

A9.7 The WLR and WLR+SMPF rental services include one tie cable; MPF includes two tie cables; WLR+FTTC includes three tie cables; and MPF+FTTC includes four tie cables.

A9.8 Therefore, with WLR and WLR+FTTC no extra tie cables need to be bought separately; with MPF and MPF+FTTC one extra tie cable must be purchased separately; with WLR+SMPF two extra tie cables must be purchased separately. This is summarised in Table A9.6 below.

Table A9.6 Services and tie cables required

Service	Tie Cables (MDF + PCP)		
	Total Required	Included With Service	Extra To Be Purchased Separately
WLR	1	1	0
WLR+SMPF	3	1	2
MPF	3	2	1
WLR+FTTC	3	3	0
MPF+FTTC	5	4	1

Source: Ofcom

Jumper movements for WLR, LLU and GEA-FTTC migration services

A9.9 There are twenty-seven different migration services offered by Openreach. The key difference between each of these lies in the technology used by the gaining and losing telecoms provider, which determines the number of jumper movements at the exchange's MDF and/or PCP. We show those migration services related only to copper services in Table A9.7 below, then in Table A9.8 the migration services involving FTTC are presented.

Table A9.7 Telecoms provider copper migration services and jumper movements

Migration Service Reference	From	To	Jumpers						
			PCP Removed	PCP Installed	PCP Total	MDF Removed	MDF Installed	MDF Total	PCP + MDF Total
1	WLR	WLR	0	0	0	0	0	0	0
2	WLR	WLR + SMPF	0	0	0	1	2	3	3
3	WLR	MPF	0	0	0	1	2	3	3

Migration Service Reference	From	To	Jumpers						
			PCP Removed	PCP Installed	PCP Total	MDF Removed	MDF Installed	MDF Total	PCP + MDF Total
4	WLR + SMPF	WLR	0	0	0	2	1	3	3
5	WLR + SMPF	WLR + SMPF	0	0	0	2	2	4	4
6	WLR + SMPF	MPF	0	0	0	2	2	4	4
7	MPF	MPF	0	0	0	1	1	2	2
8	MPF	WLR + SMPF	0	0	0	2	2	4	4
9	MPF	WLR	0	0	0	2	1	3	3

Source: Ofcom

A9.10 The different copper-based migration services are as follows:

- Service 1 – WLR to WLR: this service involves remaining with the set up in Figure A9.1 and therefore no jumpering activity at the MDF or PCP (it only consists of a systems update to reflect the change of telecoms provider). We consider that this service is only relevant to inter-telecoms provider migrations (i.e. from one telecoms provider to another) and not intra-telecoms provider migrations (i.e. a change of services provided by the same telecoms provider).

- Service 2 – WLR to WLR+SMPF: involves moving from the setup in Figure A9.1 to that shown in Figure A9.2. This means that one jumper is removed and a further two jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 3 – WLR to MPF: involves moving from the set up in Figure A9.1 to that shown in Figure A9.3. This means that one jumper is removed and two new jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 4 – WLR+SMPF to WLR: involves moving from the set up in Figure A9.2 to that shown in Figure A9.1. This means that two jumpers are removed and one jumper is installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 5 – WLR+SMPF to WLR+SMPF: involves remaining with the set up in Figure A9.2 but switching to the DSLAM or MSAN of another telecoms provider. Thus, this requires removing two jumpers connecting to the equipment of the losing telecoms provider at the MDF, and installing two new jumpers connecting to the equipment of the gaining telecoms provider at the MDF. We consider that this service is only relevant to inter-telecoms provider migrations and not intra-telecoms provider migrations.

- Service 6 – WLR+SMPF to MPF: this service relates to moving from the set up in Figure A9.2 to that shown in Figure A9.3. This means that two jumpers are removed and a further two jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 7 – MPF to MPF: involves remaining with the set up in Figure A9.3 but switching to the DSLAM or MSAN of another telecoms provider. Thus, this requires removing one jumper connecting to the equipment of the losing telecoms provider at the MDF, and installing one new jumper connecting to the equipment of the gaining telecoms provider at the MDF. An intra-telecoms provider migration option is not applicable to this service.

- Service 8 – MPF to WLR+SMPF: this service relates to the simultaneous provision of a WLR Conversion and SMPF New Provide, and involves moving from the set up in Figure A9.3 to that shown in Figure A9.2. This means that two jumpers are removed and a further two jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 9 – MPF to WLR: involves moving from the set up in Figure A9.3 to that shown in Figure A9.1. This means that two jumpers are removed and one new jumper is installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

Table A9.8 Telecoms provider FTTC migration services and jumper movements

Migration Service Reference	From	To	Jumpers						
			PCP Removed	PCP Installed	PCP Total	MDF Removed	MDF Installed	MDF Total	PCP + MDF Total
10	WLR	WLR + FTTC	1	2	3	0	0	0	3
11	WLR	MPF + FTTC	1	2	3	1	2	3	6
12	WLR + SMPF	WLR + FTTC	1	2	3	2	1	3	6
13	WLR + SMPF	MPF + FTTC	1	2	3	2	2	4	7
14	MPF	WLR + FTTC	1	2	3	2	1	3	6
15	MPF	MPF + FTTC	1	2	3	1	1	2	5

Migration Service Reference	From	To	Jumpers						
			PCP Removed	PCP Installed	PCP Total	MDF Removed	MDF Installed	MDF Total	PCP + MDF Total
16	MPF	MPF + FTTC	1	2	3	0	0	0	3
17	WLR + FTTC	WLR + FTTC	0	0	0	0	0	0	0
18	WLR + FTTC	MPF	2	1	3	1	2	3	6
19	WLR + FTTC	WLR + SMPF	2	1	3	1	2	3	6
20	WLR + FTTC	WLR	2	1	3	0	0	0	3
21	WLR + FTTC	MPF + FTTC	0	0	0	1	2	3	3
22	MPF + FTTC	MPF + FTTC	0	0	0	1	1	2	2
23	MPF + FTTC	WLR + FTTC	0	0	0	2	1	3	3
24	MPF + FTTC	MPF	2	1	3	1	1	2	5
25	MPF + FTTC	MPF	2	1	3	0	0	0	3
26	MPF + FTTC	WLR + SMPF	2	1	3	2	2	4	7
27	MPF + FTTC	WLR	2	1	3	2	1	3	6

Source: Ofcom

A9.11 The different migration services involving FTTC are as follows:

- Service 10 – WLR to WLR+FTTC: involves moving from the set up in Figure A9.1 to that shown in Figure A9.4. This means that one jumper is removed at the PCP and two new jumpers are installed at the PCP. No jumper changes are required at the MDF for this service. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 11 – WLR to MPF+FTTC: involves moving from the set up in Figure A9.1 to that shown in Figure A9.5. This means that one jumper is removed from the

PCP and one jumper is removed from the MDF, and two new jumpers are installed at the PCP and two new jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 12 – WLR+SMPF to WLR+FTTC: involves moving from the set up in Figure A9.2 to that shown in Figure A9.4. This means that one jumper is removed at the PCP and two jumpers are removed at the MDF, and two new jumpers are installed at the PCP and one new jumper is installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 13 – WLR+SMPF to MPF+FTTC: involves moving from the set up in Figure A9.2 to that shown in Figure A9.5. This means that one jumper is removed from the PCP and two jumpers are removed from the MDF, and two new jumpers are installed at the PCP and two new jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 14 – MPF to WLR+FTTC: involves moving from the set up in Figure A9.3 to that shown in Figure A9.4. This means that one jumper is removed at the PCP and two jumpers are removed at the MDF, and two new jumpers are installed at the PCP and one new jumper is installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 15 – MPF to MPF+FTTC: involves moving from the set up in Figure A9.3 to that shown in Figure A9.5, where the customer changes telecoms provider. This means that one jumper is removed from the PCP and one jumper is removed from the MDF, and two new jumpers are installed at the PCP and one new jumper is installed at the MDF. Refer to service 23 for the equivalent intra-telecoms provider migration.

- Service 16 – MPF to MPF+FTTC: involves moving from the set up in Figure A9.3 to that shown in Figure A9.5, where the customer remains with the same telecoms provider. This means that one jumper is removed from the PCP and no jumpers are removed from the MDF, and two new jumpers are installed at the PCP and no new jumpers are installed at the MDF. Refer to service 22 for the equivalent inter-telecoms provider migration.

- Service 17 – WLR+FTTC to WLR+FTTC: this service does not involve any jumpering activity at the MDF or PCP (it only consists of a system update to reflect the change of telecoms provider). We consider that this service is only relevant to inter-telecoms provider migrations and not intra-telecoms provider migrations.

- Service 18 – WLR+FTTC to MPF: involves moving from the set up in Figure A9.4 to that shown in Figure A9.3. This means that two jumpers are removed at the PCP and one jumper is removed at the MDF, and one new jumper is installed at the PCP and two new jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 19 – WLR+FTTC to WLR+SMPF: involves moving from the set up in Figure A9.4 to that shown in Figure A9.2. This means that two jumpers are removed at the PCP and one jumper is removed at the MDF, and one new jumper is installed at the PCP and two new jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 20 – WLR+FTTC to WLR: involves moving from the set up in Figure A9.4 to that shown in Figure A9.1. This means that two jumpers are removed at the PCP and one new jumper is installed at the PCP. No jumper changes are required at the MDF for this service. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 21 – WLR+FTTC to MPF+FTTC: involves moving from the set up in Figure A9.4 to that shown in Figure A9.5. This means that one jumper is removed at the MDF and two new jumpers are installed at the MDF. No jumper changes are required at the PCP for this service. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 22 – MPF+FTTC to MPF+FTTC: involves remaining with the set up in Figure A9.5 but switching to the DSLAM or MSAN of another telecoms provider at the exchange. Thus, this requires removing one jumper connecting to the equipment of the losing telecoms provider at the MDF, and installing one new jumper connecting to the equipment of the gaining telecoms provider at the MDF. A system update to reflect the change of telecoms provider for the FTTC service would also be required. We consider that this service is only relevant to inter-telecoms provider migrations and not intra-telecoms provider migrations.

- Service 23 – MPF+FTTC to WLR+FTTC: involves moving from the set up in Figure A9.5 to that shown in Figure A9.4. This means that two jumpers are removed at the MDF and one new jumper is installed at the MDF. No jumper changes are required at the PCP for this service. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 24 – MPF+FTTC to MPF: involves moving from the set up in Figure A9.5 to that shown in Figure A9.3, where the customer changes telecoms provider. This means that two jumpers are removed from the PCP and one jumper is removed from the MDF, and one new jumper is installed at the PCP and one new jumper is installed at the MDF. Refer to service 25 for the equivalent intra-telecoms provider migration.

- Service 25 – MPF+FTTC to MPF: involves moving from the set up in Figure A9.5 to that shown in Figure A9.3, where the customer remains with the same telecoms provider. This means that two jumpers are removed from the PCP and no jumpers are removed from the MDF, and one new jumper is installed at the PCP and no new jumpers are installed at the MDF. Refer to service 24 for the equivalent inter-telecoms provider migration.

- Service 26 – MPF+FTTC to WLR+SMPF: involves moving from the set up in Figure A9.5 to that shown in Figure A9.2. This means that two jumpers are removed from the PCP and two jumpers are removed from the MDF, and one new jumper is installed at the PCP and two new jumpers are installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

- Service 27 – MPF+FTTC to WLR: involves moving from the set up in Figure A9.5 to that shown in Figure A9.1. This means that two jumpers are removed from the PCP and two jumpers are removed from the MDF, and one new jumper is installed at the PCP and one new jumper is installed at the MDF. Both inter-telecoms provider and intra-telecoms provider migrations would result in the same jumper movements.

Annex 10

Service volume forecasts

Introduction

A10.1 In this annex, we explain the approach we have taken to forecast service volumes in the WLA and WFAEL markets.[60] We set out the key outputs of the volumes model below.

A10.2 Volume forecasts are important for setting charge controls because they impact costs in the following ways:

- the existence of fixed and common costs means that unit costs will increase if volumes fall and, conversely, decrease if volumes rise due to economies of scale and scope. These fixed and common cost effects are reflected in cost and asset volume elasticities, which are discussed in more detail in Annexes 11 and 15; and

- shifts in demand (e.g. from copper broadband to fibre broadband) will result in changes to the mix of network components and potentially the cost profile of our modelled efficient operator.

A10.3 Our volume forecasts have been prepared to input into the WLA top-down and bottom-up models, as well as any analysis required within the scope of this review. For example, our WLR line forecasts are used as part of our common cost allocation where we allocate fixed and shared costs across copper and fibre services, detailed in Annex 11.

A10.4 In Volume 2, Sections 2 and 4, as well as Annexes 11 and 12, we have set out our proposals for modelling an ongoing fixed network providing telephone and broadband internet services, including superfast broadband (SFBB) to residential and business customers. We consider it appropriate to model an overlay fibre to the cabinet (FTTC) network on top of an ongoing copper network. We are using an anchor technology pricing approach meaning that we will treat all demand on the Openreach network as if it is served by either copper or FTTC.

A10.5 There is always a degree of uncertainty when estimating future service volumes. In this case, the migration of subscribers to SFBB is an important element for our forecasts and the rate of future migration is uncertain. In part this uncertainty is due to take-up having only significantly occurred more recently (thereby limiting the number of actuals that we can base our forecasts on). However, Virgin Media's investment in Project Lightning (its most recent large scale investment programme) and the effects of our Physical Infrastructure Access (PIA) remedy further add to the uncertainty. Therefore, we have considered a range of factors which may affect the likely take-up of specific services, which we explore further below.

[60] We note that not all services within these markets will be charge controlled. However, we still need forecast service volumes for services that are not charge controlled since they impact the calculation and allocation of fixed and common costs within these markets.

A10.6 Where possible, we use input data that is publicly available, which allows us to publish as much of our model as possible, with the aim of improving transparency of our analysis. In order to forecast service volumes, we have considered the following sources of information:

- historical volume data found within BT's RFS; the Department for Communities and Local Government (DCLG)[61]; the Department for Business, Energy and Industrial Strategy (BEIS)[62]; the Office for Budget Responsibility (OBR)[63]; and market research commissioned by Ofcom[64]; and

- forecasts provided by downstream telecoms providers including BT, Daisy, EE, Plusnet, Sky, TalkTalk, and Vodafone as well as FTTC forecasts by Analysys Mason.[65] These forecasts are used to cross-check against our modelled forecasts, allowing us to test the robustness of our model and whether our modelling assumptions are reasonable.

A10.7 We also requested copper[66] and fibre[67] service volume data from BT for the financial years 2012/13 through to 2020/21 using our statutory information gathering powers, of which the final five years are forecast data.[68]

A10.8 We consulted on possible approaches to fibre cost modelling and volume forecasts in the May 2016 Consultation and published a non-confidential version of the volumes forecast model. We have updated our forecasts and our approach (where appropriate) in light of our consideration of responses to that consultation as well as new data that we have received.

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[61] DCLG, 12 July 2016, *Live tables on household projections* http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households.

[62] BEIS, 13 October 2016, *Business population estimates 2016* https://www.gov.uk/government/statistics/business-population-estimates-2016.

[63] OBR, March 2016. *Economic and fiscal outlook – March 2016* http://budgetresponsibility.org.uk/efo/economic-fiscal-outlook-march-2016.

[64] Ofcom, various annual documents from 2011 to 2015, *The Communications Market* http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/.

[65] Analysys Mason, *FTTx coverage, conversion and capex: worldwide trends and forecasts 2015–2020*, August 2015. We also received stakeholder information from responses to s.135 requests.

[66] BT's response dated 3 December 2015 to question 2 of the 1st BT s135 request; BT's response dated 25 February 2015 to the follow-up questions relating to the 1st BT s135 request; BT's response dated 2 September 2016 to question 23 of the 2nd joint WLA WBA BT s.135 request.

[67] BT's response dated 25 February 2015to the clarification question L of Ofcom's follow-up dated 4 February 2016for the 1st BT s135 request; BT's response dated 12 September 2016to questions 25 and 26 of the 2nd joint WLA WBA BT s.135 request; BT's follow-up response dated 27 October 2016 to question 26 of the 2nd joint WLA WBA BT s.135 request.

[68] In our volumes forecast model we have used data provided directly by BT using our statutory information gathering powers and from the RFS. The scope of the data captured is different from that published in Ofcom's telecommunications market data update table as the telecommunications table includes alternative network infrastructure available in the UK (for example Virgin Media).

Summary of our volume forecasts

A10.9 We have built a model (referred to as the volumes model) to project volumes of WLR, MPF, SMPF, and GEA line rentals, as well as their associated connections and ancillary services, up to 2028/29.

A10.10 We consider the volumes forecast model can also inform our expectation of market trends and thus provide an input into analysis other than the estimate of the relevant charge control 'X'.[69] Over the forecast period, based on our modelling assumptions, we estimate the following broad market trends that act as key drivers for our final service volumes for 2015/16 and 2020/21:

- the total number of fixed line households will increase from 24.8 million to 26.2 million[70];
- the average number of Openreach lines per household to fall from 0.87 to 0.80;
- the total number of Openreach lines to fall from 25.1 million to 24.5 million;
- take-up of broadband on Openreach lines will increase from 79% to 88% of Openreach lines; and
- the proportion of Openreach broadband lines that are GEA will increase from 26% to 66%.

A10.11 The main outputs of the volumes model are summarised in the table below. We discuss our volume forecasts for specific services in the Copper volume forecasts and Fibre volume forecasts sub-sections below.

[69] For example, we have used the SMPF volume forecasts to support our decision to de-regulate this market and the GEA bandwidth forecasts to support our choice of an anchor product.
[70] We also expect the proportion of mobile-only households to slow trend from c.10% of all UK households to c.9% over this charge control period.

Table A10.1: Summary table of WLA and WFAEL volume forecasts

	2015/16 Actuals		2020/21 Forecasts	
	Number of lines (millions)	Share of all Openreach lines	Number of lines (millions)	Share of all Openreach lines
Openreach WLR lines (without SMPF or GEA)[71]	[✂]	[✂]	[✂]	[✂]
SMPF (total)	7.1	28%	3.2	13%
MPF (without GEA)	[✂]	[✂]	[✂]	[✂]
GEA-FTTC[72]	5.1	20%	14.1	58%
Total Openreach lines	**25.1**		**24.5**	

Source: Volumes model using Ofcom forecasts based on BT actuals with adjustments for Project Lightning and PIA.

Structure of this annex

A10.12 The remainder of this annex is structured as follows:

- **May 2016 WLA Consultation on fibre cost modelling** – we summarise the proposals made in this consultation and stakeholder responses with regards to service volume forecasting;
- **Model framework and structure** – we set out the structure of the volumes model, in particular the key modelling steps and how the outputs are used in the bottom-up and top-down models;
- **General forecasting assumptions** – we provide an overview of the general forecasting assumptions that drive both copper and fibre voice and broadband service volumes. We set out what these assumptions are, what we've done and the rationale for choosing our proposed assumptions;
- **Copper volume forecasts** – we set out the specific assumptions for the copper voice and broadband services provided by Openreach; and
- **Fibre volume forecasts** – we set out the specific assumptions for the fibre broadband services provided by Openreach.

May 2016 WLA Consultation on fibre cost modelling

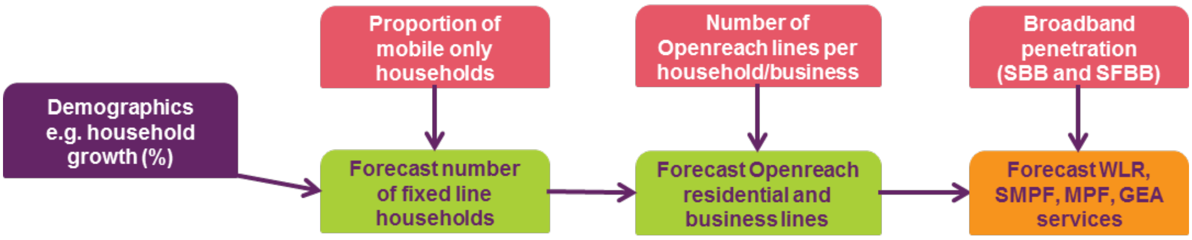
Summary of May 2016 volume forecast proposals

A10.13 In the May 2016 WLA Consultation on fibre cost modelling we included a presentation of our proposed high level approach to forecasting volumes and provided a version of the volume forecasting model for stakeholders to review. We set out at a high level how the 2016 NGA model projects service volumes in Figure A10.2:

[71] We note that this includes both residential and business lines that use WLR but not a subsequent SMPF or GEA line.

[72] Note that this includes both GEA-FTTC and GEA-FTTP service volumes.

Figure A10.2: Flow chart for WLA service volumes module



Source: Ofcom.

A10.14 We explained that there are multiple approaches that could be used to forecast service volumes but we consider our proposed approach to lead to reasonable service volume forecasts. Furthermore, we consider it beneficial that we follow a consistent approach to forecasting Openreach residential and business lines as in the 2014 FAMR Statement volumes model.

A10.15 We separately forecast SFBB service volumes (i.e. GEA services) since they currently represent a significant proportion of the WLA market, and we expect this to increase in the future. We use general forecasting assumptions which impact both the copper and fibre voice and broadband service volumes.[73] On top of these general forecasting assumptions, we also apply specific forecasting assumptions to individual copper and fibre voice and broadband services.

A10.16 We compare our forecasts with those provided by telecoms providers (including BT) in order to assess the robustness of the assumptions used when deriving our forecasts. For our SFBB service volumes, we also cross-check our forecasts against Analysys Mason's forecasts for SFBB volumes in the UK.

Summary of Stakeholder responses

A10.17 We received responses on our approach to volume forecasting set out in the May 2016 Consultation from BT, Virgin Media, Vodafone and TalkTalk.[74] BT considered the overall design of the service volumes model to be logical but suggested improvements in some areas.[75] Virgin, Vodafone and TalkTalk disagreed with our approach to only forecast FTTC service volumes over the modelled period.

A10.18 BT disagreed with our use of UK household growth and suggested UK dwelling growth as a more accurate driver for fixed line household growth. BT also had concerns with the transparency of our "Openreach penetration" assumptions. In particular, BT argued the importance of explicitly showing the impact from network competitors on Openreach broadband lines. With regards to Openreach NGA services, BT argued that it is unclear what the model assumes about customer

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[73] These relate to household projections, the number of Openreach lines that are provided to UK households, the growth in broadband lines per household and the growth in service volumes. See paragraph 4.8 of the May 2016 WLA Consultation on fibre cost modelling.

[74] Non-confidential versions of stakeholder responses are available via this link: https://www.ofcom.org.uk/consultations-and-statements/category-3/wholesale-local-access-market-review-fibre-cost-modelling.

[75] BT, Non-confidential response to the May 2016 WLA Consultation on fibre cost modelling, 10 June 2016, paragraph 75. https://www.ofcom.org.uk/__data/assets/pdf_file/0029/83099/openreach.pdf.

demand for data (including both consumption and the desired download and upload speeds).[76]

A10.19 We consider stakeholders' comments on our modelling assumption to only forecast FTTC service volumes rather than account for other technologies to be about the assumed network dimensions and technology over the modelled time period rather than necessarily Ofcom's approach to forecasting service volumes. We have summarised and responded to these comments in Volume 2, Section 2 and Annex 12, which sets out our approach to technology choice and the bottom-up model.

Model framework and structure

A10.20 We propose to model service volumes using the following steps:

- **Forecasting the number of fixed line UK households**: the volumes model includes forecasts for the number of UK businesses and households, after excluding mobile-only households, up until 2028/29 (the final year of our volumes model);

- **Forecasting the number of Openreach lines**: we forecast the number of voice lines per business site and per residential household[77], and then multiply this by the business site and fixed line household forecasts to forecast total Openreach lines.[78] We have also included adjustments which account for the impact of the PIA remedy and Project Lightning, where we consider that these developments will mean that historical trends may not be representative of future trends;

- **Forecasting individual rental volumes**: these forecasts use assumptions with regards to Openreach lines, on the change in overall broadband take-up, superfast broadband take-up, and the proportion of Openreach lines consumed by BT; we then estimate how the forecasted Openreach lines are split between MPF, WLR, SMPF and GEA; and

- **Forecasting connections and ancillary services**: following our forecasted rental volumes, we forecast the volume of connections and ancillary services, e.g. for migrations.

General modelling approach

A10.21 The outputs of the volumes model are split into two categories:

- **Outputs for top-down model** – this includes all WLR, SMPF, MPF, and GEA line rentals, connections and ancillary services (e.g. migrations). These forecasts are then used to drive the forecasted costs in the top-down model in conjunction

[76] BT, non-confidential response to the May 2016 WLA Consultation on fibre cost modelling, 10 June 2016, paragraphs 75 to 90.

[77] We have based these forecasts on historical data from Openreach on number of lines, in conjunction with DCLG and BEIS data on households and business sites, and industry level split of business and residential lines.

[78] BT's volume data does not differentiate between business and residential lines. We therefore split them into business and residential lines using data held by Ofcom on the proportion of business and residential lines across the entire industry.

with the base year costs and volume elasticities. Our top-down modelling approach is discussed in more detail in Annex 11.

- **Outputs for bottom-up model** – this includes all forecasted GEA volumes, split into four categories: rentals, PCP provision, connections requiring a visit to the end user, and software changes. These are used in conjunction with the bottom-up model's cost volume drivers to forecast costs. Our bottom-up modelling approach is discussed in more detail in Annex 12.

A10.22 The next charge control period lasts until 31 March 2021; however, we have explicitly forecast volumes up to 2028/29. This is because the volumes model provides inputs into the bottom-up cost model, which forecasts costs beyond the charge control period.

A10.23 We have produced these long-run forecasts assuming the ongoing use of FTTC services to be consistent with the bottom-up cost model. As discussed in Annex 12, our bottom-up model uses an anchor technology approach which assumes all superfast broadband services are provided using FTTC. Our forecasts are consistent with this modelling approach and so do not seek to forecast all the different services that will be provided, or the technology that will be used, in the long-run.

A10.24 We forecast specific services, as well as general market trends after the charge control period, using three-year average growth rates with dampening factors.[79] Over the longer term, continuous growth (whether negative or positive) at a high rate will often be implausible. Therefore, we have used:

- dampening factors – to slow down the three-year trends to ensure that they are consistent with plausible and stable long-run levels for the key forecast variables; and

- three-year moving averages – to ensure that our forecasts are also a reasonable reflection of recently observed trends.

A10.25 We consider it appropriate to use a dampening factor even when the historical trend is relatively stable if there is also volatility around the trend. The use of a moving average without a dampening factor could result in forecasted volumes replicating any observed volatility. We consider it likely that replication of such volatility would result in spurious accuracy which could also lead to incorrect forecasted costs.[80]

A10.26 However, we consider it appropriate to be more explicit about what we are assuming for broadband and superfast broadband take-up, given the importance of these assumptions. We note that our broadband take-up assumptions were determined using a similar methodology, i.e. assessing historical trends and determine how they will continue going forwards. The difference is that we consider it likely that stakeholders will more readily relate to our model inputs for broadband

[79] A dampening factor is a divisor applied to the observed historical growth rates in order to calculate a lower magnitude forecasted growth rate. For example, if MPF rentals grew on average by 14% per annum between 2012/13 and 2015/16, then the forecasted growth for 2016/17 will be 14% divided by the dampening factor (e.g. 14% divided by 1.4 giving a forecasted 10% growth rate in 2016/17).
[80] For example, a decrease in volumes in one year followed by an equal increase in volumes in the next year could lead to a modelled fall in capital expenditure for the first year followed by an increase in the next. It is unlikely that this would occur in the real world, so the inclusion of dampening factors in our model results in a better approximation of the real world.

take-up than if we assumed a specific dampening factor instead. Therefore, we consider this to be a deviation from the presentation of our approach (given the circumstances of the model variable) rather than a deviation from our general modelling approach.

Default dampening factor

A10.27 Unless otherwise stated, we forecast using a three-year moving average growth rate with a dampening factor of 1.4. We consider this dampening factor is appropriate when volumes are relatively stable (i.e. limited fluctuations) since it is close to 1 (equivalent to applying no dampening factor). Furthermore, it is consistent with the dampening factor applied in 2014 which adds to regulatory certainty.[81]

Alternative dampening factors

A10.28 We note that an alternative dampening factor (i.e. not 1.4) is applied when we consider actuals to be particularly different to future growth, e.g. when a service is relatively new and has recently experienced very high growth which is likely to slow down going forwards.

A10.29 Furthermore, we consider it appropriate to not apply a dampening factor if recent actuals appear to be consistent with a long-term trend. For example, if volumes have been stable for the last three years and we have no reason to suggest that demand for that service will change over the charge control period.

A10.30 We note that market conditions could change within the review period such that historical trends are not an accurate representation of trends within the charge control period. We have compared our forecasts with forecasts from other sources (e.g. BT and other telecoms providers, as well as external consultant reports). This allows us to sense-check our forecasting assumptions (including our dampening factors) to determine their robustness against data from stakeholders and independent sources.

General forecasting assumptions

A10.31 Consistent with the 2014 FAMR Statement volume forecast model, we have identified five general assumptions that we use to drive our service volume forecasts:

- the change in the number of households;
- the change in the number of mobile-only households;
- the change in the number of business sites;
- the number of Openreach lines per fixed line household/business; and
- standard and superfast broadband take-up.

[81] We consider it appropriate to assume a default dampening factor of 1.4 as this will ensure consistency with the previous volume forecasts.

A10.32 For each of these parameters, we set out below what they are, how we incorporate them within the volumes model, and the evidence and rationale to support our proposed assumptions.

Number of households

A10.33 The Department for Communities and Local Government (DCLG) publishes forecasts for the number of UK households[82] based upon ONS population projections.[83] We have adjusted the DCLG calendar year forecasts into mid-year financial year forecasts[84] to be consistent with the actuals that BT has provided for WLA and WFAEL line rentals.

A10.34 We do not agree with BT's submission[85] that the uncertainties involved in forecasting household growth mean that our forecasts should instead be based on dwellings. We consider it likely that dwelling[86] forecasts are correlated with household forecasts and in fact observe similar proportional growth rates for the household and dwelling figures that BT has submitted.

A10.35 We note that recent dwellings growth (as provided in BT's response) suggests a flattening to around 0.6% increase per annum. This is compared to the average per annum household growth in the volumes model of around 0.9% over the charge control period. Therefore, we consider it unlikely that the use of dwelling growth will significantly impact our forecasted unit costs.

A10.36 In any case, the DCLG does not publish dwelling forecasts so to account for dwelling growth we would likely need to adjust household growth forecasts or extrapolate dwelling growth from these figures.

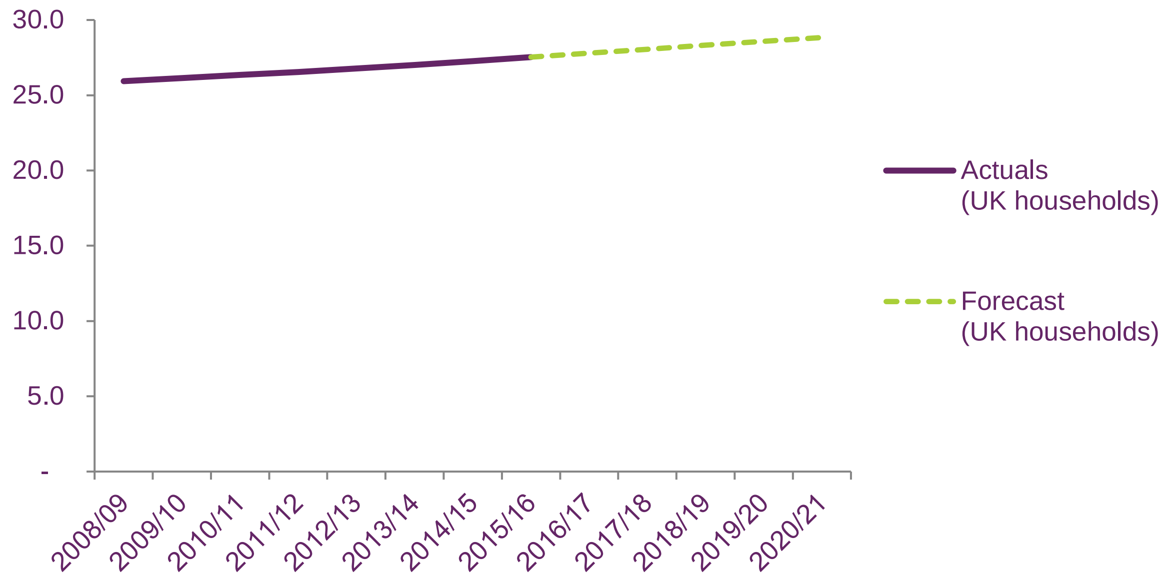
A10.37 We do not consider it appropriate to adjust household growth to account for recent dwelling growth being below household growth. Furthermore, we consider it appropriate to use the long-term forecasts published by the DCLG rather than make assumptions of our own. As part of our work to set charge controls for WLR and LLU in the 2014 FAMR we met with the DCLG[87] who told us that adjusting the long term forecast to account for short term restrictions or effects has historically proven not to be as accurate as simply using the long-term forecast.

[82] A household is defined, as in the 2001 census, as one person living alone or a group of people living at the same address with common housekeeping, i.e. sharing either a living room or at least one meal a day.
[83] DCLG, *Live tables on household projections*, 12 July 2016 http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households
[84] Our understanding is that the reported DCLG figures are based upon mid-year calendar year values. Therefore, we have converted the DCLG figures into financial years by adding 0.25 of the growth in that year to the reported calendar year figure.
[85] BT, Non-confidential response to the May 2016 WLA Consultation on fibre cost modelling, 10 June 2016, paragraph 76 to 81.
[86] The 2011 Census defines a dwelling as a single self-contained household space (an unshared dwelling) or two or more household spaces at the same address that are not self-contained, but combine to form a shared dwelling that is self-contained.
[87] Meeting with DCLG, 7 November 2013.

A10.38 As such, we are of the view, as in the 2014 FAMR statement[88], that adjusting our household forecasts to account for dwellings growth would not improve the accuracy of our household forecasts.[89] Therefore, we consider it unlikely that the use of dwelling growth will result in better volume forecasts and in any case, it is unlikely to result in significantly different forecasts.

A10.39 We forecast UK households to increase from 27.5 million households in 2015/16 to 28.8 million in 2020/21. We expect this increase in UK households to flow through to an increase in the number of Openreach lines, although not on a 1-to-1 basis.

Figure A10.3: Forecast of UK residential households (in million)



Source: Department for Communities and Local Government (including Ofcom adjustment to create mid-year values)
http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households

Mobile-only households

A10.40 We consider it appropriate to remove households with no fixed line as these households do not contribute to Openreach's service volumes. We refer to these as 'mobile-only households' and have forecasted the proportion of UK households that fall under this category, based on the last three years of actuals. This is consistent with the 2014 FAMR Statement, where we recognised that the decline in the proportion of mobile only households was a key parameter affecting the number of fixed lines.

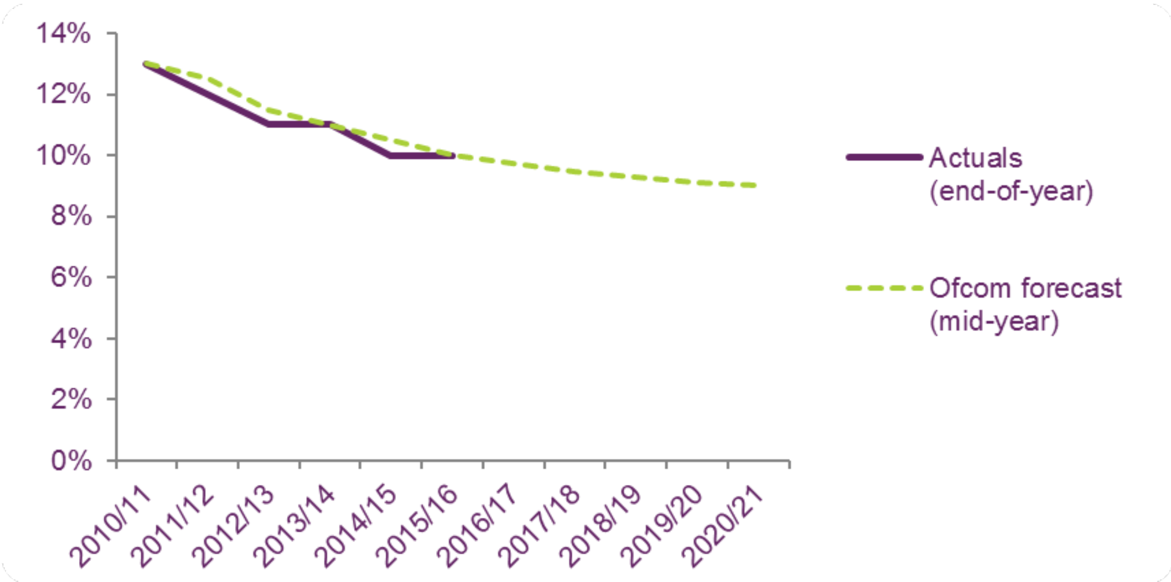
[88] Ofcom, 2014 FAMR Statement, paragraphs A24.90 to A24.96.
[89] The DCLG also stated that its household projections are extensively used in Local Authority planning. As such, the future supply of dwellings is not independent of the DCLG's projection of households, as a projection of excess demand for households may, for example, lead to the release of more land for development.

A10.41 We note that the survey results published in the Ofcom Technology Tracker[90] (the source of our mobile-only actuals) have a margin of error in the region of plus or minus two percentage points. However, we consider this survey to be the best available source for determining mobile only households.

A10.42 The proportion of UK households that are mobile-only has steadily declined in the last three years but appears to have flattened at around 10%. We consider the relatively low data usage caps for mobile broadband compared to fixed broadband, with the increasing demand for data, is likely to limit the willingness of customers to only use mobile broadband. We do not expect the increased take up of LTE[91] to change this trend over this charge control period.

A10.43 We have used a three-year moving average growth rate to continue the historical decline but with a dampening factor of 1.6. This is to recognise the potential flattening in 2015/16 and ensures that the proportion of mobile only households does not drop below 9% over this charge control period. Figure A10.4 below shows the forecast proportion of mobile only households in the UK.

Figure A10.4: Forecast of the proportion of UK households that are mobile-only



Source: Ofcom Technology Tracker (survey fieldwork between January and February each year)

Business sites

A10.44 We consider it appropriate to only consider the forecasted growth of small and medium sized enterprises (SMEs)[92] as it is likely that larger businesses would

[90] Ofcom, *Technology Tracker*, for each year the data is of Quarter 1 for 2009-2014 and Half 1 for 2015-2016 but for all the fieldwork period of January to February is used https://data.gov.uk/dataset/technology-tracker-wave-3-2012.

[91] Long Term Evolution ("LTE"), also known as 4G, provides faster data rates than 3G. Furthermore, we note the recent auctions of below 1 GHz spectrum to be used for 4G which is likely to result in better penetration of mobile data signals within households.

[92] The most frequently used upper limit for SMEs is 250 employees so we have calculated the number of firms with 1 to 249 employees. We note that this is consistent with our approach in the 2014 FAMR Statement and that a similar figure is obtained if we only looked at firms with 1 to 49 employees.

obtain a service using a leased line rather than a WLA or WFAEL based product. We have used historical data on the number of registered sites for SMEs published by BEIS[93] to inform the starting point for our forecasts.

A10.45 The number of business sites significantly increased from 2012/13 to 2014/15. We expect this increase to continue over this charge control period although note that recent economic uncertainty may dampen future growth relative to recent actuals. We have used a three-year moving average growth rate with a dampening factor of 1.6.[94] We have picked a slightly higher dampening factor due to the observed flattening in 2015/16 and consider an dampening factor greater than 1.6 would inappropriately ignore the significant growth observed from 2012/13 to 2014/15.

Figure A10.5: Forecast of UK Business sites (millions)

Source: private sector businesses with 1 to 249 employees; Ofcom mid-financial year adjustment to data provided by the Department for Business, Innovation & Skills (BIS)[95]
https://www.gov.uk/government/statistics/business-population-estimates-2015

A10.46 It seems reasonable to expect a change in the economy to impact growth in the number of small and medium businesses. Therefore, we have created a flexible assumption that applies the percentage change in GDP to the business growth rate, although in our base case we do not apply this adjustment. We have used the most recently available externally produced and published GDP forecast from the OBR.[96]

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[93] BIS, *Business population estimates*, October 2015 https://www.gov.uk/government/statistics/business-population-estimates-2015.

[94] We note that significant growth has occurred only over the last three years when previously business sites remained stable. Therefore, to be consistent with the reasonable long term expectation that trends will level off we have applied a dampening factor to smooth trends within the model.

[95] We adjusted the beginning of calendar year figures provided by BIS into mid-year financial figures consistent with our household forecasts and Openreach service volumes (actuals).

[96] OBR, March 2016, *Economic and fiscal outlook – March 2016.*

Openreach lines per fixed line household/business

A10.47 We have estimated the number of Openreach residential and business lines by applying the industry level split of residential and business fixed lines to total Openreach lines. We have used data on the total number of UK business and residential fixed lines, at an industry level, which is consistent with the information published in Ofcom's annual Communications Market Reports.[97]

A10.48 We found that the number of Openreach lines per fixed line household has remained relatively stable at around 0.87 since 2011/12. Therefore, we have used a three-year moving average growth rate with no dampening factor to continue this flat trend.

A10.49 We also found that the number of Openreach lines per business site has continually declined between 2011/12 and 2015/16 from 3.41 to 2.64. Business lines appear to be in long term decline, even with recent growth in the number of business sites. We consider it likely that this trend is due to the declining use of ISDN and increasing take-up of VoIP as an alternative to traditional fixed voice calls.[98]

A10.50 We have used a three-year moving average growth rate to continue this decline, with a dampening factor of 1.4. We do not see any factors which would cause this underlying trend to significantly change over this charge control period. Therefore, we do not consider it appropriate to apply a greater dampening factor.

A10.51 We have also included flexible assumptions that account for the impact of the PIA remedy as well as Virgin Media's network expansion under Project Lightning. These flexible assumptions are to account for a potentially greater decline in the number of Openreach lines per household or business than indicated by the last three years of actuals. We have based our estimates of the potential impact of Project Lightning from Virgin Media's forecast.[99] The potential impact of PIA is calculated by Ofcom's assessment of the likely rollout and penetration rate (based on data from both informal and formal information requests to telecoms providers).

A10.52 These assumptions reduce the number of forecasted Openreach lines relative to the counterfactual of no impact from PIA or Project Lightning.[100] For example, the medium case assumption for Project Lightning assumes that [✂] (~1.6) million additional households move to Virgin Media's network by the end of the charge control period.[101]

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[97] We note that small differences can be observed due to the exclusion in the volumes model of business 'other' lines which we understand may include non-PSTN lines.

[98] Ofcom, *The Communications Market Report*, 6 August 2015, page 286. http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr15/CMR_UK_2015.pdf.

[99] Virgin Media's response dated 02 March 2017 to question 2 of the 3rd s.135 request, dated 07 February 2017.

[100] We consider it appropriate to smooth the volume impacts over the charge control period given the degree of uncertainty associated with these forecasts. Assuming a more precise year-on-year forecast may lead to spurious accuracy compared to our modelling simplification of estimating an overall impact and spreading this evenly over the charge control period.

[101] We have assumed a penetration rate of 35%, 40%, and 45% for the low, medium, and high scenarios respectively and applied this to Virgin's total forecasted [✂] (~4) million premises passed by Project Lightning. We have used the Project Lightning forecasts as this is a significant investment by Virgin Media that is both publicly known and already underway.

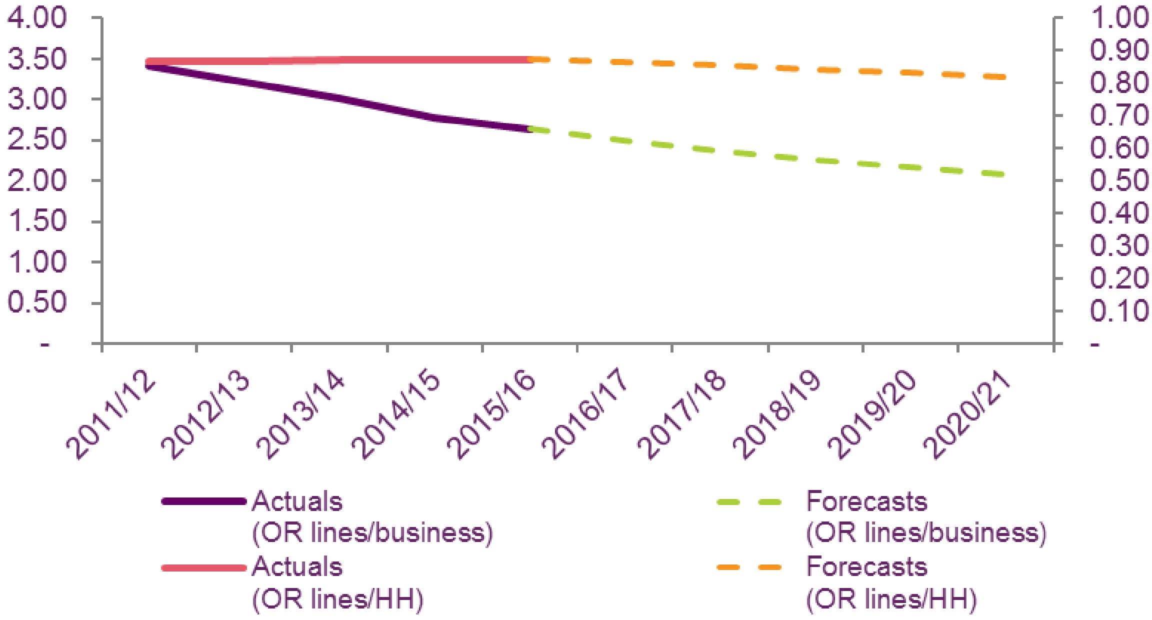
A10.53 There is a significant degree of uncertainty around the impact of our PIA remedy on volumes over the charge control period. We have included a range of estimates for the number of households which will use fixed voice and broadband services provided over a new access network built using PIA by the end of the charge control period. This range is based on estimates of the number of homes passed by new access networks built using PIA and the penetration rates that could be achieved. In our high case, we assume one million homes passed by the end of the charge control period (based on our assessment of the likely maximum speed at which a new access network can be deployed in the first years of deployment) and an assumption about penetration of 40%. This results in 0.4 million households using fixed voice and broadband services provided over a new access network built using PIA by the end of the charge control. Given the uncertainty over the charge control period, we have taken a more conservative approach for our medium and low case assumptions for PIA where we assume 0.15 million and 0.04 million respectively. In our base case, these reductions are applied specifically to broadband lines (both SBB and SFBB) and so do not affect voice-only lines.

A10.54 We have modelled the impact by calculating an average per annum forecast and applying this to each of the modelled years, except for PIA where we apply the impact from 2018/19 onwards (i.e. when the new PIA remedy will be implemented). In other words, we have assumed a per annum change in Openreach lines of around 0.3 million per annum due to Project Lightning and 0.05 million per annum due to PIA.

A10.55 We recognise that the impact on each year of the charge control may vary but we consider it appropriate to apply this modelling simplification. This is because the forecasted impact of network competition is relatively uncertain and forecasting the impact for each year adds to that uncertainty. Therefore, we consider it inappropriate to add any further complexity when it is unlikely to result in a more accurate forecast.

A10.56 Our forecasts are shown in Figure A10.6 below with the left-hand axis showing the lines per business site and the right-hand axis showing the scale for residential lines per household.

Figure A10.6: Forecast of Openreach lines per household (HH) and per business site



Source: Ofcom forecast based upon Openreach actuals and applied to BIS and DCLG forecasts with Ofcom adjustments (e.g. for PIA and Project Lightning).

A10.57 We recognise that the impact of the PIA remedy and Project Lightning on WLA service volumes in this charge control period adds to the uncertainty of forecasting service volumes. Therefore, we have included low and high volume scenarios that allow us to test the sensitivity of our volume forecast assumptions with regards to forecasted unit costs. The results of this sensitivity analysis are shown in Annex 14.

Broadband and superfast broadband penetration

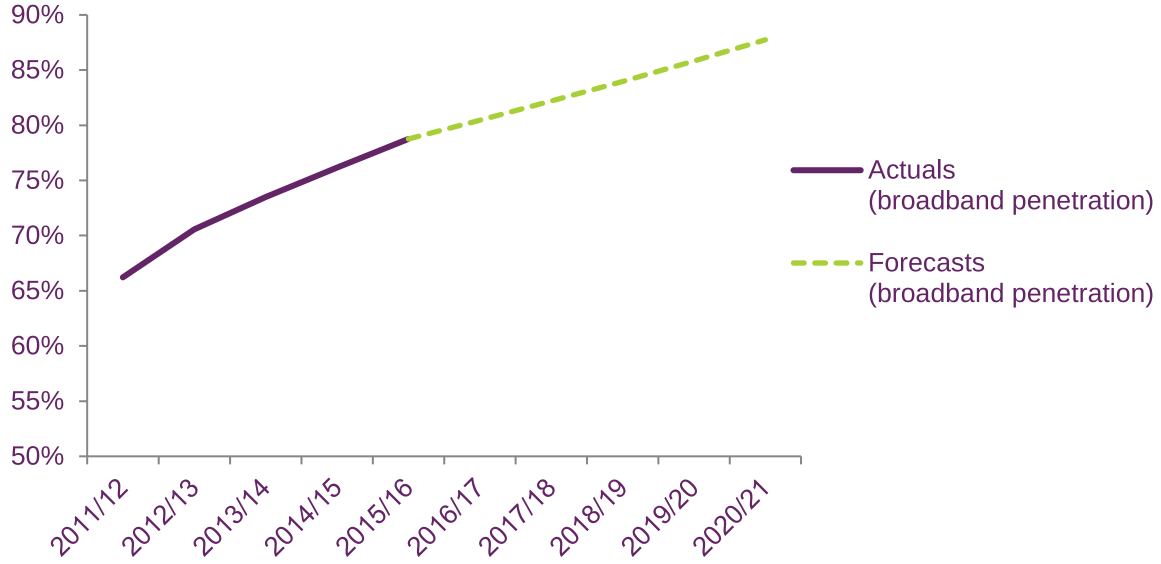
A10.58 We refer to the take-up of broadband for Openreach lines as “broadband penetration” which includes both SBB and SFBB services. We refer to the relative take-up of SFBB to overall broadband take-up as “superfast broadband penetration”.

A10.59 We have observed that the take-up of broadband for Openreach lines has continuously increased since 2011/12, but this trend has recently started to flatten off. Based upon the more recent growth in broadband penetration for Openreach lines, we have assumed a per annum growth rate of 2% up until 2020/21. We consider it likely that broadband take-up of Openreach lines will continue to grow at the current rate such that it will reach 88% by 2020/21.[102]

A10.60 Our forecasts for broadband penetration in this charge control period are set out in Figure A10.7 below, in light of the historical growth since 2011/12.

[102] We consider this to be consistent with Analysys Mason’s forecast of residential broadband household penetration which appears to [✂] in 2016. This is [✂] than our own forecasts but we note that our forecast does not include households supplied by Virgin Media which will have a higher broadband penetration than Openreach lines.

Figure A10.7: Forecast broadband penetration of Openreach lines



Source: Ofcom forecast based upon Openreach actuals

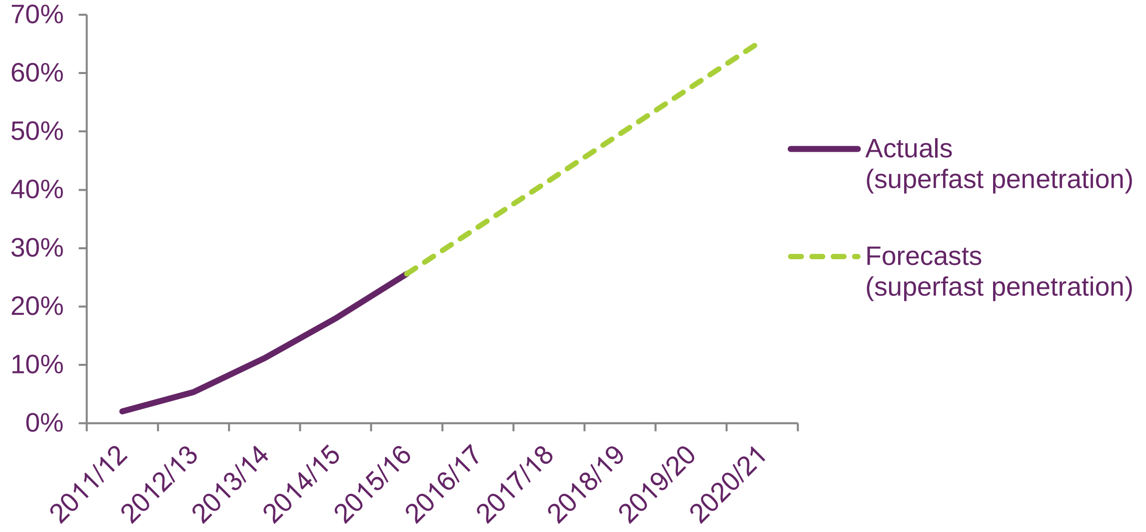
A10.61 We consider it likely that this growth will flatten after 2020/21 as the market tends towards full saturation. Therefore, we use a three-year moving average growth rate with a dampening factor of 1.4 after 2020/21 to slowly flatten this 2% per annum growth. This leads to our forecasted fixed line broadband penetration tending towards 96% by 2028/29.

A10.62 SFBB penetration (which in this context we mean the proportion of Openreach broadband lines that use GEA) has continually increased since 2011/12. We have assumed that SFBB penetration will increase by 8% per annum during this charge control period, excluding the impact from network competition[103]. This 8% is based on the observed 2015/16 increase and the fact that SFBB has been increasing over the last three years (thus we consider it appropriate not to dampen the 2015/16 actual).

A10.63 This results in 66% of Openreach broadband lines being superfast in 2020/21. The figure below shows our forecasts for the increase in SFBB penetration for the next charge control period.

[103] Given that we apply the impact of network competition on broadband lines only, this results in the final broadband penetration figures to be slightly lower than if we assumed no impact from network competition.

Figure A10.8: Forecast superfast penetration of Openreach broadband lines



Source: Ofcom forecast based upon Openreach actuals[104]

A10.64 We consider it appropriate to dampen this rapid growth in superfast broadband penetration after 2020/21 as the market tends towards full saturation near the end of the forecasted period (i.e. 2028/29). We have applied a three-year moving average growth rate to continue this growth but with a dampening factor of 2, leading to superfast penetration to flatten around 87% in 2028/29.[105]

A10.65 We note that BT considers it important to explicitly model consumer trends in data consumption and bandwidth requirements over the forecast period. Our broadband penetration forecasts (both for superfast and standard) do not explicitly set out these customer demand variables. Instead, we have used historical trends to estimate future trends, which implicitly models customer demand. In order to address the uncertainty of future demand, we have determined low and high scenarios and assessed the impact that this has on unit costs (see Annex 14 for our sensitivity and scenario analysis).

A10.66 Furthermore, we have assessed our forecasts against alternative sources and do not consider them to differ widely. We note that our GEA forecasts are [✂] than forecasts provided by Analysys Mason (who forecast the [✂] GEA volumes out of all the sources we have considered). We find that our forecasts are lower than BT's forecasts up until 2019/20, [✂]. We note that BT forecasts a [✂] of FTTC growth after 2019/20 which is likely due to BT's expected [✂][106].

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[104] BT's response dated 25 February 2015 to the clarification question L of Ofcom's follow-up dated 4 February 2016 for the 1st s.135 information request and BT's response (dated 12 September 2016) to Question 25 of the Second joint WLA WBA s135 request (dated 18 August 2016).

[105] If we applied a dampening factor of 1.4 or lower, our model forecasts negative volumes for copper broadband lines (which is clearly not feasible), thus we have applied a dampening factor greater than 1.4. We also consider it reasonable to expect superfast broadband penetration of 87% in 2028/29 but have low and high scenarios for this assumption.

[106] BT's follow-up response dated 27 October 2016 to questions 24 and 26 of the 2nd joint WLA WBA BT s.135 request.

A10.67 Furthermore, we consider it unlikely that growth in superfast take-up will increase over the charge control period relative to the growth observed over the last two years. It is often the case with new technology that early adopters quickly move to the new product whilst the average customer gradually switches, which is why we forecast a flattening of superfast broadband growth after the charge control period. We do not consider it likely that take-up of SFBB will dampen (relative to historical take-up) over the charge control period given our proposed remedies for GEA.[107] Furthermore, our forecasts of FTTC in 2020/21 are in between the range of alternative forecasts that we have considered (including forecasts provided by non-BT telecoms providers).

Figure A10.9: Comparison of GEA-FTTx forecasts, 2011/12 to 2020/21 (millions) [✂]

✂

✂

Source: Ofcom forecast from BT data.[108]

A10.68 Based on the general forecasts above, we now set out our forecasts for specific WLA and WFAEL services. Although we make specific assumptions for individual services, these general forecasts provide the underlying market trends and thus have an impact on individual service volumes.

Copper volume forecasts

Forecast drivers and assumptions

A10.69 In this section, we set out the assumptions used for forecasting specific copper services. We have requested actuals (from 2012/13 to 2015/16) and forecasts (from 2016/17 to 2020/21) for copper service volumes from BT and other telecoms providers using our statutory information gathering powers. We have used these data to determine our forecasts for Openreach copper services. Where possible, we have used publicly available service volumes from the RFS in order to improve the transparency of our modelling.

A10.70 Forecasting specific services is often difficult as these volumes can be affected by the complex interaction of various factors. Where we believe it would not introduce material error, we have forecast service volumes using simple methods, e.g. extrapolating current trends. Alternatively, we forecast some ancillary service volumes using the historical relationship of that service to its underlying line rental service, and apply this to the relevant forecasted line rental service.

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[107] We note that we have explicitly estimated the impact of network competition into our volume forecasts and so any impact will have already been factored into our model.

[108] BT's response dated 25 February 2015 to the clarification question L of Ofcom's follow-up dated 4 February 2016 for the 1st BT s.135 information request; BT's response dated 12 September 2016 to question 26 of the 2nd joint WLA WBA BT s.135 request; and BT's follow-up response dated 27 October 2016 to question 26 of 2nd joint WLA WBA BT s.135 request; Analysys Mason incumbent FTTx forecasts (August 2015 report).

A10.71 In addition to our general forecasting parameters, we also consider the following key parameters will significantly influence demand for copper services:

- the potential for further LLU rollout; and
- internal and external split of Openreach broadband volumes.

A10.72 We set out below the definition of each of these parameters, how we have used the parameters and the rationale for our approach.

The potential for further LLU rollout

A10.73 In the 2014 FAMR Statement we anticipated that LLU rollout would slow down, since the customer base in the remaining exchanges that were not yet unbundled was small.[109] Consistent with our previous expectation, we consider it likely that LLU rollout will continue to be very limited in this charge control period as supported by the flattening of MPF Rentals over the last few years.

A10.74 This expectation of limited further LLU rollout is particularly relevant for forecasting co-mingling new provides, as well as LLU single and bulk migrations. However, it is also an important driver for our forecasted split of MPF and WLR+SMPF for copper broadband lines, as discussed below.

Internal and External Split

A10.75 An internal copper line is one that BT internally purchases from Openreach, whereas an external copper line is one that is purchased by a non-BT telecoms providers. We have assumed a per annum decline in the proportion of internal copper broadband lines of 1% over the charge control period.[110]

A10.76 We note that the limited potential for further LLU rollout is likely to result in a gradual (rather than substantial) decline in the internal proportion of copper broadband lines. This is particularly the case if telecoms providers focus on upgrading customers to SFBB rather than expanding customer reach.

A10.77 We forecast internal SMPF Rentals based on growth in copper broadband lines and the assumed change in the internal share of copper broadband lines. However, we forecast external SMPF Rentals differently as these services are driven by a different underlying factor (i.e. migration to MPF).[111]

A10.78 For WLR Rentals we forecast the internal and external split based upon the average proportion over the last three years of actuals and held constant into the future. This is because the internal and external split for WLR Rentals has been relatively stable since 2011/12. We note that it is possible for these ratios to change due to a new entrant using WLR with GEA. However, we have applied this modelling simplification given that the internal and external split of WLR does not

[109] 2014 FAMR Statement, paragraph A24.199.

[110] We have included a flexible assumption that applies the PIA impact to external volumes only which acts counter to this 1% per annum change (i.e. internal share of copper broadband lines declines by slightly less than 1% per annum). However, in our base case we assume that movement to alternative networks will apply proportionally to internal and external volumes (based on the in-year mix).

[111] Specifically, we use a three-year average growth rate with a dampening factor, thereby using the historical decline to forecast future switching of external SMPF to MPF.

impact our forecasted unit costs. Furthermore, we find that our external WLR forecasts are consistent with the forecasts from other telecoms providers.

A10.79 We consider these assumptions appropriate given the maturity of the copper WLA and WFAEL market and the limited additional LLU rollout expected within this charge control period.

WLR Volumes

A10.80 Total WLR Rental forecasts are based upon the difference in the forecasted total Openreach lines and forecasted MPF lines. We note that BT forecasts a significantly greater decline in WLR compared to our forecasts, which is primarily driven by BT's external WLR forecasts. We note that the volume forecasts from non-BT telecoms providers indicate relatively stable WLR forecasts. Therefore, we consider it appropriate to forecast a slight decline in total WLR Rentals. These WLR volumes are used as part of our common cost allocation as set out in Annex 11.

Analogue Core and Premium WLR Rentals

A10.81 WLR Rentals include both Analogue Core WLR Rentals and Analogue Premium WLR Rentals (as defined in the RFS). Analogue Core WLR Rentals are voice line rentals primarily used by residential customers, whilst Analogue Premium WLR Rentals are voice line rentals primarily used by business customers.

A10.82 In the last three years, the core and premium split for WLR Rentals has maintained a stable ratio and we expect this trend to continue. Therefore, we use the average ratio (over the last three years) to forecast the split of WLR service volumes. However, we note that this assumption has limited impact on forecasted unit costs given we propose to not charge control WLR Rentals.

A10.83 Similarly, the internal and external split for these services has maintained a stable ratio and we expect this trend to continue. Therefore, we use the average ratio (over the last three years) of internal and external WLR Rentals to forecast WLR service volumes.

A10.84 We do not separately forecast different service levels for WLR Rentals in the volumes model. However, we take into account the different service level mixes within the top-down cost model as part of our QoS adjustments (see Annex 11).

WLR Connections

A10.85 The WLR Connections service is used to connect households such that a WLR Rental can be purchased. The volume of these services are primarily driven by the number of home movers, migrations from cable, and new household formation. In the light of this, we consider it a reasonable assumption that the number of WLR Connections is a stable proportion of the number of WLR Rentals.

A10.86 For external volumes, we forecast the number of WLR Connections by carrying forward the average ratio between WLR Connections and their respective WLR Rentals that we have observed over the last three years.[112] However, we have found that the ratio of internal WLR Connections to their respective internal WLR Rentals has steadily fallen over the last three years. Therefore, we have used the

[112] This means that the internal and external split for WLR Rentals is also applied to the WLR connections.

most recent (i.e. 2015-16) ratio for internal WLR Connections. We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

WLR Transfers

A10.87 WLR Transfers are used when end customers change their WLR provider. We found that demand for WLR Transfers has significantly fluctuated between 2011/12 and 2015/16. However, internal volumes have become relatively more stable since 2014/15 and external volumes have become more stable since 2013/14.

A10.88 To some extent, the volume of WLR Transfers is driven by the take-up of MPF but the relationship is complex.[113] We consider further LLU rollout to be limited and so we expect WLR Transfers to have reached a stable equilibrium. We expect the number of WLR Transfers to fluctuate during the charge control period but to generally follow the change in WLR Rentals.[114]

A10.89 Therefore, we forecast the volume of WLR Transfers based upon the historical ratio of WLR Transfers to their respective WLR Rentals. We apply the same ratio to all forecasted years. For the internal ratio, we use an average of the last two years of actuals, recognising the relatively more stable ratios for internal WLR transfers over the last two years. For the external ratio, we use an average of the last three years. We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

WLR Conversion

A10.90 WLR Conversion is a service used to migrate from MPF to WLR purchased without SMPF (a migration from MPF to WLR + SMPF is likely to be a simultaneous conversion, which we forecast separately). We consider it likely that these (non-simultaneous) conversion services are primarily driven by the number of MPF Rentals. This is because as the number of MPF Rentals increases, the greater the churn from MPF each year which increases the likelihood that a customer moving to a telecoms provider using WLR (without SMPF) [115] is moving from a telecoms provider using MPF.

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[113] As telecoms providers move from using SMPF to MPF, this results in a decline of WLR rentals as well as a reduction in churn between telecoms providers using WLR as the number of purchasers of WLR other than BT reduces.

[114] We note that in the 2013 FAMR Consultation we did not link WLR Transfers to WLR Rentals (see paragraph 8.79) as we expected the decline in WLR Transfers to be greater than the decline in WLR Rentals. This was because we expected WLR rentals to become largely used by just one telecoms provider (i.e. downstream BT), thus the opportunity for intra-WLR migrations would significantly reduce. We kept this approach in the 2014 FAMR Statement (paragraphs A24.163 to A24.164). We consider it likely that the most recent actuals will have incorporated this reduction in intra-WLR migrations (this is supported by the change in the transfer-to-rental ratios), so we consider it appropriate to now link our forecasts for WLR Transfers to our forecasts for WLR Rentals.

[115] We note that this includes any movement from MPF to WLR + GEA as we understand such a migration would require a WLR Conversion with an appropriate GEA connection service. Therefore, because we expect in some case for WLR to be bought with GEA, we continue to expect WLR Conversions to have significant and growing volumes.

A10.91 We find that the ratio of internal WLR Conversions to MPF Rentals has fluctuated over the last three years. However, the ratio of external WLR Conversions to MPF Rentals has gradually decreased over the last three years.

A10.92 Therefore, we forecast the volume of WLR Conversions based upon the historical ratio of WLR Conversions to total MPF Rentals. We apply the same ratio to all forecasted years. For determining the internal ratio, we have used an average of the last three years of actuals, whilst for the external ratio we have just used the 2015/16 ratio.[116] We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

MPF Volumes

MPF Rentals

A10.93 MPF Rental volumes have increased over recent years and we forecast they will continue to do so. This is primarily driven by the increase in broadband penetration and migration from SMPF to MPF or WLR + GEA to MPF + GEA.

A10.94 We forecast MPF Rentals based on our forecast of external GEA volumes (minus our forecast of WLR + GEA services) and the copper broadband volumes that remain when we exclude SMPF Rentals. We note that our forecasts for WLR with GEA is based on information provided by other telecoms providers (e.g. [✂]). However, we have used a three-year average growth rate and dampening factor of 1.4 to forecast [✂] (provider) usage after 2018/19. Furthermore, we have extrapolated [✂] (provider) forecasts since it did not directly provide forecasts for the combination of WLR and GEA.

A10.95 We forecast a continuing increase in MPF Rentals over the charge control period, which is consistent with forecasts from telecoms providers. We found that forecasts for MPF Rentals from non-BT telecoms providers show [✂], and BT's forecasts show a flattening in MPF growth. We consider it likely that other telecoms providers will have a better understanding of future demand for MPF than BT. Our MPF rental forecasts are broadly in between BT's and other telecoms providers' forecasts, [✂].

A10.96 We do not separately forecast different service levels for WLR Rentals in the volumes model. However, we take into account the different service level mixes within the top-down cost model as part of our QoS adjustments (see Annex 11).

MPF New Provides

A10.97 MPF New Provides are primarily purchased when a customer moves into a household that did not previously have a WLR connection. These can be either new households or users churning from cable services.

A10.98 There has been an increase in the usage of total MPF New Provides over the previous three years, triggered by the take-up of MPF. We expect that the number of MPF New Provides over the forecast period will continue to broadly be the same and will trend with MPF Rentals.

[116] We consider it appropriate to use the most recent data point (i.e. in 2015/16) given that it is unclear whether the ratio will continue to decline or fluctuate in the future, thus we use the most up-to-date reflection of demand.

A10.99 However, we have found that the ratio of external MPF New Provides to external MPF Rentals has gradually fallen over the last few years and flattened in 2015/16. Therefore, we forecast that MPF New Provides will increase in line with MPF Rentals, using the 2015/16 ratio of new provides to rentals which we apply across all modelled years.[117]

MPF Single Migrations

A10.100 MPF Single Migrations are caused by churn to MPF from either WLR or a different MPF provider. The increase in broadband penetration and LLU rollout are possible drivers of this service. We consider it likely that the increase in broadband penetration (both SBB and SFBB) will be the more dominant driver, given limited further LLU rollout expected in this charge control period. We might expect churn to fall as customers migrate to SFBB and require faster and more reliable speeds, which appears to be supported by the last three years of actuals.

A10.101 We consider that MPF Single Migrations will increase in line with total Openreach broadband lines.[118] We note that the ratio of MPF Single Migrations to total Openreach broadband lines has declined over the last few years (suggesting a falling churn rate). We have used the 2015/16 ratio to forecast MPF Single Migrations.[119]

MPF Bulk Migrations

A10.102 MPF Bulk Migrations are driven by telecoms providers moving large quantities of customers from WLR plus SMPF to MPF. This primarily occurs in exchanges where a telecoms provider has added MPF capability at an exchange.

A10.103 In the 2014 FAMR Statement, we forecasted external MPF Bulk Migrations based upon the reduction in external SMPF lines less those customers on SMPF that would have churned to other providers during that year. In other words, MPF Bulk Migrations were modelled as the remaining reduction in SMPF once churn had been accounted for.

A10.104 If we were to apply the same approach, our model would need to assume a churn rate of less than 9%, which may be inconsistent with the churn rate of around 15% in 2011/12, otherwise we would forecast negative volumes by the end of the charge control. We note that the last two years of actuals suggest stable volumes for MPF Bulk Migrations but such a modelling approach would be inconsistent with the substantial reduction from 2013/14 to 2014/15.

A10.105 Therefore, we consider it appropriate to adjust the 2014 approach whilst maintaining the same logic (i.e. MPF bulk migration is still driven by moves to MPF from WLR+SMPF). We consider it reasonable to assume that telecoms providers are in a period of migrating their existing user base at a steady state and that this might last for the next two or three years. However, afterwards there will no longer

[117] We consider it appropriate to use the most recent actual, consistent with the approach in the 2014 FAMR Statement, given that this decline is likely due to limited LLU rollout which we consider is likely to continue over the charge control period.

[118] Total Openreach broadband lines is taken as total MPF lines plus total SMPF lines plus internal GEA lines.

[119] We consider it appropriate to use the most recent data point (i.e. in 2015/16) given that it is unclear whether the ratio will continue to decline or fluctuate in the future, thus we use the most up-to-date reflection of demand.

be enough SMPF customers for it to be worthwhile for other telecoms providers to migrate them in bulk.

A10.106 We note that it is possible that bulk migration to MPF may occur because of movement to GEA. This would happen if a telecoms provider wins some customers using WLR plus GEA on a case by case basis and then migrates them over to MPF with GEA at a later date. However, we consider it unlikely that this will occur, and the forecasts provided by other telecoms providers support this view.

A10.107 Therefore, we have forecast external MPF Bulk Migrations based on the reduction in external SMPF lines less those customers that churned to other providers during that year. However, when this estimate results in negative volumes, we have set MPF Bulk Migrations to zero (which in our model occurs in 2019/20). We have assumed zero internal MPF Bulk Migrations, consistent with the observed actuals.

Co-Mingling New Provides

A10.108 Demand for Co-Mingling New Provides is caused by unbundling exchanges and capacity expansion. At a detailed level, the volumes of co-mingling new provide services are driven by parameters which are difficult to predict, such as the spare capacity telecoms providers have in their already installed racks and in each BT exchange, and market share fluctuations in different geographies.

A10.109 The number of room builds in the forecast period is expected to decrease as the level of new unbundled exchanges decreases. However, we note that there are also upgrade services within the Co-Mingling New Provides basket.[120] Therefore, it is not clear whether overall volumes will necessarily fall for this basket of services.

A10.110 We have used a three-year average growth with a dampening factor of 1.4 to forecast Co-Mingling New Provides. However, as set out in Annex 11, we have adjusted the top-down model to hold unit costs flat for the co-mingling set up component (which is exclusively used by co-mingling new provide services).

Co-Mingling Rentals

A10.111 Co-Mingling Rentals are a collection of products relating to the running costs of building space used for unbundled lines used by telecoms providers other than BT. This building space is used for both MPF and SMPF equipment, depending on the exchange and the telecoms provider in question. Service volumes for Co-Mingling Rentals can increase due to further unbundling and capacity expansion, and can decrease due to decommissioning of old or under-utilised equipment and consolidation of MPF and SMPF providers.

A10.112 Between 2011/12 and 2013/14, the volume of Co-Mingling Rentals increased which was likely driven by the increase in broadband penetration and unbundling of exchanges (resulting in an increase in MPF Rentals). Going forward, we expect broadband penetration and MPF rental volumes to continue to increase which will result in service volume growth for Co-Mingling Rentals.

[120] For example, purchasing of HDF sub racks.

A10.113 Therefore, we forecast these services to trend with external LLU volumes using the most recent (in this case 2013/14[121]) ratio of Co-Mingling Rentals to external LLU rentals, and apply this ratio to the forecasted external LLU rentals.

SMPF Volumes

A10.114 Although we do not propose to charge control SMPF Rentals, we do propose to charge control SMPF Hard Ceases. Given that the forecasts for SMPF Hard Ceases is correlated with SMPF Rentals, we need to forecast SMPF Rentals.

A10.115 Furthermore, the volumes model is used by Ofcom as a tool for forecasting future demand and so is not solely used for forecasting unit costs in order to set charge controls.

<u>SMPF Rentals</u>

A10.116 The SMPF Rentals have been declining over recent years and we forecast they will continue to do so. This is primarily driven by migration from SMPF to MPF[122] and superfast broadband penetration (given that SMPF is not used with GEA).

A10.117 We forecast internal SMPF Rentals based on the forecasted growth rate in copper broadband lines and the forecasted change in the internal share of copper broadband lines.[123] Our forecasts of external SMPF Rentals are based on a three-year average growth rate with a dampening factor of 1.4. This results in the forecasted volume of external SMPF Rentals to flatten, consistent with our forecasted decline in MPF Bulk Migrations.[124]

A10.118 Our forecasts for external SMPF Rentals are consistent with the forecasts provided by other telecoms providers. We note that BT forecasts a significantly greater decline in total SMPF Rentals than we forecast in the volumes model. This is due to differences in both external and internal SMPF forecasts.

A10.119 For internal SMPF Rentals forecasts, the [✂] in SMPF is likely due to BT forecasting a greater increase in [✂] volumes.[125] We consider it unlikely that superfast broadband penetration will be significantly greater than forecasted in the volumes model, given our cross-checks. However, we have assessed this as a sensitivity (see Annex 14) to determine the impact that this might have on forecasted unit costs. For external SMPF forecasts, the [✂] is inconsistent with the forecasts provided by other telecoms providers.

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121 BT was unable to provide co-mingling rental volumes for 2014/15 and 2015/16 that Ofcom considered to be consistent over time. Therefore, we have used the 2013/14 ratio as this is the most recent figure that can be assessed against an historical trend.

122 This includes both the migration of external SMPF volumes to external MPF as well as migration of internal SMPF to external MPF within this charge control period.

123 In practice, this results in the decline in external SMPF resulting in an increase in external MPF on a 1-to-1 basis.

124 We note that external SMPF Rentals continue to decline after MPF Bulk Migrations are modelled to be at zero. We consider this to be consistent with a movement to SFBB and churn (e.g. movement from external SMPF to internal SMPF and upgrading from SMPF to GEA).

125 BT, Confidential follow-up response (dated 27 October 2016) to Question 24 and 26 of the Second joint WLA WBA s135 request.

A10.120 Therefore, we have not adjusted our forecasts for SMPF Rentals as we consider them to be appropriate in light of recent actuals as well as forecasts from other telecoms providers.

SMPF New Provides

A10.121 SMPF New Provides are used when a telecoms provider requires a new SMPF connection to a previously WLR-connected line. We understand that the volume of SMPF new provides per annum is primarily driven by new standard broadband customers, home movers, and churn from MPF-based service providers and cable.

A10.122 We do not expect the effect of home movers to change with time and so we believe SMPF New Provides can be effectively modelled as a percentage of the total SMPF Rentals. However, we expect that migrations from MPF will be implemented using Simultaneously Provided Conversions, which allows significant cost savings.

A10.123 Therefore, we forecast these services based upon the average ratio (over the last three years of actuals) of SMPF New Provides to SMPF Rentals and multiply this ratio by the forecasted volume of SMPF Rentals. We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

SMPF Single Migrations

A10.124 SMPF Single Migrations are driven by customers migrating their broadband from one telecoms provider using SMPF to another telecoms provider using SMPF. We expect these services to reduce as the number of SMPF lines falls.

A10.125 We forecast SMPF single migrations based on prior year churn from SMPF Rentals. For internal volumes, we use churn from external SMPF Rentals only and apply the likelihood that the customer migrates to BT and continues to use SMPF[126]. For external volumes, we use churn from total SMPF Rentals and apply the likelihood that the customer migrates to an LLU SMPF provider[127].

A10.126 We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

SMPF Bulk Migrations

A10.127 SMPF bulk migrations are caused by operators moving all their customers to SMPF, which we consider will be significantly less likely to occur going forwards. In the 2014 FAMR, we identified three potential drivers for SMPF bulk migration service volumes:

- LLU operators migrating their WBA customer base onto their on-net SMPF platform;
- migration of EE's LLU customers to BT Wholesale's SMPF platform[128]; and,

[126] This is calculated as the proportion of broadband lines that are internal SMPF for a given year.
[127] This is calculated as the proportion of broadband lines that are external SMPF for a given year.
[128] In April 2010, Orange (now EE) signed a deal with BT to switch its customers from LLU to BT Wholesale's network.

- migration of customer lines from IP-Stream to BT's 21CN Wholesale Broadband Connect platform.

A10.128 We expect all the above drivers to become less important over this review period because we have assumed:

- further LLU rollout to be limited and for other telecoms providers to prefer MPF over SMPF;
- all EE customers have been moved to BTW's network; and
- IP-Stream to WBC migration to slow down, or stop.

A10.129 Our forecast is based on an assumed reduction of SMPF Bulk Migrations of 80% year on year and held constant after 2020/21.[129] We have found this to be consistent with BT's forecasts which show a substantial decline in SMPF Bulk Migrations in 2016/17[130]. We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

SMPF Simultaneously Provided services

A10.130 As set out in the 2014 FAMR Statement, there are cost synergies where SMPF New Provide is simultaneously provided with WLR Conversions or WLR Connections.[131] We have forecasted these simultaneously provided services. We consider it likely that simultaneous provision of WLR and SMPF new connections will primarily apply to internal volumes in this review period.[132]

A10.131 We have requested actuals from BT for these simultaneously provided services. However, given that these services are relatively new products, BT was only able to provide actuals for 2014/15 and 2015/16. Therefore, we have attempted to estimate forecasts based on trends and ratios of related services, considering the two years of actuals.

A10.132 For the 2014 FAMR Statement, we forecasted Simultaneously Provided Conversions based on our estimate of MPF customer migration to a WLR+SMPF provider. Applying this forecasting approach results in forecasts that are substantially different from the actuals provided by BT. Therefore, we have instead used the most recent (i.e. 2015/16) ratio of Simultaneously Provided Conversions to standard WLR Conversions and applied this ratio to the standard WLR Conversion forecasts.

A10.133 We forecast Simultaneously Provided Connections based on the proportion of WLR lines which are consumed with SMPF in each year. We consider this to represent the likelihood of a new WLR Connection also taking an SMPF New Provide at the same time. We then apply this ratio to WLR Connections (both basic and premium).

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[129] In light of our assumed 80% year-on-year reduction throughout the charge control period, we forecast near zero volumes for SMPF bulk migrations after 2020/21.

[130] Given that two of the potential drivers for SMPF Bulk Migrations is determined by BT, we consider it likely that BT is well placed to forecast volumes for these services.

[131] 2014 FAMR Statement, paragraphs A8.93 and A8.99.

[132] Given the sunk costs of LLU rollout and the movement to superfast broadband in this charge control period, we consider it likely that non-BT telecoms providers will purchase MPF or WLR+GEA for new connections.

We note that our forecasts for this service do not impact our final forecasted unit costs since we propose to not charge control this service.

Hard Ceases

A10.134 Hard Ceases includes both MPF and SMPF Hard Ceases. These services are primarily used by telecoms providers where an MPF or SMPF service has been ceased but the jumpers have been left in place. Hard ceases then remove these jumpers. Left in jumpers may arise where lines are ceased due to home movers (i.e. homes becoming empty) and people churning away from LLU services (i.e. moving to other networks).

A10.135 We expect Hard Cease volumes to change in line with SMPF and MPF Rentals. Therefore, we consider it appropriate to forecast Hard Ceases based on historical ratios (between Hard Ceases and their respective rentals) and apply these ratios to our forecasted LLU rentals.

A10.136 We found that the ratio of internal Hard Ceases to internal LLU rentals has fluctuated around 10% over the last three years. The ratio of external Hard Ceases to external LLU rentals appears stable over the last two years.

A10.137 Therefore, we have used the last three years of ratios to determine the forecast ratio for internal Hard Ceases, and the last two years of actuals to determine the forecast ratio for external Hard Ceases.

Tie Cables

A10.138 Tie Cables connect from the Main Distribution Frame (MDF) to a telecoms providers' network equipment within the BT exchange. Each customer supplied by an LLU operator will be connected to that telecoms provider via a pair of copper wires on the tie cable. As such, we expect these services to be primarily driven by LLU rental volumes.

A10.139 Therefore, we forecast these services based on the average ratio (over the last three years of actuals[133]) of Tie Cables to LLU rentals and apply this to the forecasted LLU rentals. This forecasting method is used both for Tie Cables sold internally and externally.[134] We note that we have taken a different approach than in the 2014 FAMR Statement since the previous approach was inconsistent with the 2013/14 actuals.

Fibre volume forecasts

Forecast drivers and assumptions

A10.140 We have requested actuals (from 2012/13 to 2015/16) and forecasts (from 2016/17 to 2020/21) for fibre service volumes from BT and other telecoms providers using our statutory information gathering powers. We have used this data to determine our forecasts for Openreach fibre services.

[133] As with co-mingling rental volumes, BT was unable to provide consistent volumes after 2013/14. Therefore, we have used the 2013/14 ratio when forecasting.
[134] We note that this is different to our approach in the 2014 FAMR Statement. We found that our previous forecasting approach did not accurately predict recent actuals so we consider it appropriate to change our approach.

A10.141 There were 5.06 million GEA lines in 2015/16 (mid-year rental figure), out of which 5.02 million lines are FTTC with the remaining (c. 40,000) GEA lines being FTTP. Before forecasting the volumes of specific fibre services, we have had to consider how we deal with the following key factors:

- forecasting FTTP volumes as FTTC;
- internal and external split of fibre services; and
- how to split fibre volumes between commercial and non-commercial areas.

A10.142 We set out below what each of these factors are, how we've specifically modelled them and the rationale for doing so.

Forecasting FTTP volumes as FTTC

A10.143 As indicated in our May 2016 WLA Consultation on fibre cost modelling and as discussed in Volume 2, Sections 3 and 5 and Annex 9, in our bottom-up model we assume that all SFBB services are provided using FTTC based on VDSL2 technology. Therefore, in order to be consistent with the bottom-up model, the volumes model aggregates GEA-FTTP service volumes into the GEA-FTTC forecasts.

A10.144 We consider this appropriate given our general modelling approach and that GEA-FTTP service volumes (i.e. the FTTP wholesale product provided by Openreach) are currently low, and likely to continue to be low relative to GEA-FTTC over this charge control period. For the purpose of creating flexibility within the volumes model, we have included a switch which allows GEA-FTTP volumes to be separately forecasted.[135]

Internal and External Split

A10.145 An internal fibre line is one that BT internally purchases from Openreach, whereas an external fibre line is one that is purchased by a non-BT telecoms providers.

A10.146 We consider this reasonable given that other telecoms providers are likely to focus on obtaining SFBB customers and BT currently serves a large proportion of FTTC subscribers. Furthermore, we note that the internal proportion of GEA lines fell from around [✂]% (72-81)% in 2014/15 to around [✂]% (72-81)% in 2015/16.

A10.147 Therefore, we have assumed a [✂] (4-7)% per annum decline in the proportion of Openreach GEA lines that are internal in this charge control period.[136] We propose to forecast external volumes by subtracting the forecasted number of internal GEA lines from the forecasted number of total GEA lines. This results in nearly an equal split of internally and externally purchased GEA lines by 2020/21.

[135] We have also included an assumption on how we anticipate the proportion of GEA volumes that are FTTP will change over time. As a placeholder, we have assumed a 0.5% per annum increase in the proportion of GEA lines that are FTTP (with a low estimate of 0% and high estimate of 1%).

[136] We have included a flexible assumption that applies the PIA impact to external volumes only which acts counter to this [✂] (4-7)% per annum change (i.e. internal share of fibre broadband lines declines by slightly less than [✂] (4-7)% per annum). However, in our base case we assume that movement to alternative networks will apply proportionally to internal and external volumes (based on the in-year mix).

A10.148 After 2020/21, we forecast the proportion of GEA lines that are internal using a three-year moving average with a dampening factor of 1.6. We consider it unlikely that the forecasted change in internal to external split over the charge control period will continue past 2020/21 thus we have used a dampening factor greater than 1.4. We consider this a reasonable approach to forecast the internal and external split outside of the charge control period but note that it does not impact forecasted unit costs.

Commercial split

A10.149 BT has provided 2014/15 and 2015/16 actuals for the commercial split of GEA rentals, connections, and ceases. [137] We have assessed these splits and consider them to be reasonable.[138] Therefore, we have used these figures to calculate the commercial split for 2014/15 and 2015/16.

A10.150 The volumes model forecasts total GEA service volumes in light of actuals going back to 2011/12. We then calculate a “commercial conversion factor” which is the proportion of total GEA service volumes that is estimated to be commercial. This is then used to forecast commercial volumes for all modelled years.

A10.151 As explained below, we have separately estimated a commercial conversion factor for GEA Rentals[139] and GEA Ceases. We then calculate commercial GEA connections as a remainder based on our commercial GEA Rentals and commercial GEA Ceases.[140]

GEA Rentals

A10.152 The volumes model provides historical volumes prior to 2014/15 for the bottom-up NGA model. However, the GEA volumes available to BT, going further back than 2014/15, is not at the level of detail and granularity requested by Ofcom.[141] Therefore, the volumes model needs to estimate the commercial split for 2011/12 to 2013/14, noting that GEA volumes prior to 2011/12 would likely be almost entirely commercial.

A10.153 However, the historical commercial split has a limited impact on unit costs given that we are proposing to use a CCA approach for cost recovery within the bottom-up model. In order to assess the impact, we have considered two potential approaches, which can be flexed within the control module:

i) use a straight line trend from 2014/15 such that the commercial split is 100% in 2011/12;

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137 BT, Confidential follow-up response (dated 8 September 2016) to Question 5 of the Sixth s135 request (dated 20 May 2016).

138 For example, we found that the GEA service volumes split is [✂] to the split of repair and maintenance hours for GEA. We also found that the connection to rental ratio in subsidised areas is [✂] than in commercial areas for 2014-15 and 2015-16. We consider this reasonable given that subsidised areas are at a relatively earlier stage of take-up than commercial areas.

139 We have applied the GEA rental conversion factor to GEA bandwidth changes and GEA migrations.

140 In other words, GEA Rentals (end of Year 2) = GEA Rentals (end of Year 1) + GEA Connections (Year 2) – GEA Ceases (Year 2).

141 BT’s follow-up response dated 8 September 2016 to question 5 of the 6th BT s.135 request.

ii) use the in-year capex proportions as provided by BT.

A10.154 The benefit of the straight line approach is that it smooths historical commercial volumes and is a relatively simple to implement and understand. We might expect in-year capex to be correlated with the commercial volume split but it is unclear that this is the case. However, we note that our choice for historical commercial volume forecasts does not significantly change forecasted unit costs due to the CCA approach in the bottom-up model. We have assumed the capex data as a proxy since we consider this is the best use of available information.

A10.155 The key aspect of forecasting the rental commercial split is estimating the steady state figure (i.e. the proportion of total GEA Rentals that are commercial at the end of the model period). Once we have determined this figure, we have made assumptions about how we get from the current split to the final split.

A10.156 The steady state figure is calculated using the current and forecasted number of homes connected via subsidised FTTC cabinet deployment[142], adjusting for the potential impact of Project Lightning and the PIA remedy. We consider the forecasted commercial split of homes passed by cabinet to be an appropriate estimate for the steady state proportion of GEA Rentals[143], which we found to be around 69%. Therefore, we have assumed that in 2028/29 (i.e. the final year in our volumes model) the commercial conversion factor for GEA rentals would be 69%.

A10.157 We explicitly assume a per annum decline of one percentage point in the commercial conversion factor for GEA Rentals during the charge control period, given that this results in a smooth trend from actuals to the assumed steady state. After which, we assume that the commercial split for GEA rentals should trend towards the steady state value on a straight line basis.

Figure A10.10: Commercial conversion factor for GEA Rentals, 2011/12 to 2028/29

✂

✂

Source: Ofcom; GEA Connections, Ceases, and GEA Other

A10.158 We have estimated commercial GEA connections using the change in GEA rentals plus GEA ceases in that year, except for in 2014/15 and 2015/16 where we use BT's actuals.[144]

[142] BT's response dated 4 March 2016to question 1 of the 2nd joint WBA WLA BT s.135 request; BT's response dated 6 November 2015 to questions 3.1 to 3.4 of the 1st joint WBA WLA BT s.135 request.

[143] We note that this approach does not account for areas that were exchange only (i.e. where premises are connected directly to the exchange rather than via a street cabinet). However, we have no evidence or reason to suggest that the long-run commercial split for these areas should be so different that it would significantly impact the national figure used.

[144] We note that the GEA rentals are mid-year figures whilst the GEA connections and ceases are end-of-year figures. Therefore, when calculating GEA connection we have converted the mid-year rental figures into end-of-year by taking the average of consecutive mid-year figures. For example,

A10.159 For GEA Ceases in 2014/15 and 2015/16 we found that the commercial conversion factor (based on actuals) is higher than that for GEA Rentals. We consider it likely that commercial areas will continue to have a greater proportion of GEA ceases relative to the rental split. This is because telecoms providers are less likely to cease SFBB services on Openreach's network if they face limited availability of alternative networks in subsidised areas.

A10.160 We have estimated the GEA Ceases commercial conversion factor by multiplying the conversion factor for GEA rentals by 1.05. This figure is consistent with the observed relationship between the rental and ceases commercial conversion factor in 2014/15 and 2015/16. We note that for some previous years multiplying the rental commercial conversion factor by 1.05 results in a figure above 100%. This is clearly not possible so we have set a cap on the commercial split for GEA ceases to be at 100%.

GEA Volumes

A10.161 We note that we forecast GEA volumes at a national level (as well as a commercial only level) for two reasons:

- We have more information on national volumes than commercial. We consider it appropriate to use the additional information that we have on national volumes to better inform our commercial volume estimates.

- We forecast and allocate common costs at a national level. This is to ensure that the appropriate amount of common costs are allocated to fibre in light of our equi-proportional mark-up (EPMU) approach.

GEA Rentals

A10.162 National GEA volumes (i.e. including volumes in state funded areas) have been rapidly increasing over recent years as demand rises for faster fixed broadband. Our forecasts for national GEA volumes are driven by a combination of Openreach line growth, broadband penetration growth, and SFBB penetration.

A10.163 We forecast external national GEA Rentals to be around 7 million by 2020/21 which is consistent with forecasts from telecoms providers (including BT). We note that BT forecasts greater overall GEA Rentals in the next few years than found in the volumes model. We consider our forecasts to be reasonable given the reasons set out in paragraphs A10.66 and A10.67 above.

GEA Rentals split by bandwidth

A10.164 We have also split our forecasts for GEA Rentals into the various FTTC bandwidths that Openreach currently provides (i.e. 18/2, 40/2, 40/10, 55/10, and 80/20). As set out in Volume 1 Section 8, we propose setting a charge control on GEA Rentals with a 40/10 bandwidth. In light of the use of a charge control on an anchor product, we also propose to allocate common costs across GEA-FTTC Rentals based upon the current bandwidth gradient (see Annex 11). In order to do so we need to forecast the service volumes for each of the available GEA-FTTC bandwidths.

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taking the average of the 2016/17 and 2017/18 mid-year figures to obtain an end-of-year 2016/17 figure.

A10.165 We have obtained historical data from BT for GEA-FTTC rentals with 40/2, 40/10, and 80/20 bandwidths. We have used this split to forecast the proportion of future GEA rentals that are 40/2, 40/10, and 80/20. When forecasting the proportional splits by bandwidths we take the historical trends and apply a three-year moving average growth rate with a dampening factor of 1.4.

A10.166 We have forecasted the proportion of internal and external GEA 40/10 volumes to be the remainder after we have calculated the volumes of other bandwidth services, which ensures that the summation of the different bandwidths adds up to our total forecasted volume.

A10.167 However, on top of this we have used Openreach forecasts[145] (up to 2018/19) for GEA-FTTC rentals with 18/2 and 55/10 bandwidths. This is because these are new products and thus no actuals are available to use for forecasting. We have assumed constant volumes for these services after 2018/19, except for internal GEA 55/10 FTTC services where we have applied the average growth rate approach as set out in paragraph A10.165 above.

A10.168 We note that there is greater uncertainty when forecasting volumes for GEA 18/2 and GEA 55/10 FTTC services, since these are relatively new services. In fact, BT has told us that these particular volume forecast are old and were generated just as these products were launched i.e. there was no certainty about take up. We recognise that forecasts can continue to change as market demand changes or when actuals do not match previous forecasts.

A10.169 We would generally aim to update our forecasting approach to take into account more reliable or accurate information. We will obtain further information for the Statement, including 2016/17 actuals for GEA 18/2 and GEA 55/10 FTTC services as well as updated BT forecasts. However, we consider it reasonable to use the forecasts already provided by BT for GEA 18/2 and GEA 55/10 FTTC services as part of this consultation. We note that the forecasted bandwidth split for GEA-FTTC is used to allocate common costs across fibre services. We consider it unlikely that any new volume information for these services would result in our forecasted unit costs being outside of our proposed ranges.

A10.170 These assumptions result in the 55/10 and the 40/10 GEA bandwidths growing the most. We consider this reasonable as we expect the 55/10 bandwidth to be [✂] (a key product), and the 40/10 product to be [✂] (also a key product). Our forecasts are given below:

Figure A10.11: Forecasts for GEA, broken down by bandwidth (millions)

✂

✂

Source: Ofcom forecasts.

[145] BT's response dated 25 February 2015 to the clarification question L of Ofcom's follow-up dated 4 February 2016 for the 1st BT s.135 request;
BT's response dated 12 September 2016 to question 26 of the 2nd joint WLA WBA BT s.135 request;
BT's follow-up response dated 27 October 2016 to question 26 of the 2nd joint WLA WBA BT s.135 request.

GEA-FTTC Connections

A10.171 GEA-FTTC Connections are used when new GEA lines are installed. These services are split into PCP only install (i.e. cabinet only installation), managed engineer install (this includes installing equipment at the premises of the end customer), and start of stopped line.

A10.172 There has been an increase in the usage of GEA connections over the previous three years, triggered by rapid and recent increase in GEA rentals. We expect that the number of GEA connections will continue to increase over the next few years as more lines use FTTC.

A10.173 We forecast the national level of GEA-FTTC Connections in a similar way to how we forecast commercial only GEA-FTTC Connections. We forecast GEA-FTTC Connections based on the change in end-of-year GEA Rentals, for internal and external, plus the internal and external GEA Ceases in that year.[146]

A10.174 We have also forecasted the proportion of GEA-FTTC Connections that require an Openreach engineer visiting the end user's premises. We use three year moving average growth rates with a dampening factor of 1.4, recognising the recent and substantial switch to primarily using PCP Only installations. We expect this trend towards primarily using PCP only installations to continue over the charge control period, and so consider it appropriate to not apply a dampening factor greater than 1.4.

GEA CP to CP Migration

A10.175 GEA CP to CP Migration is used when the telecoms provider running the SFBB service for a given premises (via an Openreach GEA product) changes. Since the service was initially offered in 2013/14, GEA CP to CP migration has increased significantly year on year driven by the increase in GEA Rentals. We expect that the number of GEA CP to CP Migrations over the forecast period will continue to increase.

A10.176 We find nil volumes for GEA CP to CP Migrations in 2012/13 and very few volumes in 2013/14. Therefore, we consider only the most recent actuals (i.e. 2014/15 and 2015/16) should be used for our forecasts. We consider it appropriate to reflect growth in FTTC Rentals within the forecasted GEA CP to CP Migrations. We have forecasted the ratio of migrations to rentals for GEA (rather than assuming it is constant) because we expect churn between telecoms providers using GEA to increase with an increasing proportion of GEA-FTTC Rentals that are external.

A10.177 Due to the availability of information, we have applied a different approach for 2016/17 and 2018/19. For 2016/17, we have used the growth rate from 2014/15 to 2015/16, applying a dampening factor of 3. For 2017/18, we have applied the growth rate from 2014/15 to our forecasted 2016/17 volume, applying a dampening factor of 3. From 2018/19 onwards, we have used a three-year moving average growth rate with a dampening factor of 3.

A10.178 We consider it appropriate to use a high dampening factor given that this migration service is relatively new and so the last two years of actuals show a substantial

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[146] We have not used the forecasted GEA Migrations to determine the movement from internal to external GEA-FTTC Connections. This is because we forecast the external and internal split for GEA Migrations to be roughly 50%, and thus the net migrations are forecasted to be close to zero.

proportional increase. We do not consider it reasonable for a similar proportional increase to continue over the charge control period. Therefore, we have applied a substantially higher dampening factor (around double the default) in order to create forecasts that appear reasonable (e.g. a churn rate of around 7% for SFBB at the end of the charge control period).[147]

GEA Other

A10.179 Within the volumes forecast model we aggregate the following GEA ancillary services under “GEA Other”:

- bandwidth changes; and
- ceases.

A10.180 We follow a similar approach to forecasting GEA bandwidth changes as GEA CP to CP Migration (i.e. based upon three year moving average with dampening factor of 3). However, instead of forecasting the ratio of GEA Other to GEA rentals, we directly forecast volumes for GEA ceases and bandwidth changes. Furthermore, we apply the three-year average growth rate from 2016/17 onwards.

A10.181 This is because we consider the most recent actuals better reflect future volume growth since these services have been purchased from 2010/11 and so are likely to show a more stable growth rate over the last couple of years. However, like with GEA migrations, we consider it appropriate to apply a substantially higher dampening factor than 1.4. This is because we consider it unlikely that future growth will be anywhere near as substantial as that observed over the last three years. We note that this assumption results in around 12% of GEA line rentals having a cease in 2020/21, which we consider is consistent with observed household movement.[148]

A10.182 We also found that the 2012/13 volume for GEA Other was high. We consider it likely that this is due to the use of the bandwidth change service following the launch of the new 80/20 GEA product. Therefore, we have estimated the 2012/13 GEA cease volumes to be an average of the 2011/12 and 2013/14 figures, with GEA bandwidth changes explaining the remaining GEA Other volumes.[149]

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[147] This is consistent with a July 2013 Analysys Mason Report on churn rate with SFBB customers http://www.analysysmason.com/About-Us/News/Insight/Superfast-broadband-churn-reduction-Jul2013/ [accessed 26 March 2017].
[148] DCLG, English Housing Survey Headline Report 2013-14, October 2015 (revised) https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/469213/English_Housing_Survey_Headline_Report_2013-14.pdf.
[149] This also results in the 2016/17 forecast for GEA bandwidth changes to be based upon a two-year average growth rate.

Annex 11

Charge control cost model: top-down model documentation

A11.1 This annex sets out the approach we have taken to estimating the unit costs of MPF services over the charge control period from April 2018 to March 2021, using our top-down model and how we allocate common costs across rental services (WLR, MPF and GEA). In this annex we explain:

- the design of the top-down model;
- how we allocate common costs in the top-down model;
- how we calculate the 'X' value for our CPI-X control;
- the adjustments we have made to our base year data to make it suitable for forecasting; and
- how we have approached several other detailed modelling issues.

Introduction

A11.2 As set out in Volume 2, Section 3, our charge control proposals involve top-down modelling based on an ongoing copper network (providing WLA and WFAEL services) alongside bottom-up modelling of an overlay fibre network (providing GEA services[150]). This annex details our proposals in relation to the top-down model, which we have used to estimate the costs of MPF services.

A11.3 In Section 5 we went on to outline that the top-down model is based on the current cost accounting (CCA) cost approach that uses financial capital maintenance (FCM) and the fully allocated cost (FAC) standard. We use base year data from BT's Regulatory Financial Statements (RFS) which we assess and adjust in the Base Year Model. Our overall approach to top-down modelling copper services is the same as it was in the 2014 FAMR Statement.

A11.4 The top-down model calculates how the nominal costs of relevant services will change over the period of the charge controls. The top-down model is ultimately used to calculate the values of X for a CPI-X glide path for the services (and baskets of services) in the charge controls. In addition, the top-down model forecasts:

- Total common costs associated with BT's WLA and WFAEL services. These are the costs shared between WFAEL (WLR) and WLA (LLU and GEA) services which cannot be attributed directly to them. We set out below how we propose to define common cost as the difference between BT's FAC and the long-run incremental cost (LRIC).

[150] Our bottom-up modelling is explained in Annex 12.

- LRIC for BT's copper WLA and WFAEL services including LLU and WLR rentals, connections, migrations and other relevant ancillary services. We propose to rely upon outputs from BT's LRIC model for this calculation.[151] As set out in Annex 12 the LRICs for GEA services will be calculated within our bottom-up model.

Top-down model design

Approach to top-down modelling

A11.5 As set out above and in Section 2, we aim to model an efficient ongoing copper network and to do this we propose to use a top-down model. Top-down modelling involves the use of accounting information to forecast how BT's efficiently incurred costs will change over time relative to the base year. The top-down model is constructed around the costs and volumes of network components and estimates how unit costs change over time.[152]

A11.6 The cost for each of Openreach's services (e.g. MPF Rental) is calculated using the costs of several underlying network components (e.g. E-side copper capital). Some network components are shared across many different services (e.g. network components that include duct costs), while others are consumed by a smaller set of services (e.g. network components that include equipment costs for specific services).

Level of aggregation used in the model

A11.7 In the 2015/16 RFS, BT reports the costs of regulated WLA and WFAEL services on what it refers to as a service level and a network component level. Both measures have been subject to a degree of aggregation by BT. In building the top-down model, we considered the appropriate level of aggregation to use.

A11.8 The network components reported in the RFS are super-components, which are made up of more detailed network components. Therefore, the reported super-component unit cost in the RFS is a weighted average of the unit costs of its constituent network components.

A11.9 Our general view is that the use of more disaggregated input data is likely to provide more accurate forecasts of costs. If the relative weights of the network components that make up a super-component were to change over the forecasting period,[153] the base year super-component unit costs implied by the usage factors may not be representative of super-component unit costs in subsequent years. Thus, we gathered cost and usage factor data from BT on a component basis (rather than on a super-component basis). As set out above, we forecast network component costs on a component basis in the model.

[151] BT models the LRIC for each of its network components and then provides its estimates to Ofcom as part of its AFIs.
[152] See Section 14 of BT's Accounting Methodology Document (AMD), 28th October 2016 http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/AccountingMethodologyDocument2015-16.pdf.
[153] For example, due to a change in the volume mix of services using the various components.

A11.10 Similarly, the services reported in the RFS are in fact groupings of more disaggregated service variants sold by BT. For example, the Co-mingling New Provide and rental services BT reports are made up of many different services provided by BT in relation to co-location in BT's exchanges.

A11.11 For some services, BT records volume and pricing data based on individual services but we understand that it is not always possible for BT to provide cost and usage factor data to the same level of disaggregation.[154] Thus, in the model we have forecast costs at the service group level, which implicitly assumes the mix of service variants within service groups will remain constant over the forecasting period. In order to ensure that revenues are forecast on the same basis as costs, we have aggregated the volume and pricing data to the service group level.

A11.12 In summary, we have attempted to model costs at the most disaggregated level possible (i.e. at the component level) whilst revenues we have modelled at either the service or basket level.

Base Year Model

A11.13 The starting point when modelling a charge control using a top down approach is to establish a relevant cost base, which we refer to as the base year costs for the charge control. Our base year costs and the adjustments we have made to them are calculated within a standalone model, which we refer to as the Base Year Model. The outputs of the Base Year Model are used as inputs into our top-down model (as discussed further below).

A11.14 Our established practice is to use the most recently available, audited information underlying the RFS as the base year data for our top-down charge control models. Accordingly, for the top-down model published alongside this consultation we have used BT's 2015/16 RFS, and we anticipate updating this to use 2016/17 as the base year for the top-down modelling underpinning the Statement.

A11.15 The data supplied by BT in response to our s.135 requests has provided us with detailed disaggregated cost data that have been derived from the 2015/16 RFS. BT has provided disaggregated financial data for 2015/16 on a network component basis for WLA and WFAEL services at the same level of aggregation as those reported in the 2015/16 RFS. We make various adjustments to these base year data in order to use them for forecasting. We describe these adjustments later in this section.

Top-down model

A11.16 Forecasting costs for BT's WLA and WFAEL services is relatively straightforward, and uses the same conceptual approach as the 2014 WLR LLU cost model. The top-down model performs the following six key calculations, which are explained further below:

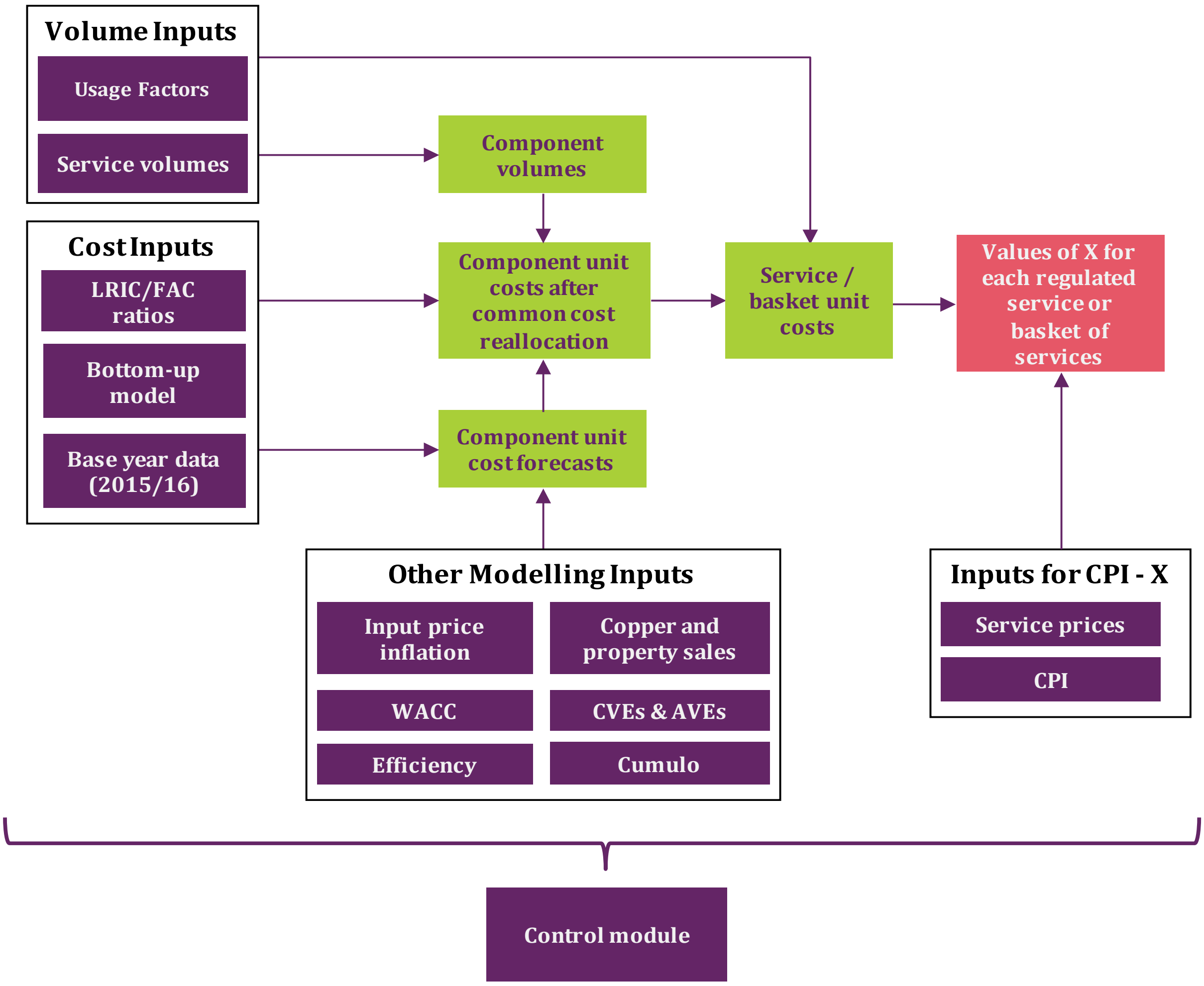
- Step 1: Forecast service volumes over the modelling period using the outputs of the Volumes model (see Annex 10 for details on our approach to forecasting service volumes).

[154] This is because BT's regulatory cost system, REFINE, uses broadly the same level of service disaggregation reported in the RFS.

- Step 2: Convert service volumes to Network Component volumes using service usage factors.
- Step 3: Calculate forecasts of the capital costs and opex for each network component using estimated asset price changes, efficiency forecasts, and by applying the AVEs and CVEs to network component volume forecasts.
- Step 4: Calculate future service costs based on the amount of each network component that a given service uses (i.e. by using the usage factors).
- Step 5: Allocate common costs to reflect incremental cost differences, as well as to reflect any policy decisions, see below.
- Step 6: Calculate the X-values to be used in the CPI-X controls for each service or basket of services, as appropriate.

A11.17 The structure for the top-down model is set out below.

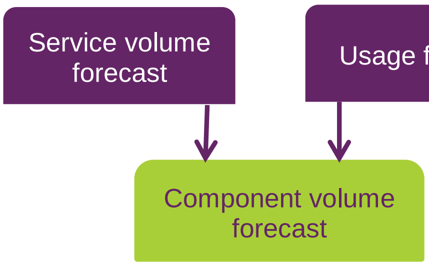
Figure A11.1: Structure of the top-down model



Network component volumes

A11.18 The first stage of the top-down model is to take the service volume forecasts in the volumes model use them in combination with usage factors to derive a measure of the total required usage of each network component. Usage factors describe the quantity of each network component used by each product[155] and are also used later in the modelling process for cost allocation from network components to services. This process is illustrated below.

Figure A11.2: Approach to converting service volumes into network component volumes



Source: Ofcom.

A11.19 We calculate usage factors based upon 2015/16 unadjusted costs, network component volumes, and service volumes as provided by BT. We have cross-checked these usage factors against those calculated and provided by BT[156] and found them to be broadly consistent.[157] In addition our approach ensures consistency across the top-down cost and volume models.

A11.20 We propose to apply these usage factors for all modelled years prior to the start of the charge control (i.e. from 2015/16 up to 2017/18). Generally, we consider it appropriate to apply constant usage factors throughout the period we are modelling because this ensures a consistent basis for forecasting component volume growth.[158] However, when we know that the allocation of component costs across services will change significantly in the future, it may be appropriate to forecast changes in the usage factors.

A11.21 In this case our proposals regarding QoS, as well as the expected change in service level mixes, mean that we expect certain allocations to change in the future. Specifically, the repair related components that are shared across WLR and MPF will be adjusted to reflect future service level mixes and our QoS proposals. However, these adjustments do not consider the changing relative usage of these shared repair related components across WLR and MPF (given the different service level mixes across WLR and MPF).

A11.22 Therefore, we have adjusted the usage factors for certain components and services while keeping the rest of the usage factors constant over time. Furthermore, we have applied adjustments for all three years of the charge control due to the year-on-year proposed changes for quality of service.

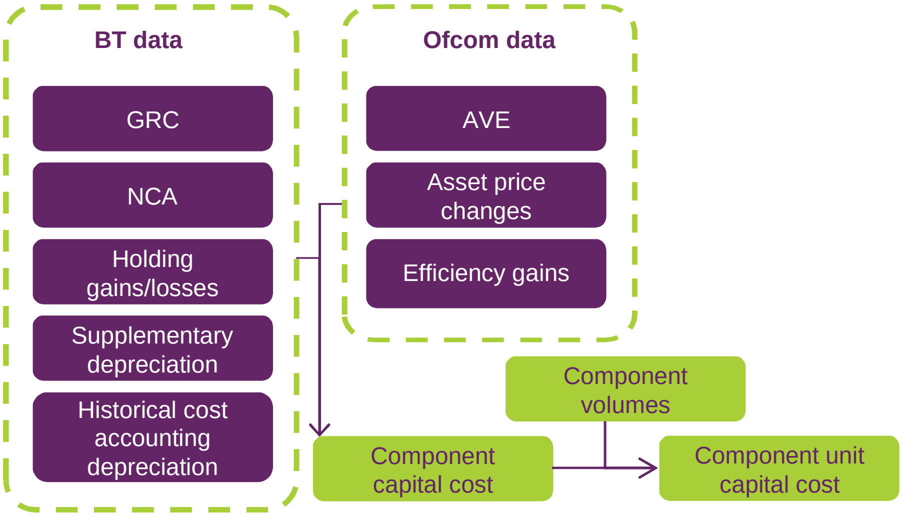
[155] For example, the usage factor of LLU Line Testing Systems for MPF will be 1, as a single line testing system is used in each MPF product.
[156] BT, Confidential response dated 17 November 2016 to Question 4 of the 19th s135 notice dated 2 November 2016.
[157] Furthermore, we believe that any significant differences are due to the adjustments that we have made (e.g. QoS forecasted relative fault rates and service level differentials) or due to different modelled service volumes (e.g. for co-mingling services).
[158] Specifically, it ensures that the forecasted service volume growth is directly applied to the component volume growth.

Unit annualised capital cost

A11.23 The next step is to forecast annualised capital costs for each network component for each year of the charge control, and to convert this into network component unit capital costs.

A11.24 Ofcom has requested capital cost data (via our formal information powers for the Base Year Model, which we then adjust as set out above. The top-down model then uses the adjusted 2015/16 Gross Replacement Cost (GRC), Net Replacement Cost (NRC), Net Current Assets (NCA), and Operating Capability Maintenance (OCM) Depreciation on a network component basis for forecasting network component unit capital costs. For future years, the network component unit capital costs are forecasted using AVEs, efficiency gains, network component volume forecasts, and asset price changes as estimated by Ofcom. This is illustrated below.

Figure A11.3: Approach to forecasting network component unit capital costs



Source: Ofcom.

Unit opex

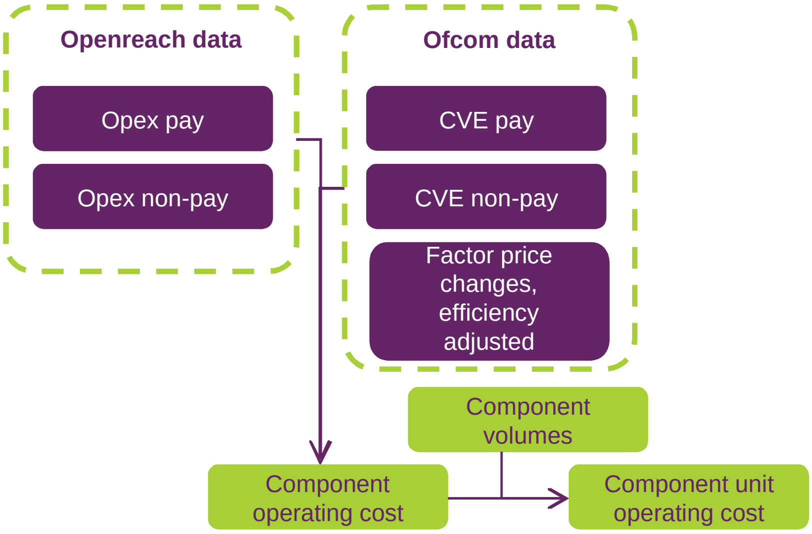
A11.25 At this point, we forecast the operating costs per network component for each year of the charge control, and then converted these into network component unit operating costs.

A11.26 BT operating cost data has been provided (partially redacted for publication of this model) split by pay and non-pay operating expenditure, and depreciation.[159] This operating cost data is split by network component and by service, as set out in the Base Year Model.

A11.27 The top-down model uses 2015/16 pay and non-pay (excluding cumulo) operating expenditure on a network component basis for forecasting network component unit operating costs. For future years, we forecast the network component unit operating costs using CVEs, factor price changes adjusted for efficiency gains, and network component volume forecasts as estimated by Ofcom. This is illustrated below.

[159] We note that the top-down model treats OCM depreciation as part of the capital cost forecasting whilst BT's accounts treat it within its total CCA operating costs.

Figure A11.4: Approach to forecasting network component unit operating costs

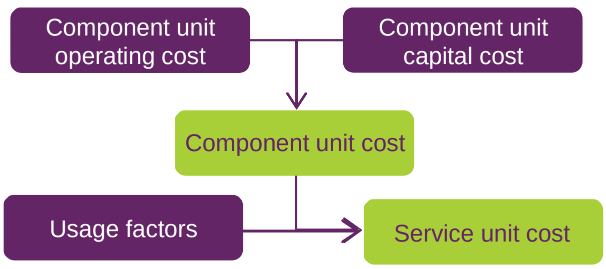


Source: Ofcom.

Unit service costs

A11.28 Finally, we combine the forecast network component unit operating and capital costs to obtain total network component unit costs (on a FAC basis). We then apply usage factors to convert network component unit costs into service unit costs. This is illustrated below.

Figure A11.5: Approach to converting network component unit costs into service unit costs



Source: Ofcom.

Forecast LRIC

A11.29 The top-down model also forecasts the unit network component LRIC. This is because some services are proposed to be regulated with:

- reference to their forecast LRIC rather than forecast FAC; or
- a different allocation of common costs than attributed within BT's FAC.

A11.30 The forecast LRIC has been calculated by applying the 2015/16 LRIC to FAC ratio, as calculated by us on a network component basis based upon BT data in the Additional Financial Information (AFI) to the forecast network component unit FAC.

We then apply the same usage factors to convert this network component unit LRIC into a service unit LRIC.

A11.31 For prices regulated at LRIC, the unrecovered common costs are then recovered from the main rental services. We set out our proposed approach for allocating common costs below.

Cost forecasting approach

A11.32 BT's efficiently incurred costs include the costs it incurs for:

1. Acquiring assets that are used to provide its services (capital costs or capex); and

2. Operating those assets and providing the services more generally (operating costs or opex).

A11.33 In the top-down model, we forecast capital costs and operating costs separately. We discuss each in turn below.

Forecasting of capital costs

A11.34 We set out below the terminology that we use when discussing capital cost forecasting in the top-down model. We then provide details of the steady state and additional elements of our forecasting approach, and explain how we have applied the approach in the top-down model. This includes the forecasting equations that we have used, for both the steady state calculation as well as the additional elements of our forecasting approach.

Top-down modelling approach to capital cost forecasting

A11.35 As set out in Section 3, we are proposing to use the CCA FAC cost standard for setting the next charge controls. We adopt the Financial Capital Maintenance (FCM) approach to CCA for establishing the allowed capital costs for BT.

A11.36 The FCM approach seeks to maintain the financial capital of the firm, and hence the firm's ability to continue financing its functions. For modelling purposes, this involves including an allowance 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 addition to an allowance to undertake the capital expenditure (capex) required to retain the output capability of the firm's assets.

A11.37 Under the top-down modelling approach, we forecast steady state and additional capital costs separately. The purpose of steady state capex is to replace the assets that have come to the end of their life over the year, and therefore are disposed of, so that the firm can maintain its output capability in the steady state.

A11.38 Additional capex on the other hand represents the changes that a firm makes to its asset base to meet changes in demand. Steady state and additional capex interact in the following ways:

- Both steady state and additional (positive and negative) capex are derived from the gross replacement value (GRC) of the firm's asset base. This implies that steady state and additional capex (be that positive or negative) all relate to new assets, i.e. assets that are yet to have depreciated in value.[160]

- When volumes increase, the firm increases the size of its asset base by investing in positive additional capex on top of its steady state capex.
- When volumes decrease, the firm decreases the size of its asset base by means of a flow of negative additional capex on top of its steady state capex (i.e. it replaces new assets at a slow rate than it is disposing of old assets).

A11.39 For modelling purposes, negative additional capex is either where the firm forgoes investing steady state capex, or where it disposes some of its assets i.e. additional disposals:[161]

- In the case of the former, modest volume decreases result in positive steady state capex being offset against negative additional capex such that the resulting total (in-year) capex is positive, or at the limit equal to 0; and
- In the case of the latter, greater volume decreases mean negative additional capex outweighs positive steady state capex, resulting in negative total capex. The value of negative total capex represents the forecast of additional disposals required to reduce the firm's asset base, in addition to the disposals that the firm makes in the steady state.

Top-down model capital cost equations

A11.40 The table below sets out the abbreviations used in the cost forecasting equations.

[160] In the base year, BT's steady state capex is set equal to OCM depreciation, which is a function of the GRC of the firm's assets. In subsequent years, steady state capex is derived from the previous year's steady state capex, accounting for input price changes and efficiency. Additional capex (both positive and negative) is derived from the firm's GRC in the previous year. Both steady state and additional capex are then used to calculate steady state and additional GRC respectively. Steady state and additional GRC are used to derive NRC, and ultimately return on mean capital employed. NRC reflects the value of a firm's assets accounting for the effect of depreciation. Hence, by deriving NRC from capex that has been calculated based on the previous year's GRC, the top-down modelling approach assumes that all capex, (steady state, positive additional and negative additional) relates to assets that are yet to have depreciated in value.

[161] For example, where the firm sells its assets on the secondary market or redeploys them within its business.

Table A11.6: Abbreviations used in cost forecasts

Abbreviation	Description
SS	Steady state
Add	Additional
Total [x]	Steady state [x] + Additional [x]
CVE/AVE	Cost-volume elasticity or Asset-volume elasticity
Eff	Efficiency change percentage
Pay(t) / Non-pay(t)	Pay / non-pay operating costs in time period t

Source: Ofcom

A11.41 Table A11.7 below presents the steady state and additional capital cost equations used in the top-down model. It shows that steady state costs are primarily driven by asset lives, forecast changes in input price and assumed improvements in efficiency, while additional costs are primarily driven by volume changes in conjunction with AVEs, as well as input price changes and efficiency improvements. Annex 15 provides details on the AVEs, CVEs, efficiency and input price changes used to forecast operating and capital costs.

Table A11.7: Equations used to forecast capital costs

Cost	Steady state (SS)[162]	Additional (Add)
GRC	SS GRC(t) = SS GRC(t-1) * [1 + IPC(t)] + SS Capex(t) – SS Disp(t)	Add GRC(t) = Add GRC(t-1) * [1 + IPC(t)] + Add Capex(t)
OCM dep	We assume straight line depreciation, and calculate as:SS OCM dep(t) = SS GRC(t) / asset life Where asset life is equal to the ratio GRC/OCM dep in the base year.	Add OCM dep(t) = Add GRC(t)/asset life
Cum OCM dep		Add Cum OCM dep(t) = Add Cum OCM dep(t-1) * [1 + IPC(t)] + Add OCM dep(t)
Capex	Base year capital expenditure is assumed to be equal to OCM dep. Subsequent years are calculated as: SS Capex(t) = SS Capex(t-1) * [1 + IPC(t)] * (1 – eff)	It is assumed Add Capex is required where: SS Capex(t) + Add Capex ≥ 0. Add Capex(t) = total GRC(t-1) * [1+IPC(t)] * AVE * %change vol(t) * (1 – eff)
Disp	Base year disposals are assumed to be equal to base year capex. Subsequent years are calculated as: SS Disp(t) = SS Disp(t-1) * [1 + IPC(t)]	
NRC	SS NRC(t) = SS NRC(t-1) * [1 + IPC (t)] + SS Capex (t) – SS OCM dep (t)	Add NRC(t) = Add GRC(t) – Add Cum OCM dep(t)
NCA	NCA(t) = NCA(t-1) * [1+ volume change %][163]	
HGL	HGL(t) = - [Total NRC(t-1) * IPC(t)]	
Return on capital	Return on capital (t) = [NRC(t) + NCA(t)] * pre-tax nominal WACC	

Source: Ofcom

A11.42 We note that it is difficult to forecast NCA and there are several different approaches that can be used. For example, NCA might be driven by inflation or service volume growth. It is unclear whether NCA is correlated with service volume growth or inflation. We consider our proposed approach to be appropriate given that it ensures a consistent modelling approach with regards to the current charge controls.

Forecasting of operating costs

A11.43 The table below presents the equations used in the top-down model to forecast operating costs. Under our approach, operating cost forecasts are driven by forecast volume changes in conjunction with CVEs, as well as forecast changes in input prices and assumed cost savings from efficiency.

[162] Base year values of GRC, OCM dep, NRC, NCA and HGL are taken from BT's responses to s.135 requests and include our base year adjustments set out above.
[163] This uses component volume changes. Therefore, we implicitly assume that the unit NCA cost per component does not change over time consistent with the 2014 WLR LLU cost model.

Table A11.8: Equations used to forecast operating costs

Calculation	Description[164]
Pay	Pay(t) = Pay(t-1) * [1 – eff] * [1 + IPC(t)] * [1 + %volume change(t) * CVE]
Non-pay	Non-pay(t) = Non-pay(t-1) * [1 – eff] * [1 + IPC(t)] * [1 + volume change %(t)* CVE]

Source: Ofcom.

A11.44 Annex 15 provides details on the CVEs, efficiency and input price changes used to forecast operating costs.

Calculation of total service cost forecasts

A11.45 In order to calculate cost forecasts for baskets of services, it is necessary to convert the forecasts of network component costs into service costs. We do this by carrying out the following steps:

- unit network component costs(t) = network component costs(t) / network component volumes(t);
- unit service *A* costs(t) = matrix multiplication of unit network component costs(t) and cost usage factors by service *A* for each of the network components; and
- service *A* costs(t) = unit service *A* costs(t) * service *A* volumes(t).

Treatment of common costs

A11.46 Once we have calculated the service costs, we need to consider how we go about allocating common costs. As explained in Section 3, we propose to allocate common costs between MPF and GEA services based on an EPMU approach. In order to achieve this, we first explain below how we have forecast GEA common costs, and then how we have allocated these costs across the different services.

Forecasting GEA common costs

A11.47 As set out in Annex 12, we have built a bottom-up model that forecasts the costs faced by a hypothetical efficient operator when building and operating a modern NGA overlay network. We have used this model to estimate the LRIC for GEA services provided by Openreach.

A11.48 The top-down model forecasts common costs using LRIC to FAC ratios for BT's network components. For copper services, this is based upon BT's estimates for LRIC and FAC but an alternative approach is required for GEA services.

A11.49 We found that BT's Network Component Costs (which are an aggregation of different network cost elements) do not easily map onto the bottom-up model's

[164] Base year values of pay and non-pay operating costs are taken from BT's responses to s.135 requests and include our base year adjustments as set out above. Subsequent years are forecast using the equations set out in this table.

network elements. This means that there may be an inconsistency when comparing the bottom-up model's network component LRICs to BT's network component FACs.[165] Therefore, we do not consider it appropriate to determine LRIC to FAC ratios for BT's Network Component Costs using the bottom-up model's LRIC.

A11.50 We propose calculating the common costs that are attributed to GEA services based on base year costs and forecast forwards in a consistent manner to other network component costs in the top-down model. We have set out this two-stage approach in further detail below.

A11.51 We consider it appropriate to use BT's 2015/16 FAC, with the Base Year adjustments, and LRIC from the 2015/16 bottom-up model to determine the base year GEA common costs. This is assessed at the service level and we consider it appropriate to attribute total GEA common costs to commercial GEA service volumes, as set out in Annex 10. We have also applied a pro rata uplift to the calculated base year FTTC common costs to account for common costs allocated to FTTP.[166]

A11.52 In order to determine unit costs at the end of the charge control period, we need to apply forecasting assumptions to this 2015/16 GEA common cost. We have applied a weighted average annual efficiency rate and price inflation, based on the 2015/16 cost breakdown of the GEA common cost stack.

A11.53 For the annual efficiency rate, we have assumed no efficiency rate for ROCE[167], depreciation and cumulo. We have applied the top-down model's opex efficiency rate, weighted by the proportion of GEA common costs that are opex. This results in a weighted average efficiency rate of around 2.5% (representing a reduction in common costs over time).

A11.54 For the annual price inflation, we have assumed RPI for the capital cost element of the 2015/16 GEA common cost and a weighted average opex price inflation (using the pay and non-pay price inflations assumed in the top-down model). This results in a weighted price inflation of around 2% (which varies year on year in line with the forecast variations in RPI and opex inflation).

A11.55 As a modelling simplification, we estimated the weighted average opex price inflation based on the pay and non-pay split for BT's GEA FAC. We found that BT's

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165 We note that it is possible to further aggregate BT's cost components such that a reasonable comparison can be made with the network elements used in the bottom-up model. However, we would then need to ensure consistency across multiple elements of the top-down and bottom-up model which results in greater model complexity (e.g. use LRIC to FAC ratios to determine GEA specific component AVEs and CVEs for each year, determine efficiency rates for GEA common costs that are consistent with what the bottom-up model estimates). We do not consider it likely that this approach would lead to significantly different forecasted unit costs, nor that these forecasts would necessarily be more accurate. Therefore, we consider it appropriate to applied our simplified approach because we consider it more proportionate and transparent.

166 In our modelling, we have assumed FTTP service volumes to be FTTC which means that total common costs from FTTC (actuals) underestimate total common costs from GEA.

167 We note that the top-down model assumes a capex efficiency but we consider this to have a limited impact on the ROCE. Therefore, we assume no capital cost efficiency for the purposes of forecasting GEA common costs.

FAC and the bottom-up model's LRIC suggest broadly similar breakdowns of opex for pay (around 70%) and non-pay.

A11.56 We note that the top-down model only applies RPI inflation to access duct, copper, and fibre based capital costs, but as a modelling simplification we have applied this to the total capital cost for GEA common costs.[168] We apply this simplification due to the difficulty of mapping the bottom-up model's network elements with BT's MCE asset categories.

Common cost allocation in the top-down model

A11.57 Common costs are costs that are shared between WLR, LLU, and GEA services which cannot be attributed directly to these services. We have not looked to reallocate common costs that are currently allocated to other markets to our charge controlled services, because to do so could undermine our ability to set charges that incentive efficiency investment. Therefore, when setting regulating charges, as set out in Section 2, we typically adopt an approach that reflects a compromise among several different objectives.

A11.58 We define common cost as the difference between BT's FAC and LRIC. We have set the charge control caps for some services using their forecast LRIC rather than forecast FAC. We need to allocate the common cost for services that are set below forecast FAC to give BT the opportunity to recover its efficiently incurred costs.

A11.59 For prices regulated at LRIC or zero, the unrecovered common cost is then recovered over WLR, MPF and GEA rental services. We have also allocated common costs across copper and fibre services using an EPMU approach. Our overall proposed approach to common cost allocation can be summarised in the following steps:

- Calculation of common costs to be allocated;
- Allocation across copper and fibre services;
- Allocation across copper services; and
- Allocation across fibre services.

A11.60 We set out our rationale for our approach to allocating common costs in Section 2 and the implementation of our proposed approach in more detail below.

Calculation of common costs to be allocated

A11.61 In Section 4, we have set out the cost standards (i.e. LRIC or FAC) for the services that we propose to set charge controls. The overall common costs to be allocated across services is made up of the common costs forecast for:

- services that we propose to set at LRIC or zero (rather than FAC); and

168 We consider it likely that most of the GEA common costs are duct, copper, and fibre based given that most the bottom-up LRIC consists of other costs (e.g. equipment, cabinet, and exchanges).

- rental services (WLR, SMPF, MPF, and GEA).[169]

A11.62 In order to forecast the amount of common costs to be allocated we need to determine the difference between forecast LRIC and forecast FAC. As set out above, we forecast FAC in the top-down model on a component basis and then allocate these components costs to services using usage factors. We forecast LRIC on a component basis by applying 2015/16 LRIC to FAC ratios based on BT data. We then convert these component level LRICs into service level LRICs by applying the same usage factors as we applied to calculate FAC.

A11.63 We have then calculated the difference between total LRIC and total FAC for services that we propose to set at LRIC, as well as the three copper rental services. We note that the calculated common cost includes services that we do not propose to set charge controls (e.g. WLR and SMPF rentals). This is because we consider it appropriate to align the allocation of common costs across all copper rentals, as set out in Section 3.

A11.64 We have applied a separate but consistent approach to forecasting common costs that BT has allocated, within its regulated accounts, to fibre services. We have set out our approach to forecasting GEA related common costs above.

<u>Allocation across copper and fibre services</u>

A11.65 As explained in Section 3, we consider it appropriate to use an EPMU approach to allocate common costs across copper and fibre. This results in a LRIC+ control on both copper and fibre.

A11.66 In order to determine the proportion of common costs to be allocated to GEA, the EPMU approach uses the proportion of total forecast LRIC for WLA and WFAEL rental services[170] that is due to GEA. The remainder of common costs is then allocated to copper rental services.

A11.67 For example, if the amount of common costs to be allocated was £50 million, total forecast LRIC for WLA and WFAEL rentals was £100 million, and the forecast LRIC for GEA was £50 million (i.e. 50% of the total), then GEA rentals would be allocated £25 million of common costs (i.e. 50% of £50 million).

A11.68 We note that the total GEA LRIC uses national, rather than commercial only, volumes given that our charge control on GEA is on a national basis. Consistent with this, we have allocated the GEA common costs across national GEA volumes.

<u>Allocation across copper services</u>

A11.69 In light of the amount of common costs to be allocated to copper rental services, using the EPMU approach set out above, we consider it appropriate to allocate common costs across WLR and MPF rental services on an equal basis.[171] This

[169] We note that most of the common costs that are allocated comes from WLR, MPF and GEA rental services.

[170] Note that this is calculated as the unit LRIC for each rental service (i.e. WLR, SMPF, MPF, and GEA) multiplied by the relevant volumes for each rental service.

[171] Note that this implies no common costs to be allocated to SMPF rental services. We note that BT's pricing flexibility for WLR and SMPF means that it can recover a proportion of the common costs that we have allocated to WLR rentals from SMPF rentals instead.

allocation of copper common costs is consistent with our approach in the 2014 FAMR Statement where we ensured a LRIC differential between WLR and MPF.

A11.70 We have adjusted the total common costs to be allocated to copper accounting for the copper scrap recovery and PIA implementation cost adjustments. We then divide this figure by the total number of WLR and MPF lines. This results in £32.90 of common costs being allocated to MPF Rentals on a per line basis in 2020/21.

Allocation across fibre services

A11.71 Having allocated common costs to fibre services using the EPMU approach we must then consider how these common costs will be recovered across fibre services given our proposed anchor product approach. Specifically, we consider what proportion of the common costs allocated to fibre should be specifically allocated to BT's 40/10 GEA product (i.e. the VULA charge control anchor product).

A11.72 We propose to allocate fibre costs in line with the existing price ratio of BT's GEA-FTTC charges, as shown in the table below.[172] Furthermore, we have calculated the forecast GEA 40/10 charge such that, if BT were to maintain the existing ratio of prices relative to our control on GEA 40/10, based on our volume forecasts, it would recover its efficiently incurred costs across all fibre services.

Table A11.9: Current GEA-FTTC prices relative to GEA 40/10 FTTC rental

	18/2	40/2	40/10	55/10	80/20
Price relative to 40/10 GEA-FTTC	54%	93%	100%	114%	134%

Source: Openreach's FTTC price list as of 7 February 2017

Calculation of the X

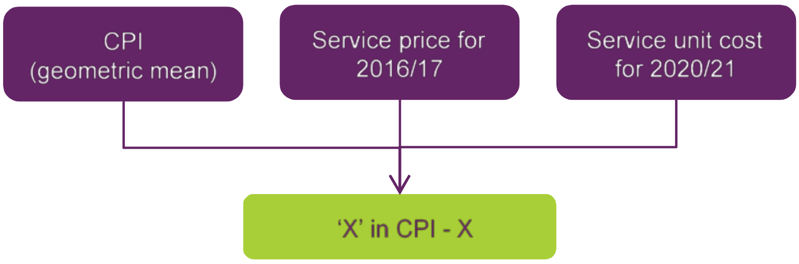
A11.73 The X in a CPI-X glide path is ordinarily the annual percentage change required to equalise costs and charges at the end of the charge control period, which is 2020/21. However, as explained in Section 3 our proposed charge control uses an adjusted glidepath that set prices equal to our estimates of costs in 2019/20.

A11.74 In order to determine the X-values required for these glidepaths, we calculate the "original X-value" (i.e. as if the charge control applied at the start of 2017/18) for individual services using the following inputs for each product, as illustrated below:

- proposed charges in nominal terms (as adjusted for common cost allocation) in 2019/20;
- the CPI geometric mean (for the period 2016/17 to 2019/20); and
- service prices in 2016/17.

[172] We believe this is the best available approximation to how BT may price its higher and lower speed services.

Figure A11.10: Calculating the value for 'X' in CPI-X for individual services



Source: Ofcom.

A11.75 The X-value is fixed for the control period and as such it must be based on the forecast for CPI inflation, rather than the inflation figure for the base year. To ensure the correct unit cost target is achieved, the value for X is based on a geometric average of the forecast CPI inflation rates for the charge control period.

A11.76 In order to calculate the X-values for our modified glide path, we determine the percentage change required to glide prices at the start of the control to the 2018/19 forecast charge, as calculated based on the 'original X value' discussed above. We then apply the original X for the subsequent year (2019/20). Finally, we determine the percentage change required to reduce prices in line with our estimate of the reduction in costs between 2019/20 and 2020/21.

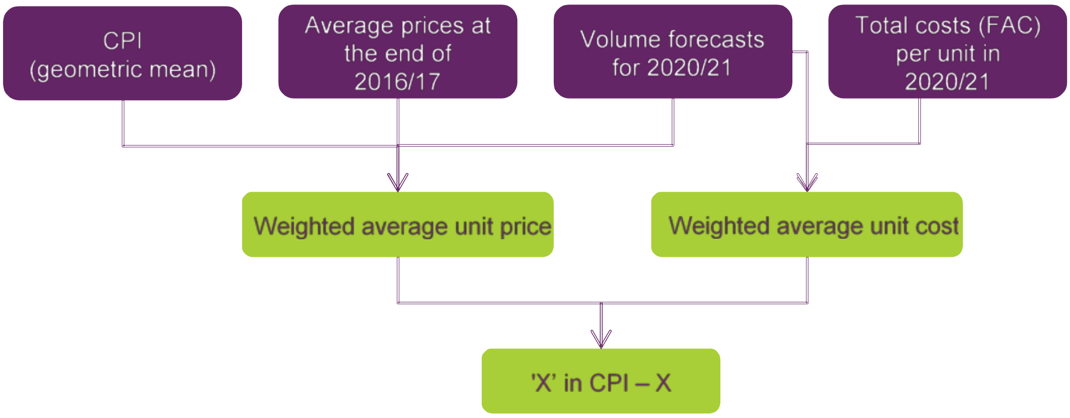
Baskets of services

A11.77 The next step is then to calculate the X-values for services that we have aggregated into baskets. The reasoning behind the basket design proposals are set out in Section 2. As set out in Section 3, we have aggregated various services into charge control baskets.[173] Most of these baskets are incorporated into BT's accounts (i.e. these services have already been incorporated into the cost, revenue and volume data provided). However, we have separately forecast costs for the co-mingling services and then aggregated these unit costs into a Co-mingling New Provide and Rental basket (as found in BT's RFS).

A11.78 We calculate the X-value for our service baskets in a similar way as above but take into account the 2020/21 volume weighting of the individual services within the basket, as illustrated below).

[173] A charge control basket is defined as the group of services that are subject to a common charge control restriction.

Figure A11.11: calculating the value for 'X' in CPI-X for baskets of services



Source: Ofcom

Adjustment to the base year data

Approach to adjusting data in the Base Year Model

A11.79 Having analysed the base year data received from BT, we propose to make a number of adjustments to ensure that the costs are an appropriate basis for forecasting the efficient level of costs to use in setting the charge control on MPF services.

A11.80 In identifying potential adjustments, we have considered whether the cost data:

- Is consistent with that used in previous regulatory decisions;
- Contains any obvious errors or inappropriate accounting methodologies;
- Includes any 'one off' costs that should be excluded; and
- Represents BT's costs in light of future changes to the industry.

A11.81 In considering whether to make adjustments to the base year data it is necessary for us to exercise regulatory judgement based on our understanding of BT accounting data.

Proposed adjustments

A11.82 The adjustments that we propose to make to the base year data within our base year model in respect of WLA are shown below.[174]

[174] Based on 2015/16 RFS and market structure which approximates with the proposed market structure

Table A11.12: Summary of adjustments to our base year model on WLA market (£m)

Proposed Adjustment	Opex Impact	Mean Capital Employed (MCE) Impact
15/16 RFS Total	1,316[175]	4,359
Correct MPF Errors	[✄]	-
Remove cumulo costs	(44)	-
Include restructuring and property provision costs	21	-
Remove subsidised FTTC Deployment	[✄] (~(92))	[✄] (~(382))
Adjustment for service maintenance level differentials	[✄]	-
Adjustment for Service Level Guarantees (SLGs)	[✄] (~(28))	-
15/16 Revised Total	[✄]	[✄]

Source: Ofcom analysis; note that red numbers in round brackets indicate a subtraction.

A11.83 Each of these adjustments and their impacts on opex and MCE are discussed in turn below.

Correction of MPF errors

Explanation of the adjustment

A11.84 We undertook an analysis of MPF unit costs by comparing the movement in network component costs in the 2015/16 RFS against the cost in the restated 2014/15 RFS. Where we identified large unexplained movements, we requested further information from BT. In its reply to our request, BT identified an inconsistency in relation to capitalisation credits relating to self-installation.[176]

A11.85 BT's Accounting Methodology Document (AMD) explains how field provisioning capital costs recorded on its profit and loss statement are re-attributed to the balance sheet in BT's Regulatory Reporting System.[177] BT identified that the apportionment methodology used for these capitalisation credits was not the same as that for the original costs. It intends to remove this inconsistency in the 2016/17 RFS and will include details of the required methodology change in the Change Control Notification that it is expected to publish on 31 March 2017.[178]

Calculation of the adjustment

A11.86 BT provided us with a breakdown of how this inconsistency should be removed for services within the WLA and WFAEL markets. We estimate that the removal of this inconsistency moves net £[✄]m of opex away from the WLA markets. Note that

[175] Note £2m rounding error between this figure and figure as presented in the 2015/16 RFS.
[176] BT's response dated 20 February 2017 to question 10 of 24th BT s.135 request.
[177] BT, 2016, Accounting Methodology Document, page 70 http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/AccountingMethodologyDocument2015-16.pdf.
[178] BT's response dated 20 February 2017 to question 9 of the 24th BT s.135 request.

within the WLA market, £[✂] is attributed to MPF rentals and £[✂] is taken out of GEA services (mainly FTTC connections).

Table A11.13 Impact on WLA market of proposed adjustment for MPF error

Proposed Adjustment	Opex Impact (£m)
Correct MPF errors	[✂]

Source: BT data.[179]

Removal of cumulo costs

Explanation of the adjustment

A11.87 BT's cumulo costs are the non-domestic rating costs BT pays on its rateable network assets. As we explain in detail in Annex 17 new rateable values will apply from 1 April 2017 and are anticipated to be significantly higher than those currently in force.

A11.88 Within the 2014 FAMR Statement, cumulo was forecast in line with the base year costs. However, due to the large increase that is anticipated in BT's rates bill and the difficulty in capturing this and its attribution to services within our standard cost modelling approach, we have forecast it separately. This process is described in Annex 17, and in order to avoid double-counting of cumulo costs it is necessary for us to remove all cumulo costs from the base year data.

Calculation of the Adjustment

A11.89 BT provided us with its operating costs with cumulo reported separately. This amounted to a £43.5m impact on opex within the WLA market.[180] Therefore, the adjustment was made to directly remove these costs from the base year.

Table A11.14 Impact on WLA market of proposed adjustment for cumulo

Proposed Adjustment	Opex Impact (£m)
Remove Cumulo costs	(44)

Source: BT.

Inclusion and smoothing of restructuring and property rationalisation provision costs

Explanation of the adjustment

A11.90 In the 2016 BCMR Statement we decided to remove BT's Restructuring and Property Rationalisation provision costs from the base year costs and replace them with the smoothed average of these costs over a three-year period. Restructuring costs are associated with changes in BT's organisational structure that result in employee redundancies, and are also known as leaver payments.

[179] BT's response dated 20 February 2017 to question 10 of 24th BT s.135 request.

[180] BT's response dated 28 November 2016 to question 3 of 19th BT s.135 request.

A11.91 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 will include an element of judgement as to the level of future costs and savings.

A11.92 As part of our review of BT's 2015/16 Statutory Financial Statements for 'one off' items we identified that BT incurred £29m in relation to Property Rationalisation provision costs and nothing in relation to Restructuring costs.[181] We noted that both types of cost displayed a high level of volatility, in particular the 2015/16 restructuring cost looked low in comparison to previous years, as shown below.

Table A11.15 Restructuring and Property Rationalisation provision costs (£m)

	2013/14	2014/15	2015/16
Restructuring costs	276	315	-
Property Rationalisation provision costs	-	45	29

Source: BT Group Plc Annual report & Form 20-F 2016

A11.93 As in BT's 2015/16 Statutory Financial Statements, leaver costs included in Operating costs before specific items have risen from £8m in 2014/15 to £109m.[182] Given that no Restructuring costs were recorded in 2015/16 this suggested that there were no real costs or that there might have been a change in accounting policy in 2015/16 reclassifying leaver payments within the Restructuring cost specific item to an Operating costs before specific item.

A11.94 We asked BT to provide a breakdown for WLA and WFAEL services for 2013/14, 2014/15 and 2015/16 of the Restructuring and Property Rationalisation provision costs. We also asked what the Restructuring Costs for 2015/16 would have been. BT responded that Restructuring costs, if accounted on the basis as in 2014/15, would have been £[✂]m across WLA and WFAEL.[183]

A11.95 In the 2016 BCMR Statement we considered that the Restructuring and Property Rationalisation provision costs are forward looking and efficiently incurred as they produce future efficiency benefits and reduce future property related costs. As with the 2016 BCMR Statement we consider that if we were to exclude these costs then this may lead to lower efficiency assumptions. We therefore propose to include these costs in base year model.

A11.96 Consistent with the 2016 BCMR Statement, given the continued variability of these costs, the amount of discretion that BT has in this process and the lack of transparency of their calculation, we propose that for the purposes of modelling our base year costs, these costs should be smoothed over a three-year period.

[181] BT Group plc Annual report and Form 20F, page 187
http://www.btplc.com/Sharesandperformance/Annualreportandreview/pdf/2016-Annual-Report.pdf
[182] BT Group plc Annual report and Form 20F, page 185.
[183] BT's Response to s135 number 19 dated 17 and 22 November 2016 to question 10.

Calculation of the adjustment

A11.97 BT provided network component costs for both the Restructuring Costs and Property Rationalisation provision cost for WLA and WFAEL services for 2013/14, 2014/15 and 2015/16.[184] We combined the three years of data to produce a smoothed three-year average. We then replaced the 2015/16 base year opex data with our smoothed calculation. The impact amounted to £0.4m increase in respect of Rationalisation Costs and £21m increase in respect of Property rationalisation provision, amounting to £ 21.4m in total.

Table A11.16 WLA Restructuring and Property Rationalisation provision costs and proposed adjustment (£m)

	2013/14	2014/15	2015/16	3 year average	Proposed adjustment
Restructuring costs	57	35	15	36	21
Property Rationalisation provision costs	N/A	4	3	4	0.4

Source: Ofcom analysis based on BT data.

Remove subsidised FTTC Deployment

Explanation of the adjustment

A11.98 In setting the WLA charge controls we are seeking to model an efficient national commercial operator and as a starting point we use BT's costs and volumes as inputs for our model. In the case of WLA, BT has received external funding (via BDUK) to support its investment in superfast broadband and broadband in hard-to-reach rural areas.

A11.99 BDUK funding and costs are included within the 2015/16 RFS and therefore would lead to inaccurate costs for the efficient national commercial operator we wish to model. We therefore propose to remove all costs and income associated with the subsidised services and adjust the associated volumes and costs for the commercial services. In effect, we adjust the base year GEA service costs to reflect the unit FAC for BT's commercial deployment.[185]

Calculation of the adjustment

A11.100 BT provided a breakdown of the cost of deployed subsidised services, which amounted to [✂] £(~91.7)m in opex and [✂] £(~381.5)m in MCE.[186] We propose to remove these costs from our base year.

[184] BT's responses dated 17 and 22 November 2016 to question 10 of the 19th BT s.135 request and its response dated 13 January 2017 to question 15 of the 23rd BT s.135 request.
[185] We have also assessed the difference in unit FAC between BT's commercial and subsidised deployment of FTTC. We found that the unit FACs were broadly similar (a difference of less than 2 %) and that the national average unit FAC was less than 1% different than the commercial unit FAC (in part because commercial volumes currently represent the clear majority of national volumes).
[186] BT's response dated 20 February 2017 to question 3 of 24th BT s.135 request.

Table A11.17 Impact on WLA market of proposed adjustment for Subsidised FTTC Deployment (£m)

	Opex Impact	MCE Impact
Remove subsidised FTTC deployment	[✄] (~(92))	[✄] (~(382))

Source: BT

Adjustment for service maintenance level differentials

Explanation of the adjustment

A11.101 As explained in Section 3, BT offers MPF products at a variety of SMLs which determine the speed with which a fault will be rectified (or service level guarantees become payable). Meeting the different service levels require different amounts of effort and resources from BT and hence they have different costs.[187]

A11.102 At the time of the 2014 FAMR Statement, MPF provision at SML2 was most prevalent, and was the service that our charge control was applied to. This service offers repair by the end of the next working day from the report of a fault, from Monday to Saturday.[188] However, in 2015 BT made an SML1 variant of MPF available, offering repair by the end of the next working day plus one, from Monday to Friday. The SML1 service is priced at a discount to the charge controlled SML2 service.[189]

A11.103 CP take up of the SML1 variant commenced in April 2016. In Section 3 we set out our proposal to set a charge control on the rental for MPF at SML1. However, the base year (2015/16) data we have collected from BT relates to a period before SML1 was being used.

A11.104 If we used 2016/17 as the base year for the statement, we would reassess the adjustment required based on how much of the migration to SML1 was covered by the 2016/17 data.

A11.105 We therefore need to make an adjustment to the (2015/16) base year operating costs for reactive repair of the access network in the base year to account for the difference in the mix of service options available between the base year and our forward look period.

A11.106 The only difference between SML1 and SML2 is in the Service Level Agreement (SLA) on the speed of repair. All other cost driving elements are the same, and therefore out of scope for our assessment of the cost differential.

[187] A description of these different services levels can be found in the 2017 QoS Consultation.
[188] 2017 QoS Consultation, Section 5.
[189] Openreach Price list.
https://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=to6u3F12FmH4GL92i3NosR9iCKrrD%2FZpzK1a%2FvJOccNZ6rNZujnCs99NbIKJZPD9hXYmiijxH6wrCQm97GZMyQ%3D%3D

Calculation of the adjustment

A11.107 We have used the outputs of the Resource Performance Model to understand the differential in resources required to provide services at SML1 rather than SML2.[190] This model assesses the change in effort (i.e. resource required) when moving from SML2 to SML1.

A11.108 For MPF, this essentially results in costs being deflated in order to remove the higher costs that are associated with providing SML2. We have applied a similar approach to WLR to account for any change in service mix.

A11.109 We have applied three different adjustment factors to the operating costs of repair related cost components for changes relating to service mix:

- Shared repair components[191] – repair related components that are shared across WLR and MPF. The costs for these components are allocated across WLR and MPF using our usage factors;
- WLR specific repair components – repair related components that are allocated to WLR on a one-to-one basis; and
- MPF specific repair components – repair related components that are allocated to MPF on a one-to-one basis.

A11.110 For the shared repair components, we have weighted the SML differentials by factoring in the current and expected volume mix for SML1 and SML2. We then apply this weighted differential to the operating costs that relate to provisioning and repair for the four shared repair components.

A11.111 In the base year, the repair related operating costs are not broken out, i.e. some of the costs within the repair related components are not impacted by changes in service level. Therefore, we need to calculate the proportion of total operating costs (for the specified components) that are specifically due to repair activities.[192] We then weight our three different adjustment factors by these proportions before applying them to the relevant base year operating costs.

A11.112 We use our adjustment factors on the unadjusted base year costs to calculate how costs should change within the base year. We then apply these changes in cost to the unadjusted base year in a consistent way as the other base year adjustments. The impact of this adjustment is negligible.

[190] 2017 Quality of service for WLR, MPF and GEA, Annex 7 https://www.ofcom.org.uk/__data/assets/pdf_file/0033/99645/QoS-WLR-MPF-GEA.pdf

[191] These are D side copper current, E side copper current, Local exchanges general frames maintenance, and Analogue line drop maintenance. However, we have also included repair costs that BT has allocated to D side copper capital, E side copper capital, Local exchanged general frames equipment, WLA tie cables, Dropwire capital & analogue NTE, and MDF Hardware jumpering. We consider these costs to be relevant for our SML adjustment but note that we do not adjust the usage factors for these other components (given that they primarily relate to provisioning and capital costs).

[192] We have determined these proportions using information provided by BT in its confidential response dated 20 and 24 February 2017 to the 24th s.135 request.

Table A11.18: Impact of service level adjustment on the WLA market (£m)

Proposed Adjustment	Opex Impact
Service level adjustment	[✂]

Source: Ofcom analysis based on Resource Performance Model.

Adjustment for Service Level Guarantees (SLGs)

Explanation of the adjustment

A11.113 SLGs are contractual payments made by BT to other telecoms providers to compensate for BT's failure to meet agreed performance criteria (such as time taken to complete an installation) set out in the Service Level Agreements. As set out below, we propose to allow BT to recover SLG payments that we might expect given our proposed service standards and proposals for retail automatic compensation.

A11.114 Due to proposals set out in the 2017 QoS Consultation,[193] there will be a change in the dynamics of SLGs that is not reflected within the 2015/16 RFS. In the review period, we expect the number of faults and therefore the cost of SLG payments to decrease. However, with the introduction of automatic compensation[194] we anticipate that the cost per payment will increase as telecoms providers negotiate changes to the SLG regime in response to compensation payments. Due to this change these aspects are being modelled separately and therefore need to be removed from the base year 2015/16 costs.

Calculation of adjustment

A11.115 In order to calculate this adjustment, we have gathered information from BT in relation to the total SLG payments it made for WLA services in 2015/16 and removed these from our base year costs. According to BT, it spent [✂] £(~27.6)m on SLG payments in 2015/16.[195] We then identified the network components that SLG payments are allocated to. We removed the costs relating to SLG payments from these network components from our base year opex.

Table A11.19 Impact of SLG adjustment on the WLA market (£m)

Proposed Adjustment	Opex Impact
Service level guarantees	[✂] (~(28))

Source: BT.

Adjustments in the top-down forecasting model

A11.116 In addition to the adjustments we make to the top-down data in the base year model, we also make several adjustments in the top-down forecasting model to base year data that we use for forecasting. These adjustments relate to:

[193] Ofcom, Quality of service for WLR, MPF and GEA – Consultation.

[194] Ofcom, Automatic Compensation. March 2017.

[195] BT's response dated 17 November 2016 to question 9 of the 19th s.135 request.

- The calculation of usage factors;
- Steady state and ongoing network adjustments; and
- Quality of service related adjustments.

Calculation of usage factors

A11.117 The top-down model forecasts costs based on network components which we then use to determine service costs. Usage factors allow us to:

- Convert network component costs to service level costs and vice-versa; and
- Convert service volumes to component volumes and vice-versa.

A11.118 We have made an adjustment to the usage factors for WLR, SMPF, and MPF rentals with respect to the four QoS related components that are shared across these services.[196] In order to maintain consistency with the previous cost model, we have normalised the MPF usage factor to 1.21[197], which is our calculated usage factor prior to the QoS adjustment.

A11.119 As set out above, we expect the service level mix to change over the charge control period. Therefore, we consider it appropriate to reflect the new service level mix, as well as any changes in fault rates, in the modelled usage factors. This is consistent with the approach taken in the 2014 FAMR Statement,[198] with our proposed usage factors shown below:

Tables A11.20: Adjusted usage factors by service level (2018/19, 2019/20, and 2020/21)

		WLR Basic Rentals	MPF Rentals	SMPF Rentals
2018/19	Fault rate allocation	0.74	1.00	0.33
	Service level allocation	1.025	1.00	1.033
	Combined usage factor used in model[199]	0.91	1.21	0.41
2019/20	Fault rate allocation	0.74	1.00	0.33
	Service level allocation	1.033	1.00	1.044
	Combined usage factor used in model	0.93	1.21	0.41
2020/21	Fault rate allocation	0.74	1.00	0.33

[196] These are D side copper current, E side copper current, Local exchanges general frames maintenance, and Analogue line drop maintenance.
[197] In other words, we have set the usage factor for these network components for MPF to 1.21, and adjusted the usage factors for WLR and SMPF to reflect this (i.e. to maintain the ratio that we calculated using fault rate and service level allocations.
[198] Ofcom, 2014 FAMR Statement, paragraph A13.60 https://www.ofcom.org.uk/__data/assets/pdf_file/0026/78812/annexes.pdf
[199] The combined usage factor is calculated as the fault rate allocation multiplied by the service level allocation, and then applying a normalisation of the MPF usage factor to 1.21.

	Service level allocation	1.025	1.00	1.033
	Combined usage factor used in model	0.93	1.21	0.42

Source: Ofcom Resource Performance Model

Steady state and ongoing network adjustments

A11.120 As discussed in Section 2, we consider it appropriate to model the costs of an ongoing copper network, which is consistent with our proposed approach to modelling an ongoing FTTC overlay network. We have made the following two adjustments to reflect an ongoing copper network:

- Steady state capex – this adjusts the base year capex to equate to the base year OCM depreciation.

- Depreciation profile – this adjusts the cost recovery for components with heavily depreciated assets by adjusting both the asset lives (and thus the implied OCM depreciation) as well as the base year NRC.

A11.121 The steady state capex adjustment applies to all network components. We consider it likely that capital expenditure can vary significantly year-on-year over the lifetime of an asset. We consider it appropriate to smooth capex over time in order to ensure more stable prices. We note that an ongoing network would, on average over the lifetime of its assets, equate capex and disposals to OCM depreciation.

A11.122 We consider it likely that an ongoing network would have assets with NRC to GRC ratios of around 0.5 to reflect the fact that it will replace heavily depreciated assets on an ongoing basis. However, given that, in the real world, the replacement of depreciated assets can fluctuate year-on-year (for instance in response to service volume changes) we expect that in any given year the observed ratio will be different to 0.5.

A11.123 Therefore, we consider it appropriate to only adjust Network Component Costs when the ratio is significantly different to 0.5. We consider the use of a 0.3 threshold to be conservative as it limits our cost uplifts for an ongoing network to network components that appear to have very depreciated assets. We have assessed the NRC to GRC ratios for the and found that six WLA and WFAEL Network Component Costs[200] have NRC to GRC ratios below 0.30.[201]

A11.124 Therefore, we have adjusted the base year NRCs for these Network Component Costs to be equal to 50% of their respective base year GRCs, and adjusted the asset lives based on an assessment of BT's book lives. The six Network Component Costs that we have adjusted are:

[200] We exclude from our assessment any GEA specific components, as these costs are captured within the bottom-up NGA model, as well as any components that are not forecasted in the top-down model (e.g. Time Related Charges). We also exclude from our assessment components for OR Service Centres, Service Level Guarantees components, and Openreach Sales Product Management since these components do not relate to maintaining BT's network on an ongoing basis.
[201] We consider it appropriate to not adjust Network Component Costs when they are not relevant for the services that we propose modelling costs on an ongoing basis. We note that no adjustments have been made to Pair Gain since we consider this component is not relevant for an ongoing network that provides broadband services. This is because pair gain is incompatible with the use of broadband services over the copper line.

- MPF line testing systems;
- Local exchanges general frames equipment;
- Analogue line test equipment;
- Analogue line cards;
- Co-mingling power & vent; and
- Combi Card and MSAN Access – Voice.

A11.125 We find that the steady state adjustment increases the 2020/21 forecast charge for MPF rentals by around £2.2 per line. The combined impact of our ongoing network adjustments is to increase the 2020/21 forecast charge for MPF rentals by around £6.3 per line.[202]

QoS-related adjustments

A11.126 We have published a separate consultation on our approach to improving quality of service on BT's network.[203] We have made several proposals to apply quality standards to aspects of BT's performance in the installation and repair of services on its access network. Given our policy decisions, we have assessed the likely impact that these changes will have on the forecast costs in the top-down model. We have also proposed to incorporate BTs planned investment programme into the charge control, which will result in a reduction in the network fault rate.

A11.127 As part of our assessment of the costs of differing levels of quality of service we have developed a model which is described in full within our quality of service consultation. This has allowed us to calculate the difference in the resources required to meet a given volume of repair demand, while meeting our regulatory standards different service levels.

A11.128 In order to account for the lower fault rates, we have assumed that there is a linear relationship between the fault rate and the specific costs we have identified as relevant to repair activity.[204] The Resource Performance Model calculates the required resource change for a given service level following a change in the quality standards.

A11.129 We have taken a similar approach to implementing QoS related adjustments for our forecast costs as done for our base year costs, see paragraphs A11.107 to A11.112 above. However, we have uplifted the costs for each service level (see Table A11.21 below) based on the increasingly more challenging target QoS standards. We have also used forecast costs and volumes rather than the base year costs.

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[202] We note that the steady state adjustment decreases GEA rentals by around £0.40 per line, with the combined ongoing network adjustment increasing GEA rentals by around £0.80 per line.

[203] 2017 QoS Consultation.

[204] We consider this is a reasonable simplification since any non-linearity between forecasted fault rates and costs would also be reflected in forecasted QoS standards and costs. Therefore, since the two effects are working in opposite directions and we assume a linear cost trend for both, the net impact on forecasted costs is relatively small and likely to be linear.

A11.130 We have also applied a resource downlift to the repair related operating costs given our forecast reduction in fault rates. As with the Service Level adjustments, we have calculated shared, WLR specific, and MPF specific adjustment factors.[205]

A11.131 We have calculated the proportional change in fault rates and applied this to the repair related operating costs in order to forecast lower costs due to lower fault rates. For the shared adjustment, we have calculated a weighted average downlift using WLR and MPF service volume forecasts and the WLR and MPF specific downlifts set out in the table below.

Table A11.21: Forecast resource uplift (relative to base year) by service level and downlift for fault rates

	2018/19	2019/20	2020/21
Uplift for Care Level 2	4.6%	7.9%	11.3%
Uplift for Care Level 1	0.7%	2.6%	4.5%
WLR Fault Rates	[✂]	[✂]	[✂]
MPF Fault Rates	[✂]	[✂]	[✂]
Downlift to shared costs (given lower fault rates)	[✂]	[✂]	[✂]
Downlift to WLR specific costs (given lower fault rates)	[✂]	[✂]	[✂]
Downlift to MPF specific costs (given lower fault rates)	[✂]	[✂]	[✂]

Source: Ofcom Resource Performance Model.

A11.132 We find that our uplift to repair related costs due to our proposed increase in QoS standards increases the forecast MPF charge by around £0.60 per line in 2020/21. We also find that the downlift to repair costs due to forecast lower fault rates reduces the forecast MPF charge by around £2.20 per line in 2020/21.

Other top-down modelling issues

A11.133 Above we have discussed our general approach to top-down modelling and adjustments we have made to base year data. In this section, we discuss how we have approached several detailed top-down modelling issues concerning the following:

- forecasting Openreach Copper, and co-mingling component costs;
- PIA implementation costs;
- copper scrap recovery;
- cumulo payment forecasts;
- SLG payment forecasts;

[205] We consider this to be consistent with our adjustments in the base year since the other forecasting adjustments do not impact the repair related operating costs in the top-down model.

- forecasting Time Related Charge (TRCs) and Special Fault Investigation (SFI) service costs; and
- forecasting GEA common costs.

Forecasting Openreach Copper and co-mingling component costs

A11.134 The approach to forecasting costs set out above is appropriate when the required volume and cost information is available. However, we note that BT was unable to provide reliable information for some components and services and so have applied a different forecasting approach to the following components:

- Openreach Copper (CW900);
- Co-mingling set-up (CL131); and
- Tie cables (CL133).

Openreach Copper

A11.135 We have an issue when calculating the cost of the Network Component Cost "Openreach Copper" because BT has provided costs by service within our base year data but is unable to provided network component volumes. Therefore, we are unable to calculate this component's usage factor using the methodology set out above.

A11.136 We found that the Openreach Copper Component is entirely made up of the Notional Debtor cost category and thus (before our base year adjustments) is entirely NCA related costs.[206] Furthermore, the component LRIC to FAC ratio is 1 which suggests that all costs allocated to this component are incremental. Therefore, we consider it appropriate to assume that the AVEs and CVEs for Openreach Copper are equal to 1.

A11.137 In the 2016 BCMR Statement, we estimated forecasts for a component with similar characteristics (Openreach Non Copper, an administrative cost) in line with service volumes.[207] We consider this an appropriate approach to apply to Openreach Copper. We have considered two possible approaches for implementing this approach:

- Option 1 (set the Openreach Copper usage factors for WLR & MPF rentals to 1) – this results in WLR & MPF rentals entirely picking up the costs from Openreach Copper.
- Option 2 (forecast for each service based on volume growth) – this requires Openreach Copper to be separately forecast within the top down cost model. Essentially, it will maintain BT's current allocation but applying individual service volume growths to forecast these costs.

A11.138 We find that much of the costs for Openreach Copper are currently attributed to WLR and MPF and so we consider that the difference between unit cost estimates produced by the two options would be limited. It could also be argued that these

[206] This is based upon the disaggregated cost data from BT's regulatory accounts, as found in the 2014/15 AFIs.
[207] 2016 BCMR Statement, 22 March 2016, paragraph A26.52

costs are commonly shared across all copper WLA and WFAEL services and thus should be applied equally to all copper lines.

A11.139 Therefore, we propose using Option 1 to forecast Openreach Copper costs and assume an AVE and a CVE of zero. This results in the non-NCA costs not changing over time and the NCA costs following the same approach as set out above.

Co-mingling component costs

A11.140 As set out in Annex 10, we consider there to be a significant amount of uncertainty when forecasting service volumes for co-mingling new provides. This uncertainty around service volume forecasts results in uncertainty around component volume forecasts and thus unit cost forecasts for this bundle of services. In the 2014 FAMR statement, we held unit service costs constant for co-mingling new provides but with the efficiency factor applied to them.

A11.141 Based on 2015/16 cost data, we find that co-mingling new provides are made up of many different Network Component Costs but that around 99% relate to the "co-mingling set up" component. Therefore, we consider it appropriate, as a modelling simplification, to hold constant the component volumes for co-mingling set up and make no further changes to the modelling approach.

A11.142 This results in the unit cost for co-mingling new provides to gradually decline (given efficiency) over the charge control period. We note that co-mingling new provides are part of the proposed broader Co-Mingling New Provides and Rentals basket. Therefore, we consider it likely that this adjustment has a relatively limited impact on the charge control, particularly given the significantly higher service volumes for co-mingling rentals.

Tie cable component costs

A11.143 The 2015/16 RFS show that the component volumes for WLA Tie Cables have decreased from 2014/15 to 2015/16 whilst total service costs have risen significantly. As a result of the falling component volumes, the WLA Tie Cable services now attract more of the fixed cost on a per service basis, causing unit costs to rise in the base year. This suggests that BT considers the costs associated with WLA Tie Cables to not be sensitive to changes in volumes (i.e. the component costs for WLA Tie Cables are primarily fixed).

A11.144 We consider the fall in component volumes to be consistent with our forecast decline in WLA Tie Cable service volumes. However, we expect the cost volume relationship for these services to suggest a limited change in unit costs.

A11.145 Therefore, we have assessed BT's cost volume drivers (i.e. AVEs and CVEs) for the WLA Tie Cables component. We set out our detailed analysis of AVEs and CVEs in Annex 15. We propose to make an adjustment to increase our calculated AVE for Tie Cables from 0.30 to 0.87 as we consider it to be too low.

A11.146 In light of this analysis, we consider it appropriate to adjust the WLA Tie Cables component to remove the significant change in unit costs from 2014/15 to 2015/16. We propose to use the 2014/15 WLA Tie Cables component volumes, which keeps unit component costs broadly flat between 2014/15 and 2015/16. We consider this approach to be the simplest way to reflect our higher modelled AVE within the base year data.[208]

PIA implementation costs

A11.147 In the WLA charge control, we have included costs related to the Physical Infrastructure Access (PIA) remedy. We consulted on elements of a new and effective PIA remedy in December 2016[209], and we will set out our full proposals for a PIA remedy shortly.

A11.148 In order to consult on the WLA charge control, we have included a relatively wide range of cost estimates to reflect the range of potential costs of the new PIA remedy. However, we consider it appropriate for any detailed discussion on PIA implementation costs to be done in conjunction with discussion on the detailed proposals for a new PIA remedy. Furthermore, we consider it unlikely that these costs will have a significant impact on the outcome of the next charge control.

A11.149 As determined within the control module, we use an assumption of the cost of implementing the new PIA remedy as being made up of:

- a one-off cost of £30 million (with an asset life of 5 years), with no ongoing fixed costs;[210] and

- variable costs calculated as the average cost per home passed multiplied by the number of homes passed by a new access network built using PIA.

A11.150 We consider most of the variable costs to be duct related and propose to spread the PIA variable costs over an asset life of 40 years. Furthermore, we have treated the one-off and variable costs as capital costs and have included a return on capital employed (using the WACC as found in the top-down model).

A11.151 We have adopted a simple approach of spreading the PIA costs over all lines (i.e. allocated across WLR and MPF Rentals). We tested a flexible assumption that allowed this cost be spread over GEA lines only but find that this has a relatively small (c.2%) impact on forecast costs. We propose therefore to recover PIA cost over all lines on a per line basis.

Copper scrap recovery

A11.152 As set out in Annex 18, we have determined a copper scrap value that BT will be able to recoup when it moves to a FTTx only network. We have estimated the present value of the net copper scrap proceeds to be £110 million. We consider it appropriate to take account of the potential proceeds from the sale of copper, to

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208 We note that this change relates to base year costs rather than our approach to forecasting costs. However, this adjustment does not occur within the Base Year Model but instead impacts our calculated usage factors (which are only used for forecasting purposes).

209 Ofcom, December 2016, *Wholesale Local Access Market Review: Initial proposals to develop an effective PIA remedy.* https://www.ofcom.org.uk/__data/assets/pdf_file/0024/95109/Wholesale-Local-Access-Market-Review.pdf

210 For the dark fibre access remedy (as part of the 2016 LLCC), we estimated one-off implementation costs to be £[✂]m £(0-10)m. We have included a figure which is significantly higher than this to ensure that we reflect the range of potential costs of the new PIA remedy.

reflect our expectation that BT will be able to extract and sell a proportion of its E-side copper network before or shortly after the PSTN network switch-off.

A11.153 As set out in Section 2, we consider our approach to be consistent with the use of an anchor pricing approach.[211] We therefore believe that to send efficient pricing signals, the revenue earned from future copper sales should be accounted for in our charge control modelling.

A11.154 We consider it likely that BT will recover the copper scrap as part of a programme to extract relatively large volumes of copper (given it would be economically efficient to do so). We estimate that this will start to occur around 2025, based on BT's estimate for switching off its PSTN network[212], and will take around 5 years to complete, based on how long it took BT to complete most of the copper scrap recovery in its core network.[213] In other words, we consider it likely that the E-side copper scrap will be fully recovered 12 years after the start of the charge control.

A11.155 We note that the revenue earned from future copper sales is due to the residual value of assets found in the copper network. Therefore, we consider it appropriate to spread this revenue over all copper lines.[214] Furthermore, we consider the recovery of the copper scrap value over 12 years to be consistent with our approach to modelling the recovery of costs for an ongoing network.[215]

A11.156 Therefore, we have implemented the copper scrap recovery within the top-down model by:

- calculating the present value of the proceeds in 2030 based on the estimated future proceeds[216] using a discount rate of BT's cost of capital;
- converting the calculated present value into a constant real terms annual adjustment;
- attributing this adjustment across all copper access lines (i.e. WLR and MPF) adjusting for inflation over time; and
- we find that including the copper scrap recovery within the top-down model, as set out above, results in the cost of MPF Rentals in 2020/21 reducing by around £0.30 per annum.

211 Accounting for the residual value of an asset is an important part of any investment decision. Any decision to invest in a network would take account of the potential for the recovery of residual asset values at the time of disposal.

212 Openreach, *Openreach Summary of Market and Customer Insight on the ISDN2 and ISDN30 Services*, page 1 https://www.ofcom.org.uk/__data/assets/pdf_file/0036/94797/Openreach-Summary-of-Market-and-Customer-Insight-on-the-ISDN2-and-ISDN30-Services.pdf

213 BT's response dated 12 August 2016 to question 4 of the 12th BT s.135 request.

214 We note that in practice this will also benefit superfast customers given that GEA currently requires either an MPF or WLR line.

215 Specifically, we consider our approach to recovering the copper scrap value is consistent with how we model the recovery of costs associated with the copper asset in the top-down model.

216 This is calculated using our estimate of the net proceeds from the sale of E-side copper (i.e. £110 million) and inflating this by RPI (i.e. the index used for copper price inflation in our cost forecasts).

Cumulo payment forecasts

A11.157 As noted in our discussion of base year adjustments above, we have excluded cumulo payments from the base year costs. We have separately forecast BT's cumulo bill and allocated it to WLA and WFAEL services, as set out in Annex 17.

A11.158 Cumulo rates are the non-domestic (business) rates that BT pays on the rateable assets (e.g. duct, fibre, copper, exchange buildings) within its UK network. BT's total non-domestic rates bill will increase significantly over the charge control period due to the 2017 revaluation by the rating authorities. A transition scheme is in place: cumulo rates will gradually increase to their new level over a period that extends beyond the end of our proposed charge control period.

A11.159 We have forecast BT's cumulo costs, including the impacts of increasing numbers of GEA and MPF lines over the charge control period. We have then calculated attributions of these costs to WLA and WFAEL services to allow BT to recover a proportion of its cumulo rates bill for the relevant products in the charge control period.

A11.160 Our proposed method for attributing cumulo to services is very similar to the current method BT uses. The steps are:

i) estimate the cumulo costs attributable to GEA and non-GEA services in each year;[217]

ii) attribute all GEA cumulo costs to GEA rental services. We divide these costs by GEA rental volumes to produce a GEA cumulo cost per annum in each year out to 2021/22. It is these values that are input to the bottom-up model; and

iii) attribute all non-GEA cumulo costs across non-GEA network components using a profit weighted net replacement cost (PWNRC) approach. To do this we generate forecasts for the non-GEA NRCs of rateable assets for each network component in each year. We attribute those cumulo costs to network components using the same routing factors that are applied in our main top-down model.

A11.161 We use the cumulo forecasts as an input into the top-down model and they are calculated on a component basis. We consider cumulo to be part of the component LRIC and so have adjusted the forecast component LRICs (and FACs) within the top-down model. Specifically, we have removed the cumulo costs in the base year and then added in the forecast cumulo by component for each of the charge control years. This is then allocated to services using our calculated usage factors.

[217] We calculate the rateable value (RV) attributable to GEA services in each year by multiplying our forecasts of GEA rental volumes by £18 (our estimate of the per line RV based on a historical value used by the VOA – see Annex 17). This allows us to calculate a share of the total RV attributable to GEA services in each year which we then multiply by our forecasts of BT's total cumulo costs. This produces the cumulo costs attributable to GEA services and hence those attributable to non GEA services.

SLG payment forecasts

Our approach to SLG payments

A11.162 As noted in our discussion of base year adjustments above. we have excluded SLG payments from the base year costs. We have separately forecast SLG payments and we set out our approach in more detail below.

A11.163 SLGs are compensation that the purchasing telecoms provider would be entitled to should Openreach not provide a service to the quality specified in the SLA, e.g. if delivery of the service was late.

A11.164 We would expect an efficient firm to have to make some level of SLG payments. The resource commitments required to ensure that SLAs are always met are likely to be very significant and involve QoS costs that would unlikely be at an efficient level. Allowing the recovery of some SLG payments through charges is therefore likely to be consistent with allowing BT the opportunity to recover its efficiently incurred costs.

A11.165 We would normally expect lower levels of service quality to be associated with lower costs of provision and vice versa for higher levels of service quality. However, where the firm needs to pay penalty payments to its customers for failing to meet contractually agreed quality of service, as is the case with BT, lower levels of quality can result in higher costs.

A11.166 We consider the SLG payments in 2015/16 are unlikely to represent an appropriate level of SLG costs for forecasting purposes. BT's payments for SLGs in 2015/16 are likely to exceed the efficient level, given we are expecting BT to achieve a higher level of quality of service in the future. We expect that a higher quality of service will lead to fewer SLG payments.

A11.167 In principle, the level of compensation provided by SLGs should cover the average costs to telecoms providers of breaches of the quality obligations specified in the SLAs. At the retail level, we are proposing to introduce an obligation for telecoms providers to pay customers compensation for service failures associated with broadband and voice installation and repairs (automatic compensation). Our proposed automatic compensation levels are shown by the table below.

Table A11.22: Summary of automatic compensation levels (£ per day)

	Loss of Service	Delayed provisioning	Missed Appointments
Automatic compensation fees	10	6	30

Source: 2017 Automatic Compensation Consultation.[218]

A11.168 In order for SLGs to continue to cover the average costs to telecoms providers of breaches to the obligations in the SLAs, we consider that in due course SLGs will need to be changed in order to cover the costs to telecoms providers of paying automatic compensation due to Openreach network failures.

[218] Ofcom 2017, Automatic Compensation Consultation, https://www.ofcom.org.uk/__data/assets/pdf_file/0030/98706/automatic-compensation-consultation.pdf

A11.169 Given that a new SLG regime will be negotiated by industry, there is uncertainty around the level of SLG payments over the period of this charge control. Therefore, we need to exercise regulatory judgement in estimating the level of SLG payments to include in the base year costs.

A11.170 To inform our regulatory judgement, we have modelled the Openreach SLG payment costs on a bottom-up basis considering the expected improvements in QoS and pass-through of retail automatic compensation payments to SLG payments. We have used a combination of historical performance data[219] and Openreach's planned QoS improvements[220] in our calculations.

Forecasting SLG payments

A11.171 We calculate Repair SLGs on the basis of:

- (i) Repair SLG event rate * (ii) the average number of days SLGs are payable for * (iii) the daily SLG payment (£) * (iv) Forecast volume of lines.

A11.172 We have estimated the individual components as follows:

i) Repair SLG event rate: For MPF, WLR, WLR Premium and GEA(FTTC): first we estimated fault volumes as the forecast number of lines multiplied by the forecast fault rate[221]. The forecast fault rate is based on Openreach's network health plan which aims to achieve a fault rate [✂] (below 9.9%).[222] We then multiplied fault volumes by the proportion of fault volumes that we estimated Openreach will not repair within the SLA (and hence which BT has to pay SLGs on). We have based this proportion on the binding repair standards we are proposing in the 2017 QoS Consultation. For SMPF: we used Openreach's repair event rate from its best performance year (2011/12).[223]

ii) The average number of days repair SLGs are payable (SLG lead time): this is based on the shortest lead time Openreach achieved over the last 5 years.

iii) The daily repair SLG payment (£): For 2015/16 to 2017/18, this is based on the current SLG arrangement.[224] From mid-2018/19 to 2020/21, this is the sum of the

[219] We have used historic data from BT on SLG events. Source: BT's response dated 17th November 2016 to question 8 of 19th WLACC BT s.135 request.

[220] We have used information from Openreach's "network health" programme which aims to reduce the network fault rate from its current position of 110 faults/1000 lines per annum to 79 faults/1000 lines per annum. Source: BT's response dated 16th September 2016 to question 7 of 4th WLA QoS s.135

[221] The proportion of line volumes that will receive a fault.

[222] Openreach aims to reduce the fault rate from the current 11% to a level at least 10 percent below 11%.

[223] Using the same methodology as above will lead to an overestimate of SMPF repair event rates. SMPF is purchased as an add-on to WLR and typically has a much lower SLG event rate than other products.

[224] The product's current daily SLG payment for repairs is typically equal to its monthly rental price. For charge control products (MPF and GEA(FTTC)), we used current and future rental prices obtained from our charge control model. For non-charge control products, we used their current rental prices and we assumed that these prices will remain constant over time.

current SLG payment and the retail loss of service automatic compensation payment being proposed in table A11.22.

iv) Forecast volume of lines: This is the volume forecast for each of the relevant WLA and WFAEL products (MPF, WLR, SMPF and GEA (FTTC)) as estimated in our volumes model.

A11.173 Provision SLGs are calculated on the basis of:

- (i) Provision SLG event rate * (ii) the average number of days SLGs are payable for * (iii) the daily SLG payment (£) * (iv) Forecast volume of provisions

A11.174 We have estimated the individual components as follows:

i) **Provision SLG event rate**: this is based on the lowest SLG event rate Openreach achieved over the last 5 years.[225]

ii) **The average number of days provision SLGs are payable for**: this is based on the shortest lead time Openreach achieved over the last 5 years.

iii) **The daily provision SLG payment (£)**: For 2015/16 to 2017/18, this is based on the current SLG arrangement. [226] From mid-2018/19 to 2020/21, this is the sum of the current SLG payment and the retail loss of service automatic compensation payment being proposed in table A11.22.

iv) **Forecast volume of provisions**: This is the volume forecast for each of the relevant WLA and WFAEL products (MPF, WLR, SMPF and GEA (FTTC)) as estimated in our volumes model.

A11.175 There are also other SLGs that relate to the first available date (FAD) for an Openreach engineer appointment, missed Openreach engineer appointments and dead on arrival (DoA) provisions, where an installation is carried out on time but the service does not work. The methodology used to estimate these SLGs is similar to that used for the provisions SLGs, i.e. it is based on historical performance data and an estimate of the increase in SLGs due to automatic compensation.

A11.176 The forecasted total SLG payments for all relevant WLA and WFAEL products (MPF, WLR, SMPF and GEA (FTTC)) over the charge control period are shown below.

[225] We are proposing a new standard of 95% for installations (or 94% under force majeure) to be completed by their committed date by 2020/21 in the 2017 QoS consultation. However, we have used Openreach's best performance event rate for provisions instead because we believe that Openreach's performance should exceed these quality standards.

[226] Daily provision SLG is typically equal to its monthly rental for WLR and WLR Premium. We again used their current monthly rental price and assumed that this does not change over time.

Table A11.23: Payments (£m) by SLG type over the next charge control period

	2018/19	2019/20	2020/21
Repairs	14,729,210	15,056,870	10,018,535
Provisions	15,376,077	19,891,726	20,138,531
FAD	451,917	457,123	458,094
Missed Appointments	7,397,460	9,712,953	10,501,123
Dead on Arrival	3,914,386	4,048,071	4,229,947
Total	41,869,049	49,166,743	45,346,231

Source: Ofcom analysis

A11.177 We calculated each of the SLGs above using a set of assumptions. Some of these include:

- fault rates and lead time for WLR premium is the same as those for WLR;
- fault rates and lead times for provisions, FAD, missed appointments and DoA are unchanged throughout the charge control period;
- SLG arrangements remain unchanged apart from the inclusion of the full automatic compensation payment after mid-2018/19; and
- daily SLG cost for non-charge control products (WLR and SMPF) are constant over the charge control period.

A11.178 We are aware that some of these assumptions are highly uncertain and could lead to an over estimate of SLGs[227]. However, we have tested our model estimates against Openreach's historic performance data. Through this calibration process, we have found that our assumptions are a reasonable approximation of Openreach's historic performance as our estimated SLG payments for 2015/16 was only different by 0.5% from the actual SLG payments over the same period.

A11.179 BT currently allocates the costs associated with SLG payments across both rentals and their associated ancillaries (i.e. connections and migrations). However, our forecast SLG payments are only split by technology (i.e. split by WLR, MPF, SMPF, and GEA but not rentals and connections). Furthermore, unlike our cumulo forecasts, the SLG payment forecasts are by service rather by component.

A11.180 Therefore, we need to consider an appropriate allocation rule for rentals and the associated ancillaries when implementing the forecast SLG payments into the top-down model.[228] We consider the use of the usage factors for the Network

[227] For example, we assumed that SLG arrangements will not change after the introduction of automatic compensation due to uncertainties regarding the new SLG negotiations. It is likely that SLG arrangements will change to reflect automatic compensation but it might not include the full automatic compensation fee.

[228] Note that we continue to allocate the same total forecasted SLG payments to a given technology (e.g. MPF) as found in the SLG Forecast Model. We have simply implemented an allocation across rentals, connections, and migration services.

Component “Service Level Guarantees” to be the best available information for allocating SLG payments across rentals and ancillaries.

A11.181 To allocate SLG payments across rentals and ancillaries for WLR and SMPF, we have used the relative usage factors across MPF rentals and ancillaries, for Service Level Guarantees. We note that due to the different service level mixes across WLR, SMPF, and MPF that the relative payments to rentals and ancillaries may be different. However, given that we are proposing to not charge control WLR or SMPF, this allocation across WLR ancillaries is only for the purposes of the EPMU approach to common cost allocation.[229] SLG payments represent a relatively small proportion of total LRIC so we consider it unlikely that our modelling simplification will have a significant impact on the charge control.[230]

Forecasting TRC and SFI service costs

A11.182 As set out in Volume 2, Section 3, we consider that price regulation for Time Related Charge (TRCs) and Special Fault Investigation (SFI) services is necessary as the services are not contestable. In order to set a charge control, it is necessary for us to decide on appropriate unit costs based on the available information.

A11.183 However, there are limits to the robustness and reliability of the data available to inform this decision. Therefore, in making this decision we have exercised our regulatory judgement based on the information available, in this case the 2015/16 AFI with the cost trend calculated for TRCs as part of the 2016 BCMR. It is on this basis that we consider the comparison between the current hourly price and our forecast of unit costs.

A11.184 We consider it reasonable to base our proposed decision using this information, particularly given the limitations of the alternative data. Furthermore, consistent with the 2014 FAMR Statement[231], we consider that the charges for SFIs should be aligned with the underlying hourly TRC cost estimates. Therefore, we have applied the same cost trend to both TRCs and SFIs.

A11.185 We found that the FAC and revenue in 2015/16 for SFI services were broadly similar, as shown in the 2015/16 RFS. However, we find that the revenue from TRC services in the WLA market was around £37.6 million compared to a FAC of around £27.8 million in 2015/16. We note that there is a significant amount of uncertainty around the costs for these services hence our simplified approach to modelling costs. In light of this, we consider it appropriate to not apply a starting charge adjustment but instead use an adjusted glide path for both TRCs and SFIs.

A11.186 Consistent with our reasoning in the 2014 FAMR Statement,[232] in considering revenues and costs for TRCs, we acknowledge that TRCs are provided across BT’s portfolio of products and not just for LLU or WLR services (e.g. they are also provided for Ethernet). However, TRCs do not significantly differ depending on whether they are bought for WLR, LLU, or Ethernet. Therefore, for the purposes of

[229] The EPMU approach allocates common costs based on the relative LRICs of the copper and fibre rental services. Therefore, we consider it appropriate to ensure we do not significantly over estimate the forecasted LRIC for WLR services.

[230] Furthermore, we do not consider BT’s allocation across rentals and ancillaries to be necessarily the best allocation.

[231] Ofcom, 2014 FAMR Statement, Volume 1, paragraph 18.168.

[232] 2014 FAMR Statement, Volume 1, paragraph 18.90.

forecasting cost trends for TRCs and SFIs, we consider the aggregate data across all TRCs, as we do not consider there to be a need to make a distinction between the wholesale products they are provided for.[233]

A11.187 We have applied the same methodology as in the 2016 BCMR Statement[234] but using our own forecast price inflation for pay costs and opex efficiency (see Annex 12 for details on our forecasting approach). This results in an estimated cost trend of around 0.6 % per annum.[235] We have applied this cost trend to the 2015/16 unit costs of £39.46 and £48.32, for TRCs and SFIs respectively. In order to obtain a unit price in 2016/17, we have applied CPI to the unit price found in the 2015/16 AFI, which are £53.54 and £51.20 for TRCs and SFIs respectively. We then calculated the charge control X values using the methodology set out above, leading to the following results:

Table A11.24: Adjusted X values for TRCs and SFIs

	2018/19	2019/20	2020/21
TRCs	-20.0%	-11.6%	-1.4%
SFIs	-4.5%	-3.5%	-1.4%
Weighted average	-14.5%	-8.7%	-1.4%

Source: 2014/15 and 2015/16 AFIs with Ofcom forecast.

A11.188 We consider it appropriate to apply the same weighted average X to both TRCs and SFIs. This is because we expect the costs of these services to be broadly similar, given the use of similar activities, and so we consider it appropriate to align charges. Furthermore, we consider this to be consistent with our previous approach, where we aligned charges across these services.

[233] While we use the data for all TRCs for our analysis (given we would not expect costs or prices to vary significantly according to the wholesale product they are provided for), we note that here we are only imposing a charge control for those TRCs that relate to MPF and GEA services.
[234] Ofcom, 2016 BCMR Statement, paragraph 8.99.
[235] This does not consider for the changes to BT's increased cumulo. However, cumulo is not a significant proportion (less than 1%) of total costs for TRCs and SFIs. The cumulo payment for TRCs account for [✂]% of payments in 2015/16 and around [✂]% in 2020/21. The cumulo payment for SFIs account for [✂]% of payments in 2015/16 and around [✂]% in 2020/21.

Annex 12

Charge control cost model: bottom-up model documentation

A12.1 In this annex we set out the approach we have taken to estimating the unit costs of fibre based access services over the charge control period from April 2018 to March 2021, using our bottom-up model. In determining our approach, we have taken account of responses to our May 2016 WLA Consultation on fibre cost modelling.

A12.2 This annex should be read alongside the Cartesian Report at Annex 20, which provides details of how we have calculated the amount of equipment required for our modelled network and identified the costs associated with that equipment, and Annex 13 which explains our approach to calibrating the bottom-up model.

Summary of proposals

A12.3 Based on our proposals in the May 2016 WLA Consultation on fibre cost modelling and the responses we received from stakeholders, we propose to:

- use a bottom-up approach to estimate the costs of an efficient national fibre access network;
- consider FTTC as the proven modern equivalent asset (MEA) technology for modelling fibre access in the UK;
- dimension the modelled network based on BT's existing copper network;
- exclude non-commercial areas from the modelled network footprint; and
- use CCA depreciation to determine the profile of cost recovery over time.

A12.4 We are publishing our model spreadsheets, reflecting these proposals.[236]

Background

A12.5 In May 2016, we consulted on our proposed approach for modelling the costs of fibre access services in the UK. We said that the purpose of the cost model was to develop our understanding of the wholesale costs of providing fibre access services ahead of our March 2017 WLA Consultation. We noted that if we were to develop the cost model further and use it to inform our proposals in the WLA Consultation, we would publish a further version of the model at that time.

A12.6 We are now consulting on our approach for modelling fibre costs with the purpose of informing the charge controls proposed in Volume 1 Section 8 and set out in detail in Volume 2 Section 4 of this Consultation.

[236] https://www.ofcom.org.uk/consultations-and-statements/category-1/wholesale-local-access-market-review

A12.7 In arriving at our proposed approach, we have taken utmost account of the following two EC Recommendations:

12.7.1 European Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (the "**2010 EC Recommendation**");[237] and

12.7.2 European Commission Recommendation of 11 September 2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment (the "**2013 EC Recommendation**").[238]

A12.8 The remainder of this annex is structured as follows:

- first, we set out our approach to building the cost model, including the choice of technology, the modelling approach we propose to adopt and the geographic scope of the model;
- second, we describe the overall structure of the cost model, and discuss key assumptions made; and
- third, we outline our proposed approach to recovering costs over time and across services.

A12.9 Our proposed approach to model calibration and cost cross-checks, as well as our response to the stakeholder feedback on these aspects of our May 2016 WLA Consultation on fibre cost modelling, are outlined in Annex 13.

Conceptual approach to cost modelling

Choice of SFBB fixed access technology

A12.10 The purpose of our model is to calculate the cost of providing SFBB services in the UK. A number of different approaches can be used to deploy fibre in the access network in order to provide SFBB speeds. Therefore, in order to determine the costs of an efficient fibre access network, we have sought to adopt an appropriate proven efficient technology for providing nationwide fibre access.

May 2016 WLA Consultation on fibre cost modelling

A12.11 In our May 2016 WLA Consultation on fibre cost modelling we identified a number of technologies over which fibre services are currently being provided in the UK, including Coaxial Cable (DOCSIS), FTTC (VDSL2) and FTTP and set out our

[237] Commission Recommendation of 20 September 2010 on regulated access to Next Generation Access Networks (NGA) (2010/572/EU), http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32010H0572&from=EN.

[238] Commission Recommendation of 11.9.2013 on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment (C(2013) 5761), 11 September 2013, http://ec.europa.eu/smart-regulation/impact/ia_carried_out/docs/ia_2013/c_2013_5761_en.pdf.

proposal to base the modelled costs of fibre access on those of a national efficient operator, building a fibre network using FTTC and VDSL2 technology.

A12.12 In addition, we noted that during the period covered by this review, BT has announced it will commence deployment of its G.fast network. We said that the G.fast standard is a DSL technology that offers the potential for higher speeds than are provided by the VDSL2 technology. We also noted that the network architecture is currently being tested by BT.

A12.13 We highlighted that, to date, BT has primarily deployed VDSL2 based FTTC for delivering fibre services.[239] By the start of the market review period, around 90% of UK homes are expected to have VDSL2 based FTTC services available to them. We noted that this is forecast to fall to around 85% by the end of the control period due to take-up of FTTP, but we considered that FTTC will remain the predominant technology used by BT for delivering SFBB services over the period of the review.[240]

A12.14 Therefore, we proposed that in seeking to understand the efficiently incurred costs of the deployment BT has made, a model assessing the costs of a FTTC network using VDSL2 technology would appear appropriate.

A12.15 We noted that such choice of technology was consistent with the 2013 EC Recommendation, which states that:

- fibre costs should be modelled "on the basis of an efficient network using the latest technology employed in large-scale networks";[241] and
- "In light of the principle of technological neutrality NRAs should consider various approaches to modelling the hypothetical efficient [fibre] network depending on the access technology and network topology that best fit national circumstances."[242]

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.16 Those telecoms providers who responded[243] had reservations about modelling only FTTC using VDSL2 and argued that it is unrealistic to assume this will remain the dominant technology over the model's 40-year time span. In particular, all

[239] According to Analysys Mason forecasts there were around 25m UK homes passed by Openreach FTTx by the end of 2015, but only 0.3m of these were FTTP, meaning around 99% of Openreach's current NGA deployment is based on FTTC. Analysys Mason, September 2015. UK FTTx forecasts. http://www.analysysmason.com/Research/Content/Reports/FTTx-forecast-Sept2015-RDTW0/ [accessed 26 March 2017].
[240] Analysys Mason estimates that by end-2018, less than 4% of all BT FTTx connected lines will be FTTP, meaning around 96% of UK FTTx lines will be FTTC. Analysys Mason, September 2015. UK FTTx forecast. http://www.analysysmason.com/Research/Content/Reports/FTTx-forecast-Sept2015-RDTW0/ [accessed 26 March 2017].
[241] Page 15, 2013 EC Recommendation.
[242] Page 20, 2013 EC Recommendation.
[243] Respondents who commented on the May 2016 WLA Consultation on fibre cost modelling are BT, Vodafone, Virgin Media, TalkTalk, CityFibre, the Scottish Futures Trust ("SFT") and two confidential respondents.

respondents referenced the existence of plans for the deployment of other technologies, such as G.fast and FTTP.

A12.17 BT acknowledged that FTTC technology will remain the predominant technology during the market review period, but argued that "…investments in substitutes will determine the demand for VDSL2 services over the period of Ofcom's proposed financial analysis…" and therefore that costs and potential revenue opportunities would be ignored by the model.[244] BT argued we should change the model "to incorporate the potential emergence of and impact from anticipated new technologies".[245]

A12.18 Vodafone believed that "[i]t is unrealistic to assume the continued predominance of VDSL2 over the period to 2047/48". It argued that "BT has already announced plans to deploy G.fast technology to most of the UK by 2025, and in the longer term wider deployment of FTTP is a realistic prospect given the right investment environment". According to Vodafone, "these developments have the potential to materially impact modelled costs".[246]

A12.19 Vodafone stressed that because of this "unrealistic assumption […] the true cost of FTTC/VDSL2 is likely to be distorted…".[247] However, Vodafone recognised that "…it may be that until the nature and scale of the future deployment of these technologies [G.fast and FTTP] becomes clearer, it will be difficult to eliminate this distortion".[248]

A12.20 Virgin Media agreed with Ofcom that "FTTC using VDSL2 is an appropriate technology to model, as BT uses this access technology".[249] However, it argued that migration to G.fast and FTTP should be included given the concrete investment plans in place from BT, Virgin Media, and other telecoms providers that are set to take place before reaching the steady state assumed in the model.[250]

A12.21 TalkTalk argued that "modelling should not assume that FTTC will be the permanent technology in the UK", noting that BT is already trialling new technologies.[251]

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[244] BT, 2016. *Response to Ofcom consultation on possible approaches to fibre cost modelling*, paragraph 53, https://www.ofcom.org.uk/__data/assets/pdf_file/0029/83099/openreach.pdf.
[245] BT, 2016, paragraph 54.
[246] Vodafone, 2016. *Response to Ofcom's Consultation: Wholesale Local Access Market Review: Approaches to fibre cost modelling*, paragraph 3.3, page 10, https://www.ofcom.org.uk/__data/assets/pdf_file/0034/82789/vodafone.pdf.
[247] Vodafone, 2016, paragraph 3.4, page 10.
[248] Vodafone, 2016, paragraph 3.4.
[249] Virgin Media, 2016. *Response to Ofcom's WLA – Consultation on Possible Approaches to Fibre Cost Modelling – May 2016*, page 4, https://www.ofcom.org.uk/__data/assets/pdf_file/0024/83517/virgin_media.pdf.
[250] Virgin Media, 2016, page 5.
[251] TalkTalk, 2016. *Response to consultation on possible approaches to fibre cost modelling*, paragraph 3.8, https://www.ofcom.org.uk/__data/assets/pdf_file/0026/82691/talktalk.pdf.

A12.22 CityFibre believed that by modelling only FTTC using VDSL2 technology, there is a high risk that price regulation of FTTC could undermine the investments in ultrafast technologies.[252]

A12.23 The Scottish Futures Trust ("SFT") believed that we should also consider other technology approaches through the modelling of a number of different providers to benchmark any FTTC modelling.[253]

Ofcom's analysis

A12.24 We agree with stakeholders that new broadband technologies are likely to emerge and be deployed in the UK over the modelled time horizon. In particular we note BT's plans to commence rollout of a new G.fast network with the aim of reaching 10 million households within the charge control period.[254]

A12.25 In order to capture these rollout plans in our cost model, we would have to form a view as to the scale and timing of BT's G.fast deployment, the cost of such deployment, and the extent to which consumers will adopt G.fast over the duration of the model.

A12.26 In our May 2016 WLA Consultation on fibre cost modelling, we highlighted that BT is still testing how it will deploy G.fast. The evidence we have seen suggests this remains the case: according to Openreach, G.fast trials and pilot deployments are underway involving BT (including BT Wholesale) and TalkTalk.[255] Furthermore, we understand BT plans to deploy G.fast at existing cabinets, and is assessing whether there is a case to deploy G.fast further into the D-side network.[256]

A12.27 The outcome of the trials and pilots and the final details of network deployment will determine the scale and timing of BT's G.fast rollout. Therefore, it would be premature at this stage to anticipate what the costs and volumes of BT's G.fast network will be over the control period. As such, we believe FTTC remains the proven MEA technology[257] for modelling fibre access in the UK.

A12.28 As discussed in Volume 2, Section 3, in the past, we have dealt with similar uncertainty around the rollout of new technologies by adopting an anchor pricing approach. Specifically, we have modelled service unit costs based on the "old" technology such that consumers are not made worse off by the introduction of "new" technologies. Under this approach, operators are encouraged to introduce new technologies when they lead to lower unit costs and/or deliver higher value to consumers. As an example, in our 2014 FAMR Statement[258], we anchored access

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[252] CityFibre, 2016. *WLAMR Consultation on possible approaches to fibre cost modelling*, page 1-2.
[253] SFT, 2016. Response to Ofcom Consultation on possible approaches to fibre modelling, Page 1.
[254] BT, 2016, http://home.bt.com/news/bt-life/openreach-expands-ultrafast-fibre-plans-11364045256060 [accessed on 29 January 2017].
[255] BT, 2016, https://www.homeandwork.openreach.co.uk/fibre-broadband/ultrafast-fibre/gfast.aspx?utm_source=gfastfurl&utm_medium=Campaignfurl&utm_campaign=gfast+furl. [accessed on 12 December 2016].
[256] Meeting between Ofcom and BT staff in 28 June 2016.
[257] The MEA is the most efficient proven technology of providing SFBB services.
[258] See, e.g., paragraphs 3.40 to 3.66 in Ofcom, 2014. *Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 – Volume 2: LLU and WLR Charge Controls*, Statement, https://www.ofcom.org.uk/__data/assets/pdf_file/0032/78836/volume2.pdf.

prices to an ongoing copper network, irrespective of the fact that BT was already deploying a fibre access network.

A12.29 We propose to adopt a similar approach for modelling fibre costs in this review; namely, by modelling the costs of an ongoing FTTC overlay network over the model time horizon. We consider this approach to be consistent with our proposal to impose a charge control on BT's 40/10 GEA product, while retaining pricing flexibility on other bandwidth variants.

A12.30 We believe this combination of a product and technology anchor will protect the incentives of telecoms providers to rollout new ultrafast broadband technologies, without affecting the position of existing SFBB customers.

Bottom-up cost modelling approach

A12.31 In determining our proposed approach to estimating the costs of an ongoing fibre access overlay network based on an FTTC topology using VDSL2 technology, we need to consider whether to estimate the costs on a top-down[259] or bottom-up[260] basis.

May 2016 WLA Consultation on fibre cost modelling

A12.32 In our May 2016 WLA Consultation on fibre cost modelling, we proposed to use a bottom-up approach to model fibre costs. We noted that we had used bottom-up models in the past to set cost-based charge controls, for example in the regulation of Mobile Termination Rates (MTRs)[261] and in the regulation of fixed call origination and fixed call termination in the 2013 Narrowband Market Review.[262]

A12.33 We considered that, in the present context, a bottom-up approach would provide more robust cost estimates than a top-down approach for fibre services. In particular, we outlined a number of advantages of using bottom-up modelling over top-down modelling. These include:

- bottom-up models are generally more transparent than top-down models. Bottom-up models can usually be published without the need to redact large amounts of confidential information. This should mean that it is clearer to all

[259] A top-down approach uses total network cost data and allocates these costs to services based on service usage factors. This approach does not rely on detailed assumptions about how the network is constructed. Instead, the modelled costs are calculated using cost-volume elasticities which reflect assumptions about the way the cost of high-level network components change as traffic rises or falls.
[260] A bottom-up approach estimates how much network equipment is needed to meet the expected level of output based on technical assumptions in relation to network capacity and dimensioning algorithms. It then calculates the total cost of this network equipment using evidence of the capital and operating costs of each piece of equipment.
[261] Ofcom, *Mobile Call Termination Market Review 2015-18: Statement on the markets, market power determinations and remedies*, 17 March 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-call-termination-14/statement/MCT_final_statement.pdf.
[262] Ofcom, 2013. *Narrowband Market Review. Statement.* https://www.ofcom.org.uk/__data/assets/pdf_file/0014/50720/final_statement.pdf.

stakeholders why and how services drive network components which in turn drive service costs.

- A top-down modelling approach would require estimates of CVEs and AVEs which will be difficult to obtain (in a robust way) given the lack of historical accounting data. It also relies to a greater extent on the use of confidential information. Conversely, by using network build parameters, bottom-up modelling allows a more accurate calculation of the underlying (long-run) cost-volume relationships (i.e. CVEs and AVEs).

A12.34 We also said that our proposed approach was consistent with the 2013 EC Recommendation which states that, for the purposes of setting fibre (cost orientated) access prices:

> "NRAs should adopt a [bottom-up] LRIC+ costing methodology that estimates the current cost that a hypothetical efficient operator would incur to build a modern efficient network, which is a [fibre] network."[263]

A12.35 While we proposed using a bottom-up modelling approach, we said that we planned to base some input data on top-down sources (for example, costs associated with infrastructure shared between copper and fibre services). In addition, we proposed to use top-down data to calibrate the bottom-up model.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.36 Most of the telecoms providers who responded disagreed with our bottom-up approach, explicitly stating a preference for a top-down approach.

A12.37 BT stressed that, regardless of the modelling approach, Ofcom should use Openreach's historical actual cost data for historical periods to avoid hindsight bias.[264] On our bottom-up proposal, BT believed that "[t]he proposed network design, component count, and build assumptions are not detailed enough to capture all of the costs" and will create unrealistic outputs.[265] BT noted the significant regional variances in deployment costs, and argued that taking simple averages would understate the impact of these differences in costs.[266]

A12.38 Virgin Media believed the starting point of the analysis should be the actual costs incurred by BT and therefore that a top-down approach was the most appropriate.[267] Virgin Media argued that "[Bottom-up] models are prone to missing pools of relevant cost entirely, or over/under dimensioning cost elements because these models are a simplification of the network being modelled".[268] It noted that "BT currently has a fully developed, audited, top-down CCA model, populated with BT's historical costs, details of its network infrastructure, service volumes and

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[263] 2013 EC Recommendation, page 19.
[264] BT, 2016, paragraph 57.
[265] BT, 2016, paragraph 60.
[266] BT also asked Ofcom to explain how we would propose to estimate a kilobyte per second peak parameter and how we propose to deal with the replacement of assets before the end of their useful life due to actual demand outstripping forecast demand. These points are addressed in Section 4 of the Cartesian Report at Annex 20.
[267] Virgin Media, 2016, page 5.
[268] Virgin Media, 2016, page 6.

revenues across the historical period on [sic] which this review seeks to cover"; so, it reasoned, "…it would seem counterintuitive not to make full use of this to analyse FTTC costs".[269]

A12.39 TalkTalk argued that a bottom-up model is more likely than a top-down model to lead to allocative inefficiency, since no audited accounting data will be available to inform Ofcom's estimates and other data will be scarce as there are no other FTTC networks in the UK and cross border estimates would not be representative.[270] In addition, TalkTalk believed there is a lack of evidence to support Ofcom's claim that a bottom-up approach provides greater transparency. It argued "there are more likely to be confidentiality issues in the data underlying a [bottom-up] model than a [top-down] one, as the unit costs incurred by BT for various network elements are more likely to be commercially confidential than heavily aggregated total expenditure " in top-down models.[271]

A12.40 TalkTalk also argued that our use of bottom-up models in other Market Reviews should not be a reason for adopting a bottom-up approach in this case because the markets in question were significantly different to the WLA market. In particular, these markets were oligopoly markets with multiple operators holding SMP, whereas in the WLA market BT is a monopoly supplier.[272]

A12.41 TalkTalk however recognised that as "…Ofcom will not have access to a long series of regulatory accounts for FTTC products which would permit CVEs to be calculated on a top-down basis", a bottom-up approach would be appropriate for calculating cost volume elasticities.[273] However, it stressed these elasticities should be calculated on a top-down basis in the longer term as more data becomes available.

A12.42 Both TalkTalk and Virgin Media[274] also commented on maintaining a consistent approach with the copper model currently in use. Specifically, TalkTalk argued that "[b]y adopting different methodologies for MPF and GEA regulation, Ofcom risks making its task more difficult in future regulatory periods [as voice customers migrate from copper to fibre], as it will need to construct separate models for the two elements of SOGEA".[275] We interpret these two elements to be the copper and fibre segments comprising the FTTC network.

A12.43 Vodafone was the sole respondent to support the proposal to model the costs of a fibre access network on a bottom-up basis. It agreed that the bottom-up approach would lead to "more accurate modelling of cost-volume relationships, greater transparency, and consistency with the 2013 EC Recommendation". It also agreed that "the recovery of common costs should be considered in a coordinated fashion across all relevant services [i.e. as part of the wider March 2017 WLA Consultation], in order to minimise the risk of over- or under-recovery".[276] However, Vodafone raised the concern that the inclusion of top-down input data into the model would

[269] Virgin Media, 2016, page 7.
[270] TalkTalk, 2016, paragraph 2.4.
[271] TalkTalk, 2016, paragraph 2.6.
[272] TalkTalk, 2016, paragraph 2.7.
[273] TalkTalk, 2016, paragraph 2.14.
[274] Virgin Media, 2016, page 7.
[275] TalkTalk, 2016, paragraph 2.5.
[276] TalkTalk, 2016, paragraph 3.7.

appear to contradict the approach proposed by Ofcom and sought clarification over how these input data would be used.[277]

Ofcom's analysis

A12.44 Stakeholders raised a number of concerns in relation to our proposal to use a bottom-up approach for modelling fibre costs. We have grouped these into three main categories:

- a bottom-up model carries the risk of understating (or overstating) actual costs;
- a bottom-up model is likely to rely heavily on BT's commercially sensitive data and make the model less transparent; and
- a bottom-up approach is inconsistent with the modelling approach used for copper services, and previous Market Reviews where such an approach was adopted are not relevant to the WLA market.

A12.45 We address each of these concerns in turn below.

A12.46 We agree that there is a risk that a bottom-up model will understate (or overstate) costs. A bottom-up model, like any model, is a simplification of the real world. It is based on aggregated engineering assumptions about how a network is built and the identifiable costs associated with installing and running such a network. It is likely that such a bottom-up model will miss some costs due to the aggregation process. A top-down model is based on actually incurred costs, so is less likely to suffer from over or understating costs.

A12.47 For this reason, we consider it good practice to calibrate our bottom-up models against top-down data. Model calibration involves us checking the outputs of the bottom-up model, such as equipment counts and total asset values, against the equivalent data from a top-down source. This type of calibration allows us some confidence that our modelling is correctly capturing all relevant costs and this approach is consistent with the approach we have taken when building bottom-up models in the context of other market reviews.[278] Annex 13 sets out our approach for calibrating the bottom-up model.

A12.48 We note that a top-down model is also a simplification of reality. It uses simplified elasticities (i.e. AVEs and CVEs) to approximate the underlying long-run cost-volume relationships in order to forecast costs. In fact, these elasticities tend to become less reliable when service volumes are changing over time[279], which is currently the case of fibre access services. In contrast, a bottom-up model could more accurately calculate these long-run cost-volume relationships by using network build parameters which mimic the planning rules that operators use in practice for dimensioning a network. We therefore believe that a calibrated bottom-up model is better able to forecast costs in this case than a top-down model.

[277] TalkTalk, 2016, paragraph 3.8.

[278] See, e.g., paragraph A6.170 in Ofcom, 2013, Narrowband Market Review. https://www.ofcom.org.uk/__data/assets/pdf_file/0014/50720/final_statement.pdf.

[279] This is because the LRIC to FAC ratios used to inform the AVEs and CVEs tend to vary with service volumes, i.e. as the network grows in size, economies of scale and scope start to kick-in, making network costs less sensitive to changes in volumes.

A12.49 Furthermore, we are concerned about how costs are allocated to GEA services in BT's top-down data. In reviewing BT's 2014/15 and 2015/16 RFS, we identified costs which appeared to have been wrongly attributed within fibre access services. As a result, we engaged Cartesian to review GEA costs – a non-confidential version of its report is published alongside this Consultation.[280] As set out in Annex 22, we are proposing a number of changes to the way BT reports GEA services within the RFS based on the Cartesian recommendations.

A12.50 In terms of model transparency, we consider that any model of a national FTTC network using VDSL2 is likely to rely substantially on confidential BT data. This is because BT is the only national FTTC network operator in the UK and, importantly, BT does not publish fibre access cost information in the RFS. Consequently, BT is likely to regard this information (including aggregated fibre access top-down data) as commercially sensitive. So regardless of the type of model used, many of the assumptions in the cost model are likely to rely on BT confidential data.

A12.51 However, compared to a top-down approach, a bottom-up approach provides greater detail on how the underlying cost-volume relationships were calculated. This is because, in a top-down model, the AVEs and CVEs used to forecast costs are informed by a BT LRIC model that is not in the public domain. Conversely, a bottom-up model allows stakeholders to observe the underlying cost-volume relationships and potentially allow third parties to validate the model inputs and outputs by populating the model themselves, using their own data.

A12.52 To assist stakeholders in verifying the outputs of the bottom-up model, we have sought to disclose the information that we can, subject to our statutory duties relating to the disclosure of confidential information. In particular, where inputs are to be kept confidential, we have provided randomised numbers where appropriate, as done in previous cost models.

A12.53 In relation to Virgin Media's assertion that a fully developed, audited BT top-down model already exists for fibre services we note that:

- BT's auditors do not express an audit opinion on the RFS beyond the market summary although they do some checks on the services that BT is required to report separately, and GEA services are not currently subject to such obligation; and

- as mentioned at paragraph A12.49 above, Cartesian and ourselves have found inadequacies in the methodology BT uses to attribute costs between GEA services in the privately provided information accompanying BT's RFS.

A12.54 Finally, we do not believe, as suggested by some respondents, that using a bottom-up approach for fibre services would raise consistency issues with the way we analyse copper costs. As explained further below, we are now proposing to use CCA depreciation to determine how modelled fibre costs are to be recovered over time, which is consistent with our cost recovery approach for copper services. We are also proposing to assess any common costs shared between copper and fibre services as part of a separate top-down analysis (see paragraphs A12.134 to A12.147). These proposals will ensure that copper and fibre costs are assessed in a coordinated fashion and that the costs that are common between services are appropriately recovered. We note that while the 2013 EC Recommendation

[280] https://www.ofcom.org.uk/consultations-and-statements/category-1/wholesale-local-access-market-review

recommends the adoption of a bottom-up approach, it acknowledges the need for stable and predictable wholesale copper access prices over time.

A12.55 With regard to TalkTalk's claim that the reasons for adopting a bottom-up approach in previous market reviews do not apply in this case because the markets are different, we note that we are not proposing a bottom-up approach on the basis of market structure, though we state that we will follow the best practices that have been adopted in these previous exercises. We also note that the 2013 EC Recommendation recommends the adoption of a bottom-up approach regardless of whether the market is monopolistic or oligopolistic.

A12.56 In addition, as to TalkTalk's view that a bottom-up approach would risk having to construct separate models for the two elements of SOGEA, we stress that SOGEA has not yet been launched, and, as such, we cannot speculate on whether (and how) this service will be regulated. In any event, having two models will give us the flexibility to cost the service in the most appropriate manner, should the need arise in future market reviews.

A12.57 In summary, we consider the bottom-up approach to be a more appropriate way to model the cost of FTTC services in this case. Bottom-up modelling has the advantage of greater transparency in this case and enabling the more accurate identification of the underlying cost-volume relationships. A bottom-up modelling approach would also be consistent with the approach recommended in the 2013 EC Recommendation on NGA costing methodologies.

Scorched node approach

A12.58 In using a bottom-up approach, we need to determine whether to model a completely hypothetical fibre access network with the most efficient (lowest cost) design and topology (a scorched earth approach), or to use the deployment of existing infrastructure as a starting point for any modelling exercise (a scorched node approach).

May 2016 WLA Consultation on fibre cost modelling

A12.59 In our May 2016 WLA Consultation on fibre cost modelling we proposed to use a scorched node approach, whereby the network topology and dimensioning in terms of number and location of network civil infrastructure (namely copper cabinets and local exchanges) is based on those currently existing. Specifically, we proposed to align the number and location of key civil infrastructure elements with the network deployed by BT.

A12.60 We argued that although a scorched earth approach would allow us to model the most efficient network possible, it would add considerable complexity to the modelling process and would potentially omit migration costs (i.e. the costs of moving from one previously efficient topology to the new efficient topology). Given the model is of an overlay FTTC deployment on an existing copper network, we considered that it would not seem appropriate to model this overlay network on a copper network topology that is different from that used to provide existing copper services without incurring some migration costs.[281] We also noted that a scorched

[281] It would be very difficult to accurately estimate such migration costs given that there is no real-life example available for comparison.

earth approach would limit our ability to use the model to assess the cost of BT's actual FTTC deployment.

A12.61 Conversely, we considered that a scorched node approach would allow the bottom-up model to be grounded in reality, since it does not construct an entirely new civil infrastructure network for the purposes of deploying a fibre access network.

A12.62 In proposing the scorched node approach, we noted that we have had utmost regard to the 2013 EC Recommendation, which states that:

> "When modelling an [fibre] network, NRAs should include any existing civil engineering assets that are generally also capable of hosting an [fibre] network as well as civil engineering assets that will have to be newly constructed to host an [fibre] network."[282]

A12.63 The 2013 EC Recommendation goes on to say that:

> *"*Therefore, when building the bottom-up LRIC+ model, NRAs should not assume the construction of an entirely new civil infrastructure network for deploying a [fibre] network."[283]

<u>Responses to the May 2016 WLA Consultation on fibre cost modelling</u>

A12.64 BT agreed with our proposal of a scorched node approach, believing it "should provide a closer match to Openreach's actual overlay FTTC network".[284] However, it expressed concerns that it remained unclear what civil infrastructure costs were to be included in the model and that the model should take into account all incremental costs incurred for new civil infrastructure in fibre access network deployment.[285]

A12.65 Virgin Media supported a scorched node approach if Ofcom persists with a bottom-up model, noting the consistency with the approach adopted by Ofcom in previous bottom-up modelling exercises in the context of other market reviews.[286]

A12.66 TalkTalk also agreed that a scorched node approach is most appropriate if using a bottom-up approach for the reasons set out in our consultation document.[287]

A12.67 SFT agreed that the modelling should be based on building upon an existing network, although it warned that "any costings and/or assumptions should be based upon elements of the existing network being in usable condition" and that the "modelling should not provide allowances for the rectification of poor condition infrastructure".[288]

A12.68 CityFibre argued that "it is not clear what costs Ofcom would consider to be migration costs; as the network is already built, then the nodes are already defined,

[282] 2013 EC Recommendation, paragraph 32.

[283] 2013 EC Recommendation, paragraph 32.

[284] BT, 2016, paragraph 62.

[285] BT, 2016, paragraph 62. We address this comment in more detail under the "Shared CGA and NGA infrastructure" section below.

[286] Virgin Media, 2016, page 7.

[287] TalkTalk, 2016, paragraph 3.3.

[288] SFT, 2016, pages 1-2.

and would be captured in the scorched node modelling approach which will include dedicated FTTC components (in the bottom up overlay model) and shared use of infrastructure (to be determined by the WLA review)". CityFibre also noted however that "there would be migration costs incurred in any future deployment of ultrafast networks which, as noted above, would require alterations to the existing network topology" and welcomed Ofcom's views on how this would be covered in our proposed modelling approach.[289]

A12.69 Whilst Vodafone acknowledged the practical benefits of a scorched node approach, it was the sole respondent to raise concerns in relation to it. Vodafone noted that the current network topology deployed by BT for its FTTC services is heavily influenced by the legacy left by its copper-based origins so that an efficient network topology would feature far fewer optical nodes and be less costly overall. Vodafone also warned that "BT plans to change its network fundamentally […] over the medium term (within the timescale considered by the model), vacating most of its exchanges. Therefore, applying a scorched node approach to BT's current network topology inflates costs above not only efficient greenfield levels, but also above BT's own likely level of costs in the medium to longer term."[290]

Ofcom's analysis

A12.70 The majority of respondents agreed with our proposal to use a scorched node approach for modelling fibre costs.

A12.71 The main concern raised was in relation to the implementation of the scorched node approach, rather than to the approach itself. Specifically, Vodafone and other respondents[291] were concerned that applying a scorched node approach to BT's network deployment would lead to an inefficient network design, with Vodafone arguing more specifically that BT is likely to reduce the number of local exchanges in the medium to longer term.

A12.72 In this regard, in modelling an FTTC overlay network we are tied to an architecture with copper from the customer to the cabinet. Whilst if this network was to be planned now BT might do it differently, BT's existing copper network is the outcome of the accumulation of decisions BT has made over time and it would be inappropriate to assume otherwise for the purposes of modelling an FTTC network.

A12.73 Some of these decisions entail determining how to connect cabinets back to exchanges as part of the FTTC rollout. Whilst BT has re-used existing civil infrastructure to provide these connections where possible, it has not used all of the existing local exchanges (i.e. all child exchanges) in its FTTC build but only a subset of them (the parents). We have followed this approach, which implies that around [✂] of BT's local exchanges[292] do not have optical equipment in them, in the model we have developed. So, in effect, the scorched node approach already

[289] CityFibre, 2016, page 2.
[290] Vodafone, 2016, paragraph 3.9.
[291] A confidential respondent noted that "[a] fibre to the cabinet approach can significantly reduce the number of exchange nodes required, well below the numbers BT currently use", while SFT argued that "any costings and / or assumptions should be based upon elements of the existing networks being in usable condition", and that "[t]he modelling should not provide allowances for the rectification of poor condition infrastructure" (pages 1-2, SFT, 2016.).
[292] See paragraph 3.38 in Annex 28 of the 2016 BCMR Statement. We assume a similar pattern for commercial FTTC areas.

anticipates that a lower number of local exchanges are used in deploying a FTTC network, as suggested by Vodafone.

A12.74 More generally, we believe that as a matter of principle, BT's network design decisions should not be judged based on how a network would be designed if deployed today – but by the information available at the time when the network was planned and deployed. Unless we find evidence suggesting that BT made inefficient network design choices, based on the information available at that time, we will seek to mirror BT's actual FTTC network rollout.

A12.75 In this regard, we have deviated from BT's actual FTTC network deployment in a number of cases. These are set out and explained in Annex 13. For instance, we have assumed a lower number of Optical Line Termination (OLT)s and Optical Concentration Rack (OCR)s than observed in BT's FTTC network. This is because, while verifying our model outputs, we were not able to reconcile BT's actual element count with the count that would result from applying BT's own planning and capacity rules. We believe these rules are reasonable and consistent with the guidelines set out by equipment manufacturers. Therefore, we have not mirrored BT's actual network deployment in this case.

A12.76 As explained in Annex 13 we have also conducted a calibration exercise against BT top-down costs to ensure that our modelled costs are in line with real world costs.

A12.77 As to CityFibre's point on migration costs, we note that in our May 2016 WLA Consultation on fibre cost modelling we referred to these costs in relation to a scorched earth approach (and not to a scorched node as suggested by CityFibre). Although we agree with CityFibre that, in principle, migration costs may also arise in a scorched node model as a result of the introduction of new technologies, these would not arise in our case given our choice of modelling an ongoing FTTC network.

NGA network dimensions and geographic coverage

<u>May 2016 WLA Consultation on fibre cost modelling</u>

A12.78 In our May 2016 WLA Consultation on fibre cost modelling we proposed to model a fibre access network based on the coverage area of the current and likely future FTTC network footprint in the UK (excluding the Hull area served by KCOM).

A12.79 Based on our scorched node approach, we proposed to dimension the modelled network to the same geographic areas and over the same timeframe as we have observed occurring in BT's network.

A12.80 We took the provisional position of including BT's commercial rollout only, i.e. excluding coverage areas that were part-funded by BDUK or any other state intervention. We noted that if we were to change our approach in this regard and include BDUK areas in the March 2017 WLA Consultation, this would impact specific volumes and costs but would not affect the overall structure of the model.

A12.81 We noted that for future years, we do not expect significant further commercial rollout as we considered BT's commercial deployment of FTTC was largely complete.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.82 BT believed we had not explained why we had excluded areas part funded by BDUK or other state intervention from the model, and requested us to clarify our reasoning for excluding these areas.[293] BT noted that certain costs are not included in the initial BDUK build costs and hence are not subject to any subsidy arrangements. For this reason, BT argued that "[i]n order that correct costs of [fibre] excluding subsidy are modelled, only costs that are subsidised should be excluded from the model". BT also requested us to clarify how our modelling will adequately deal with regional variation in costs.[294]

A12.83 BT disagreed with our assertion that if we were to change our approach, including BDUK areas would not affect the overall structure of the model. For example, BT stated, "BDUK will share FTTC-like enhancements, like copper Rearrange (CuRe) and Fibre To The Remote Node (FTTRN)". BT requested us to clarify the basis for our assertion in this regard as well as regarding Cartesian's related statement that BDUK area costs can be easily excluded.[295] BT also disagreed with our assertion that significant further commercial rollout is not expected. BT noted that "future build will utilise various solutions (FTTRN, G.Fast, Vectoring and CuRe), which will have significantly different capex and opex cost profiles". As a result, BT argued, Ofcom's model approach will not capture significant expected costs to support fibre access.[296]

A12.84 Virgin Media believed the model "currently lacks sufficient geographic disaggregation and differentiation between areas of high and low utilisation", which risks underestimating BT's costs.[297] Virgin Media considered that an advantage of a bottom-up analysis is the opportunity to capture these differences not visible in a top-down analysis.[298] As an example, it noted the possibility of reflecting the impact of other technologies, in areas already deployed, on costs and service demand.

A12.85 Virgin Media disagreed with the exclusion of BDUK areas. It argued for example that "BT is required to provide the same regulated services and network access as it is required to do in non-BDUK areas and therefore the costs and volumes from these areas are entirely relevant to the broader analysis of its cost recovery". Virgin Media noted that the characteristics of BDUK areas are likely to be distinct, and these should be modelled. Virgin Media also noted that "[e]ven if some account is taken of the subsidy provided to BT in BDUK-funded areas, the model's time horizon is 40 years, far beyond the timeframe in which the BDUK-support is provided".[299]

A12.86 Vodafone argued the model should include coverage areas that are part-funded by BDUK or other state intervention, with both costs and level of state aid contributions transparently reflected. Vodafone added that this would present the benefits of "reflecting the higher take up of FTTC in [BDUK] areas", and ensuring a more

[293] BT, 2016, paragraph 63.
[294] BT, 2016, paragraph 65.
[295] BT, 2016, Annex 1, page 28.
[296] BT, 2016, Paragraph 64.
[297] Virgin Media, 2016, pages 2 and 3.
[298] Virgin Media, 2016, page 8.
[299] Virgin Media, 2016, page 8.

accurate calibration by avoiding difficulties associated with disaggregating top-down data between non-BDUK and BDUK areas.[300]

A12.87 SFT also believed that BDUK funding should be built into the analysis on the basis that it will impact upon how costs are funded, any underlying cost of capital and the ultimate return which can be made through performance. In addition, SFT stated another reason for including BDUK areas in the bottom-up model was that "the modelling should capture how efficiencies have been realised over time through such factors as procurement and evolution of equipment, standard services and the like". SFT suggested these could be captured as an efficiency factor or as actual figures in the modelling.[301]

A12.88 TalkTalk agreed the "most suitable approach to price capping in BDUK areas under a bottom-up approach is to assume that the average cost, net of subsidy, in BDUK areas is the same as the average in commercial rollout areas…".[302] However, TalkTalk noted that "…such an approach risks over-compensating BT in BDUK areas"[303], particularly given evidence of higher than expected take-up in those areas.

Ofcom's analysis

A12.89 One of our overarching principles underpinning the design of a charge control is to set access prices such that they mimic the outcomes that would be observed in a competitive market to encourage the most efficient outcomes for consumers.[304]

A12.90 Consistent with this principle, we are proposing to model the costs of a national efficient fibre access operator (see paragraph A12.11 above). As such, we would expect an efficient operator to roll out areas which are profitable to serve. In other words, an efficient operator would not be expected to expand to areas which only become commercially viable once government subsidies are made available.

A12.91 This is not to say that government could not tender for network expansion into non-commercial areas, and that deployment would become efficient with additional funding. Such an agreement could be possible but should not affect the level of access prices in the market; otherwise, prices would no longer reflect competitive market outcomes.

A12.92 On this basis, we propose to base the FTTC model on commercial FTTC areas, excluding all areas where FTTC deployment costs have been subsidised (in part or in whole) by government and other public funding, e.g. BDUK. We consider that excluding the costs, volumes and revenues associated with subsidised rollout from our modelling is the optimal approach because it is likely to best mirror the costs of an efficient commercial network operator in the least complex manner.

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300 Vodafone, 2016, paragraph 3.10.

301 SFT, 2016, page 1.

302 TalkTalk, 2016, paragraph 3.5.

303 TalkTalk, 2016, paragraph 3.6.

304 This is consistent with our duties under section 88 of the Act requiring Ofcom not to set a price control SMP conditions except where: 1) it appears to Ofcom from the market analysis that there is a relevant risk of adverse effects arising from price distortion; and 2) it also appears to Ofcom that the setting of the condition is appropriate for the purposes of – a) promoting efficiency; b) promoting sustainable competition; and c) conferring the greatest possible benefits on end-users.

A12.93 If we include the subsidised areas, we would need to consider how to treat the subsidies BT has received. This would be complex and potentially problematic, given that:

- It is not clear that assessing the c.50 BDUK contracts involved would necessarily result in a definitive answer on whether the net cost to BT is higher or lower in subsidised areas than elsewhere. The contracts include clawback clauses so that the level of subsidy varies over time, depending on take-up – this can be realised either by BT paying money back to the local authority or extending rollout.[305]

- In negotiating contracts, parties would have been in a position to consider the level of demand experienced in commercial deployments, which began in advance of the majority of the subsidised rollout, the step change in SFBB services provided in these areas, and the interaction between demand and the clawback mechanism.

A12.94 In parallel, we are mindful of the need for BT to have the opportunity to recover efficiently incurred costs – so as not to harm investment incentives. As required by the BDUK scheme,[306] BT supplies SFBB services in non-commercial areas at a similar price as supplied in commercial areas. We would be concerned if, as a result of a charge control, BT would no longer have the opportunity to recover its efficiently incurred costs.

A12.95 We do not believe, however, that excluding subsidised areas from our bottom-up modelling would lead to such under-recovery problem. To the extent that BDUK requires BT to supply the same services at the same charges across commercial and non-commercial areas, we would expect BT to have taken that into account when determining its bids for government funding. Therefore, once government subsidies are netted off, we would expect BT to face similar average unit costs across the two areas.

A12.96 We have tested this premise by comparing BT's unit FAC in commercial and non-commercial areas. BT provided information on its GEA costs at a RFS component level as well as the commercial cost split by component.[307] Based on this information we separately calculated BT's total FAC in commercial areas and in non-commercial areas. To estimate the average unit cost in each area, we then divided the total FAC number by the corresponding GEA service volumes in the relevant area[308]. This analysis suggests that, net of subsidy, the average unit cost is broadly similar (with a difference of less than 2%) across the two areas; implying no cost recovery problem.

[305] We note that BT have deferred £229m of fibre grant funding in 2015/16 and expects this money to be re-invested to improve reach and quality of the network (see presentation BT Capital Markets Day, 2015/16 results, 5 May 2016 - http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/Q4/Downloads/Slides/CapitalMarketsDay-Part1.pdf).

[306] See condition 58 of the BDUK scheme. European Commission, 2012. State aid SA.33671 (2012/N) – United Kingdom National Broadband scheme for the UK - Broadband Delivery UK, C(2012) 8223 final, page 18, http://ec.europa.eu/competition/state_aid/cases/243212/243212_1387832_172_1.pdf.

[307] BT's response dated 20 February 2017 to question 3 of the 24th BT s.135 request.

[308] BT's follow-up response dated 8 September 2016 to question 5 of the 6th BT s.135 request.

A12.97 We also acknowledge TalkTalk's concern that higher than expected SFBB take-up in state aid areas could lead to overcompensating BT. We consider this risk to be limited by its temporary nature, as BT would have to give up any excess profits (due to higher than expected take-up) as part of the claw-back provisions in the BDUK contracts.

A12.98 With regard to BT's comment on its commercial rollout not being complete yet, we accept that BT continues to roll out FTTC cabinets on a commercial basis. In our May 2016 WLA Consultation on fibre cost modelling, we said that we did not expect any "significant" further commercial rollout. The evidence we have received since then confirms this remains the case, as the number of additional commercial FTTC cabinets deployed by BT continues to decline, representing c.1% of the total cabinet base in 2016/17, down from c.2% in 2015/16.[309] We have updated our FTTC rollout assumptions to reflect this.

A12.99 Also in relation to BT's response, we believe the model is flexible enough to accommodate changes to our preferred approach and include non-commercial costs, if deemed appropriate in the future. We acknowledge BT's point that different cabinet types have been deployed in non-commercial areas (i.e. FTTRN, CuRe). We believe that these cabinet types could be incorporated into the model without having to make changes to the overall structure of the model – i.e. FTTRN and CuRe cabinets could be included as additional network elements (in a similar fashion as we have modelled commercial cabinets).

A12.100 As to Virgin Media's submission on the geographic disaggregation of the model, we believe we can achieve our objective of estimating the costs of a national efficient fibre access operator by drawing on national averages, and calibrating the model outputs against BT's top-down data (so as to ensure that our cost estimates are in line with actual costs). In fact, we have changed a number of model assumptions to reflect the variations we have observed across different exchange areas as part of our calibration exercise (see Annex 13). It is our current view that adding further geographic granularity to the model would not materially improve its accuracy, while it would make our bottom-up modelling more complex.

A12.101 Finally, we disagree with SFT's view that including BDUK areas in our cost modelling would be necessary to capture cost efficiencies realised over time. We believe that excluding non-commercial areas in the cost model does not mean omitting efficiency gains. Indeed, we have sought to capture these efficiencies via the cost trends and MEA price adjustments assumed in the model (see Section 4 of the Cartesian Report at Annex 20).

Span of network in scope

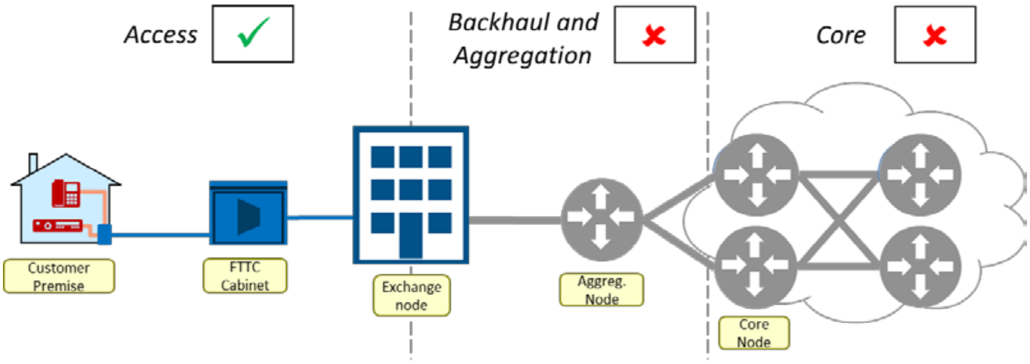
<u>May 2016 WLA Consultation on fibre cost modelling</u>

A12.102 In our May 2016 WLA Consultation on fibre cost modelling we proposed that the scope of the model should comprise the portion of the fibre access network up to the point of handover i.e. the point where access is made available to other telecoms providers.[310]

[309] BT's response dated 17 June 2016 to question H1 of the 7th BT s.135 request.

[310] In the instance of NGA, the point of handover is the Layer 2 Switch at the Exchange.

Figure A12.1: Network segments in scope for bottom-up model



Source: Cartesian.

A12.103 We argued that this approach ensures the model only captures the access portion of the network.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.104 Only BT and Virgin Media commented on this aspect of our May 2016 WLA Consultation on fibre cost modelling. BT noted for clarification it considers the correct span of network in scope to be "all of the network elements deployed for NGA including spine costs and deployment of switches and infrastructure at parent/child exchanges".[311] BT also commented that customer modem costs were missing from our cost modelling and should be included.[312]

A12.105 Virgin Media broadly agreed with the network segment in scope of the model.[313]

Ofcom's analysis

A12.106 None of the respondents disagreed with our proposal of modelling the portion of the fibre network up to the point of handover i.e. the point where access is made available to other Telecoms providers.

A12.107 For the avoidance of doubt, customer modems are considered outside the span of the modelled network, as illustrated in Figure A12.1 above.[314] Further to BT's submission that customer modem costs were missing from our cost, we have investigated whether these costs should be included in the bottom-up model and our view is that this would not be appropriate given that:

- Openreach has withdrawn customer modems from its product list, starting from April 2016; and

[311] BT, 2016, paragraph 66.
[312] BT, 2016, pages 25 and 28, Annex 1.
[313] Virgin Media, 2016, page 8.
[314] As was explained in the Cartesian Report accompanying our May 2016 WLA Consultation on fibre cost modelling, only network elements shown in blue in the diagram form part of the modelled network. The customer modems are shown in red. Cartesian, *Wholesale Local Access Market Review: NGA Cost Modelling – Network & Cost Module Documentation*, V.1, 9 May 2016, paragraph 3.1.

- BT confirmed that customer modem costs are treated as operating costs in its regulatory accounts;[315] implying that these costs are recovered within the same year they are incurred.

A12.108 The above means that BT will have recovered all of its customer modem costs by the start of the charge control period (despite some customers still using Openreach customer modems). Consequently, we do not see the need for modelling these costs in the bottom-up model for the purposes of a charge control.

Start year

May 2016 WLA Consultation on fibre cost modelling

A12.109 In our May 2016 WLA Consultation on fibre cost modelling we proposed financial year (FY) 2007/08[316] as the start year for the model (also referred to as year 0).

A12.110 This was based on examining when UK fibre access networks began to be deployed. We presented Ofcom research[317] showing that the launch date for most major UK fibre access rollouts (i.e., date at which the network rollout/trial commenced) was in FY2008/09. However, we noted that we would also expect that some preparatory and planning costs would have been incurred prior to any actual NGA rollout. As such we considered it likely that some costs would have been incurred in the year preceding initial fibre access rollout, i.e. FY2007/08.[318]

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.111 TalkTalk agreed that Ofcom's proposed start year was appropriate.[319] None of the other respondents commented.

Ofcom's analysis

A12.112 We propose to keep FY 2007/08 as the start year of the bottom-up model.

Assessment duration

May 2016 WLA Consultation on fibre cost modelling

A12.113 In our May 2016 WLA Consultation on fibre cost modelling we proposed to base the model assessment duration on the long run relationships between service volumes and component volumes (and associated costs). We considered a 40-year horizon would be sufficient to capture long run relationships, given the asset lives involved. We proposed to capture costs beyond the 40-year horizon through a perpetuity calculation.

[315] BT's response dated 17 October 2016 to follow-up question on question 20(a) of the 14th BT s.135 request.
[316] Meaning from April 2007 to March 2008.
[317] Specifically, Ofcom's 2009 Communications Market Review – Ofcom, *The Communications Market 2009*, August 2009, Table 4.10: http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr09.pdf.
[318] However, we do not consider that there would have been any material NGA rollout costs incurred before that (i.e. in 2006/07 or earlier).
[319] TalkTalk, 2016, paragraph 3.7.

A12.114 We noted that we have modelled a 40-year duration in previous Ofcom bottom-up cost models, such as in the 2013 NCC model[320] and 2015 MCT model[321]. In addition, we said that modelling a long time horizon would give us the option to use economic depreciation should we wish to calculate service unit costs on this basis.

A12.115 Given the difficulty in constructing robust forecasts over long periods, we proposed to take an approach (as we have in other models) of assuming a steady state forecast after a certain point. We therefore proposed to explicitly model out to 2027/28, which is 20 years from the start of the assessment in 2007/08, with forecast values held constant (i.e. in steady-state) thereafter.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.116 Only BT and TalkTalk commented on this specific aspect of the May 2016 WLA Consultation on fibre cost modelling. BT disagreed that a "40 year horizon is appropriate especially as the primary purpose of the model is to assess the 'Fair Bet' and the original BT business case had a 20 year time horizon". Therefore, it argued "…any model based solely on VDSL2 must be no longer than the 20-years considered when the decision to invest in the Openreach network was taken". [322]

A12.117 BT also warned that when creating volume forecast out to 2027/28, Ofcom must still carefully consider the likely development of the market. It argued that weight should be given to "(i) expected levels of demand at the point investment decisions were made; and (ii) current risks that investment in higher speed technology […] will reduce demand for VDSL2 technology in the 20 year period". BT added that when creating costs forecasts over the same period, the model must capture the risk of technology shifts and not assume economic usefulness of assets beyond the 20 year framework.[323]

A12.118 TalkTalk also believed that a 40-year horizon was "inappropriately long" and risked "modelling inaccuracy".[324] It argued that it is unlikely that FTTC will still be an actively used product in 2047, noting that no previous internet technology has lasted 40 years as a mass market product and that BT is already trialling new technologies.[325]

A12.119 TalkTalk suggested that we "adopt an assumption regarding the time period over which FTTC will remain a scale product before being replaced by G.fast, FTTP or some other technology". It argued that it would enable more accurate calculation of the appropriate VULA pricing and that it would "avoid the risk that an accelerated depreciation profile will have to be adopted for a declining product to avoid asset stranding".[326]

Ofcom's analysis

A12.120 Contrary to BT's suggestion, our cost modelling exercise does not have the primary purpose of assessing the fair bet. As pointed out in our May 2016 WLA Consultation on fibre cost modelling, our modelling aim is to understand the costs of providing

[320] https://www.ofcom.org.uk/consultations-and-statements/category-2/nmr-13.
[321] https://www.ofcom.org.uk/consultations-and-statements/category-1/mobile-call-termination-14.
[322] BT, 2016, paragraph 68.
[323] BT, 2016, paragraph 69.
[324] TalkTalk, 2016, paragraph 3.8.
[325] See paragraphs 3.8 to 3.10, TalkTalk, 2016.
[326] TalkTalk, 2016, paragraph 3.10.

broadband services over fibre access networks in order to inform our March 2017 WLA Consultation, including in relation to any proposed remedies.

A12.121 Regarding the assessment duration of the model, telecoms providers who responded disagreed with our proposal to assess the modelled costs over a 40-year time horizon. This was based on their belief that FTTC was unlikely to remain the prevalent fibre access technology for such a long period of time.

A12.122 As mentioned in paragraphs A12.24 to A12.29 and Volume 2, Section 2, while we accept that other fibre access technologies are likely to emerge and get deployed over the model time horizon, we are proposing to adopt a technology anchor pricing approach by which the costs of the modelled network are based on those of an ongoing FTTC overlay network. This means that a FTTC network would have to be modelled for the whole assessment duration of the model, irrespective of its length.

A12.123 In our May 2016 WLA Consultation on fibre cost modelling we said that such duration had to be of at least 40 years if we wish to calculate unit costs using economic depreciation. As set out further below in this annex, we are not proposing to use economic depreciation but CCA depreciation (see paragraphs A12.218 to A12.227). For this reason, we no longer see the need to model a 40-year time horizon and propose to forecast costs out to 2028/29 (rather than to 2047/48).

A12.124 We recognise that technological change in the WLA market means that some network assets could get replaced before the end of their accounting lives because they become redundant due to the introduction of new technologies. Where we find evidence of this, we propose to reflect such faster asset depreciation in our assumed asset lives rather than in the length of our model time horizon.

A12.125 This is in line with the 2013 EC Recommendation, which states that

> "When setting the economic life time of the assets in a modelled FTTC network NRAs should take into account the expected technological and network developments of the different network components."[327]

NGA services in scope

May 2016 WLA Consultation on fibre cost modelling

A12.126 In our May 2016 WLA Consultation on fibre cost modelling we set out our proposal to construct a cost model with in-built flexibility, so as to allow the modelling of costs for any service delivered over an FTTC network. This includes connections and rentals as well as ancillary services, including migrations and ceases.

A12.127 We noted that this flexibility means it is possible to use the model to calculate service costs for some or all FTTC services.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.128 Vodafone commented on BT's plans to deliver its voice services over its FTTC network (i.e. SOGEA) within the next 10 years.[328] Vodafone suggested voice services should therefore be included within the model to allow for appropriate

[327] 2013 EC Recommendation, paragraph 41, page 9.

[328] Vodafone, 2016, paragraph 3.12.

economic depreciation and common cost allocation, and that excluding these services “would appear to prejudge that consultation [the March 2017 WLA Consultation] by allocating FTTC network common costs exclusively to broadband services”.[329] However, Vodafone also noted it may be that “these issues cannot be fully resolved until the timing of the migration of voice to IP becomes clearer”.[330]

A12.129 Other CPs did not comment on the services in scope.

Ofcom’s analysis

A12.130 In general, stakeholders did not disagree with our proposal to build the bottom-up model with the flexibility to model the costs of multiple FTTC services.

A12.131 Regarding Vodafone’s suggestion to add voice within the scope of services, we note this is based on the planned launch of SOGEA by Openreach. SOGEA will change the way services are provided, with the copper bearer being included within this new GEA service (see Volume 1, Section 8). In this approach, there is no separate copper line to provide voice services. Voice services would be provided as an application over broadband (if they are provided at all – a broadband only service could be offered).

A12.132 In terms of cost recovery, the introduction of SOGEA means costs currently recovered through copper products (such as MPF and WLR) would move to this new service. However, given that SOGEA is a product yet to be launched, the extent to which it might be taken-up by telecoms providers is yet unknown – and indeed take-up may depend on how the product is priced relative to the controlled MPF and GEA prices. On this basis, we have not included SOGEA within services in scope in the bottom-up model.

A12.133 We will continue monitoring markets, and in the event that SOGEA gets introduced into the market, we will consider changing our approach where appropriate.

Shared copper and fibre infrastructure

May 2016 WLA Consultation on fibre cost modelling

A12.134 In our May 2016 WLA Consultation on fibre cost modelling we proposed to model the costs of an FTTC-based fibre access network making use of existing civil infrastructure, for example D-side copper (i.e. copper wires between the cabinet and customer premises) and E-side duct (i.e. ducts running between the exchange and the cabinet). Given that existing civil infrastructure is shared between copper and fibre services, we noted that there will also be common costs shared between these services.

A12.135 We considered the analysis of common costs between copper and fibre services would be best done in the context of a top-down assessment of costs, so as to ensure that there is no over or under recovery of such costs (including between

[329] Vodafone, 2016, paragraph 3.13.
[330] Vodafone, 2016, paragraph 3.14.

WLA and other regulated markets). We therefore proposed that such a top-down exercise would fall outside of the scope of the bottom-up modelling.[331]

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.136 BT noted that "[fibre] services attract both direct and common costs within the RFS". It stressed that common costs driven by fibre should be included in a 'fair bet' assessment, as excluding such costs completely would risk understating the true cost of supplying fibre services.[332]

A12.137 BT also requested clarification on the civil infrastructure costs which are to be included in the model.[333]

A12.138 CityFibre stressed the importance of reconsidering the allocation of network common costs to take account of the future migration of voice services to voice over broadband technology: "any future migration of voice services to voice over broadband technology will result in the need to reconsider the allocation of network common costs, such as shared duct and cables. While this does not have a direct impact on the FTTC overlay model, it will clearly have a significant impact on the overall cost structure of the superfast broadband services…".[334]

A12.139 TalkTalk argued that elements of backhaul duct and fibre, and E-side fibre should be excluded from the model as these are fixed costs common to a range of products including both VULA- and ADSL-based access products.[335]

A12.140 Virgin Media did not comment on the treatment of shared infrastructure costs, given the various alternative approaches contained in the model and the significant use of dummy/placeholder data.[336]

Ofcom's analysis

A12.141 The bottom-up model seeks to calculate the incremental cost of deploying and operating a national FTTC overlay network. On this basis, we consider that any costs which are not incremental to a national FTTC overlay network would fall outside the scope of the bottom-up model.

A12.142 This does not mean, however, that we have not analysed common costs shared between fibre and copper as part of our analysis in this review. We have done so in the context of a separate top-down assessment, which is explained in Annex 11. We note that the results and sensitivities in Annex 14 are presented after common costs have been allocated.

A12.143 In our May 2016 WLA Consultation on fibre cost modelling, we identified D-side copper/ duct and E-side duct as physical assets shared between copper and fibre services. We considered that deploying a FTTC overlay network does not require additional costs in D-side assets. This is because the aim of a FTTC network is

[331] The approach we propose to take in the bottom-up model could be described as an FTTC Overlay approach, in that the approach would seek to model the costs of only those components that are specific to NGA services.
[332] BT, 2016, paragraph 73.
[333] BT, 2016, paragraph 62.
[334] Cityfibre, 2016, page 2.
[335] TalkTalk, 2016, paragraphs 4.15 and 4.16.
[336] Virgin Media, 2016, page 8.

precisely to reuse existing copper and duct infrastructure between the customer premises and the copper street cabinet (‘PCP’). Therefore, the bottom-up model does not include incremental D-side copper and duct investments.

A12.144 However, we do recognize that additional operating costs in the D-side network may arise as a result of deploying a FTTC overlay network. Evidence from BT’s fault rate information suggests that FTTC customers tend to originate more faults in the copper network than copper customers do (see Annex 5 of the 2017 QoS Consultation). Based on this analysis, we have modelled extra repair costs in the bottom-up model. Paragraphs A12.182 to A12.184 set out our approach for modelling these costs.

A12.145 Following input from BT, we have also included incremental costs at the PCP and E-side/backhaul duct in the bottom-up model. We understand that incremental costs at the PCP may arise when the existing cabinet enclosure is not big enough to accommodate all tie cables going from the PCP to the new FTTC cabinet. In these cases, the FTTC operator needs to replace the existing PCP box with a bigger one. Information from the re-shells carried out by BT as part of its FTTC commercial programme, suggests that [✂] (10% - 30%) of existing PCPs would require re-shelling.[337]

A12.146 Regarding E-side/backhaul duct, BT provided information suggesting incremental costs may arise as a result of deploying a FTTC overlay network, due to:[338]

- existing ducts being collapsed or flooded, and thus having to be repaired in order to put down new fibre;
- existing ducts being congested, in which case new ducts would need to be built; and/or
- the cable route required for FTTC is directly buried.

A12.147 Paragraphs A12.195 to A12.201 set out our proposed approach for capturing these incremental duct costs in the bottom-up model.

Shared fibre infrastructure

A12.148 In our May 2016 WLA Consultation on fibre cost modelling we did not address the common costs shared between fibre access and other fibre-based services such as leased lines. As identified by TalkTalk, backhaul duct and fibre and E-side fibre are shared by a range of fibre products, including WLA and non-WLA services.

A12.149 If not properly accounted for, such asset sharing may lead the bottom-up model to under- or over- estimate the true LRIC of supplying fibre access. For example, existing fibre laid out for leased line services could be reused in deploying the modelled FTTC network, in which case the fibre used should not be considered as incremental for FTTC.

A12.150 However, ignoring these non-incremental costs completely may lead to undercompensating BT. This could be the case given that BT allocates fibre costs to each service (whether WLA or non-WLA) on a usage basis[339], which means that

[337] BT response dated 10 August 2016 to question 3 of the 11th WLA s.135 request.

[338] BT response dated 6 September 2016 to questions 1, 5 and 6 of the 14th WLA s.135 request

[339] See Section 6 of Annex 28 of the 2016 BCMR Statement.

a portion of the total common fibre cost pool is recovered from GEA services, irrespective of whether they are incremental or not for FTTC.

A12.151 We propose to address these cost recovery issues by:

- assuming that the modelled network reuses fibre in a portion of the backhaul routes (see Annex 20); and

- using BT's attributed costs to inform the incremental duct costs of deploying the modelled network.

A12.152 Furthermore, as part of our model calibration, we have compared our model outputs against BT's top-down costs so as to ensure that our LRIC estimate does not result in a cost recovery problem. Our calibration confirms that our model outputs are reasonably in line with BT's costs, as in Annex 13.

Structure of the bottom-up model

A12.153 At a high level, the bottom-up model performs the following five key calculations:

- Step 1: Take service volumes over the modelling period from the WLA Volume Module.

- Step 2: Dimension a network capable of meeting these service volumes.

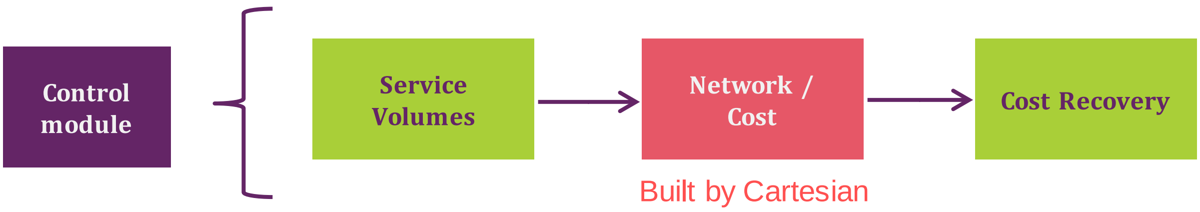
- Step 3: Calculate the cost of the assets in the dimensioned network.

- Step 4: Spread the costs of the network over time (i.e. calculate a depreciation profile for the network assets).

- Step 5: Recover the cost of the network by allocating the costs of each network element to services based on the routing factors used to dimension the network.

A12.154 These calculations have been implemented as per the model structure illustrated in the figure below. This is the same model structure as the version published alongside our May 2016 WLA Consultation on fibre cost modelling, with an additional "Control" module, which has the purpose of controlling the key parameters of the model and running the various scenarios assumed in our sensitivity analysis.

Figure A12.2: Module structure of the bottom-up model



Source: Ofcom

A12.155 Note that the Service Volumes module is described in Annex 10 of this consultation document. Further information on the Network, Cost and Cost Recovery modules is provided below.

Network and cost modules

A12.156 Details of the Network and Cost modules are set out in the Cartesian Report at Annex 20. In this subsection we describe the data sources used to populate the Network and Cost modules, provide a brief summary of these modules, and explain key cost assumptions which are not covered in detail in the Cartesian Report.

A12.157 In response to our May 2016 WLA Consultation on fibre cost modelling, telecoms providers raised a number of modelling issues in relation to the Network and Cost modules. These issues are addressed in Section 5 of the Cartesian Report.

Data sources

A12.158 To inform the assumptions in the Network and Cost modules, we have primarily relied on BT data, alongside our own (and Cartesian's) understanding of how networks are built. The BT data sources we have interrogated are:

- **BT actual asset count.** BT provided information on the number of network elements operating in its FTTC network within commercial areas. This information was supplied for elements such as FTTC cabinets, DSLAM variants, FTTC enabled exchanges, aggregation nodes, track joints and junction boxes.[340] For most of these elements, the data were provided as of March 2016, but for FTTC cabinets and exchanges enablement dates were provided, allowing us to identify the timing of BT's network rollout.

- **BT's Management Accounts**. BT provided information on its GEA specific capital and operating spend on Operational and Business Support Systems (OSS/BSS) for the period from 2010/11 to 2015/16[341]; and information on GEA specific pre-service launch costs for the period from 2008/09 to 2015/16.[342] It also supplied information on the asset lives used to book its GEA capital spend against for a number of network assets.[343]

- **BT's RFS**. BT provided information on the costs it allocates to commercial GEA services, on a LRIC and FAC basis.[344] This information was provided at a component level and for the years 2014/15 and 2015/16.

- **BT Chief Engineer's Model ('BT Model')**. This is a bespoke model used by BT for strategic and budgeting purposes. It uses a bottom up approach to dimension the network elements necessary for deploying a fibre network and calculates the corresponding costs.[345] While BT did not provide the BT Model itself, it supplied the network and cost assumptions underpinning it. Specifically, BT provided the

[340] BT's response dated 6 September 2016 to questions 1 and 5 of the 14th BT s.135 request; BT response dated 3 November 2016 to question 1 of the 7th BT s.135 request; and BT response dated 13 January 2017 to question 10 of the 23rd BT s.135 request.
[341] BT's response dated 4 July 2016 to question 7 of the 8th BT s.135 request; and BT response dated 20 September 2016 to question 9 of the 14th BT s.135 request.
[342] BT response dated 13 June 2016 to question 15a of the 16th BT s.135 request.
[343] BT response dated 6 September 2016 to question 3 of the 8th BT s.135 request
[344] BT's response dated 25 November 2016 to questions 3 and 6 of the 19th BT s.135 request.
[345] Meeting between Ofcom and BT staff on 13 May 2016.

inputs assumed in various versions of the BT Model over the period from March 2009 to May 2016.[346]

Network module

A12.159 The Network module uses the service volumes and coverage information to calculate the necessary volumes of the fibre access-specific network components. Such components include:

- FTTC cabinet (including internal equipment/electronics/wiring);
- Copper tie cable between the PCP and FTTC cabinets (including duct, copper wiring and PCP re-shelling);
- E-side and Backhaul fibre (including fibres, cable testing and cable joints); and
- Headend equipment at the local exchange (e.g. OLTs and OCRs).

A12.160 In order to determine the component volumes in each year, we propose to use an approach whereby each exchange and cabinet has a fibre access enablement date (i.e. the date at which fibre services were first available for provision). The enablement of these core network elements will drive all other associated component volumes over time.

Cost module

A12.161 Along with a summary of the module, we provide below a more detailed discussion around specific cost items such as OSS/BSS, Customer installation, Repairs, SLG payments, Cumulo and General Management (GM) costs, which are not covered in the Cartesian Report at Annex 20.

A12.162 The Cost module takes the outputs of the Network module in terms of the volume of each component purchased and in operation in each year, and multiplies these by the capital expenditure (for those assets purchased) and operating expenditure (for those assets in operation) for each component to give the total expenditure in each year.

A12.163 To estimate the capital and operating costs of each component in each year we start with an assumption for the component capital and operating cost in 2015/16 (i.e. the most recent year for which data is available), and apply an assumption relating to the trend in component unit costs over time (both historically and in the future). This allows us to estimate the component unit costs for every year of the model.[347]

[346] BT's response dated 6 September 2016 to questions 1 and 2 of the 14th BT s.135 request.

[347] For example, consider the simplified example of the costs of installing an FTTC cabinet. Over a 20-year assessment the cost may vary significantly over time. We start with a cost based on recently available data, suppose this indicated that as of today, it costs £1,000 to install an FTTC cabinet. We then apply an assumption to vary this value over time in light of expectations, for example if we anticipate the cost each year will be 5% less than the previous year, we would forecast the cost to be £950 next year, £902.5 the following year, and so on. In years prior to today, we will seek to use actual costs where available, if under the above example the 5% annual price reduction had existed the costs under the example would be £1,053 one year prior, and £1,108 two years prior, etc.

A12.164 Once we have the component unit costs in each year, we need simply to multiply these by the volume of each component in that same year in order to calculate the total expenditure per component.

OSS/BSS costs

A12.165 These costs are associated with the development of OSS/BSS systems for supplying FTTC services. Typically, these systems are not developed from scratch as operators tend to use existing platforms and upgrade them to accommodate the launching of new services.

A12.166 BT provided information on its capital and operational spend on OSS/BSS systems under its fibre access programme. According to these data, BT invested a total of £[✂] over the period from 2008/09 to 2015/16.[348]

A12.167 BT explained that such OSS/BSS spend captures the costs incurred in both commercial and non-commercial areas, as well as across the whole range of fibre access services (i.e. FTTC and FTTP).[349] BT clarified that FTTC commercial specific costs could not be isolated from the data.

A12.168 As a result, we examined whether BT's OSS/BSS spend had to be adjusted in order to remove non-commercial and/or non-FTTC related costs. To inform this analysis, we engaged telecoms providers to understand how sensitive OSS/BSS costs are both to the size of the product portfolio and to the size of the network footprint.[350] The inputs we received suggest that OSS/BSS costs are largely a fixed cost, and that one would not expect these costs to change with the number of products offered in the market and/or with the network reach. Therefore, we consider BT's OSS/BSS spend figures to be indicative of the LRIC of a national efficient FTTC operator, and hence not to require adjustment.

A12.169 To depreciate these costs in the bottom-up model, we have assumed a 5 year asset life for OSS/BSS hardware (in line with the asset life assumed for other servers and systems in the model) and a 10 year asset life for OSS/BSS software.

A12.170 Although we would generally assume the same lifetime for hardware- and software-related assets, we believe BT is unlikely to re-develop all of its OSS/BSS systems within a period shorter than 10 years. This is because we understand that BT develops its OSS/BSS software mainly in-house, therefore incurring a high fixed cost (compared to acquiring the software from a third party). This makes it more cost-effective to reuse existing OSS/BSS platforms when introducing new services into the market, thus lengthening the life of the legacy system[351]. We have therefore assumed a longer lifetime for OSS/BSS software.

A12.171 We have also verified how BT allocates OSS/BSS spend in the RFS. We have done so by analysing data on BT's cost attributions for the years 2011/12, 2012/13 and

[348] BT response dated 5 August 2016 to follow-up question on response to question 1 of the 8th WLA s.135 request; and BT response dated 13 September 2016 to question 8b of the 14th WLA s.135 request.

[349] BT response dated 13 September 2016 to question 8 of the 14th WLA s.135 request.

[350] We consulted several telecoms providers on this issue but only received response from [✂]

[351] BT response dated 13 September 2016 to question 8c of the 14th WLA s.135 request.

2015/16.[352] This data suggests that BT only apportions c.[✂] (~13%) of the identified incremental OSS/BSS spend to GEA services; while allocating the remaining spend to copper and non-WLA services. In order to avoid allowing over- or under- recovery of OSS/BSS costs we have taken BT's apportionment into account in our cost allocations for the charge controls in this review. We are currently reviewing this as part of our cost attribution review and will make proposals on how BT should apportion these costs in the RFS.

A12.172 In terms of the costs of running the OSS/BSS systems, BT provided data on its fibre specific OSS/BSS operating spend for 2014/15 and 2015/16.[353] These costs refer to labour and third party support costs related to application support and maintenance.[354] We have added these costs to the bottom-up model.

A12.173 To project OSS/BSS operating costs backwards and forwards, we have assumed these costs are dependent on the size of the systems in place. We believe this can be proxied by the cumulative OSS/BSS capital spend. Therefore, for the historical period, we have estimated OSS/BSS operating costs by applying the ratio between OSS/BSS operating costs and cumulative OSS/BSS capital spend observed in 2014/15. For the forecast period, and given that we do not expect additional OSS/BSS capital spend beyond 2015/16 (except for replacing existing assets), we have assumed OSS/BSS operating costs stay constant (in real terms), adjusted by CPI inflation.

Customer installation costs

A12.174 These costs are associated with the activities required for connecting new FTTC customers. These activities depend on the type of connection required but might include receiving and processing new orders and jumpering tie cables at the street cabinet.

A12.175 To model the cost of these connection activities we have relied on the cost assumptions in the BT Model. These assumptions provide information on the pay and non-pay cost elements of each connection activity (whether is customer site installation, SMC or PCP jumpering). They also allow us to separate out commercial-only costs.

A12.176 We note that customer installation costs are treated as operating costs in the bottom-up model. This is in contrast with BT's practice of capitalising a portion of these costs in its Management Accounts and RFS.[355] We have not followed this practice given that we are allowing BT to recover customer installation costs via one-off charges; thus effectively allowing BT to recover these costs within the same year they are incurred. On this basis, we believe that it would be inappropriate to capitalise these costs, and allow BT to earn a return on costs which have been fully recovered.

[352] BT response dated 25 November 2017 to question 12 of the 19th WLA s.135 request; and BT response dated 19 January 2017 to question 9 of the 23rd WLA s.135 request.
[353] BT response dated 5 August 2016 to follow-up question on response to question 1 of the 8th WLA s.135 request; and BT response dated 13 September 2016 to question 8b of the 14th WLA s.135 request.
[354] BT response dated 13 September 2016 to question 8c of the 14th WLA s.135 request.
[355] BT response dated 25 November 2016 to question 14 of the 19th WLA s.135 request.

Cumulo

A12.177 Cumulo rates are the non-domestic (business) rates that BT pays on the rateable assets within its UK network. The rateable assets consist primarily of duct, fibre, copper and exchange buildings. Given that deploying a FTTC overlay network requires expanding the stock of rateable assets in BT's network we consider cumulo costs as incremental to FTTC services and hence we have included these costs in the bottom-up model.

A12.178 BT's total non-domestic rates bill will increase significantly over the charge control period due to the 2017 revaluation by the rating authorities. A transition scheme is in place: cumulo rates will gradually increase to their new level over a period that extends beyond the end of our proposed charge control period.

A12.179 We have forecast BT's cumulo costs, including the impacts of increasing numbers of GEA and MPF lines over the charge control period. We have then calculated attributions of these costs to WLA and WFAEL services to allow BT to recover a proportion of its cumulo rates bill for the relevant products in this charge control period.

A12.180 Our proposed method for attributing cumulo to services is very similar to the current method BT uses. The steps are:

i) estimate the cumulo costs attributable to GEA and non-GEA services in each year;[356]

ii) attribute all GEA cumulo costs to GEA rental services. We divide these costs by GEA rental volumes to produce a GEA cumulo cost per annum in each year out to 2021/22. It is these values that are input to the bottom-up model; and

iii) attribute all non-GEA cumulo costs across non-GEA network components using a profit weighted net replacement cost (PWNRC) approach. To do this we generate forecasts for the non-GEA NRCs of rateable assets for each network component in each year. We attribute those cumulo costs to network components using the same routing factors that are applied in our main top-down model.

A12.181 Annex 17 details how we have forecasted and attributed cumulo costs.

Repair costs

A12.182 The bottom-up model includes repair costs within the unit operating costs of each network element. These costs were estimated based on theoretical fault rates, informed by assumptions in the BT Model as well as by information on the fault rates agreed between BT and manufacturers in connection with electronic equipment.[357] BT has also provided information on the average task time to repair

[356] We calculate the rateable value (RV) attributable to GEA services in each year by multiplying our forecasts of GEA rental volumes by £18 (our estimate of the per line RV based on a historical value used by the VOA – see Annex 17). This allows us to calculate a share of the total RV attributable to GEA services in each year which we then multiply by our forecasts of BT's total cumulo costs. This produces the cumulo costs attributable to GEA services and hence those attributable to non GEA services.

[357] BT response dated 13 September 2016 to question 11a of the 14th BT s.135 request.

faults assumed in the BT Model.[358] We have used this information, together with the theoretical fault rates and BT average pay rate[359], to calculate the repair costs per unit of network element per year.

A12.183 In addition, we have captured extra repair costs in the existing copper network due to the provision of FTTC services. As mentioned in paragraph A12.144, our quality of service consultation found evidence of GEA customers originating more faults in the copper network than copper-only customers. Based on this evidence, we estimated the additional fault rate generated by GEA customers. These results are presented below.

Table A12.3: Expected additional fault rates for GEA-FTTC services

	Base Year 2015/16	Year 1 2018/19	Year 2 2019/20	Year 3 2020/21
WLR addition	[✂]	[✂]	[✂]	2.4%
MPF addition	[✂]	[✂]	[✂]	0.6%

Source: 2017 QoS Consultation

A12.184 We have used these additional fault rates and our service volume forecasts to estimate the extra repair costs accrued to the modelled FTTC network. To estimate these costs beyond 2020/21 and before 2015/16, we have assumed additional fault rates stay constant as per the closest year for which we have fault rate estimates.[360]

A12.185 Note that our quality of service consultation also proposes quality standards on Openreach for both installation and repair of GEA-FTTC for the first time in this review. To meet these standards, Openreach will need to hire extra resources. Our quality of service consultation estimates these extra resources will have an impact of 11.4% on Openreach's repair costs towards the end of the charge control, and proposes to allow BT to recover these costs by applying a cost uplift on the relevant cost components over the charge control period.

A12.186 We have implemented such cost uplift in the bottom-up model by adjusting our opex cost trend assumptions. These adjustments reflect 1) the cost uplift estimated by our quality of service consultation for each year over the charge control period; and 2) the contribution repair costs have to the unit opex of each network element in the bottom-up model. We estimate these adjustments have an overall impact of c.2p (per month) in our forecasted GEA rental charge.

SLG payments

A12.187 In Annex 15 we estimate the efficient level of SLG payments over BT's fibre access network. These are calculated for the base year (2015/16) as well as for the years over the charge control period. We do so by taking into account expected improvements throughout this period for QoS parameters (i.e. the fault rate, the proportions of faults and provisions where SLGs will be payable and the average

[358] BT response dated 13 September 2016 to questions 24 and 27 of the 14th BT s.135 request.
[359] This is based on BT's average pay rate as per its 2014/15 RFS, updated by pay rate inflation in 2015/16.
[360] For example, for 2014/15, we assume the additional fault rate is the same as in 2015/16; whilst for 2021/22 we assume the rate is the same as estimated for 2020/21.

duration of those SLGs) and by assuming that BT's performance will reach efficient levels by 2020/21.

A12.188 We have added these estimated SLG payments to our bottom-up model. To project SLG payments beyond the charge control period, we have assumed that BT's quality of service stays constant – by applying the 2020/21 level of performance forecast for the various quality of service parameters to projected volumes.

A12.189 For the years prior to 2015/16, we have applied a similar approach. We have taken BT's performance for the various quality of service parameters observed in 2015/16 (the year for which we have most recent BT data) and have applied these to our historical volumes from 2010/11 to 2014/15.

General Management (GM) costs

A12.190 GM costs are management support costs shared across all FTTC services, but not across the whole organisation. These costs include, for example, those associated with first and second line managers who supervise the work of field engineers repairing and maintaining the FTTC network.

A12.191 We have drawn on RFS data to inform these costs. We have received data from BT on the GM costs it allocates to GEA service components in its 2014/15 and 2015/16 RFS.[361] BT provided this cost information on a FAC basis and for the whole UK. To get a LRIC estimate of these costs, we applied BT's LRIC to FAC ratios (by component) and then applied BT's commercial split (by component) to remove non-commercial GM costs.

A12.192 To produce forecast and backcasts (i.e. estimates of incremental GM costs before 2014/15) we have assumed that GM costs are dependent on the size of the modelled network's operating costs. This is based on the assumption that GM costs are proportional to the costs of running the network.

A12.193 We have taken BT's GM top-down costs (on a LRIC basis) and have calculated these as a proportion of our modelled bottom-up operating costs for 2014/15 and 2015/16. The resulting ratio is similar in the two years (with a difference of 0.2 percentage points). We have used the 2015/16 ratio [✂] (~(20% - 50)%)[362] – which reflects the latest information we have – and applied it to our modelled operating costs to project GM costs in the backward and forward look period of the bottom-up model.

A12.194 In calculating this proportion we have excluded cumulo costs, as we believe GM costs are unlikely to change with the size of the cumulo bill (i.e. management support costs should be unaffected by the amount of cumulo payments).

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[361] BT response dated 30 November 2016 to question 15 of the 19th WLA s.135 request.

[362] When adding BT's GM costs to our modelled operating costs (the denominator), this proportion drops to [✂] (~(15% - 40%)). This is in line with the figure one gets when looking at Openreach's costs as a whole, which comes to around [✂] (~(15% - 40%)) on a LRIC basis (BT's AFI 2 of the 2015/16 RFS).

E-side and Remote duct costs

A12.195 These are the costs associated with repairing existing ducts and building new ducts in the E-side and Backhaul segments of the FTTC overlay network.

A12.196 We are proposing to model these costs on a top-down basis for the following reasons:

A12.197 First, the available bottom-up cost data we received from BT was described by BT as being unreliable for predicting the true incremental cost for FTTC.[363] For example, BT provided the average number of meters of new and repaired E-side duct (per every new km of E-side fibre) assumed in the BT Model. Despite using this assumption for planning purposes, BT explained that, in practice, engineers typically face flooded and congested ducts (and therefore the need to repair or build ducts) more often than assumed in the model. We therefore believe that the duct assumptions in BT Model are not reflective of real world costs.

A12.198 Second, in the RFS, E-side and Remote duct costs get allocated from a common pool of duct assets to multiple services (including copper, GEA and leased lines). We understand that the basis for allocating these costs is not necessarily reflective of the LRIC of each individual service (BT apportions duct costs based on a 1997 duct survey and updates these values for GEA using GEA tie cable depreciation costs[364]). Hence, doing a bottom-up calculation could carry the risk of allowing BT to under or over recover its overall duct costs where these bottom-up calculations differ from BT's allocations.

A12.199 To avoid such potential cost recovery problem, we are proposing to capture E-side and Remote duct costs via a top-down allocation of BT's attributed costs. BT provided information on the duct costs it apportions to commercial FTTC services in the 2015/16 RFS.[365] We have added these costs to our unit LRIC estimate in the Cost Recovery module, after having depreciated the modelled capital costs.

A12.200 We could have also captured these costs through our calibration process. However, given the size of the underlying costs involved, we believe it would have been difficult to capture these costs through an appropriate lever without making a significant departure from our bottom-up evidence. For example, these costs could have been captured by adding a mark-up to the unit cost of the modelled fibre cable types. However, fibre and duct assets do not share the same asset life and therefore, capturing duct costs through fibre cable prices would have distorted our cost projection in years where fibre assets get replaced.

A12.201 Note that tie ducts between the PCP and FTTC cabinets are not shared with other services, so are explicitly modelled in the bottom-up model. To avoid double-counting these costs when adding BT's top-down duct costs, we have taken the differential between BT's top-down costs and our modelled tie duct costs.

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[363] Meeting between Ofcom and BT staff on 14 July 2016 in relation to its response to our 8th s.135 request.

[364] Cartesian, 2015. BT Cost Attribution Review, section 5.4, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/83482/ofcom_bt_cost_attribution_review_final_report.pdf.

[365] BT response dated 19 February 2016 to question 3 of 3rd BT s.135 request, BT response dated 25 November 2016 to questions 3 and 6 of 19th BT s.135 request, BT response dated 30 November 2016 to question F1 of 20th BT s.135 request, and AFI information provided alongside 2015/16 RFS.

A12.202 To project E-side and Remote duct costs backwards and forwards, we have assumed these costs follow the same profile of cost recovery as our modelled tie duct costs. This is consistent with BT's attribution basis for apportioning duct costs to GEA services, as described above.

Cost recovery module

A12.203 Once the total costs of the fibre access network have been calculated, we must determine the path of cost recovery over time and across services.

A12.204 In our May 2016 WLA Consultation on fibre cost modelling, we explained that the bottom-up model was able to calculate depreciation using both economic and accounting methods.

A12.205 In addition, we explained that the model was using the "Other UK Telecoms" weighted average cost of capital (WACC) from Ofcom's three-way disaggregation of the WACC (published in the 2016 LLCC Statement) as a placeholder, and outlined our proposed high level approach to service costing.

A12.206 We set out our approach to depreciation, cost of capital and service costing below.

Depreciation method

A12.207 Once the total costs of the fibre access network have been calculated, we have to determine how these costs are to be recovered over time. We have considered the following options:

- Economic Depreciation (ED); which may be
  - Original Economic Depreciation (Original ED); or
  - Simplified Economic Depreciation (Simplified ED); and
- Current Cost Accounting (CCA).

A12.208 In our May 2016 WLA Consultation on fibre cost modelling we outlined the advantages and disadvantages of each of these options. We said a key benefit of Original ED is that it seeks to set the optimal path of cost recovery over time by mimicking the outcomes of a benchmark competitive market. In this hypothetical competitive market, unit prices in a given year are assumed to be independent of the level of utilisation at that point in time, and instead are assumed to be linked to the level of utilisation achieved over the lifetime of the network. Consequently, there is relatively little depreciation in years when utilisation is low and relatively high depreciation in years of full, or almost full, equipment utilisation.

A12.209 We noted that Original ED has been used by Ofcom in previous bottom-up cost models, such as in the 2013 NCC model and in the 2015 MCT model; and has been supported by the Competition Commission (now the Competition and Markets Authority) each time price control matters were appealed.[366]

[366] See e.g. paragraphs 3.461 to 3.552 of the Competition Commission's Determination of 9 February 2012 in Case 1180/3/3/11 British Telecommunications plc v Office of Communications, and linked cases 1181/3/3/11, 1182/3/3/11 and 1183/3/3/11 (MCTs).

A12.210 With regard to Simplified ED, we explained that this economic depreciation method is intended to retain many of the characteristics of Original ED, but uses a simpler functional form. Under this approach, the shape of the path of unit cost recovery remains independent of the level of in-year utilisation and is therefore determined by changes in input costs alone, as in Original ED. However, the entire profile of cost recovery for an asset is given a shape which exactly mimics the profile of input cost trends, scaled so as to achieve full cost recovery. This means that unit costs derived for the final year of the modelled period may not be consistent with the competitive market benchmark (whereby prices equal the underlying unit LRIC), as would happen with Original ED.

A12.211 Finally, we said a CCA approach produces the same level of total cost recovery (over the life of the model) as economic depreciation, however the chief difference lies in the path of cost recovery over time. In particular, the use of straight-line depreciation in CCA means that depreciation is not deferred from years when utilisation is low to those when it is high, as under an economic depreciation approach. Consequently, unit capital costs tend to be inversely related to utilisation.[367]

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.212 In response to the consultation BT noted the risk of "adopt[ing] an approach to assessing cost recovery by reference to Economic depreciation charges based on implausible assumptions about the ability of the hypothetical operator to generate future value, way beyond the end of the market review period…" in the context of potential growing demand for higher speed technologies.[368]

A12.213 BT believed a more appropriate modelling approach would "[consider] payback over a much shorter period and [capture] both the risks present at the point of initial investment and the ongoing risks and challenges arising from changing technology, shifts in the nature of demand and increased competition".[369]

A12.214 Vodafone raised concerns over CCA depreciation. It argued CCA can lead to price volatility due to fluctuations in asset values and in-life asset replacements.[370] Vodafone also noted the 'saw tooth' cost profile that exists but is not apparent in the modelled profile due to the time horizon.[371]

A12.215 Vodafone also suggested additional depreciation approaches not outlined in the consultation, including an "annuity" and "tilted annuity" approach.[372]

A12.216 Virgin Media stated it would be appropriate to assess BT's cost recovery in a way that most closely mimics how it intends to recover these costs. In particular, it suggested standard accounting asset lives overestimate useful economic lives as markets shift to new technologies. Virgin Media argued that the potential for migration to alternative technologies implies that a model based on economic depreciation "…would appear to anticipate material cost recovery during a period

[367] See paragraphs 4.22 to 4.28 in our May 2016 WLA Consultation on fibre cost modelling for a further discussion on the costs and benefits of each depreciation method.
[368] BT, 2016, paragraph 99.
[369] BT, 2016, paragraph 100.
[370] Vodafone, 2016, paragraphs 3.28 and 3.29.
[371] Vodafone, 2016, paragraphs 3.30 and 3.31.
[372] Vodafone, 2016, paragraph 3.33.

when [FTTC] assets may be stranded or have long since been retired".[373] Virgin Media also suggested Ofcom take into account that BT continuously invests in its network under significant uncertainty about the evolution of the market.[374]

A12.217 TalkTalk believed the ED approach fails to provide certainty and predictability to market participants. It argued that "changes in assumptions at regulatory reviews mean that the assumed cost recovery in the future, and indeed in the past, differ significantly from regulatory period to period".[375] TalkTalk also noted that "…many FTTC assets (for example, e-side fibre) are likely to be reused for successor technologies and a proportion of their depreciation charge should therefore properly be allocated to these technologies".[376]

Ofcom's analysis

A12.218 When choosing how to depreciate the cost of the underlying network assets in a charge control, we look for a cost recovery profile that provides efficient signals for consumption and investment. This implies that, in general, the profile of cost recovery should be consistent with the path of prices which would occur in a competitive market, which is precisely what economic depreciation aims to achieve.

A12.219 In some instances, CCA depreciation could be an acceptable proxy for economic depreciation; that is, when volumes are relatively stable. When volumes are increasing or decreasing, the results of CCA depreciation are likely to diverge from those of economic depreciation, with unit costs fluctuating with changes in service volumes. Under these circumstances, as is currently the case of SFBB services, we would be more likely to choose economic depreciation.

A12.220 However, there are instances where the use of economic depreciation could be less suitable. In particular, the use of economic depreciation entails forecasting costs over a long time period (in this case 40 years). As highlighted in Annex 6, we have made a number of assumptions as to the impact of our DPA policy and Virgin's Project Lightning on the modelled network's volumes. We recognize there is considerable uncertainty around these parameters, particularly as we go further out into a 40-year forecast period. Given the sensitivity of the model outputs to service volumes (see Annex 14), we would expect such uncertainty to affect the reliability of the results of economic depreciation.

A12.221 We believe that CCA depreciation (which is dependent on volumes and cost forecasts up to the end of the charge control) would provide more robust results in this case, particularly given that the uncertainty around the impact of our DPA policy and Virgin's Project Lightning is likely to be relatively minor over the charge control period (see Annex 10).

A12.222 Furthermore, the use of CCA depreciation would be consistent with the way we assess copper costs in this price review. This has the advantage of allowing a more coherent approach for analysing common costs which are shared between copper and fibre services. As explained in Annex 11, we are proposing to analyse common costs on a top-down basis, by way of comparing BT's FAC against our LRIC

[373] Virgin Media, 2016, page 11.
[374] Virgin Media, 2016, page 12.
[375] TalkTalk, 2016, paragraph 4.12.
[376] TalkTalk, 2016, paragraph 4.13.

estimates. Therefore, keeping a consistent approach for cost recovery across copper and fibre services is important in this case.

A12.223 For the reasons above, we are proposing to use CCA depreciation to determine the appropriate cost recovery path in the bottom-up model. We believe that the current and expected growth in SFBB volumes will not be problematic in the application of CCA depreciation in this case. This is because we expect the rate of growth to slow down by the end of the charge control period, leading to more stable volumes; implying that CCA depreciation could be used as a reasonable proxy for economic depreciation.

A12.224 In reaching this proposal we have had due regard to relevant stakeholder submissions including Vodafone's concern that CCA can lead to price volatility due to fluctuations in asset values and in-life asset replacements. We have examined this by looking at the predicted cost recovery profile over the model time horizon, and have not identified any step change in the forecasted unit cost. If future charge controls are considered appropriate and our modelling of these leads to significant variations in access prices, we would consider cushioning the price impact by spreading it over a number of years.

A12.225 We have also investigated whether a CCA approach could result in BT under recovering its costs given the higher unit costs estimated over the initial years of network rollout – when network utilisation is low. Our analysis suggests that BT's actual GEA rental charge was below our estimated CCA unit cost for the period from 2010/11 to 2013/14, and above it from 2014/15 to 2019/20 – when access prices should start converging with costs due to our charge control.

A12.226 We estimated the net present value of the cash flows implied by these unit costs and charges (including the period over which no volumes are observed in BT's network) in order to assess whether the use of a CCA approach would undermine BT's cost recovery. This analysis suggests that the excess profits expected in the later period more than offset the losses in the earlier period; implying no under-recovery. Additionally, as discussed in Volume 2, Section 3, our assessment of the IRR of BT's FTTC investment suggests that the fair bet test, which is a stricter test than our cost recovery test, has been passed.

A12.227 Finally, we acknowledge that in the past we have chosen to use economic depreciation when building a bottom-up model. This was the case, for example, in the 2015 MCT and 2013 NCC price reviews. We believe these decisions are not at odds with our proposal to use CCA depreciation in this case. In contrast with the 2015 MCT and 2013 NCC reviews, we are now proposing to use both a bottom-up model and a top-down model to inform our charge control proposals. In addition, the uncertainty around our volume forecasts (particularly towards the end of the forecast period) is more pronounce in this review. We believe these circumstances justify deviating from our usual approach of combining economic depreciation with bottom-up modelling.

Cost of capital

A12.228 In our May 2016 WLA Consultation on fibre cost modelling we said that the model used the "Other UK Telecoms" weighted average cost of capital (WACC) from Ofcom's three-way disaggregation of the WACC published in the 2016 BCMR Statement. However, we warned this assumption should be seen as a placeholder and that, if appropriate, we would make proposals on our choice of WACC as part of the wider March 2017 WLA Consultation.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.229 TalkTalk agreed with Ofcom's proposal to revisit the appropriate WACC for FTTC products as part of the 2017 WLA Review.[377]

A12.230 Other respondents did not comment on our approach to cost of capital.

Ofcom's analysis

A12.231 Annex 16 sets out our approach for calculating the WACC for the years 2019/20 and 2020/21. We have used the 2019/20 WACC for Other UK telecoms of 9.5% for the purposes of setting the glide path to 2019/20 and we have used the 2020/21 WACC of 9.4% in the final year of the charge control period. We have also used these WACC estimates over the forecast period of the bottom-up model (i.e. 2017/18 to 2028/29). We have assumed the 2019/20 estimate over the period from 2017/18 to 2019/20, and the 2020/21 WACC estimate over the period beyond 2020/21.

A12.232 For past years, we have assumed the WACC determined in previous WLA charge controls and maintained the figure over the duration of the charge control period. Specifically, we have used the Rest of BT (RoBT) pre-tax nominal WACC for the period from 2007/08 to 2016/17. This is consistent with the approach we have taken in the 2016 NMR Consultation.[378] The time series of the WACC used for the historical period of the model is shown below.[379]

Table A12.4: Pre-tax nominal WACC time-series

	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Source	August 2005 Ofcom approach to risk		May 2009 OR financial framework					June 2014 FAMR Statement		
Pre-tax nominal WACC	11.4%	11.4%	11.0%	11.0%	11.0%	11.0%	11.0%	10.8%	10.8%	10.8%

Sources as provided in table.

Service costing

A12.233 As explained in our May 2016 WLA Consultation on fibre cost modelling, once we have determined how the costs of a particular network element should be recovered over time, we would need to calculate how they will be recovered from different network services.

A12.234 We said that the costs recovered by a particular service are linked to the costs that are driven by that network service, and that each network service will have a routing factor relating to each piece of network equipment, which will drive the amount of network equipment needed to carry a unit of the service.

377 Paragraph 4.14, TalkTalk. Op. cit.

378 Ofcom, 2016. Fixed Narrowband Market Review Consultation", Annex 8, paragraph A8.65.

379 Note that these past WACCs do not impact on the charge control, but have a bearing on our fair bet analysis.

Responses to the May 2016 WLA Consultation on fibre cost modelling

A12.235 Stakeholders did not comment on our proposed approach to service costing.

Ofcom's analysis

A12.236 We are proposing to keep the same approach we set out in our May 2016 WLA Consultation on fibre cost modelling for determining how costs are recovered from different GEA services.

Annex 13

Calibration of the bottom-up model

A13.1 In Annex 12 we explained our approach to building a bottom-up model. We outlined that part of this exercise was calibrating the model against top-down data. This annex explains our proposed approach to calibrating the bottom-up model and how we have implemented it, including details of the key adjustments we have made to the model as part of this process.

Summary of proposals

A13.2 We are consulting on our proposed approach to calibrating the bottom-up model. We propose to:

- calibrate the bottom-up model against asset count and cost information from a range of BT sources; and

- give most weight to verifying the bottom-up model outputs for a single period in time (a 'point calibration').

A13.3 More specifically, we propose to compare our model outputs against asset count and cost information from BT's actual commercial FTTC deployment and modelling performed by BT when planning this deployment. Based on these comparisons, we intend to assess whether the outputs of the bottom-up model are reasonably in line with real world network deployment and costs, and make adjustments where appropriate.

A13.4 We have also compared the final outputs of the bottom-up model against the charges set in a range of other European countries as a further cross-check to our bottom-up calculations. We have not made any adjustments to our calculation as a result of this cross-check.

Structure of this annex

A13.5 The remainder of this annex is laid out as follows:

- we outline our conceptual approach to calibrating the bottom-up model.

- we explain how we have implemented our proposed approach based on asset count information from BT (stage 1);

- we explain how we have implemented our proposed approach based on cost information from BT (stage 2); and

- we compare the outputs of the bottom-up model against the charges set by other European NRAs (stage 3).

A13.6 Note that all results and sensitivities in Annex 14 are calculated after the bottom-up model was calibrated.

Approach to bottom-up model calibration

A13.7 In this section we set out our proposed approach in relation to the following key methodological choices:

- network to calibrate against;
- data sources used to obtain calibration data;
- period over which to perform the calibration; and
- sequencing of the calibration.

May 2016 proposals

A13.8 In our May 2016 WLA Consultation on fibre cost modelling we proposed to compare the outputs of any fibre cost modelling work with actual operator data.[380] We stressed that it is desirable to verify the reasonableness of the outputs of our bottom-up model, and highlighted that when we have built bottom-up models in the past we have calibrated the outputs against actual real-world data wherever possible.[381]

A13.9 As examples, we said that we could compare the outputs of our cost modelling in the following two ways:

- against existing national deployments of FTTC: We noted that this was likely to use data provided by BT but would be dependent on us being able to identify GEA only costs from BT's RFS;
- against other NRAs' cost models: We noted that Ofcom is not the only NRA modelling a fibre access network and that we could, for example, check our bottom-up model outputs against the outputs of other NRAs' models, or, where the modelling approaches are sufficiently similar, we could look at other metrics such as total network costs and the quantity of network equipment.

A13.10 We also said that our final proposals on our approach to calibration and cost verification would be informed by data availability and quality.

A13.11 Only two stakeholders commented on our proposed approach to calibration. Virgin Media thought "it would be appropriate to place significantly greater weight on [top-down] information from BT rather than models produced by other NRAs as the

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[380] Ofcom, May 2016. Wholesale Local Access Market Review – Consultation on possible approaches to fibre cost modelling, paragraphs 4.32 to 4.35 https://www.ofcom.org.uk/__data/assets/pdf_file/0026/82664/Wholesale-Local-Access-Market-Review.pdf.

[381] Ofcom, March 2015, Mobile Call Termination Market Review, Statement, Annex 9 https://www.ofcom.org.uk/__data/assets/pdf_file/0019/72109/annexes_7-13.pdf; and Ofcom, September 2013, Fixed Narrowband Market Review, Statement, Annex 6, https://www.ofcom.org.uk/__data/assets/pdf_file/0014/50720/final_statement.pdf.

jurisdictions, market dynamics and incumbents they were designed to model are unlikely to closely reflect the situation in the UK".[382]

A13.12 BT recommended the use of Openreach's actual cost base to calibrate any bottom-up model.[383] With regard to comparing the bottom-up model against other NRAs' cost models, BT argued that "*[o]ther NRA's NGA models should be based on the specific network topology in their respective country*", and that "*[t]he UK has different geographical challenges to overcome when rolling out a fibre network*".[384] BT suggested that "*[a]ny model calibration against other NRA's [fibre] models needs to allow for differences in geographic topology*". As an example, BT mentioned that "*the cost of NGA in some other countries may be less [than in the UK] because of high population densities and a number of Multiple Dwelling Units (MDUs) where a number of superfast broadband customers can be served for a relatively fixed investment*".[385] We address these comments from Virgin Media and BT in the "Benchmark network" sub-section below.

A13.13 BT also raised a concern in relation to the calibration of the bottom-up model against BT's RFS. It argued that "[t]he RFS does not necessarily account for the relative aging of assets (i.e. NGA assets are generally newer than CGA assets) and may give an artificially low NGA service cost". As a result, "[a]djustments to RFS information may be required for calibration purposes and to ensure a like for like comparison".[386] We address this additional comment from BT in the "NRC" sub-section below.

Comparison Network

A13.14 As set out in Annex 12, the bottom-up model aims to estimate the costs of a national efficient FTTC operator, calculated as an overlay to an existing copper network. To do so, it assumes an efficient FTTC operator would roll out its network to the same geographic areas and over the same timeframe as we observe occurring in BT's network deployment. Consequently, we consider it appropriate to validate the outputs of the bottom-up model against BT's commercial FTTC network deployment and costs.

A13.15 We have considered whether we could compare the bottom-up model outputs against other operators' data. However, apart from BT, no other UK operator has deployed a FTTC network with a similar scale and network topology as the modelled network. Therefore, we propose to base our calibration solely on BT data.

A13.16 In our May 2016 WLA Consultation on fibre cost modelling, we said we could also compare the outputs of the bottom-up model against the outputs of other NRA models. As suggested by BT and Virgin Media there are limitations in the use of international cost comparisons and the conclusions that can be drawn from them. Namely, conditions underpinning network deployments are likely to change from country to country – meaning that unit costs cannot be easily extrapolated from one country to the other. On this basis, we do not propose to calibrate the model against charges set in other European countries in this review. However, to the extent

382 Virgin Media, 2016. Response to Ofcom's May 2016 WLA Consultation on fibre cost modelling, page 12, https://www.ofcom.org.uk/__data/assets/pdf_file/0024/83517/virgin_media.pdf.

383 BT, 2016. Response to Ofcom's May 2016 WLA – Consultation on fibre cost modelling, paragraph 106, https://www.ofcom.org.uk/__data/assets/pdf_file/0029/83099/openreach.pdf.

384 BT's response to May 2016 WLA Consultation on fibre cost modelling, paragraph 104.

385 BT's response to May 2016 WLA Consultation on fibre cost modelling, paragraph 105.

386 BT's response to May 2016 WLA Consultation on fibre cost modelling, paragraph 103.

possible, we will seek to use pricing data from other NRAs as a cross-check to our calculations.

Data sources

A13.17 To make the calibration as robust as possible we have consulted various BT data sources (some of which were also sources for other data we used to populate the model – see annex 12):

- **BT's physical asset inventory ('BT actual asset count')**. This source provides the count of elements in BT's network at a given point in time. BT provided this information for a number of network elements including FTTC cabinets, exchanges, headend equipment and aggregation nodes.[387] This data was provided as of March 2016.

- **BT's Management Accounts**. BT provided information on its capital spend on its commercial fibre access network for the period from 2010/11 to 2014/15.[388] This information was provided with a split by programme and technology (i.e. FTTC/FTTP), allowing us to identify and remove FTTP costs where appropriate.

- **BT's RFS**. BT provided information on the costs it allocates to commercial FTTC services, on a LRIC and FAC basis.[389] This information was provided at a component level and for the years 2014/15 and 2015/16. We understand that the majority of the RFS cost information reflects mid-year costs.

- **BT Model**. Based on a list of PCPs supplied by Ofcom, BT provided the modelled asset count and modelled labour and equipment (stores) costs which result from dimensioning a new FTTC overlay network reaching around 48,000 commercial cabinets, specified by Ofcom.[390] The outputs of this model were informed by BT's network and cost assumptions as of March 2016.

A13.18 For comparisons with other European NRAs' regulated charges, we have relied on cross-country data from Cullen International ('Cullen').[391] This provides information on the regulatory approach, pricing methodology and level of access prices throughout Europe in relation to fibre access services, as of April 2016.

Calibration period

A13.19 In general, we would seek to calibrate a bottom-up model for as many years as data is available. As noted above, we were able to gather BT information for various years depending on the source queried. While for asset count we collated data for a single point in time, i.e. March 2016, for costs we were able to collate data for a

[387] BT's response dated 6 September 2016 to questions 1 and 5 of the 14th BT s.135 request.
[388] BT's response dated 4 July 2016 to question 7 of the 8th BT s.135 request; and BT response dated 20 September 2016 to question 9 of the 14th BT s.135 request.
[389] BT's response dated 19 February 2016 to question 3 of the 3rd BT s.135 request; BT's response dated 25 November 2016 to questions 3, 6 and 15 of the 19th BT s.135 request; BT's response dated 20 February 2017 to question 1 of the 24th BT s.135 request; and AFIs provided alongside the 2014/15 and 2015/16 RFS.
[390] BT's response dated 6 September 2016 to questions 5 to 7 of the 14th BT s.135 request.
[391] Cullen International, 2016. Layer 2 wholesale access – Virtual unbundling (VULA) and enhanced bitstream. [updated as of April 2016].

range of years – going from one year (in the case of the BT Model) to five years (in the case of capital spend from the Management Accounts).

A13.20 Regarding BT's RFS data, we note that changes to BT's cost attribution methodologies over the period of interest for our calibration mean that costs cannot be compared over time on a consistent basis.[392] We have requested BT to provide detailed accounting data on its cost attributions for GEA services for 2014/15 and 2015/16. In examining this data, and on discussion with BT[393]we have identified an error in relation to 2015/16 costs which only slightly impacted 2014/15 costs. We still believe however that the 2015/16 RFS provide the most appropriate picture of BT's costs. Therefore, we have put more weight on BT's 2015/16 RFS accounts in this calibration.

A13.21 In addition, with regard to the capital spend information from BT's Management Accounts, we note that capital spend tends to be volatile over time. We believe such volatility could make our cost comparisons less meaningful on a year by year basis. In order to avoid such volatility affecting our cost calibration, we have looked at BT's 5-year cumulative expenditure from 2010/11 to 2014/15, as opposed to its year-on-year spend.

A13.22 Therefore, although we have looked at data relating to various years, we have mainly relied on a point calibration exercise – whereby we have verified the outputs of the bottom-up model for a single year or period, in this case 2015/16. Applying a point calibration implies that while the bottom-up model determines the shape of the LRIC cost curve over time, calibration establishes whether this cost curve is at an appropriate level in 2015/16.

Sequencing of calibration

A13.23 We have implemented the calibration of the bottom-up model in three stages:

- first, we calibrated the number of network elements dimensioned by the bottom-up model against BT modelled and actual asset count;
- second, we calibrated the bottom-up model against multiple BT cost metrics (Gross Replacement Costs (GRC), Net Replacement Costs (NRC), opex, capex, total CCA costs); and
- third, we compared the unit costs resulting from the bottom-up model against comparable charge controls set by other European NRAs after common costs have been allocated.

A13.24 These three stages, as well as data sources used, are illustrated in Figure A13.1.

[392] We have recently reviewed BT's cost attribution methodologies as part of our 2016 BCMR Statement, and BT has made adjustments to its 2015/16 RFS as a result.

[393] BT's response dated 20 February 2017 to question 9c of the 24th BT s.135 request.

Figure A13.1: Calibration process and sources used

- BT Model
- BT physical asset inventory

- BT RFS
- BT Management Accounts
- BT Model

- Cullen International (cross-country analysis)

Source: Ofcom

A13.25 Where material differences arose between the outputs of the bottom-up model and BT's data as part of this calibration process, we investigated the potential sources of the discrepancy and examined whether it would be appropriate to adjust our bottom-up model assumptions.

A13.26 As a result of these investigations, in some instances we determined it was appropriate to adjust our model inputs in order to align the outputs of the bottom-up model with BT's actual and/or modelled asset count and costs. However, we sometimes found it appropriate to deviate from BT's actual and modelled FTTC deployment. This was the case, for example, where we detected discrepancies in BT's data, or where the data did not allow us to isolate FTTC commercial specific costs (or asset count), in which case we placed more weight on the BT data underpinning our bottom-up model assumptions (described in Annex 20). These cases are discussed in further detail below in this annex.

A13.27 In deciding whether to make adjustments to the bottom-up model, we have taken into account the following two key objectives:

- ensuring outputs of the bottom-up model are consistent with the network deployment and costs of a proven national efficient FTTC access operator; and

- allowing BT the opportunity to recover efficiently incurred costs.

Stage 1: asset count calibration

A13.28 For this stage of calibration, we have relied on BT's physical network inventory data and BT Model outputs as of March 2016. The chief difference between these two sources is that while BT's physical network inventory provides actual asset count, the BT Model supplies estimated values.

A13.29 We did not consider it necessary to request actual asset count data for all the network elements in the bottom-up model.[394] In these instances, we have relied solely on the outputs of the BT Model for our calibration.

Summary of results

A13.30 We found that, for a number of network elements, our bottom-up model outputs were reasonably in line with BT's modelled and/or actual asset count data . This was partly expected as many of the assumptions in the bottom-up model were informed by BT's own data.

A13.31 However, we also observed gaps between our bottom-up model outputs and BT's asset count. In some cases, we found it appropriate to make adjustments to the bottom-up model. Where we did so, we flexed the coverage and capacity drivers to align the bottom-up model with BT's asset count.

A13.32 In other instances, we opted to deviate from BT's asset count. This was on the basis of:

- BT's modelled asset count not being comparable to our modelled network;
- BT data not aligning with what we would expect from BT's own planning rules; and/or
- the materiality of the impact of the gap observed on model outputs.

A13.33 The results of our asset count calibration are described below for key network elements[395], broken down into the following categories: exchange, fibre cable, FTTC cabinets and PCP to FTTC cabinets.

Asset count calibration - Exchange elements

A13.34 We found discrepancies between our uncalibrated bottom-up model outputs and BT's actual and modelled asset count information for the following key exchange elements: OLT and OCR chassis, OLT Southbound cards, OLT to OCR tie cables and Chamber Cable Joints.

A13.35 Figure A13.2 below compares our bottom-up model outputs and BT modelled and actual asset count for these exchange elements, after calibration.

<u>OLTs and OCRs</u>

A13.36 We found that the number of OLTs and OCRs dimensioned by the uncalibrated bottom-up model understated BT's actual and modelled asset count.

A13.37 To assess the reasons behind this gap, we have explored the following three possible explanations:

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[394] Actuals were requested for network elements for which further information was required either for populating the model or performing the calibration. These elements include OLTs, OCRs, AGNs, track joints and DSLAM variants.

[395] Excluding OSS/BSS costs, which do not have an asset count dimension, the network elements which were not covered in this asset count calibration account for around 11% of the estimated GRC in 2015/16.

- the extent to which a dual vendor strategy has been implemented;
- the impact of BT's FTTP deployment; and
- the use of national averages in the bottom-up model to dimension the modelled network.

A13.38 On the first factor, BT informed us that it has deployed both Huawei and ECI OLTs in a set of FTTC enabled exchanges.[396] Having dual vendor in the same exchange has the benefit of encouraging price and product competition between vendors once network deployment is complete. However, this comes at a cost, as it implies having to install at least two OLTs (one for each vendor) in those exchanges where a dual vendor strategy is implemented, and thus over dimension the FTTC network.

A13.39 To investigate the extent to which BT has rolled out such a strategy, we have analysed BT's actual OLT and OCR count by exchange.[397] The data suggests that BT has undertaken a dual vendor deployment in 13% of its exchanges operating within the specified network footprint.[398] This proportion excludes OLTs and OCRs installed by BT as a result of its non-commercial rollout, in consistency with our approach of modelling an efficient operator. The evidence thus indicates that a dual vendor strategy cannot explain the gap between our bottom-up model outputs and BT's modelled and actual asset count.

A13.40 Looking at the second factor, another explanation may be that BT's FTTP deployment has led to BT installing more OLTs and OCRs. BT can serve FTTP lines by using the same OLT/OCR used for connecting FTTC lines, but with the downside of reducing the available capacity for FTTC services. BT informed us that its OLT/OCR asset count is likely affected by its FTTP deployment - but believes the impact to be minimal given the size of its FTTP deployment so far.[399] The outputs of the BT Model seem to confirm this – as the model dimensions a FTTC only network and predicts a similar number of OLTs to the number that has actually been installed by BT.

A13.41 A third possible explanation is the lack of geographic granularity in the bottom-up model. The use of national averages in the bottom-up model means that areas with higher population density (and thus where more than one OLT/OCR may be required) could be under-dimensioned. This is because more populated exchange areas tend to have more cabinets and therefore more backhaul fibres going back to the exchange, which may trigger the need for a second OLT/OCR. These geographic variations are unlikely to be captured in a national average model.

A13.42 To investigate the extent to which this could result in our bottom-up model under dimensioning the modelled network, we calculated the number of backhaul fibres required on an exchange by exchange basis. This was based on the total bandwidth demand expected at each BT cabinet, to which we then applied BT's planning and capacity rules[400] to dimension the number of OLTs and OCRs

[396] BT's response dated 13 September 2016 to question 21 of the 14th BT s.135 request.

[397] BT's response dated 13 September 2016 to questions 21 and 23 of the 14th BT s.135 request.

[398] BT provided the OLT and OCR network count for a list of exchanges serving around 48k cabinets specified by Ofcom. We understand the percentage is much higher (as much as 50%) if all deployed cabinets (including those in BDUK areas) were to be included in the analysis.

[399] Call between Ofcom and BT staff on 29 November 2016.

[400] BT's response dated 13 September 2016 to question 11b of the 14th BT s.135 request.

required at each exchange. We ran this analysis for 2015/16 and 2028/29, which is the final year of our modelling period.

A13.43 The results of this analysis suggest a lower number of OLTs and OCRs than currently installed by BT, albeit higher than initially projected by the bottom-up model for 2028/29.[401] We have adjusted the utilisation factors in our bottom-up model to reproduce these results, but we have not calibrated up to the actual BT asset count.

OLT southbound cards

A13.44 We also found that the uncalibrated bottom-up model understated the number of OLT southbound cards compared to the BT Model (we did not have actual figures in this case).

A13.45 We believe this discrepancy can be partly explained by the different capacity rules which apply to different vendor equipment. While BT uses up to [✂] (~14) GE ports of an ECI southbound card, it uses up to [✂] (~24) GE ports of a Huawei card.[402] Consequently, we have updated our capacity driver and utilisation factor in the bottom-up model to reflect the blend of BT's capacity rules by equipment supplier.[403] This results in the predicted number of southbound cards aligning with BT's modelled asset count (see Figure A13.2 below).

OLT to OCR tie cables

A13.46 We found that the number of OLT to OCR tie cables (i.e. Hydra cable) dimensioned by the uncalibrated bottom-up model was lower than BT's modelled asset count (again, we did not have BT actual figures to compare the model outputs against). Given that the number of OLT to OCR tie cables is partly driven by the number of DSLAMs in the network, we have compared the ratio of DSLAMs to OLT to OCR tie cables implied in the two models.

A13.47 This comparison shows a higher ratio of DSLAMs per tie cable in our bottom-up model than in the BT Model. This is despite both models assuming the same underlying planning rules for dimensioning OLT to OCR tie cables. While we have not been able to identify the source of this discrepancy, we consider these rules to be reasonable and consistent with vendors' guidelines and we believe our implementation of these rules to be correct. As a result, we have not made any adjustments in this case.

Chamber Cable Joints (CCJs)

A13.48 Likewise, we found that the uncalibrated bottom-up model predicted fewer CCJs than estimated by the BT Model. CCJs are needed to aggregate the fibre cables connecting the DSLAMs with the exchange.

[401] The results of the analysis were reasonably in line with our modelled asset count for 2015/16 so we have not adjusted the bottom-up model outputs for that year.
[402] BT response dated 13 September 2016 to question 11b of the 14th BTs.135 request.
[403] The chosen blend reflects the importance of each equipment supplier in BT's commercial FTTC network based on the observed OLT count.

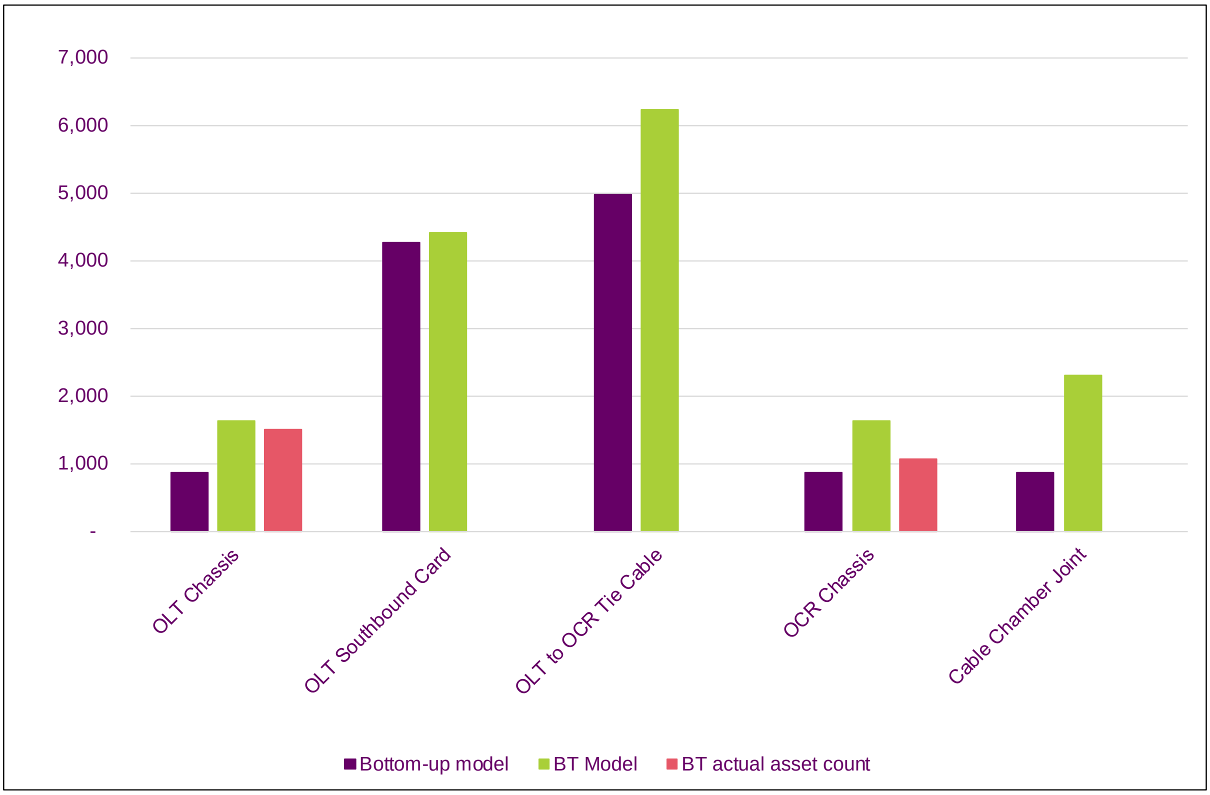
A13.49 We have investigated this discrepancy by looking at the number of CCJs per OCR implied in the two models. While the bottom-up model assumes one CCJ per OCR, the BT Model implicitly assumes 1.4.

A13.50 To assess whether this is a reasonable assumption, we have examined BT's planning and capacity rules. According to these rules, a CCJ is required to aggregate the external fibres (going from the DSLAM to the exchange) into an internal cable with a maximum capacity of 144 fibres.[404] Therefore, the number of CCJs in an exchange is determined by the number of internal cables required in the exchange. If the number of fibres (coming from the DSLAMs) exceeds 144, a second internal cable, and thus a second CCJ, would have to be installed.

A13.51 We have applied this capacity threshold to BT's cabinet data on an exchange by exchange basis (drawing on the analysis we did for OLTs and OCRs). Specifically, we have looked at the expected number of GE ports/fibres required by exchange to work out how many internal cables and CCJs would be required for 2015/16 and 2028/29. This analysis suggests the efficient number of CCJs is lower than BT's modelled asset count for 2015/16, but higher than initially estimated by the bottom-up model for 2028/29. We have therefore modified the utilisation factor in our bottom-up model to mirror our modelled efficient outcome.

A13.52 The figure below compares our bottom-up model outputs and BT asset count data for key exchange elements after having implemented the changes described above. Note that for a number of network elements BT's actuals were not available.

Figure A13.2: Asset count comparison for key exchange elements after calibration, 2015/16



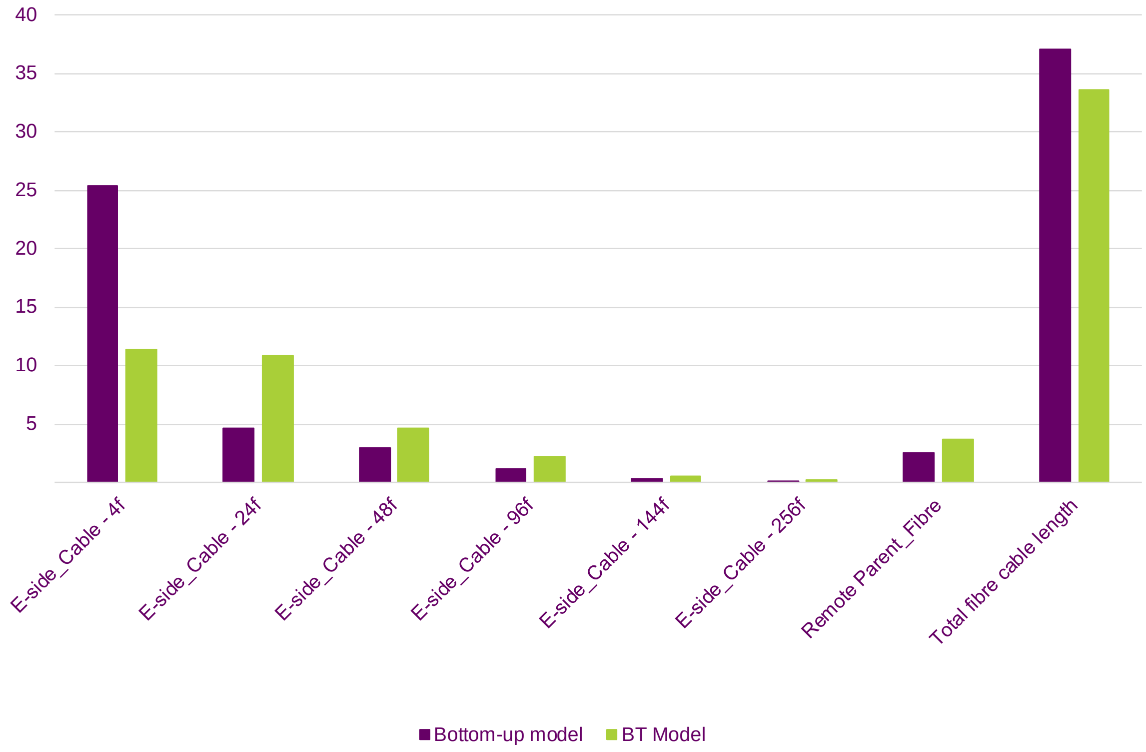
[404] BT's response to May 2016 WLA Consultation on fibre cost modelling, Figure 1, page 21.

Source: Ofcom, using BT information.[405]

Asset count calibration - Fibre cable

A13.53 Our analysis shows discrepancies in the distribution of fibre cable types between the uncalibrated bottom-up model and the BT Model. Compared to the BT Model, the estimated total cable length in the bottom-up model is longer for thinner cable types, and shorter for thicker ones. On an aggregate basis though, the outputs of the two models appear reasonably aligned, with the bottom-up model overstating BT's modelled total cable length by only c.10%. This is illustrated below.

Figure A13.3: Asset count comparison for fibre cable types after calibration, millions of km, 2015/16[406]



Source: Ofcom, with reference to BT response dated 6 September 2016 to questions 1 and 5 of the 14th BT s135

A13.54 As explained in Annex 20, fibre cable length in the bottom-up model is informed by Cartesian's geospatial analysis of BT's cabinet and exchange data.

A13.55 We consider this approach to be transparent and flexible. While this analysis can be replicated by anyone with access to BT's cabinet and exchange location data, it also enables us to easily update the cable length assumed in the bottom-up model

[405] BT's response dated 6 and 13 September 2016 to questions 1, 5, 21 and 23 of the 14th BT s.135 request.

[406] Note that the BT Model does not dimension a 256 fibre cable type, but instead models 240 and 276 fibre cable types. We have aggregated the cable length of these cable types within our E-side Cable 256 fibre component.

in the event that we find it appropriate to change the scale and coverage of the modelled network, i.e. by re-running the geospatial analysis.

A13.56 We have assessed whether the observed gaps at a cable type level could lead us to over or under estimate BT's fibre cable costs. Our analysis suggests that these cost discrepancies should tend to cancel each other out. This is because 1) average unit costs are similar for thinner and thicker cable types[407] and 2) the overall asset count is broadly aligned between the two models (see Figure A13.3 above). Consequently, we do not believe that the observed asset count discrepancies at a cable type level will result in a material cost recovery problem. We have verified this in our cost calibration below which confirms that our cost outputs are in line with BT's costs.

A13.57 Given the advantages of our current methodology and the relatively narrow gap between the aggregate fibre cable length in each model, we consider it appropriate not to modify the bottom-up model in this case.

Asset count calibration - FTTC cabinets

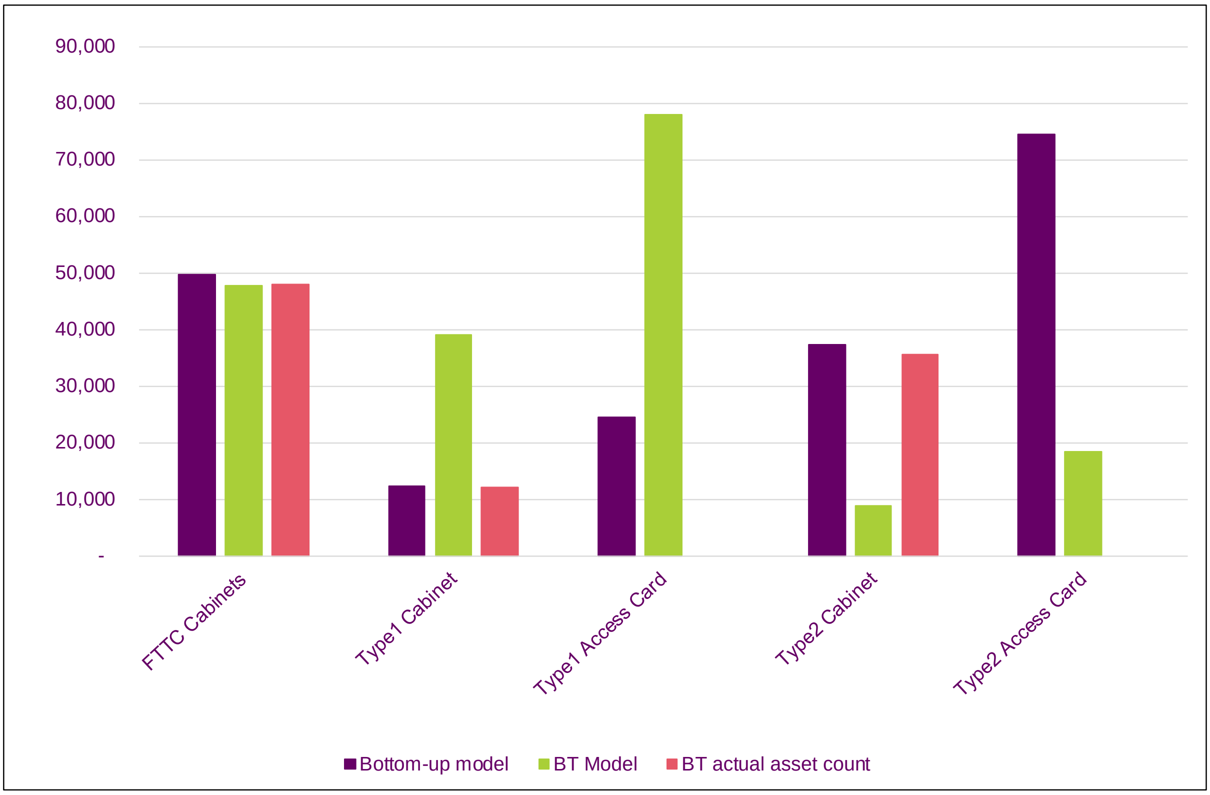
A13.58 At a cabinet level, we used BT actuals to populate the bottom-up model and so the estimated number of FTTC cabinets calculated by the uncalibrated bottom-up model was in line with BT's actual asset count data (see Figure A13.4 below). However, actual asset count data was not available for other cabinet elements such as DSLAM Access Cards.

A13.59 Despite our bottom-up model outputs being aligned with BT's actuals, we observed discrepancies against the modelled asset count projected by the BT Model. Specifically, the BT Model predicts a proportion of smaller FTTC Cabinets (i.e. Type 1 cabinets) that is larger than assumed in the bottom-up model, and above BT's actuals. This could be the case, for example, if the BT Model assumes a lower GEA take-up than actually assumed in practice by BT when dimensioning its FTTC network. Given that these are modelled values and we have based our modelling on BT's actuals, we have decided not to make further changes to the bottom-up model in this regard.

A13.60 We also detected discrepancies in the number of access cards (by cabinet type) dimensioned in the two models. These discrepancies can be explained by the different cabinet type splits assumed in each model. When taking the total number of access cards in the network, the element count appears reasonably aligned between the two models. Therefore, we have made no further changes to the bottom-up model.

[407] Whereas the per meter cost of a 4 fibre cable is £[✂] £(~2.7), the weighted average cost of thicker cables is £[✂] £(~2.6). Note that these costs include cable, sub-duct and installation costs, as well as blown fibre tube cable costs in the case of the 4 fibre cable.

Figure A13.4: Asset count comparison for key FTTC Cabinet element asset counts after calibration, 2015/16



Source: Ofcom, using BT information.[408]

Asset count calibration - PCP to FTTC Cabinet

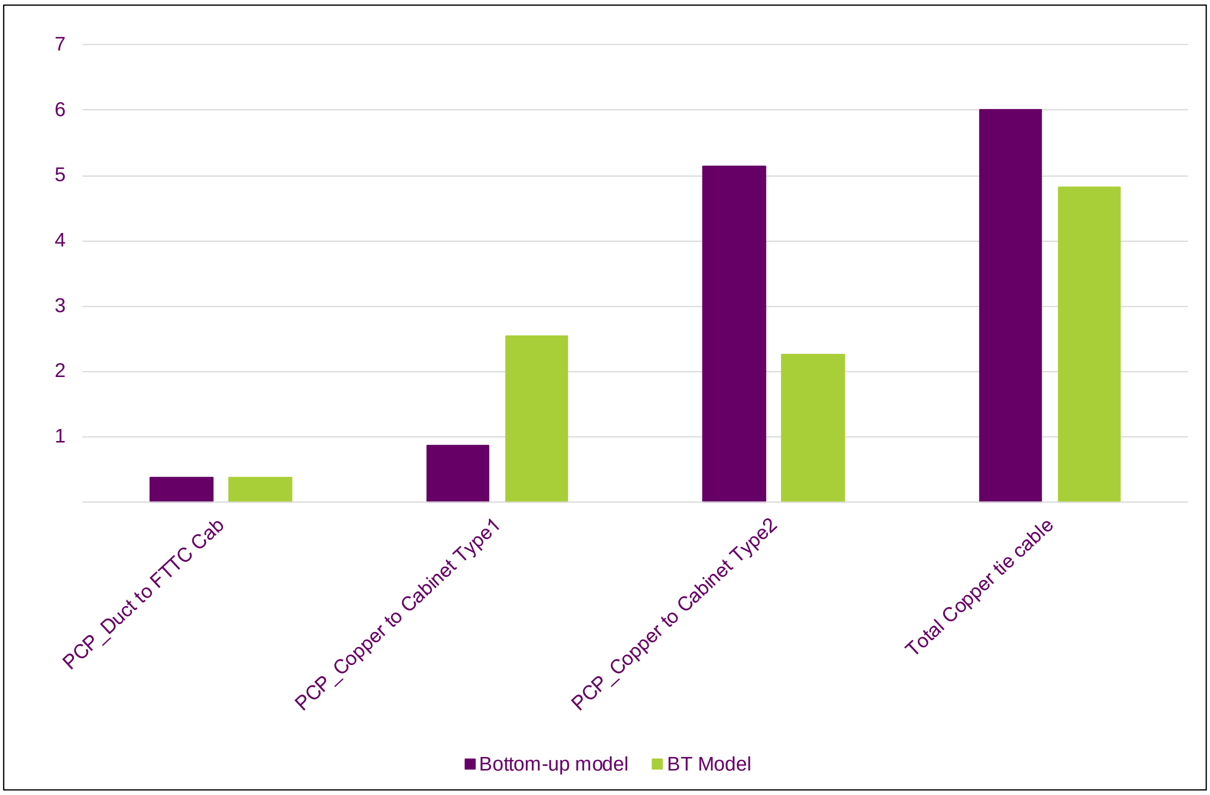
A13.61 While the total tie duct length calculated by the uncalibrated bottom-up model appears in line with BT's modelled asset count data (we did not have BT actuals in this case), we found a discrepancy in the estimated total copper tie cable length between our bottom-up model and the BT Model. This is illustrated in Figure A13.5 below.

A13.62 We believe this discrepancy can be explained by the larger share of smaller cabinets in the BT Model – see Figure A13.4 above. This larger share means that, on average, less copper tie cable is needed between the PCP and the FTTC Cabinet (i.e. smaller cabinets require half the copper tie cable in larger cabinets);[409] reducing the total cable length required in the network. Therefore, given that we have assumed a smaller proportion of small cabinets than the BT Model, we do not consider it necessary to modify our bottom-up model inputs in this case.

[408] BT's response dated 6 September 2016 to questions 1 and 5 of the 14th BT s.135 request; and BT's response dated 8 August to question 2 of the 11th BT s.135 request.

[409] The BT Model assumes [✂] (~297) copper pairs for smaller cabinets and [✂] (~624) copper pairs for larger ones. BT's response dated 6 September 2016 to question 1 of the 14th BT s.135 request.

Figure A13.5: Asset count comparison for key PCP to FTTC Cabinet elements after calibration, millions of meters, 2015/16[410]



Source: Ofcom, using BT information.[411]

Stage 2: cost calibration

A13.63 Having calibrated the bottom-up model based on asset count, we then calibrated the bottom-up model against BT's costs.

A13.64 We did so by comparing the outputs of the bottom-up model against BT's costs for the following cost metrics:

- GRC;
- NRC;
- 5-year cumulative capital spend;
- annual operating costs; and
- annual total CCA cost.[412]

[410] For informing the figures regarding the BT Model we have taken BT's modelled asset count for the following network components as per its response: civils tie duct, 100/0.5 tie cable and 50/0.5 tie cable.
[411] BT's response dated 6 September 2016 to questions 1 and 5 of the 14th BT s.135 request.
[412] CCA costs are a function of annual depreciation costs, holding gains/losses, cost of capital and annual operating expenditure.

A13.65 Figure A13.6 illustrates the combinations of data sources and cost metrics considered. Where multiple sources were available, we were able to compare our bottom-up model outputs against a range of calibration benchmarks (or data points).

Figure A13.6: Combination of cost metrics and data sources

	Data sources			
Metrics	**BT RFS – LRIC**	**BT RFS – FAC**	**BT Management Accounts**	**BT Model**
GRC	✓	✓		✓
NRC	✓	✓		
5-year cumulative capex			✓	
Annual operating costs	✓	✓	✓	
Annual total CCA costs	✓	✓		

Source: Ofcom

A13.66 In terms of data sources, despite our bottom-up model being a LRIC model we have given equal weight to BT's RFS LRIC and FAC figures. This is because the cost outputs of the BT Model (which is also a LRIC model) suggests a LRIC that is higher than the RFS LRIC. This is the case for most super-components (see Figure A13.7 below); the only exception being for the 'Other' super-component, for which we know the BT Model does not capture incremental OSS/BSS costs. [413]

A13.67 We have also given less weight to BT's actual operating expenditure sourced from BT's Management Accounts. We understand these costs may exclude incremental overheads, such as Openreach overheads, and/or other overheads incurred outside Openreach (e.g. BT Group costs / corporate overheads).

A13.68 We have also given different weight to the cost metrics considered in this analysis. In response to our May 2016 WLA Consultation on fibre cost modelling, BT stressed that RFS costs may "not necessarily account for the relative aging of assets" (see paragraph A13.13). We would expect this issue to affect the NRC and FAC metrics, but not the GRC and capex metrics. This is because the underlying aging of assets will affect the extent to which these assets are depreciated; which is a factor that has no bearing on the GRC and capex metrics, which depend on asset prices and volumes, but not on depreciation costs. Therefore, we have given less weight to the NRC and FAC, and more weight to the GRC and capex.

Level of cost aggregation

A13.69 For each cost metric, we looked at two levels of cost aggregation:

[413] We also note that BT's RFS LRIC model aims to capture the LRICs of components on a top-down basis, whereas our bottom-up model aims to measure the LRICs of services on a bottom-up basis.

- super-components, which identify costs for specific segments of the FTTC network, i.e. exchange, E-side, FTTC Cabinet, PCP, Other; and

- aggregate costs (i.e. the sum of all super-components).

A13.70 While a super-component level allows more granular comparisons, it has the drawback of relying on an accurate mapping between the different data sources and our bottom-up model outputs. As described below, this was not always possible.

A13.71 For example, in the case of BT's RFS, some cost components (such as FTTC Repairs and OR Service Centre – Assurance NGA) have overlaps with two or more super-components. In these instances, we apportioned the costs to the super-component which was expected to drive most of the underlying component costs.

A13.72 For this reason, comparisons at a super-component level are less reliable than comparisons at an aggregate level; hence we have put less evidential weight on them. Still, we found these more disaggregated comparisons useful to identify costs which could explain the observed discrepancies.

Duct and provision costs excluded

A13.73 We have conducted our cost calibration after excluding duct and provision costs. This is because:

- duct costs are not explicitly modelled in the bottom-up model (but are instead added later in the bottom-up model as a top-down allocation); and

- provision costs receive a different treatment in our bottom-up model (i.e. whilst they are treated as operating costs in the bottom-up model, they are partly capitalised in BT's accounts[414]).

Summary of results

A13.74 The results of the cost calibration can be summarised as follows:

- For GRC, NRC, capex and total CCA costs, the outputs of the 'asset count' calibrated bottom-up model were reasonably in line with BT's costs on both an aggregate and super-component basis; so we did not find it necessary to make adjustments to the bottom-up model.

- For annual operating costs, the outputs of the 'asset count' calibrated bottom-up model were below BT's costs at both aggregation levels and across all data sources; so we found it appropriate to adjust the bottom-up model in this case.

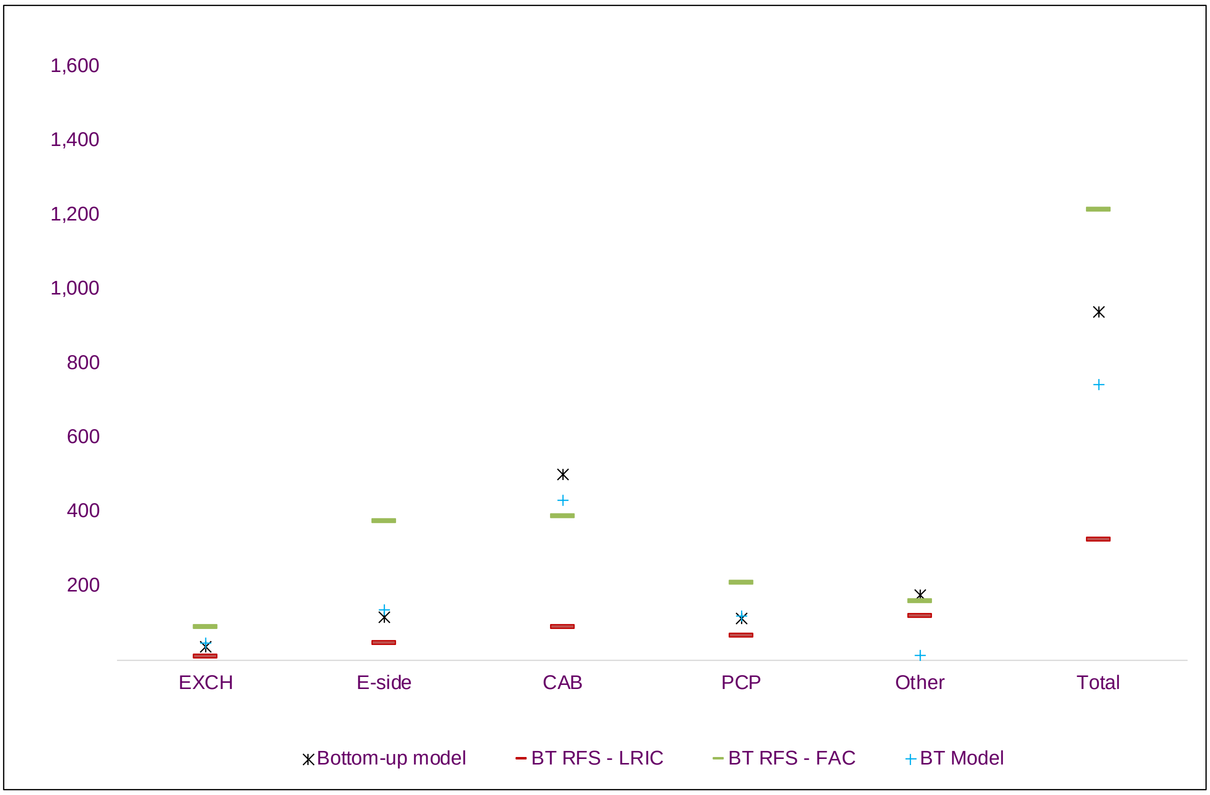
A13.75 The results of our cost calibration, and the adjustments made to the bottom-up model are explained in greater detail below for each cost metric.

[414] BT's response to actions raised on 14 July 2016 as a follow-up to BT response to 8th BT s.135 request.

Gross Replacement Costs

A13.76 We found that our GRC estimate is reasonably in line with BT's costs in 2015/16 at an aggregate and super-component levels (see Figure A13.7). [✂]. We observed a similar result for 2014/15.

Figure A13.7: GRC, 2015/16, £m [redacted]



Source: Ofcom, using BT information.[415]

Net Replacement Costs

A13.77 A similar outcome was observed for NRC, but with the nuance that our estimated NRC came closer to BT's RFS FAC than our GRC estimate. This is illustrated in Figure A13.8.

A13.78 At a cabinet level, we note that our NRC estimate is above BT's RFS FAC by around £90m. We have examined the reason for this by looking at the implied NRC to GRC ratios, which is an indicator of the speed at which network assets are depreciated. While this ratio is 65% in our bottom-up model, this is 53% in the RFS FAC. This means that the RFS assumes a larger proportion of FTTC Cabinet assets have been depreciated by 2015/16 than predicted in the bottom-up model.

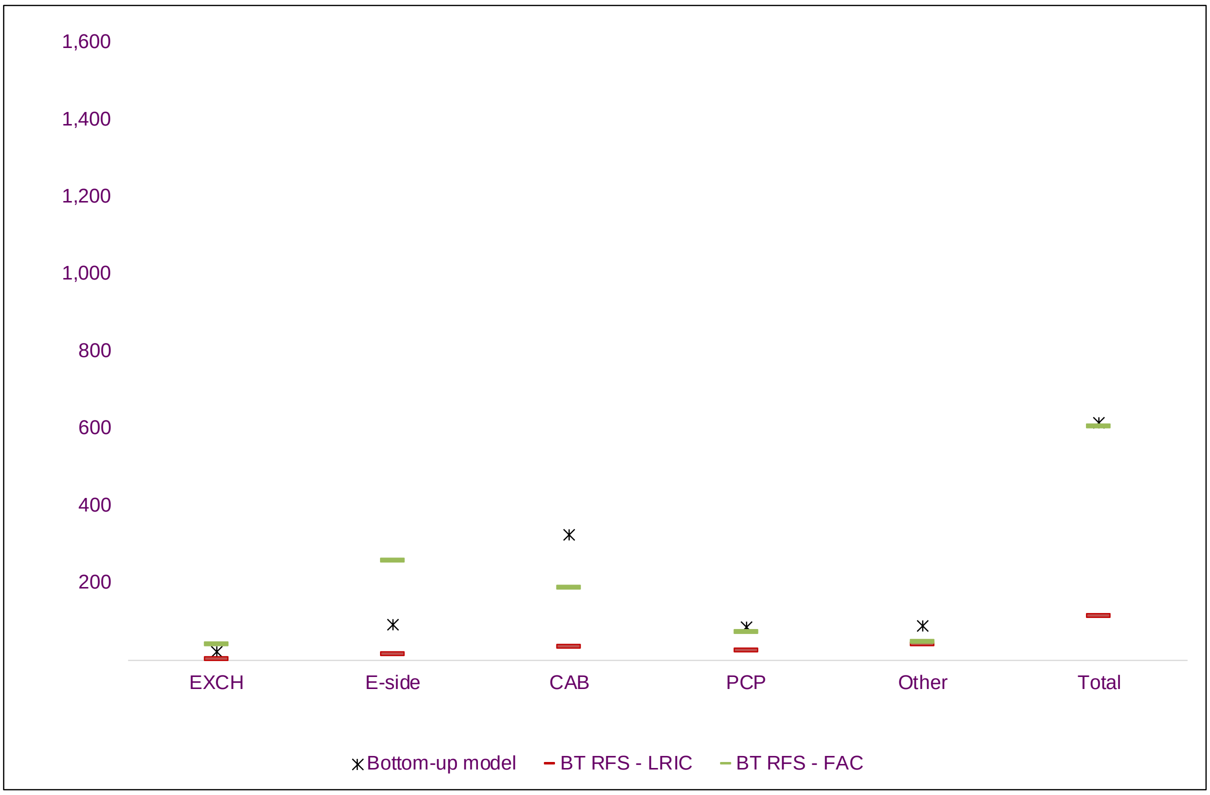
A13.79 In relation to this, BT raised the concern (in response to our May 2016 WLA Consultation on fibre cost modelling) that cost attributions in the RFS may "not

[415] BT's response dated 6 September 2016 to question 1 of 14th BT s.135 (for BT Model); and BT response dated 19 February 2016 to question 3 of 3rd BT s.135 request, BT response dated 25 November 2016 to questions 3 and 6 of 19th BT s.135 request, BT response dated 30 November 2016 to question F1 of 20th BT s.135 request, and AFI information provided alongside 2015/16 RFS (for RFS figures).

necessarily account for the relative aging of assets" (see paragraph A13.13). This means that NRC to GRC ratios in BT's RFS would be distorted if costs are apportioned from a pool of assets with different aging. For example, a pool of copper and fibre assets is likely to result in a lower NRC to GRC ratio than a pool of fibre only assets, which are likely to have a younger age. This distortion could explain why our NRC estimate came closer to the RFS FAC than our GRC estimate.

A13.80 For this reason, we have put less weight on our NRC comparison and more weight on our GRC comparison. This is consistent with the approach we have taken in the 2015 MCT Statement, where we calibrated the bottom-up model against the GBV and used the NBV – which is the equivalent to the NRC when using HCA – as a cross-check.[416] Consequently, we have not made adjustments to the bottom-up model in this regard.

Figure A13.8: NRC, 2015/16, £m [redacted]



Source: Ofcom, using BT information.[417]

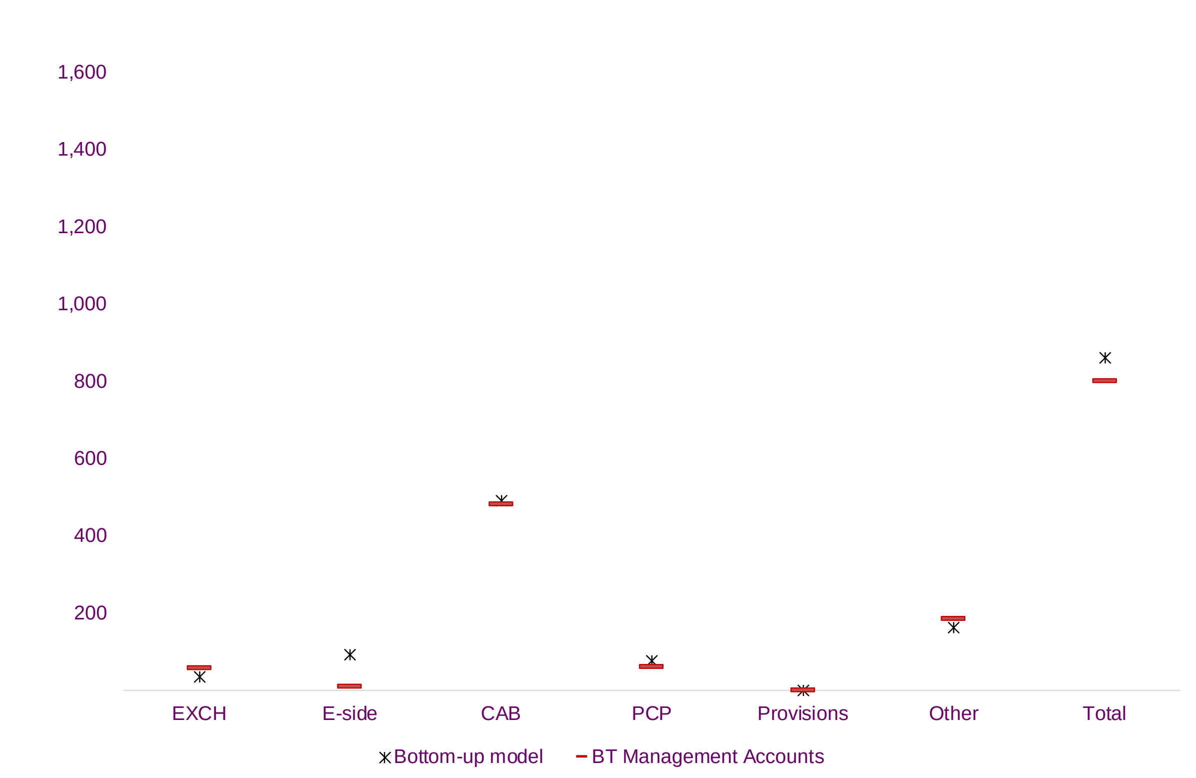
5-year cumulative capital spend

A13.81 We found that our modelled 5-year cumulative capital spend is reasonably in line with BT's capex at both aggregation levels (see Figure A13.9 below). [✂] We have therefore not made further adjustments to the bottom-up model.

[416] 2015 MCT Statement, Annex 9, paragraph A9.7, https://www.ofcom.org.uk/__data/assets/pdf_file/0019/72109/annexes_7-13.pdf.

[417] BT response dated 19 February 2016 to question 3 of 3rd BT s.135 request, BT response dated 25 November 2016 to questions 3 and 6 of 19th BT s.135 request, and AFI information provided alongside 2015/16 RFS.

Figure A13.9: 5-year cumulative capital GEA specific spend, 2010/11 to 2014/15, £m [redacted]



Source: Ofcom, using BT information.[418]

<u>Annual operating costs</u>

A13.82 Our cost calibration pointed at the uncalibrated bottom-up model significantly understating BT's annual operating costs across all super-components. This was the case for 2014/15 and 2015/16.

A13.83 We investigated this discrepancy by looking at BT's RFS costs at a more granular level. Specifically, we examined the costs allocated to the cost activities which underpin the relevant RFS cost components. This analysis identified a number of costs missing in the bottom-up model – the most important being incremental General Management (GM) costs. Other missing costs included meter reading and maintenance costs.

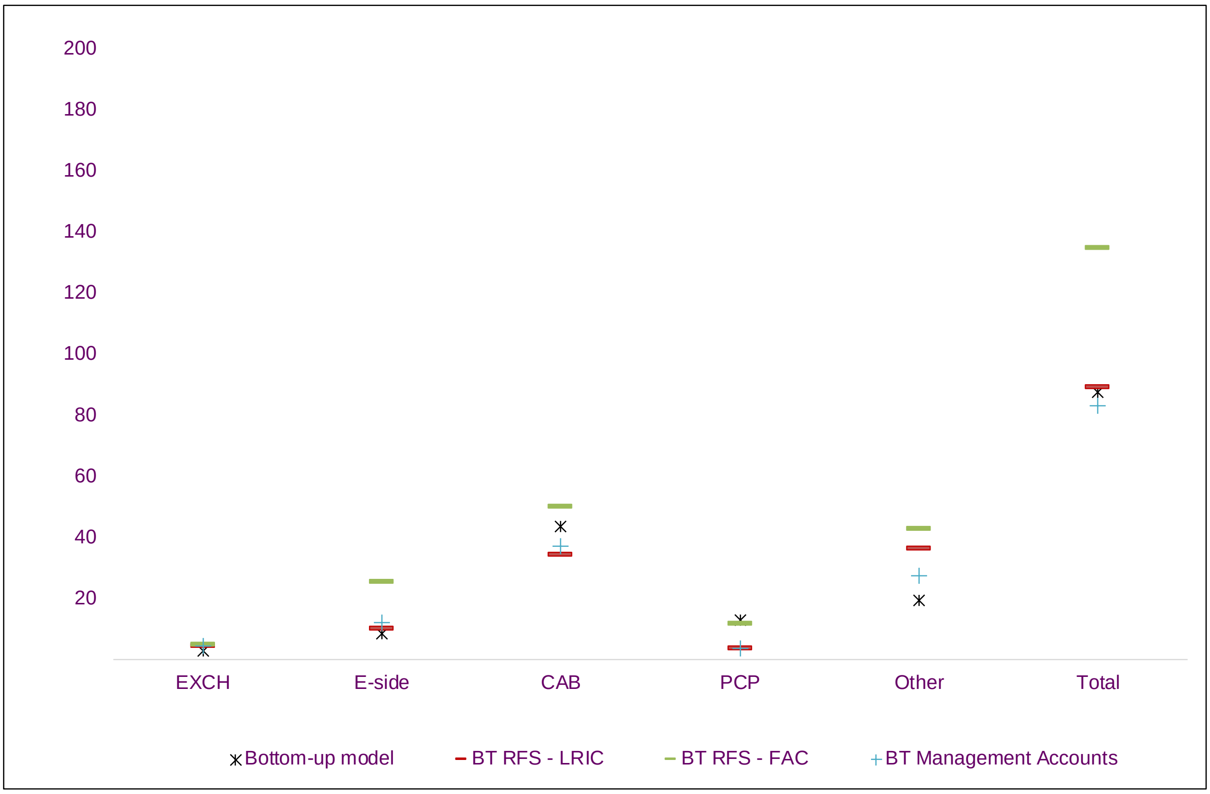
A13.84 We considered it appropriate to add these missing costs to the bottom-up model. Annex 12 sets out our approach for estimating incremental GM costs.[419]

A13.85 To verify whether our model outputs were now in line with BT's operating costs, we re-ran our cost calibration. This re-calibration confirmed that the outputs of bottom-

[418] BT's response dated 4 July 2016 to question 7 of 8th BT s.135 request; and BT response dated 20 September 2016 to question 9 of 14th BT s.135 request.
[419] See Annex 17.

up model are now within a reasonable range of BT's annual operating costs for 2015/16 (see Figure A13.10).[420]

Figure A13.10: Annual operating costs (post adjustments), 2015/16, £m [redacted]



Source: Ofcom, using BT information.[421]

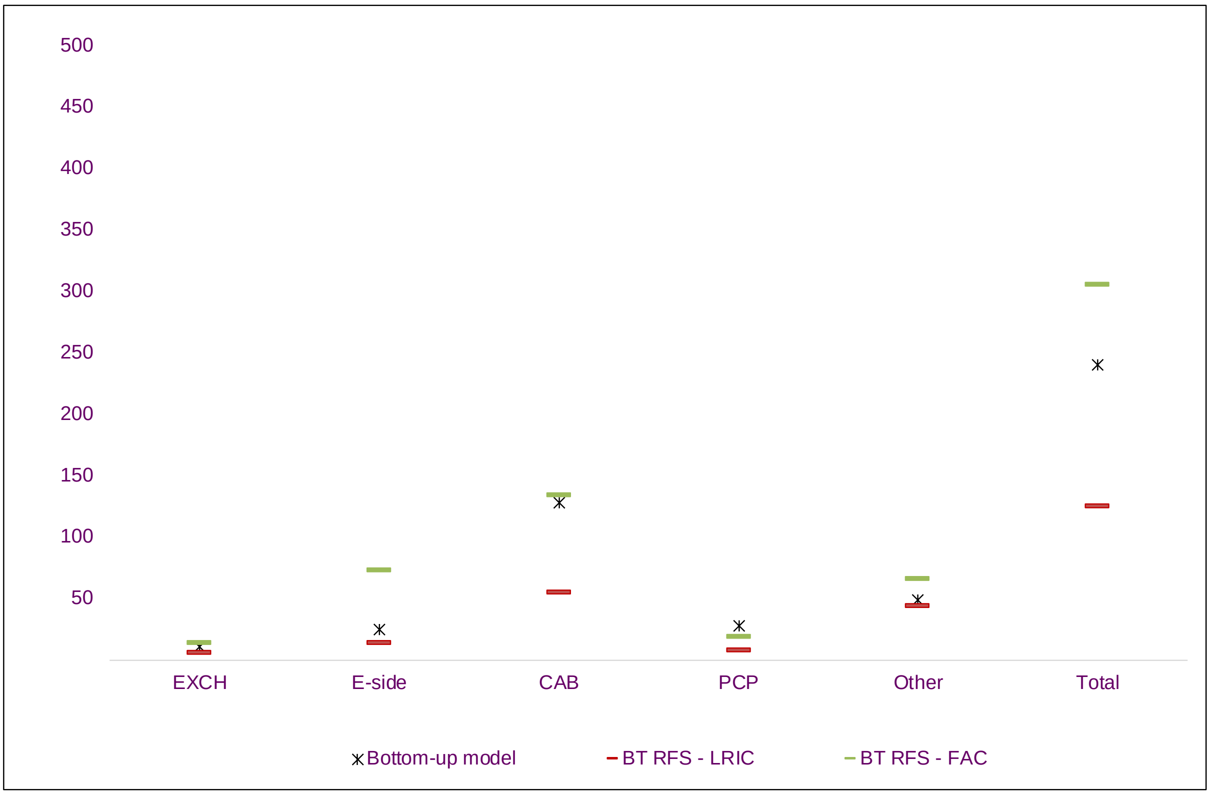
Total annual CCA costs

A13.86 Finally, our calibration shows that the total annual CCA costs estimated by the bottom-up model are reasonably in line with BT's costs in 2015/16, both at an aggregate and super-component level. This result holds after the missing operating costs, identified in the subsection above, are added into the bottom-up model (see Figure A13.11). We have verified this for 2014/15 and have observed a similar outcome.

[420] We re-ran the calibration for 2014/15 as well and found that our model outputs are still below BT's operating costs in this year. However, as explained in paragraph A13.20, there are cost adjustments missing in BT's 2014/15 RFS, which would have reduced BT's operating costs. We have therefore put less weight on BT's 2014/15 costs in this calibration.

[421] BT response dated 13 June 2016 to question 15a of the 16th BT s.135 request (for BT Management Accounts); and BT response dated 25 November 2016 to questions 3 and 6 of 19th BT s.135 request, and AFI information provided alongside 2015/16 RFS (for RFS figures).

Figure A13.11: Total annual CCA costs (post adjustments), 2015/16, £m [redacted]



Source: Ofcom, using BT information.[422]

Stage 3: European NRAs' charge controls

A13.87 As a third and final stage of our analysis, we have compared our unit cost estimate for GEA rentals against the charges set by other European NRAs for similar fibre-based access services.

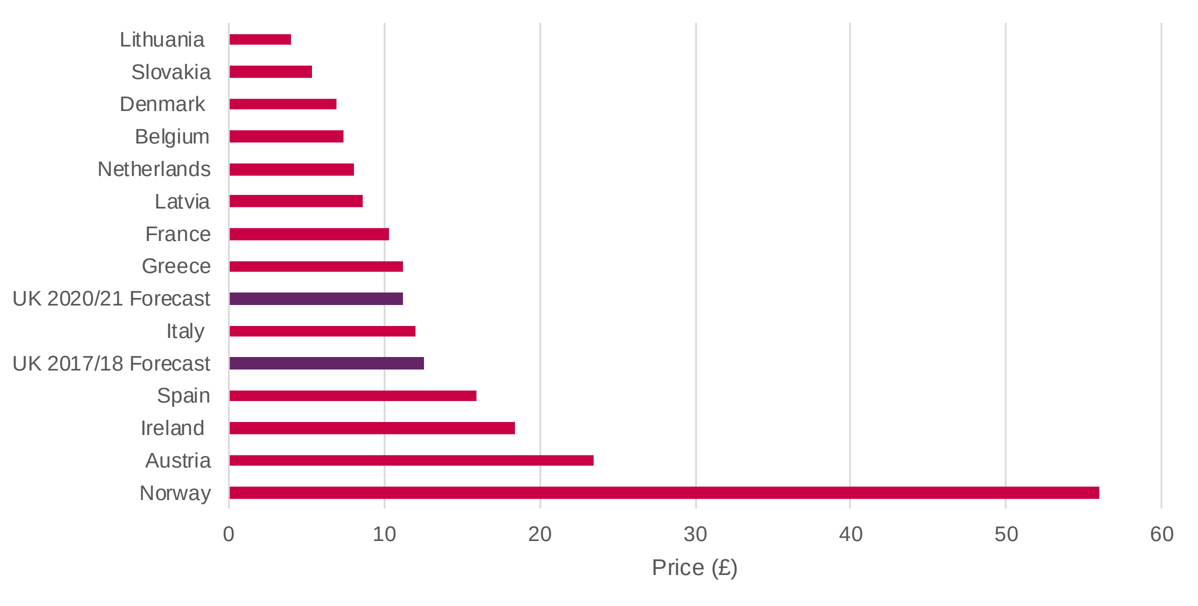
A13.88 Above, we recognised there are limitations in the use of international comparisons due to the lack of comparability of network deployments and costs across countries. Consequently, we said we would only compare our model outputs against other NRAs' access prices as a cross check.

A13.89 Figure A13.12 below compares our unit cost estimate (including common costs) against fibre access charges in the European countries for which information was publicly available. To aid comparison, we have added our forecasted MPF rental charge to our GEA 40/10 unit cost estimate for the UK, as fibre and MPF access prices are bundled together in the majority of the European countries included in the analysis. year average exchange rate.[423]

[422] BT response dated 19 February 2016 to question 3 of 3rd BT s.135 request, BT response dated 25 November 2016 to questions 3 and 6 of 19th BT s.135 request, and AFI information provided alongside 2015/16 RFS.

[423] The 5-year average was calculated based on spot exchange rate reported by the Bank of England for the period from 18 October 2011 to 17 October 2016. Bank of England, 2016, http://www.bankofengland.co.uk/boeapps/iadb/index.asp?SectionRequired=I&first=yes&HideNums=-1&ExtraInfo=true&Travel=NIxIRx&levels=1 [accessed on 18 October 2016].

Figure A13.12: Fibre access prices [MPF+GEA] in the UK and other European countries[424]



Source: Ofcom based on bottom-up model for the UK and Cullen International, 2016. Layer 2 wholesale access – Virtual unbundling (VULA) and enhanced bitstream, for other European countries.

A13.90 In addition to the comparability issues identified above, we stress that this analysis has a number of caveats:

- exchange rates have observed significant volatility over the last two years, which can distort the ranking of countries in the comparison.
- characteristics of the underlying fibre access products, such as download speed and access technology (FTTC/FTTP), vary from country to country.
- in some countries fibre prices have remained unregulated, e.g. Netherlands, Germany, Ireland and Norway, meaning that access prices in these countries may not reflect costs.
- the relevant timeframe and cost standard used to set access prices also varies across the sample.

A13.91 These issues reinforce our view that our model outputs should not be calibrated against the charges set by other NRAs. Nonetheless, the comparison does show that our forecasted MPF + GEA 40/10 rental charge is in line with fibre charges in other European countries.

[424] UK price includes MPF and GEA 40/10 rental charges. Note that access seekers in Austria need to pay an additional backhaul charge on top of the fibre access price. Prices in European countries were converted to pounds based on a 5-year average exchange rate.

Annex 14

Bottom-up and top-down model results and sensitivities

Introduction

A14.1 This annex presents the base case results of our bottom-up and top-down models for the forecasted unit costs of GEA and MPF rentals respectively. We also discuss the sensitivity of our models to changes in key inputs, illustrate the model outputs under low cost and high cost scenarios and explain how we have derived the ranges of results we are consulting on.

A14.2 As explained in Volume 2, Section 4, the top-down and bottom-up models are run using a common control module, which contains inputs to each of the models, allows these inputs to be varied and presents a summary of the results from the models. All results presented in this annex can be replicated using the pre-set scenarios in the control module.

A14.3 The bottom-up model calculates the costs of GEA services on a LRIC basis, which is inputted to the top-down model. The top-down model calculates the costs of LLU services, allocates common costs to copper and fibre services, and calculates the final X numbers for baskets of services.

A14.4 The remainder of this annex is structured as follows:

- we first explain the impact of common cost allocation between copper and fibre;
- we present the top-down model results and sensitivities;
- we present the bottom-up model results and sensitivities; and
- we combine sensitivities to produce our overall high and low unit cost estimates for MPF and GEA rentals, which form the range of costs on which we are consulting.

Impact of our common cost allocation between copper and fibre

A14.5 Our overall approach to allocating common costs between copper and fibre is explained in Section 2, and the implementation of this is explained in Annex 10. In summary we have allocated common costs across copper and fibre services using an equi-proportional mark-up (EPMU). However, we propose to allocate the same common cost per line for MPF and WLR rentals when forecasting costs in the top-down model.

A14.6 This allocation of common costs has an impact on the rental charges for both MPF[425] and GEA, which we set out in Table A14.1 below. This shows that the

[425] We note that it also has an impact on forecasted costs for WLR and SMPF, as shown in the top-down model, but that we do not propose setting charge controls for these rental services.

allocation of common costs leads to a decrease in the cost of MPF rentals and an increase in the costs of GEA rentals.

Table A14.1: Forecast costs in 2020/21 before and after allocation of common costs (£ per annum, nominal prices)

	Before[426]	After
MPF Rentals	90.96	81.98
GEA Rentals	35.87	52.77

Source: Outputs from top-down and bottom-up model

Top-down model results and sensitivities

A14.7 This section presents the outputs of the top-down model under the base case scenario and sensitivity analysis based on changes in key assumptions, focussing on the MPF rental service. It is laid out as follows:

- we first show the base case results for MPF rentals, connections, and related ancillaries;
- we then show the cost component breakdown for the base case for MPF rentals;
- we then describe the assumptions used in the base case that we flex as part of the sensitivity analysis;
- we then analyse the sensitivity of the unit cost of MPF rentals under a range of assumptions; and
- we show the base case results for MPF ancillary services.

Model results for the base case

A14.8 Our base case annual unit cost estimates for MPF rentals, and one-off cost estimates for MPF connections and ancillary services are presented in Table A14.2 below. For most of these services, the unit cost estimates are below Openreach's current access prices; implying negative 'X' values. Note that the adjusted glidepath in Volume 2, Section 3 means that access prices need to align with costs by 2019/20, so the negative 'X' values for co-mingling charges in 2020/21 are reflective of changes in the underlying unit cost estimates.

[426] Note that our 'before' figure shows the forecasted MPF Rentals using a weighted average cost across SML1 and SML2, whilst the 'after' figure is specifically for SML1. Furthermore, the 'before figure' for GEA Rentals does not include any common costs that are currently allocated by BT to GEA Rentals, whilst the 'after' figure will include a proportion of the common costs that BT currently allocates to GEA.

Table A14.2: Base case MPF service results

Service	Charges at 31 March 2017 (£)	Nominal unit cost (£)		Charge control 'X'		
		2019/20	2020/21	2018/19	2019/20	2020/21
MPF Rental (SML1, annual)	85.29	82.28	81.98	- 4.6%	- 3.5%	- 2.4%
MPF New Provides	Various			- 27.5%	- 15.9%	- 5.3%
MPF Single Migration	30.26	21.13	20.44	- 23.5%	- 13.6%	- 5.2%
MPF Bulk Migration	20.97	12.52	12.19	- 31.3%	- 18.1%	- 4.7%
Hard Ceases	Various			- 27.6%	- 15.9%	- 4.7%
Other MPF Ancillaries	Various			- 55.9%	- 34.2%	- 6.0%
Co-Mingling New Provides and Rentals[427]	Various			+ 54.6%	+ 22.9%	- 5.3%
Tie Cables	Various			-2.0%	-2.2%	- 3.6%

Source: Outputs from the control module

A14.9 Compared to the current MPF rental charge of £85.29 per annum (which is £7.11 per month), the forecast unit cost in 2020/21 is £81.98 per annum (which is £6.83 per month).

Base case cost stack for MPF rentals

A14.10 Before coming to our sensitivities analysis, we show our base case estimate of the cost of MPF rentals breaks down by component (before our common cost allocation). This is shown below.

Table A14.3: Breakdown of MPF Rental costs by component in 2020/21, before common cost allocation (£, nominal prices)

Cost component	Cost
E-side copper capital	7.44

[427] We note that the relatively large positive X for this basket is due a current misalignment of revenues and costs. We find that revenues have substantially fallen between 2013/14 and 2014/15, whilst costs have remained broadly the same. Therefore, we have investigated further and found that [✂]. We have assessed the impact of [✂] in the co-mingling new provides and rentals basket. Making this adjustment approximately halves the 2018/19 and 2019/20 Xs (as shown), with no impact on the 2020/21 X given that this only represents our forecasted cost trend rather than a misalignment of revenues and costs.

Cost component	Cost
E-side copper current	3.13
D-side copper capital	41.35
D-side copper current	7.66
Local exchanges general frames equipment	2.34
Local exchanges general frames maintenance	1.12
Analogue line test equipment	0.25
Dropwire capital & analogue NTE	16.74
Analogue line drop maintenance	2.07
MPF Line Testing Systems	5.80
Service centre – Assurance WLA	0.56
Openreach sales product management	0.53
LLU systems developments	0.17
Service Level Guarantees	1.01
Openreach Copper	0.70
Ofcom Licence Fee Openreach	0.09
Total	**90.96**

Source: Outputs from top-down model.

Sensitivity analysis

A14.11 We have conducted a sensitivity analysis on the key assumptions used when forecasting costs for MPF rental services. The purpose of this analysis is to test how the model behaves when its input parameters are flexed, and all results are presented following our allocation of common costs. We first briefly recap the base case assumptions used.

Demand assumptions

A14.12 We have forecasted service volumes in the volumes model, where we have made many different assumptions (see Annex 10 for details). The key assumptions that impact MPF rentals are:

- Forecasted total Openreach lines: this is driven by forecasted growth in the number of households that use a fixed line, whilst accounting for the impact of competitive networks (e.g. Virgin Media's network[428] or network competition due to the new and effective PIA remedy[429]).

[428] In the base case, we assume that over the charge control period around 0.3m customers per annum are migrated from Openreach's network on to Virgin Media's network.
[429] In the base case, we assume that over the charge control period around 0.17 million homes are passed using the PIA remedy per annum, with 30% of the homes passed purchasing a retail

- Broadband penetration: in the base case, we have assumed that, over the charge control period, the proportion of Openreach lines that are used to provide broadband to retail customers increases by 2% each year.

Input cost assumptions

A14.13 In order to forecast capital costs, we need to applied a weighted average cost of capital (WACC) which allows BT an appropriate return on its capital investments. In the base case, we assume a nominal pre-tax WACC of 8.1% (see Annex 16 for details on our methodology and calculations).[430]

A14.14 We have also estimated the possible cost savings (for operating and capital costs) that BT can make in the future. In the base case, we assume an opex efficiency of 5.5% and capex efficiency of 3%.

A14.15 We have also estimated the price trends for the cost inputs that BT uses. In all scenarios, we have assumed RPI for the capital cost trends for duct and copper assets and flat prices for all other assets. In the base case, we have assumed a 3.1% per annum increase for pay input costs and 2.4% per annum for non-pay input costs.

A14.16 Finally, as set out in Annex 11, we have forecasted cumulo (see Annex 17 for details) and SLG payments separately. In the base case and in 2020/21, we forecast £ 7.08 of cumulo per MPF line per annum and £ 0.89 of SLG payments per MPF line per annum.[431]

Values changed as part of the sensitivity analysis

A14.17 We have altered the above parameters in order to carry out a sensitivity analysis. When setting values for the analysis, we have sought to use values that are sufficiently different from the base case to test the top-down model, but not so different that we believe they would fall outside what could be a reasonable range for each parameter. The sensitivities that we have used are:

- **Volumes:** we include a low volume sensitivity which assumes a greater impact from PIA[432] and Project Lightning[433], and dampened household and business site

broadband service that is provided via the PIA remedy. This reduces the number of MPF lines sold by Openreach.

430 We assume a nominal pre-tax WACC of 8% in 2020/21 but 8.1% for all other years.

431 Note that we do not have a high or low assumption for the SLG payment forecasts.

432 We assume 0.33 million homes passed with PIA per annum with a penetration rate (i.e. proportion of homes passed that result in customers moving away from Openreach's network) of 40%.

433 We assume that [✂] (~0.36) million homes per annum switch to Virgin's network due to Project Lightning.

growth[434]; and a high volume forecast in which we essentially assume the opposite[435];

- **WACC:** the high and low sensitivities are 9.1% and 7.1% respectively[436];
- **Efficiency:** the high and low sensitivities are 3.5% and 6.5% for opex respectively, and 1% to 5% for capex respectively;
- **Input operating cost trend:** the high and low sensitivities are 3.5% and 2.5% for pay respectively, and 3% and 2% for non-pay[437] respectively;
- **Cumulo:** the high and low sensitivities primarily impact the attribution of cumulo across MPF and GEA.[438] We forecast the per line cumulo for the 2020/21 annual MPF charge to be between £ 7.98 and £6.46 .

A14.18 The results of these sensitivities are summarised in Table A14.4 below. We present the base case LRIC+ in the top row with the various high and low scenarios sequentially below. In all cases the model behaves as we would expect when the input assumptions are changed, both in terms of the direction and the size of the change in model output.

Table A14.4: Sensitivity analysis for MPF Rental services, impact on 2020/21 nominal charges

Scenario		MPF Rental LRIC+
Base case	Base	£81.98
Volumes	High	- £1.82
	Low	+ £2.25
WACC	High	+ £3.41
	Low	- £3.42
Efficiency	High	- £2.67
	Low	+ £4.40
	High	+ £0.65

434 For households, we assume a 0.5 percentage point reduction in growth (relative to the base case) and apply a dampening factor of 1.8 (rather than 1.6) to the observed decline in the proportion of mobile only households. For business sites, we apply a dampening factor of 1.6 (rather than 1.4) and consider forecasted GDP which further dampens our forecasted business site growth.

435 Specifically, we assume that 0.07 million homes passed with PIA per annum with a penetration rate of 20%, and [✂] (~0.28) million homes switch to using Virgin's network due to Project Lightning. We also assume a 0.5 percentage point increase in household growth (relative to the base case) with a dampening factor of 1.4 (rather than 1.6) applied to the observed decline in the proportion of mobile only households, and a dampening factor of 1.2 (rather than 1.4) for business site growth.

436 For 2020/21, we assume a high and low of 9% and 7% respectively.

437 This scenario also assumes high and low opex cost trends in the bottom-up model but we note that this has a limited impact on MPF costs.

438 Note that in the control module, the high and low cumulo scenarios are in relation to the high and low cumulo forecast to GEA, which results in a low and high forecast for MPF (i.e. the scenarios show the impact of attributing more and less cumulo to GEA).

Input operating cost trend	Low	- £0.69
Cumulo	High	- £1.70
	Low	+ £2.09

Source: Outputs from the control module

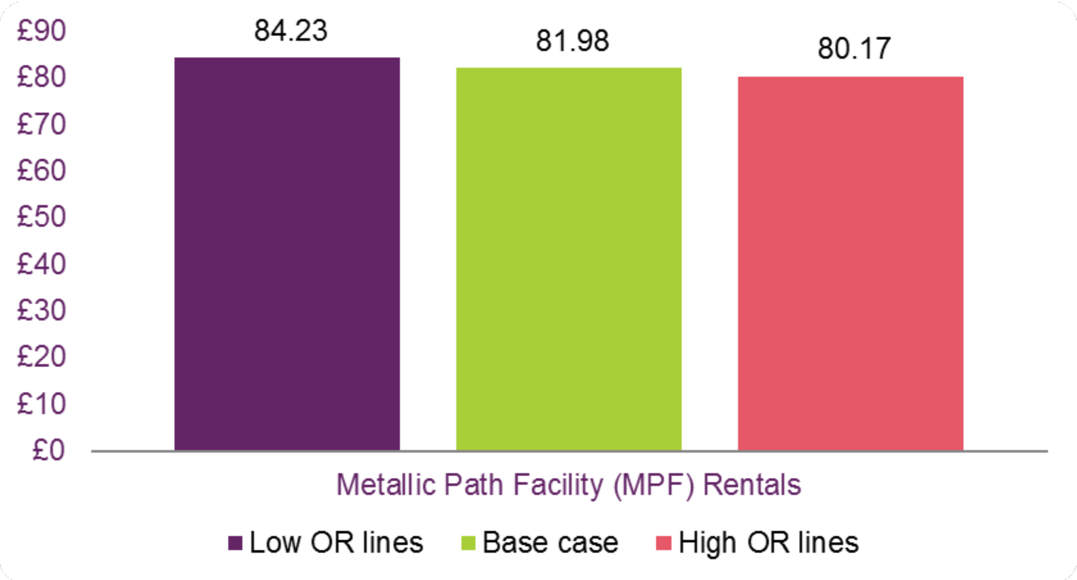
A14.19 We provide and assess the results for each of these sensitivities in greater detail below. Figure A14.5 presents the base case forecasted unit cost for MPF Rental services in the middle, and the low case to the left and the high case to the right of it.

Volume sensitivity

A14.20 We find that the forecasted charge for MPF Rentals is relatively sensitive to our high and low volume forecast scenarios. The base case volume scenario is made up of a number of different input assumptions that are changed for the low and high case. This results in the overall impact of a high and low scenario to be collectively large even when the sensitivity of the individual assumptions is not significant.

A14.21 As expected, a greater number of forecasted Openreach lines results in a lower forecasted unit cost for MPF Rentals. The results of this sensitivity analysis are shown below.

Figure A14.5: Volumes sensitivity on MPF Rentals in 2020/21 (£, nominal prices)

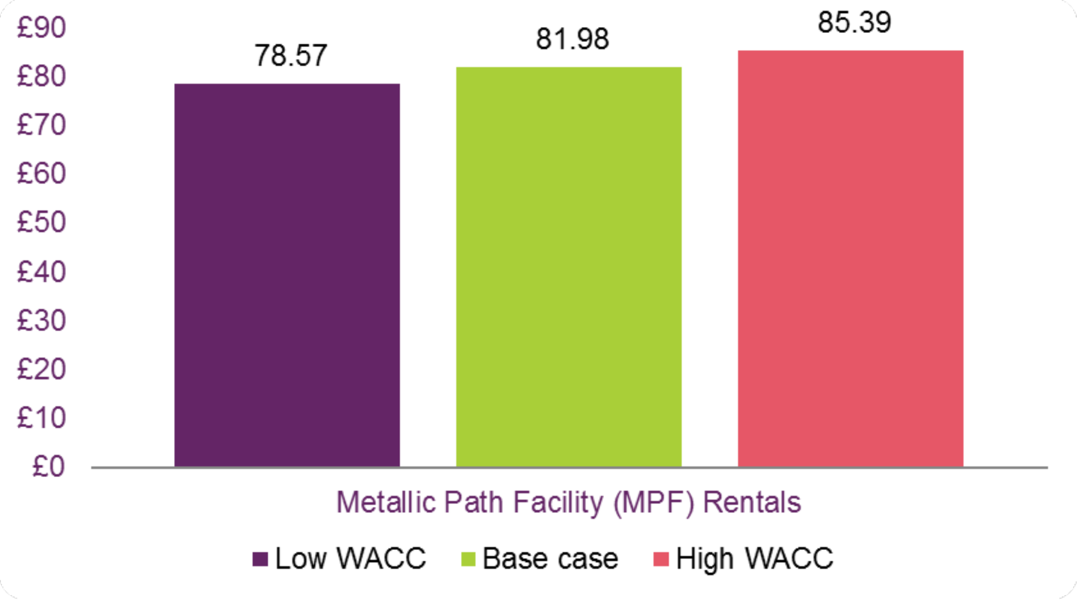


Source: Outputs from the control module

WACC sensitivity

A14.22 We find that there is a significant impact on the forecasted charge for MPF Rentals when assuming the high and low scenario for WACC. The return on capital employed is determined by the WACC multiplied by the mean capital employed (MCE). This means that when MCE is high, a one percentage point change in WACC can result in a large amount of additional capital costs and thus a higher FAC. As expected, a higher WACC results in a higher forecasted unit cost for MPF Rentals. The results of this sensitivity analysis are shown below.

Figure A14.6: WACC sensitivity on MPF Rentals in 2020/21 (£, nominal prices)

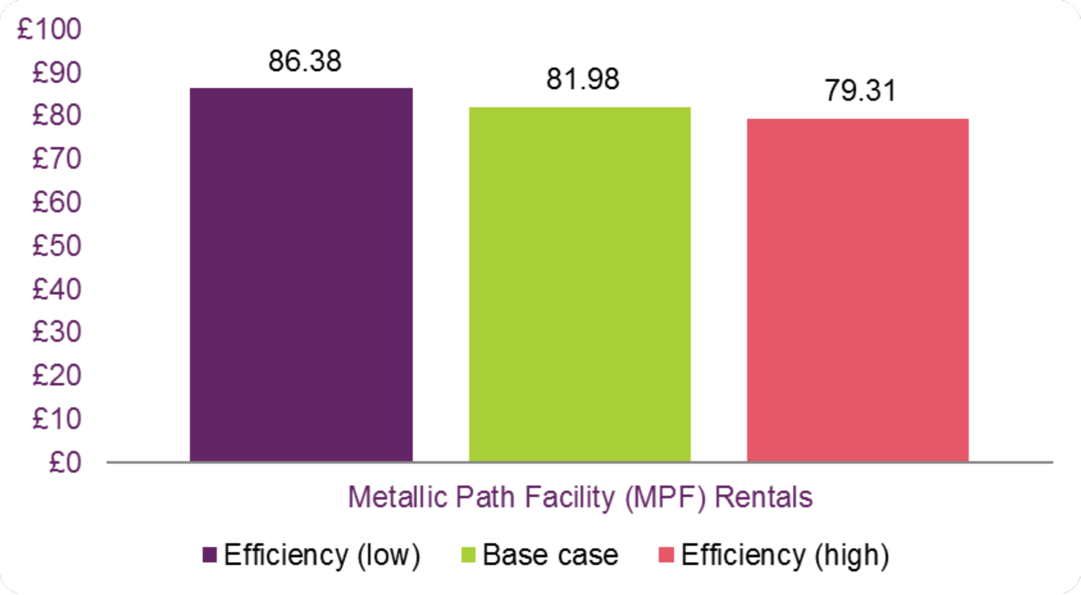


Source: Outputs from the control module

Efficiency sensitivity

A14.23 The efficiency sensitivity has one of the greatest impacts on forecasted MPF Rental charges. As expected, a higher efficiency rate results in a lower forecasted unit cost for MPF Rentals. The results of this sensitivity analysis are shown below.

Figure A14.7: Efficiency sensitivity on MPF Rentals in 2020/21 (£, nominal prices)

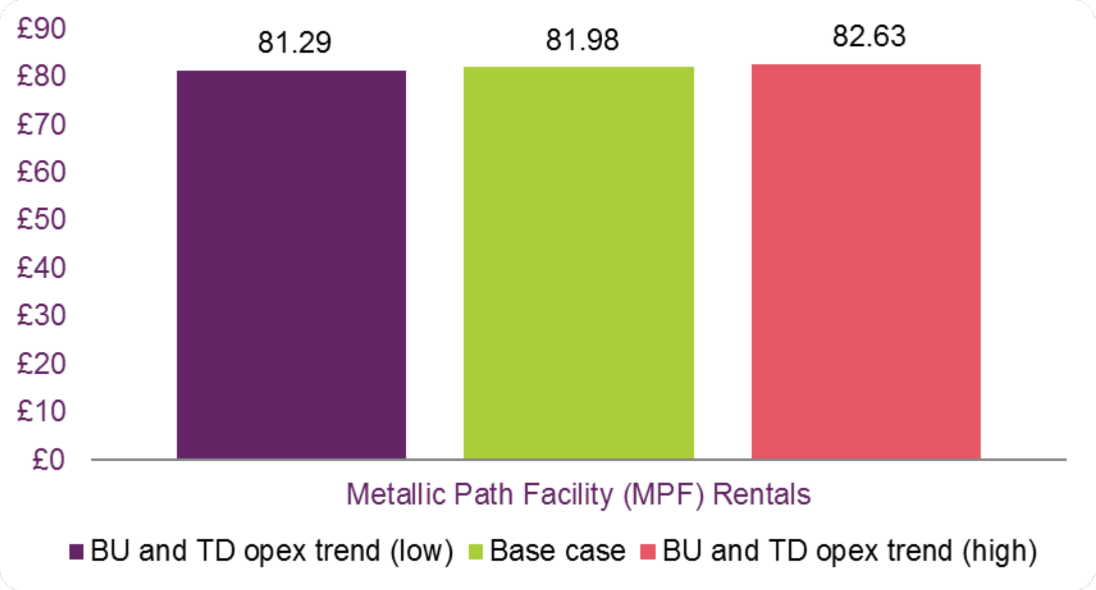


Source: Outputs from the control module

Input operating cost trend sensitivity

A14.24 We find that there is a limited impact on the unit cost for MPF Rentals when assuming the high and low scenario for the operating cost trends. As expected, a higher cost trend results in a higher forecasted unit cost. This limited impact is likely due to the relative certainty regarding the opex input cost trends[439], hence the sensitivity only increasing and decreasing the cost trend by 0.5 percentage points. The results of this sensitivity analysis are shown below.

Figure A14.8: Input operating cost trend sensitivity on MPF Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module

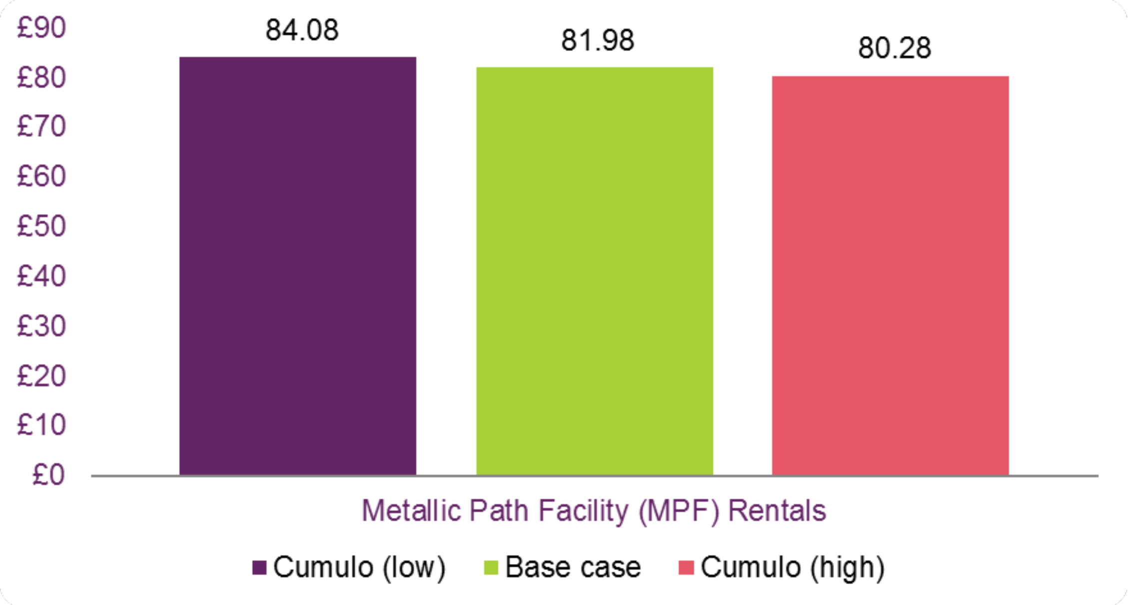
Cumulo sensitivity

A14.25 The high and low cumulo scenarios involve changing the total cumulo amount and also the cumulo attribution method. The low scenario reduces the cumulo bill, decreases the attribution to GEA-FTTC and thus increases the attribution to MPF; the opposite occurs in the high scenario.[440]

A14.26 We note that any impact from cumulo has an added impact of changing the amount of common cost per line.[441] For example, a lower unit cumulo cost for MPF Rentals results in a lower common cost per line due to the EPMU approach.[442] The results of this sensitivity are shown in below.

[439] Although in any given year the opex input cost trends may vary from our base case estimate, we expect that over the course of our forecast period the average cost trend will not significantly vary from our base case (hence the use of +- 0.5 percentage points for our range).
[440] The assumptions used to create a high and low cumulo scenario are detailed in Annex 17.
[441] This is due to our proposed approach to allocate fixed and common costs using an equi-proportional mark-up approach (as set out in Annex 11). This approach allocates common costs based on the relative long run incremental costs (LRICs) of copper and fibre services. We model cumulo as part of the service LRICs.
[442] Cumulo falls within the GEA and MPF LRICs, and the increase in cumulo results in a greater proportional change to the GEA LRIC than MPF which leads to GEA picking up a greater proportion of common costs.

Figure A14.9: Cumulo sensitivity on MPF Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module

FAC and charges for MPF ancillary services

A14.27 In Volume 2 Section 3 we proposed to use a LRIC standard to set charges for MPF migration services, and allocate the corresponding common costs to MPF rentals. For all other MPF ancillary services, we proposed to set charges on a FAC basis. In the table below we present our cost estimates for MPF ancillary services (including connections) in 2020/21, before and after the allocation of common costs.

Table A14.10: Forecast ancillary unit costs in 2020/21 before and after allocation of common costs (£ per annum, nominal prices)

	Before	After
MPF New Provide Services	£24.36	£24.36
MPF Single Migrations	£21.90	£20.44
MPF Bulk Migrations	£13.30	£12.19
Hard Ceases basket	£14.48	£14.48
Other MPF ancillaries basket	£5.12	£5.12
LLU tie cables basket	£23.43	£23.43
LLU Co-mingling New Provides and Rentals services basket	£4,906.50	£4,906.50

Source: Outputs from top-down and bottom-up model

Bottom-up model results and sensitivities

A14.28 This section presents the base case results of the bottom-up model and accompanying sensitivity analysis. Mirroring the analysis carried out above for the top-down model, we first show the model outputs under the base case scenario, then describe the key assumptions flexed in order to test the sensitivity of the model and present the results of our sensitivity analysis. All model outputs and sensitivities are presented after the allocation of common costs.

Model results for the base case

A14.29 Our base case unit cost estimates for the modelled GEA services are presented in Table A14.11 below. These estimates are below Openreach's current access prices; implying negative charge control 'X' values. Note that the lacuna adjustments mean that access prices need to align to costs by 2019/20, so positive 'X' values in 2020/21 for GEA connection and ancillary services are reflective of year on year changes in our unit cost estimates.

Table A14.11: Base case bottom-up model results

Services	Current level of charges, £ per annum	Unit cost (£ per annum, nominal)		Charge control 'X'		
		2019/20	2020/21	2018/19	2019/20	2020/21
GEA 40/10 Rental	88.80	57.00	52.77	-27.8%	-16.1%	-9.4%
GEA Connection	49.00	40.77	42.12	-13.7%	-8.3%	+1.3%
GEA Start of Stopped Line	32.52	2.86	2.95	-82.6%	-57.9%	+1.1%
GEA CP to CP Migration	11.00	2.86	2.95	-61.6%	-38.5%	+1.1%
GEA 40/10 Bandwidth changes	11.25	6.74	6.69	-31.2%	-18.0%	-2.8%

Source: Outputs from the control module

A14.30 Compared to the current GEA 40/10 rental charge of £88.80 per annum (which is £7.40 per month), the forecast unit cost in 2020/21 is £52.77 per annum (which is £4.40 per month).

Sensitivity analysis

A14.31 We have performed a sensitivity analysis on our GEA 40/10 rental cost estimate by flexing several key model assumptions in relation to:

- demand inputs: total Openreach lines, BB and SFBB take-up and commercial split of GEA volumes (as described in Annex 10);
- network inputs: cabinet type split, bandwidth demand, asset lives and cabinet power consumption (as described in Annex 20); and
- cost inputs: WACC, cumulo, element unit costs and element unit cost trends (as described in Annexes 16, 17, and 20).

A14.32 The sensitivities we have tested are summarised in the table below.

Table A14.12: Bottom-up model sensitivities

Assumption		Low	Base case	High
Demand inputs	Total OR lines	See paragraph A14.12A14.10		
	Take-up growth[443]	BB: 1% SFBB: 7%	BB: 2% SFBB: 8%	BB: 3% SFBB: 9%
	Commercial split in steady state[444]	67%	69%	71%
Network inputs	Cabinet type split	Small cab [✂] (~10%) Large cab [✂] (~90%)	Small cab [✂] (~34%) Large cab [✂] (~66%)	Small cab 40% Large cab 60%
	Bandwidth demand	-20%	Base case (see Network module)	+20%
	Asset lives	DSLAM 5 yrs FTTC cab 15 yrs Duct 20 yrs	DSLAM [✂] (~7.1) yrs FTTC cab [✂] (~23.4) yrs Duct [✂] (~46.8) yrs	DSLAM [✂] (~10) yrs FTTC cab [✂] (~25) yrs Duct [✂] (~50) yrs
	Power consumption	0.05 kWh[445] / cab / year	[✂] (~0.12) kWh / cab / year	0.15 kWh / cab / year
Cost inputs	WACC	8.4%	9.4%	10.4%
	Cumulo	Profit weighted net replacement cost (PWNRC) as the cumulo attribution basis (see Annex 17)	Rateable value of £18 per GEA customer as the attribution basis (see Annex 17)	Rateable value of £27 per GEA customer as the attribution basis
	Unit capex	-20%	Base case (see Network module)	+20%
	Unit opex			
	Capex cost trend			
	Opex cost trend			

Source: Ofcom analysis

A14.33 We show the results for each of these sensitivities in a series of graphs below and discuss each in turn. In each case, we present the base case forecasted unit cost for GEA rentals in the middle, and the low case to the left and the high case to the right of it.

Demand inputs

A14.34 As shown in Table A14.12 our demand sensitivity analysis has three elements to it. The results of the first of these, the total Openreach lines (as described above) are

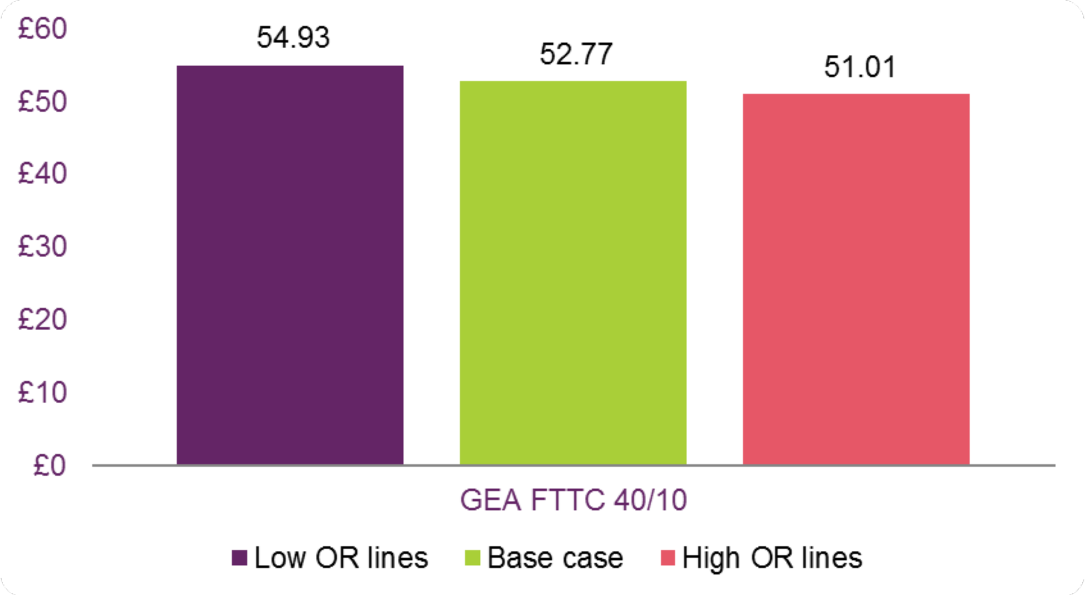
[443] Other parameters are also flexed in this sensitivity (i.e. penetration growth dampening factors) but which only affect post 2020/21 results.

[444] Other parameters flexed include the volume growth in FTTC volumes necessary to achieve the assumed steady state commercial split and the uplift applied to commercial split for GEA other services.

[445] Kilowatt-hour is a measure that indicates the power in kilowatts multiplied by the time in hours.

shown below. A lower number of GEA lines results in a higher GEA unit cost and *vice versa*, as we would expect.

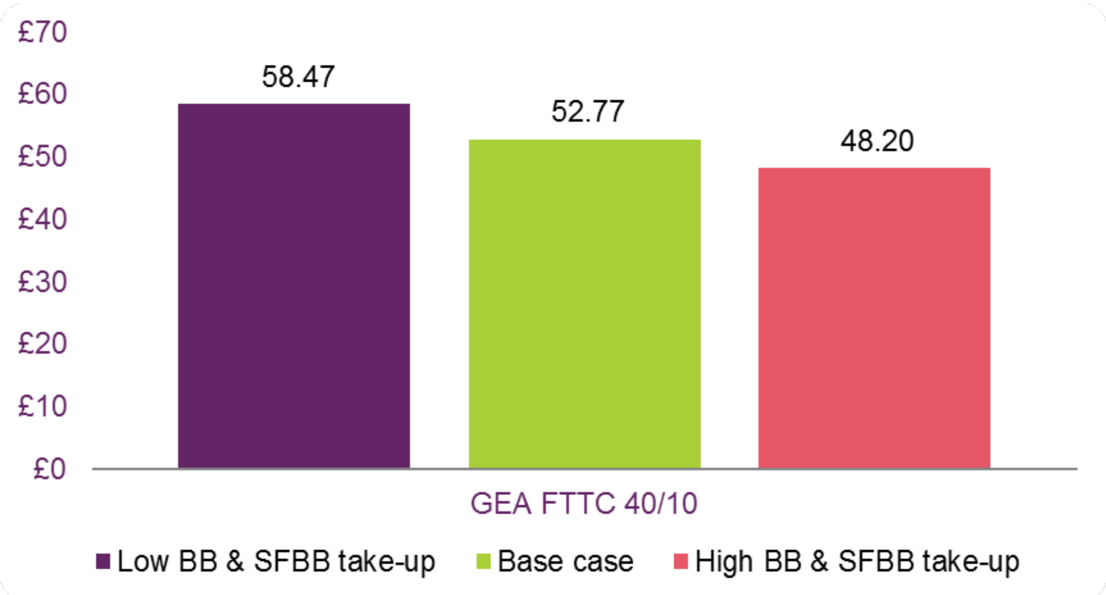
Figure A14.13: Openreach lines sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module

A14.35 The effect of the second element of our demand sensitivity, annual growth in the take-up of BB and SFBB services is shown in Figure A14.14 below. In the low case, we assume 1% BB growth and 7% SFBB growth, and in the high case 3% and 9% growth respectively. These compare to base case assumptions of 2% BB growth and 8% SFBB growth. Lower BB and SFBB growth results in a higher GEA unit cost and *vice versa*, as we would expect.

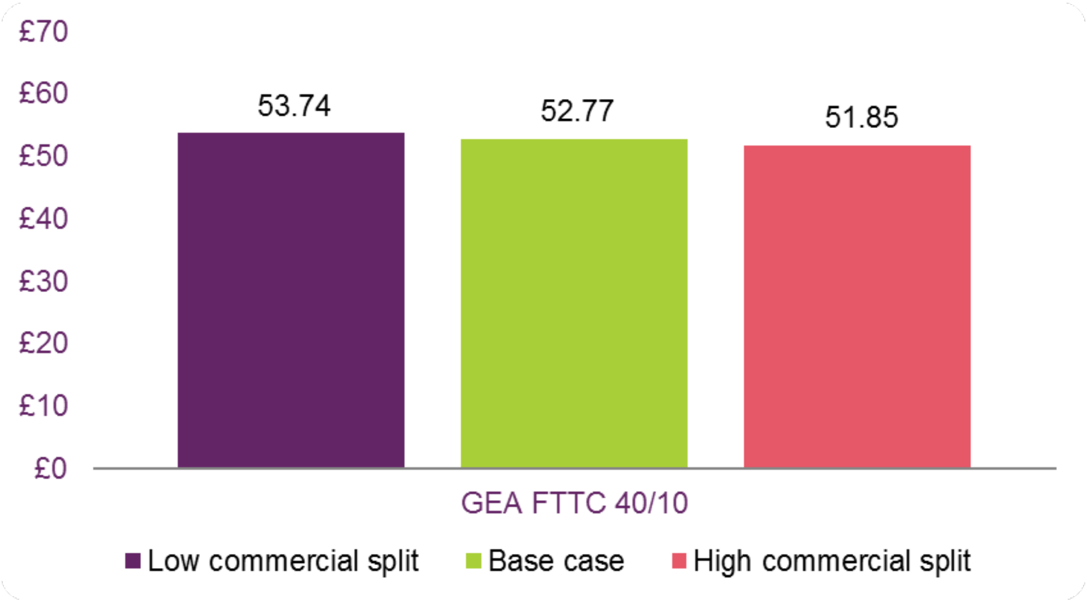
Figure A14.14: BB and SFBB take-up sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module.

A14.36 The effect of the third element of our demand sensitivity, the commercial split is shown below. In the low case, we assume 67% of UK GEA rental volumes are commercial and in the high case 71%, compared to a base case assumption of 69%. As expected, the GEA unit cost is lower in the higher commercial split scenario, and *vice versa*; as a higher commercial split implies a greater number of GEA lines for the modelled network, which in turn implies a lower unit cost.

Figure A14.15: Commercial split sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module.

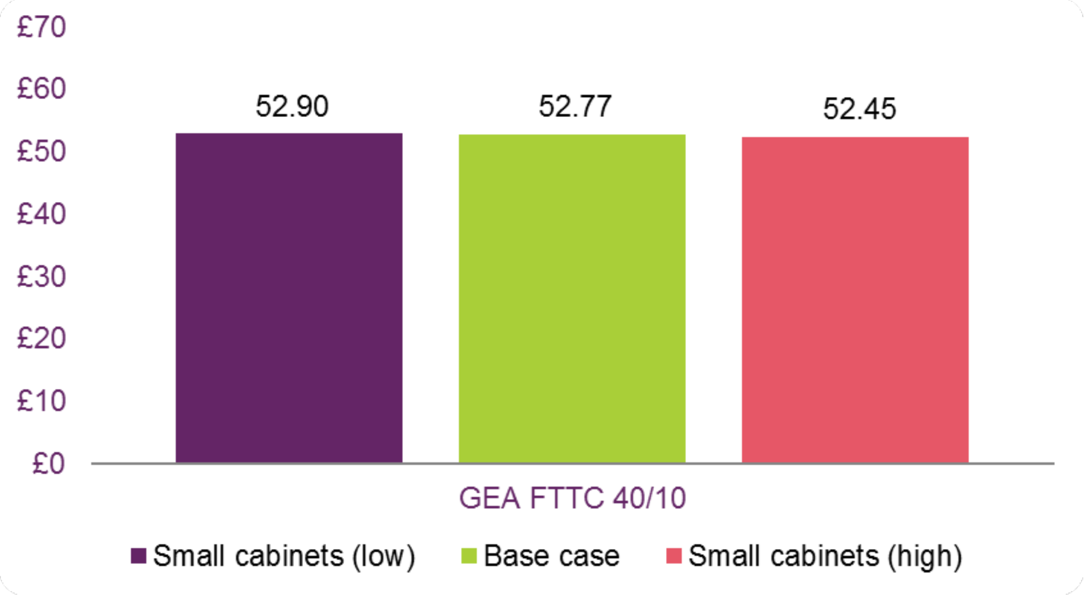
<u>Network inputs</u>

A14.37 As summarised in Table A14.12 we have tested the sensitivity of the bottom-up model to network inputs in four ways. We find that the forecasted GEA Rental charge is relatively insensitive to any of the network inputs examined.

A14.38 Figure A14.16 below shows the sensitivity of the results to the split assumed between small and large cabinets. In the low case, we assume that [✂] (~10%) of FTTC cabinets are small (Type 1 cabinets) and in the high case 40%, compared to a base case assumption of [✂] (~34%). Our results are fairly insensitive to these scenarios, with the low case producing slightly higher unit costs and *vice versa* in the high case.

A14.39 The above results can be explained by the fact that smaller cabinets are less expensive to build; so the greater the share of smaller cabinets in the modelled network, the lower the unit cost would be. This effect is somewhat offset by the fact that a second cabinet is more likely to be required if a small (rather than a large) cabinet is installed in the first place. However, this effect does not seem to be big enough to offset the input price effect (described above) in our low and high case scenarios.

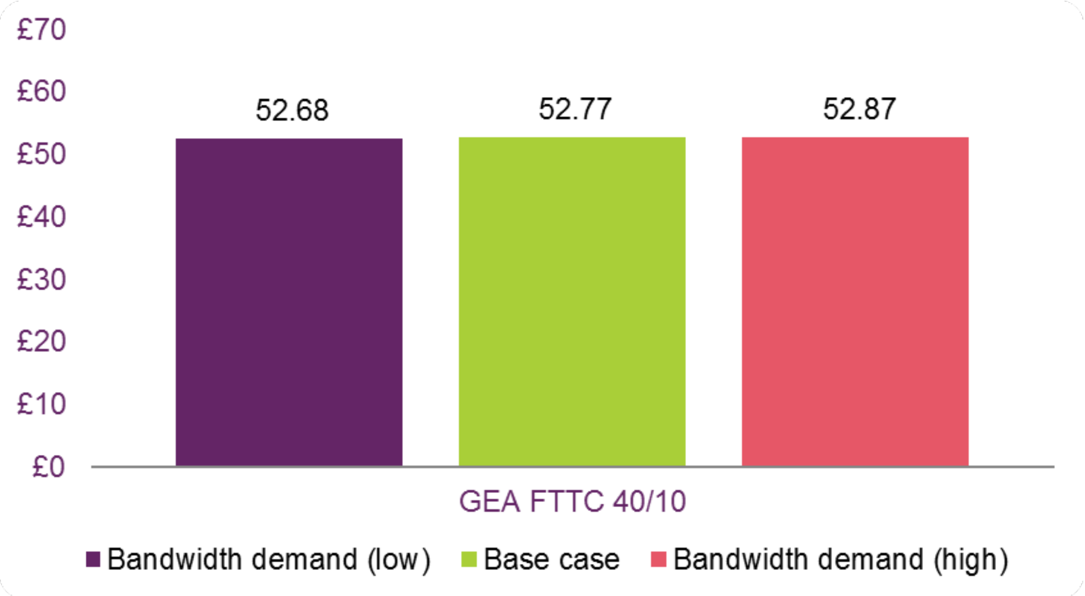
Figure A14.16: Cabinet type split sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module.

A14.40 Our results are also relatively insensitive to bandwidth demand, as shown in Figure A14.17 below. In the low case we assume bandwidth demand growth is 20% below and in the high case 20% above that in the base case scenario (described in Annex 20). The low case produces a very slightly lower unit cost result, and vice versa in the high case, as higher bandwidth demand growth may require additional fibre links from the cabinet to the Exchange, as well as additional port capacity at the Exchange. This result suggests that the marginal cost of supplying higher bandwidth services is close to zero.

Figure A14.17: Bandwidth demand sensitivity on GEA Rentals in 2020/21 (£, nominal prices)

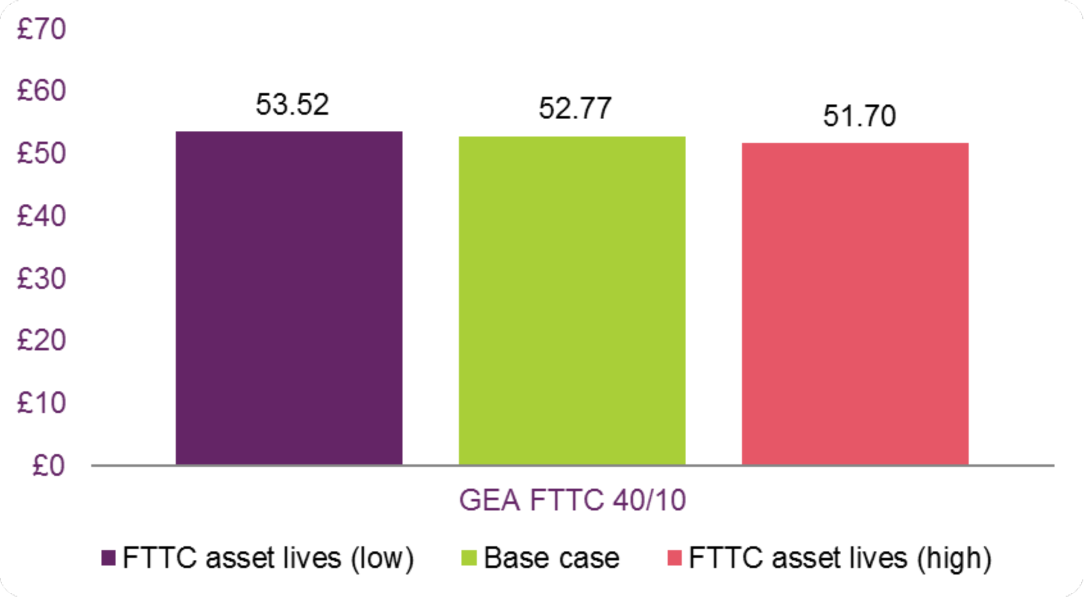


Source: Outputs from the control module.

A14.41 Figure A14.18 shows sensitivity to asset life assumptions, and indicates that while the impact is greater than in the sensitivities described above, the unit cost remains relatively flat across the different scenarios tested. In the low case, we assume an asset life of 5, 15 and 20 years for DSLAM, street cabinet and duct assets respectively; and in the high case [✂] (~10, ~25 and ~50) years, compared to a base case assumption of [✂] (~7.1, ~23.4 and ~46.8) years.

A14.42 Our results are relatively insensitive to these changes, with the low case producing slightly higher unit costs and *vice versa* in the high case. This is because the longer the asset life assumed, the lower the depreciation charge. The results suggest that even if new ultrafast broadband technologies (e.g. G.fast and FTTP) were to leave some FTTC assets redundant (and hence their asset lives shortened to accelerate depreciation) we would not expect this to have a significant impact on the forecast GEA unit cost by 2020/21.

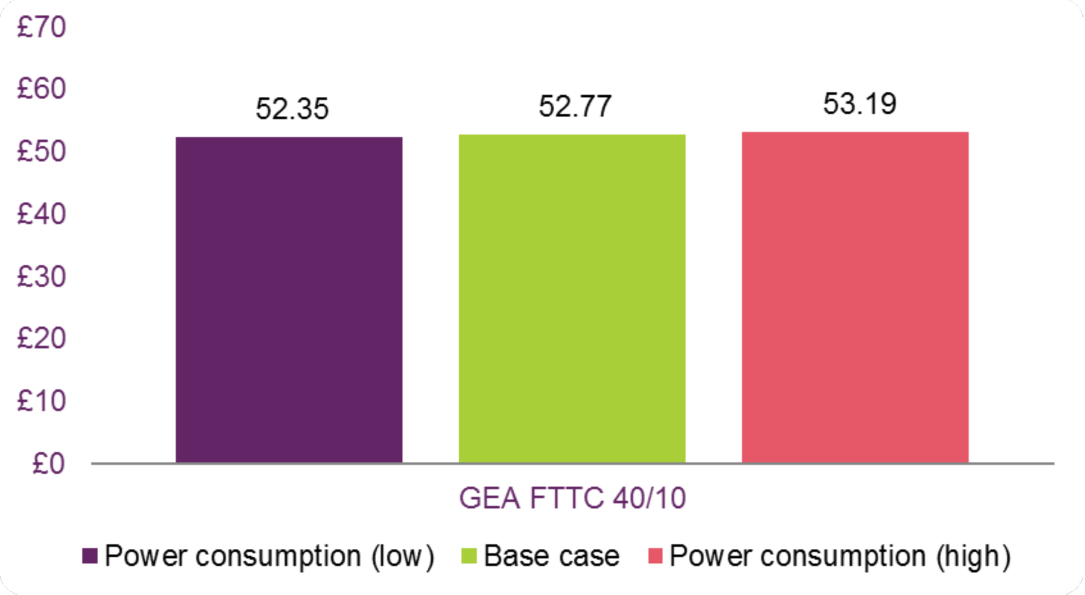
Figure A14.18: Asset lives sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module.

A14.43 In terms of network inputs, Figure A14.19 shows the sensitivity of the results to changes in our DSLAM power consumption assumptions. In the low case, we assume each cabinet on average consumes 0.05 kWh per year and in the high case 0.15 kWh, compared to a base case assumption of [✂] (~0.12) kWh. As we would expect, lower power consumption results in a lower unit cost, and *vice versa*, but the results are relatively insensitive.

Figure A14.19: DSLAM power consumption sensitivity on GEA Rentals in 2020/21 (£, nominal prices)

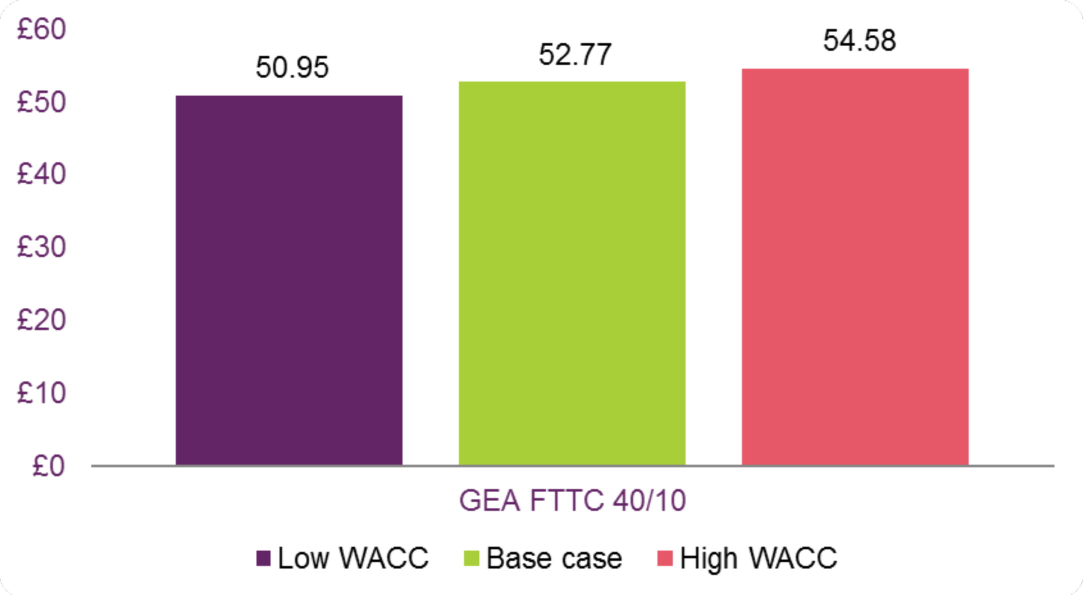


Source: Outputs from the control module.

<u>Cost inputs</u>

A14.44 Turning to cost inputs we find that there is a moderate impact on the forecast GEA rental charge when varying the WACC, as shown in Figure A14.20 below. In the low case, we assume a (pre-tax nominal) WACC of 8.4% and in the high case 10.4%, compared to a base case assumption of 9.4%. As we would expect, a lower WACC results in a lower unit cost for GEA rentals and *vice versa*.

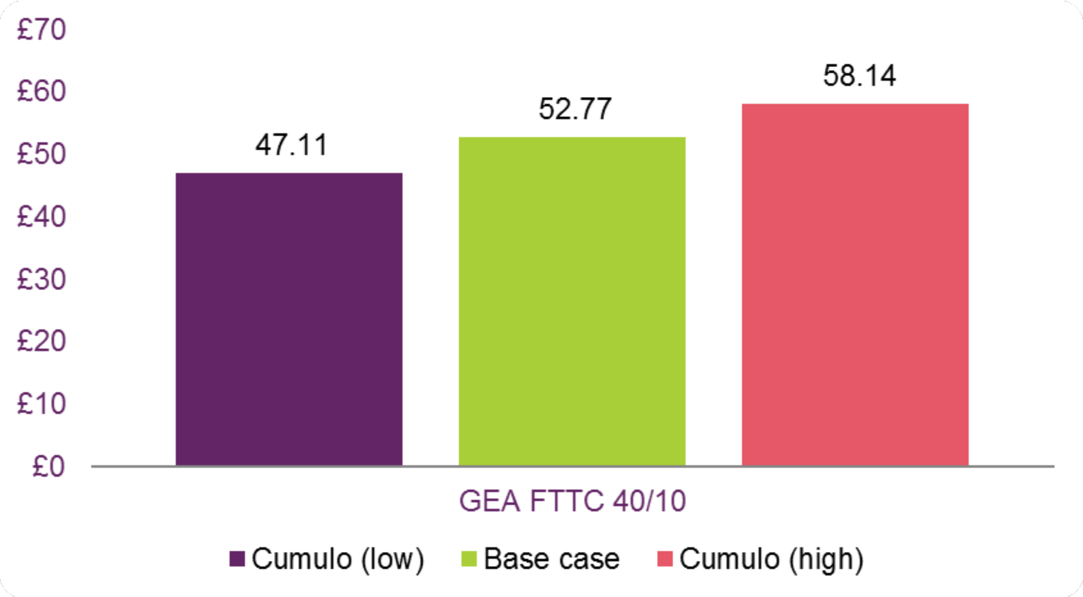
Figure A14.20: WACC sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module.

A14.45 Our sensitivity results in relation to cumulo are shown in Figure A14.21 below. The high and low scenarios involve changing the total cumulo amount and also the cumulo attribution method. The low scenario reduces the cumulo bill, decreases the attribution to GEA-FTTC and increases the attribution to MPF; the opposite occurs in the high scenario.[446] We find that the low cumulo assumptions result in a lower GEA service unit cost, and *vice versa* for the high assumption, with the direct effects of the change in cumulo being amplified by the impact that this also has on common cost allocations due to our EPMU approach.[447]

Figure A14.21: Cumulo sensitivity on GEA Rentals in 2020/21 (£, nominal prices)

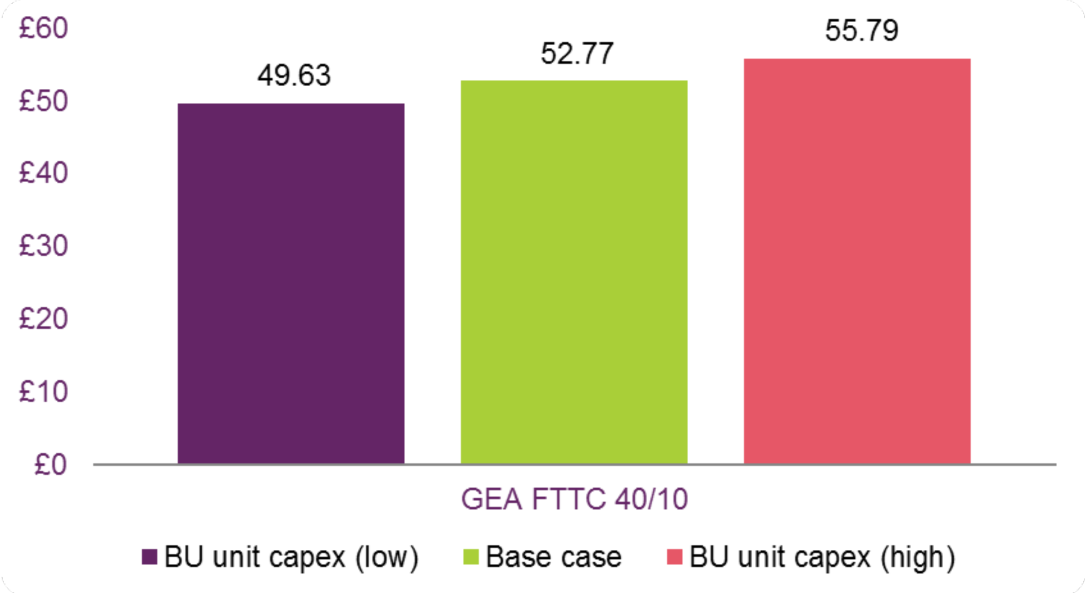


Source: Outputs from the control module.

A14.46 Figure A14.22 below shows the sensitivity of our GEA rental forecast to changes in the unit capex assumptions. In the low case, we assume unit capex is 20% lower than in the base case, and 20% higher in the high case. As we would expect, a lower unit capex leads to a lower GEA unit cost and *vice versa*.

[446] The assumptions used to create a high and low cumulo scenario are detailed in Annex 17.
[447] Cumulo falls within the GEA and MPF LRICs, and the increase in cumulo results in a greater proportional change to the GEA LRIC than MPF which leads to GEA picking up a greater proportion of common costs.

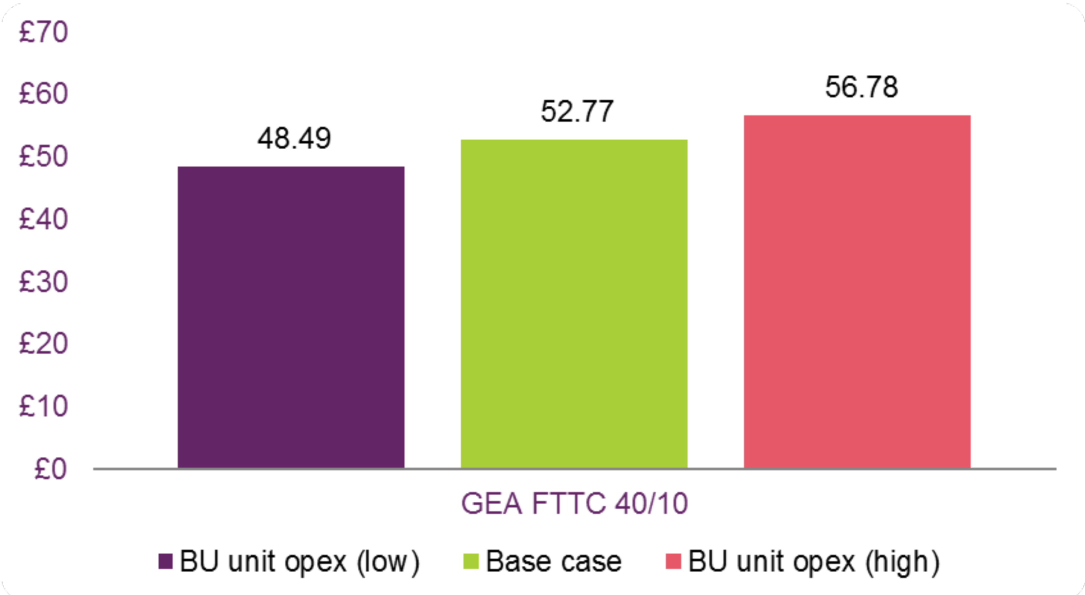
Figure A14.22: Element unit capex sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module.

A14.47 Figure A14.23 below shows the corresponding sensitivity for changes in the unit opex assumptions. In the low case, we assume unit opex is 20% lower than in the base case, and 20% higher in the high case. As we would expect, a lower unit opex leads to a lower GEA unit cost and *vice versa*. We note that the impact in the opex sensitivity is larger than the impact in the capex sensitivity, because of the greater importance opex has in the service cost stack.[448]

Figure A14.23: Element unit opex sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



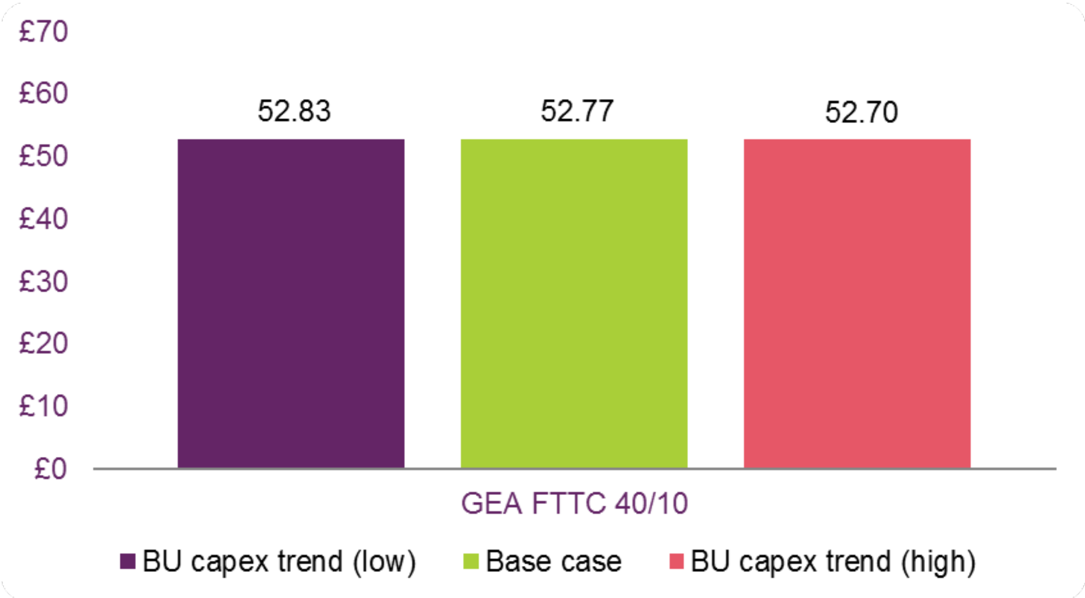
[448] Our cost modelling suggests that by 2020/21 operating costs will account for around 70% of the total GEA service cost stack.

Source: Outputs from the control module.

A14.48 We have tested the sensitivity of the bottom-up model to changes in our cost trend assumptions. Figure A14.24 below shows the sensitivity to capex trends, with the low scenario assuming figures 20% below those in the base case, and the high scenario assuming figures 20% above.

A14.49 Although the impact is modest, the low capex trend assumption results in a higher GEA unit cost, and *vice versa*. This seemingly counterintuitive result can be explained by consideration of the two opposing effects at play. Faster unit capex growth translates into higher element unit costs, making it more expensive for the network operator to replace/deploy network assets in future. However, growing unit capex represents a holding gain (negative cost) on existing network assets. This effect is likely to dominate in a mature network where service volumes are relatively stable over time, which we would expect to observe in the modelled network towards the end of the charge control period.

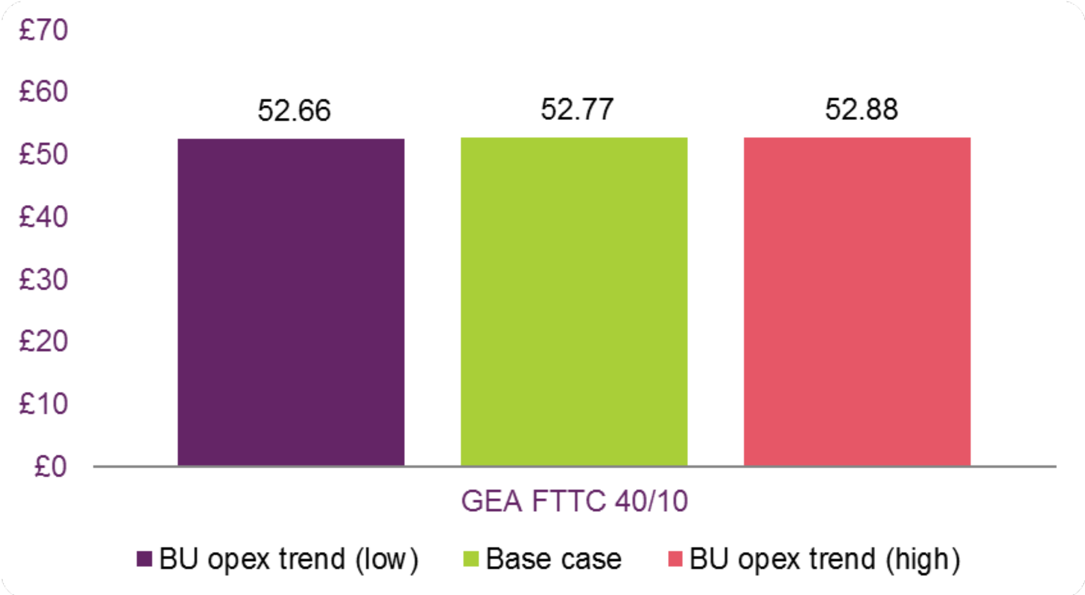
Figure A14.24: Element capex trend sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module

A14.50 Figure A14.25 below shows the sensitivity to opex trends, with the low case assuming figures 20% below those in the base case, and the high case assuming figures 20% above. The impact of this sensitivity is modest, but the low opex trend assumption produces slightly lower unit costs and *vice versa*, as we would expect.

Figure A14.25: Element opex trend sensitivity on GEA Rentals in 2020/21 (£, nominal prices)



Source: Outputs from the control module

High and low unit costs (combined scenarios for MPF and GEA rentals)

A14.51 In order to produce a range of possible values around out base case results for the unit costs MPF and GEA rentals, we have defined high cost and low cost scenarios. These scenarios combine the different assumptions that we have tested individually above. The different sets of assumptions for the three scenarios are summarised below.

Table A14.26: Summary of assumptions in low, base case, and high unit cost scenarios

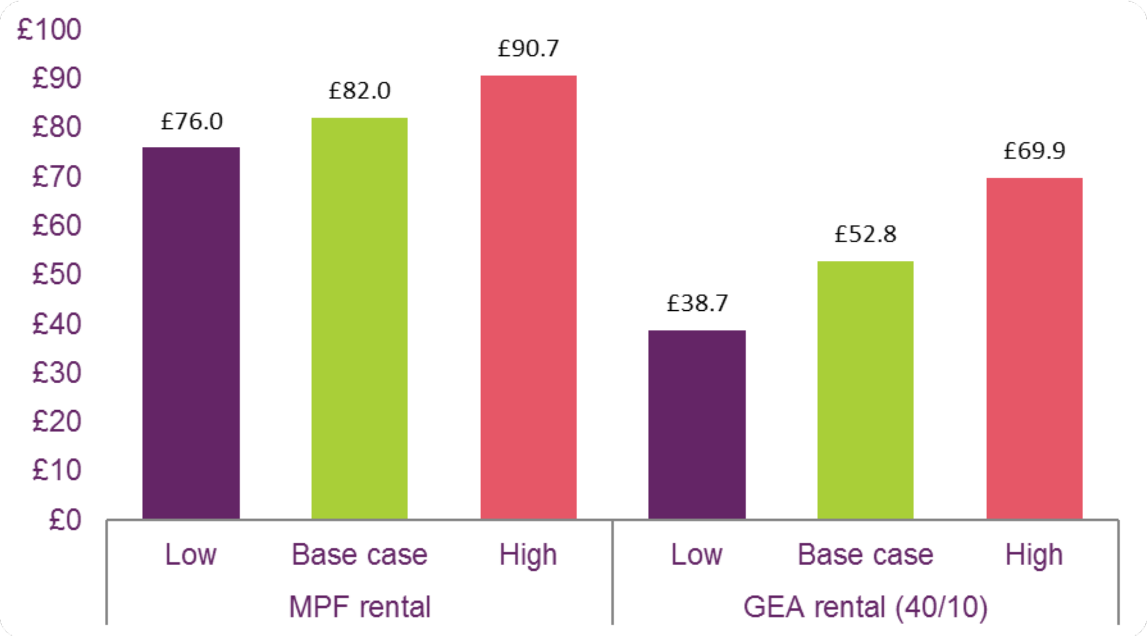
	Low unit cost	Base case	High unit cost
Volumes[449]	High	Base case	Low
WACC	Low		High
Efficiency	High		Low
Opex trend	Low		High
Cumulo	Low		High
GEA asset lives	High		Low

Source: control module

A14.52 The resulting unit costs for MPF and GEA rentals can be seen below.

[449] This assumes the same high and low volumes scenarios except that we have also applied the high and low commercial NGA volume assumptions, as set out in the bottom-up model section above.

Figure A14.27: MPF and GEA annual rental charges for 2020/21 (£, nominal)



Source: Outputs from the control module

Therefore, we propose in this consultation to set an MPF annual rental charge for 2020/21 of between £76 and £90.7 (or £6.33 and £7.56 per month), and a GEA annual rental charge for 2020/21 between £38.7 and £69.9 (or £3.22 and £5.83 per month).

Annex 15

Top-down modelling inputs

Introduction

A15.1 This annex provides the rationale for some of the key assumptions that we propose to make when forecasting costs for the purposes of setting the charge controls. In this annex, we set out our analysis that supports our modelling inputs relating to:

- input price inflation for both operating costs and asset prices;
- cost and asset volume elasticities; and
- efficiency.

A15.2 These assumptions are used within the top-down model. The inflation assumption on operating costs is also used in the bottom-up model.[450] The Weighted Average Cost of Capital (WACC) is discussed separately in Annex 16. Our approach to volume forecasting is set out in Annex 10.

A15.3 The above three input assumptions are linked. For example, when assessing appropriate efficiency targets for the top-down model we do so having first removed the impacts of inflation and changes in volumes. We therefore need to adopt a consistent approach between these different sets of assumptions. In summary:

- **Pay and non-pay operating cost inflation**. We have considered a range of evidence when assessing pay cost inflation including BT data and forecasts and external pay cost indices. We propose to adopt a pay cost inflation rate between 2.5% and 3.5% and use a base case of 3.1% within our forecasts. For non-pay operating costs we derive an overall inflation assumption by weighting together separate inflation estimates for energy costs, accommodation costs (rent and rates) and other accommodation costs and by assuming all other non-pay operating costs increase at CPI. We propose to adopt a non-pay inflation rate between 2.0% and 3.0% and use a base case of 2.4% within our forecasts.
- **Asset price inflation**: we propose to adopt asset price change assumptions such that duct and copper assets are valued consistently with how they are revalued for CCA purposes in BT's RFS. We propose to assume that all other asset prices stay constant in nominal terms.
- **Asset volume elasticities (AVEs) and cost volume elasticities (CVEs)** are used to determine how component costs change when component volumes change. We calculate a pay CVE, a non-pay CVE and an AVE for each component based on component LRIC to FAC ratios we derive from BT's LRIC model outputs. We give a table with the values we use in our forecasts in the detailed discussion on AVEs and CVEs below.

[450] As explained in Annex 12 the bottom-up model uses network engineering algorithms to dimension and cost an MEA network, thereby capturing cost-volume relationships and efficient network design choices. We have separately gathered component unit cost information as part of the bottom-up modelling process, as explained in Annex 20.

- **Efficiency:** we forecast that BT will achieve cost savings over the charge control period. For operating costs we have considered a range of different evidence, although our primary sources are BT's RFS and its historical and forecast management accounting data. We propose to adopt an efficiency assumption on operating costs between 3.5 and 6.5% and use a base case of 5.5% within our forecasts. For capex we have only considered evidence using BT data. We propose to adopt an efficiency assumption on capex between 1% and 5% and use a base case of 3% within our forecasts.

A15.4 In the remainder of this annex we discuss each of these three areas in turn, describing the data sources we have used and the analysis we have undertaken.

Input price inflation

A15.5 As set out in Volume 2 Section 3 we are setting a cost based price control using a CPI-X control. Separately from how we index the charge control, it is also necessary to define how prices for the cash costs we are forecasting, both operating costs and capital expenditure, vary over time. As in the 2014 FAMR Statement, our modelling approach considers cost inflation separately from efficiency and the effects of changes in volumes. We forecast inflation for pay and non-pay operating costs and assets separately. The operating cost inflation assumptions are used to forecast costs within both the top-down model[451] and the bottom-up model.[452] The asset inflation assumptions discussed here are only used in the top-down model.

A15.6 In reviewing sources of evidence to derive our estimates for input price inflation, we have analysed a mixture of historical and forecast evidence from a range of sources, including BT and other independent sources.

Pay and non-pay inflation

A15.7 We have considered both historical and forecast data to forecast BT's future pay inflation. We have considered:

- historical pay cost data from BT's Annual Reports;
- historical and forecast pay data from BT's management accounts (including PVEOs[453] & total labour costs (TLC) analyses);
- public reports of BT's discussion on future pay awards with the Trade Unions; and
- economy-wide studies of historical and forecast movement in pay costs.

A15.8 When reviewing management accounting data we have focused on the results for two BT divisions: Technology and Service Operations (TSO) and Openreach, as

[451] The historical and forecast rates are also used within our assessment of appropriate efficiency targets.

[452] Only pay and non-pay operating cost inflation has been calculated and used within the bottom-up model.

[453] "PVEO" is a management accounting tool which breaks down annual movements in costs into changes due to Price (inflation), Volume effects, Efficiency (or cost transformation) and Other.

these divisions contribute the vast majority [✂] (~80-100%)[454] of pay costs for the services within the top-down model and also the vast majority [✂] (~80-100%)[455] of pay costs for the services covered by the bottom-up model. In the rest of this annex we refer to these two BT divisions as 'Relevant Divisions'. We also refer to the set of services covered by the top-down model as 'Relevant Services' and those covered by the bottom-up model as 'GEA Relevant Services'.

BT's Annual Report pay costs

A15.9 BT reports its pay costs in its Annual Report and shows how these break down between wages and salaries, social security costs, pension costs, and share based payment expenses. By comparing these to full-time equivalent employees (FTE), also reported by BT, it is possible to generate annual increases in each of the components of pay costs per FTE over time.

A15.10 We have, however, not used this data to generate our pay cost inflation assumptions. This data covers employees in all BT divisions. We believe our analysis should be more focused on pay cost inflation in the Relevant Divisions, given these divisions account for the great majority of pay costs for the Relevant Services and GEA Relevant Services. The Relevant Divisions may have experienced different changes to grade and skill mix from those in, for example, BT's Global Services, BT Retail or Consumer divisions.

BT management accounting pay costs (including PVEO & TLC analyses)

A15.11 BT has historically provided us with its own PVEO analyses that show how divisions' costs are forecast to change from one year to the next due to price changes (P), volume effects (V), efficiency (E) and other (O). For the Relevant Divisions[456] these PVEO analyses analysed pay costs separately from non-pay costs, though there was no breakdown into the different types of pay costs such as wages and salaries, pension costs and social security costs.

A15.12 The pay cost price changes within these PVEO analyses represent estimates of historical and forecast pay inflation that are BT-specific and that reflect BT management's knowledge of the labour markets and the relevant grade-mix (for example the relevant proportions of managerial and non-managerial staff) within each division.

A15.13 Openreach is now the only BT division which still produces PVEO analysis.[457] Until March 2016 TSO and Openreach produced analyses of Total Labour Costs (TLC) that showed how pay costs were forecast to change over the coming year with the impacts of inflation, volume and efficiency separately identified.[458] We obtained the Openreach PVEO analysis and the Openreach and TSO TLC analyses for 2016/17.

A15.14 However, TSO's and Openreach's most recent TLC analyses, from their October 2016 submissions to Group, provided no indication of the pay inflation assumption that had been used, instead only including information on total pay costs and

454 BT's response dated 9 December to question D1 of the 20th BT WLA s.135 request.
455 BT's response dated 9 December to question D1 of the 20th BT WLA s.135 request.
456 [✂].
457 BT's response dated 7 December to question E2 of the 20th BT s.135 request.
458 BT's response dated 17 June 2016 to question C2 of the 7th BT s.135 request.

headcount.[459] In addition, BT told us that internal discussions on these submissions was still continuing and so the numbers had not yet been agreed.[460] Therefore we have generated pay inflation numbers for 2016/17 from these submissions by calculating the change in pay costs per full time equivalent employee (FTE).

A15.15 Table A15.1 below shows pay inflation estimates for each Relevant BT Division derived from PVEO analyses up to 2015/16 and from TLC analyses for 2016/17.

Table A15.1: Pay cost inflation – derived from PVEO analysis and divisional total labour cost forecasts

	2013/14	2014/15	2015/16	2016/17
Openreach	[✂]	[✂]	[✂]	[✂]
TSO	[✂]	[✂]	[✂]	[✂]

Source: BT PVEO data.[461]

A15.16 The inflation trend derived from examining Openreach's PVEOs suggests that inflation was in the region of 2.0% to 3.5%, with an average[462] of [✂]. Looking forward, the TLC analysis suggests BT forecasts pay inflation in the region of [✂] with a weighted average of [✂].

A15.17 We have also undertaken analysis of Openreach PVEO capex data. The price element in these PVEO analyses "relates mainly to Pay inflation and some Supplier inflation."[463] Within this data BT also provided total capitalised pay in each year for each programme.[464] We have used this information to estimate pay inflation on the basis that most the price effects within these capex PVEOs is pay inflation. This gave us estimates of 3.0% in 2016/17. This supports the above estimates for Openreach forecast pay cost inflation.

<u>Reports of the pay agreement with the Trade Unions</u>

A15.18 In 2014 BT reached a 33-month pay agreement (up to 30 May 2017) with the CWU[465] and Prospect[466] Trade Unions. In general, the CWU represents non-managerial staff; Prospect represents managers. The 2014 pay agreement was for a 2% increase in base pay in 2014 plus a flat rate increase of £200, which equated

[459] BT's response dated 27 January 2017 to question 11 of the 23rd s.135 request. [✂].
[460] BT's response dated 27 January 2017 to question 11 of the 23rd s.135 request.
[461] BT's responses: dated 17 June 2016 to question C2 of the 7th BT s.135 request; dated 20 September 2016 to question 29 of the 14th BT s.135 request; and dated 27 January 2017 to question 11 of the 23rd BT s.135.
[462] A simple unweighted average of the data points.
[463] BT's response dated 27 January 2017 to question 13 of the 23rd s.135 BT s.135 request.
[464] Further details on the information BT provided is given at the end of this Annex when we discuss our estimates of capital efficiency See paragraphs A15.245 and A15.246.
[465] BT, Pay Review 2014, http://www.cwu.org/telecoms-financial-services/department-and-businesses/bt/bt-pay-2014/.
[466] BT, Pay Review 2014, https://www.prospect.org.uk/our-industries/telecoms/employers/bt/payreview/2014

to rises of between 2.5% and 3%. The pay agreement for 2015 and 2016 was for an increase of 2.5%[467].

A15.19 This pay deal only lasts until mid-2017 and will not cover the first or subsequent years of the charge control period. While the CWU and Prospect unions are discussing the next pay deal with BT management, we understand that agreement has not yet been reached. According to the CWU, its negotiating team "has met with BT on several occasions to discuss this year's pay award which is due in January's wages".[468]

A15.20 We therefore place little weight on this evidence for this consultation though we note that the annual changes reported are broadly consistent with the historical management accounting data we presented in the previous section. Any pay deal is only directly relevant to the wages and salaries element of pay costs and indirectly relevant to social security costs (which tend to increase with base pay). Total pay costs also include pension costs and share based payment expenses. We will however review and include any further evidence on wage settlements when we make our decision on pay inflation for the Statement.

Economy-wide pay indices

A15.21 We have also considered several non-BT sources of information for input pay inflation.

A15.22 In Figure A15.2 below we present the latest ONS data on annual changes in average weekly earnings from the ONS Survey of Hours and Earnings.[469] These annual changes can be considered an estimate of average historical pay inflation for the UK, however they only relate to the wages and salaries element of pay costs.

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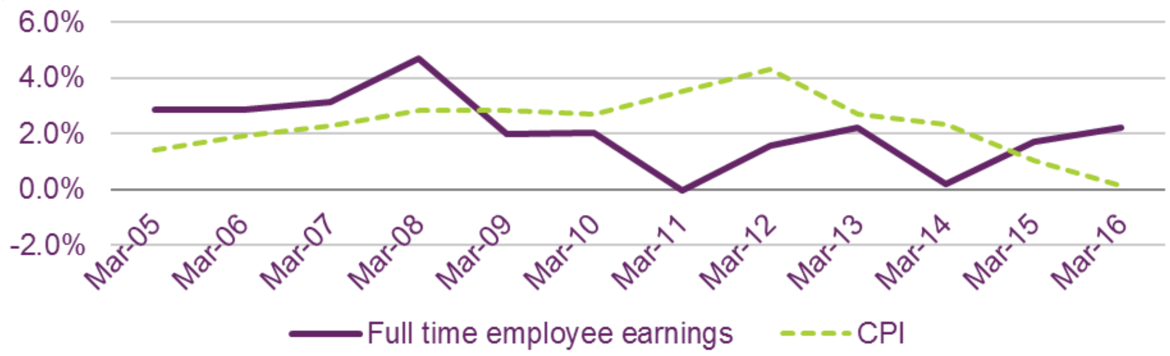
467 There have been subsequent discussions between BT and the CWU in both 2015 and 2016 resulting from RPI falling outside the range 2-3% but the net result has been no change to the agreement. These discussions have been reported on the CWU website. See, for example, http://www.cwu.org/media/news/2015/april/15/pay-rise-for-bt-members/.

468 CWU, 2017. http://www.cwu.org/telecoms-financial-services/department-and-businesses/bt/bt-pay-2017/

469 ONS, 2016. *Annual Survey of Hours and Earnings, 2016 Provisional Results*, *Office of National Statistics*. https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/bulletins/annualsurveyofhoursandearnings/2016provisionalresults.

Figure A15.2: Annual percentage change in median full-time gross weekly earnings for all employees



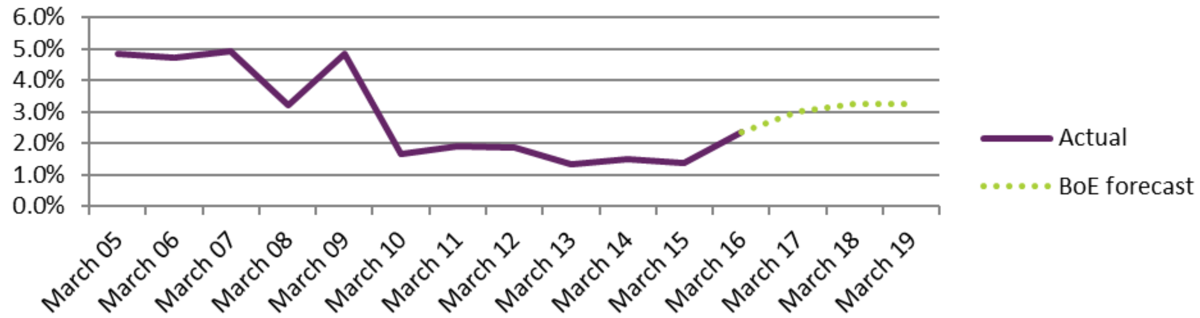
Source: Ofcom calculations.[470]

A15.23 Figure A15.2 suggests that since March 2010, UK average weekly earnings growth has been between 0% and 2% (on average 1.3%) and below CPI inflation, except for the latest provisional data for March 2016. In contrast, the period before 2009 was characterised by higher growth of around 3% and above CPI inflation. One might expect information on CPI and RPI to influence pay negotiations and so for changes in wage increases to lag changes in CPI or RPI by one pay negotiation cycle. However, the data in the above figure provides little support for that hypothesis.

A15.24 While pay inflation has been relatively low recently, this has not always been the case and it is therefore important not to look only at the recent past but also forward. We have therefore examined other economy-wide pay indices.

A15.25 The ONS also publishes data on historical annual growth in average weekly earnings (total pay, i.e. including bonuses). The advantage of this data series is that this metric is also forecast by the Bank of England.[471] Figure A15.3 shows the latest historical data and forecasts.

Figure A15.3: Annual percentage change in average weekly earnings (total pay). Actual and Bank of England Forecast



Source: Ofcom analysis.[472]

[470] Based on ONS, 2016. Figure 1.

[471] Bank of England, 2017. *Inflation report*. http://www.bankofengland.co.uk/publications/Documents/inflationreport/2017/feb.pdf

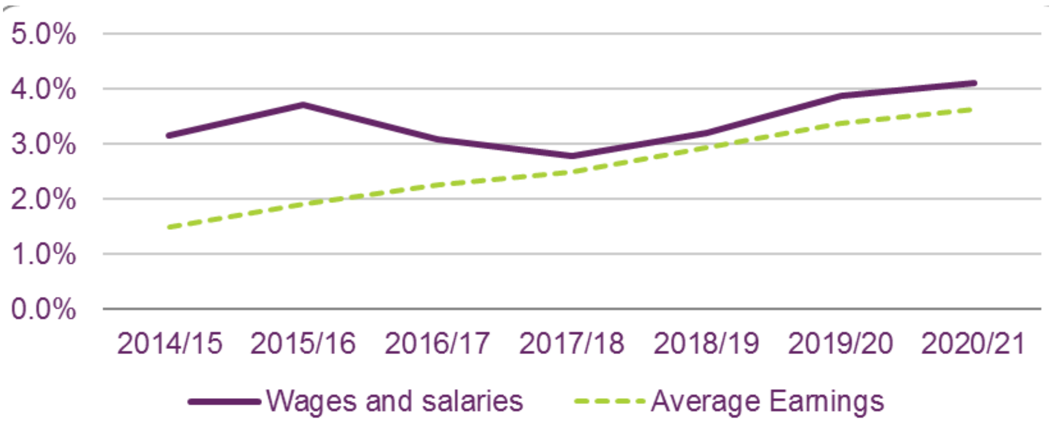
[472] Based on Office of National Statistics, 2017. *Data series KAB9*. *https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/earningsandworkinghours/timeseries/kab9* and Bank of England, 2017. Table 5d.

A15.26 The historical annual changes in weekly earnings given in Figure A15.3 are more variable than those given in Figure A15.2 but the overall change is similar. Average total weekly earnings (including bonuses) grew at 1.3% per annum since March 2010 based on the data from Figure A15.2, compared to 1.7% per annum based on the data from Figure A15.3.

A15.27 However, the Bank of England forecast, which was used in its February 2017 Inflation Report, suggests that the percentage change in average weekly earnings (total pay) will increase from current levels up to 3.25% per annum. This equates to an average rate of 3.1% per annum from our base year, 2015/16, up to the end of the forecasts (2018/19).

A15.28 The Office for Budget Responsibility (OBR) publishes an average earnings growth forecast index. Figure A15.4 below presents the latest OBR forecasts for both wages and salaries and average earnings.

Figure A15.4: Latest OBR forecasts of average earnings and wages and salaries



Source: Ofcom analysis.[473]

A15.29 The OBR, like the Bank of England, is therefore predicting that growth in average earnings[474] will increase over the charge control period. The OBR forecasts that average earnings will grow by 2.9% per annum from our base year, 2015/16 through to the end of the forecast period, 2020/21. The highest increase is 3.6% in 2020/21, similar to the 3.25% forecast by the Bank of England for 2018/19.

A15.30 We have used forecast data from the OBR in previous charge controls. However, we have also noted that, while these indices may be a good indicator of changes to wages and salaries and social security costs, they do not cover all pay costs.[475] For example, they do not cover pension costs or share based payment expenses.

<u>Proposal to set pay inflation at 3.1% per annum.</u>

A15.31 Having considered the above evidence, we propose to adopt a pay cost inflation rate within the range of 2.5% to 3.5%. We use a base case within this range of 3.1%, as the rate per annum for our forecasts.

[473] Based on Office of Budget Responsibility, 2016. *Economic and fiscal outlook November 2016.* Table 3.7 http://cdn.budgetresponsibility.org.uk/Nov2016EFO.pdf [accessed 27 March 2017].
[474] The metric "average earnings" is calculated as wages and salaries divided by employees.
[475] 2016 BCMR Statement, paragraphs A.32.167 to A32.169.

A15.32 We have determined this by considering the different sources of evidence presented above and weighting these together using our regulatory judgement. For 2016/17 we have evidence from BT's forecast TLC and PVEO data, to which we give the most weight, as well as the old trade union agreements and external forecasts for the economy as a whole. This suggests pay inflation of 2.5% per annum. After 2016/17 we only have external forecasts from the ONS, OBR and Bank of England, all of which suggest that pay inflation is likely to increase. For 2017/18 and onwards we have estimated pay inflation using our 2016/17 assumption and then reflected the change in pay inflation provided from these external forecasts. Our final proposed input for the average annual pay inflation over the period 2016/17 to 2020/21 is a range of 2.5% to 3.5% with a base case of 3.1%.

Non-pay operating costs

A15.33 Non-pay operating costs cover a range of different types of costs that may face very specific and different inflationary pressures. Consistent with our approach in other recent charge controls,[476] we propose to estimate inflation for certain types of non-pay costs separately in order to forecast non-pay inflation rates more accurately. We then weight the results together to produce a non-pay inflation assumption separately for Relevant Services and for GEA Relevant Services that reflects the different cost mix for these two groups of services.

A15.34 The non-pay costs we have considered separately are:

- energy costs;
- accommodation costs – rent and rates; and
- other accommodation costs (excluding cumulo rates costs[477]).

<u>Energy costs</u>

DECC/BEIS forecasts

A15.35 The Department for Energy and Climate Change, DECC (now part of BEIS, the Department for Business, Energy and Industrial Strategy[478]), has historically published energy projections (UEPs) that analysed and projected future energy use and greenhouse gas emissions in the UK. The projections were based on assumptions of future economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables.

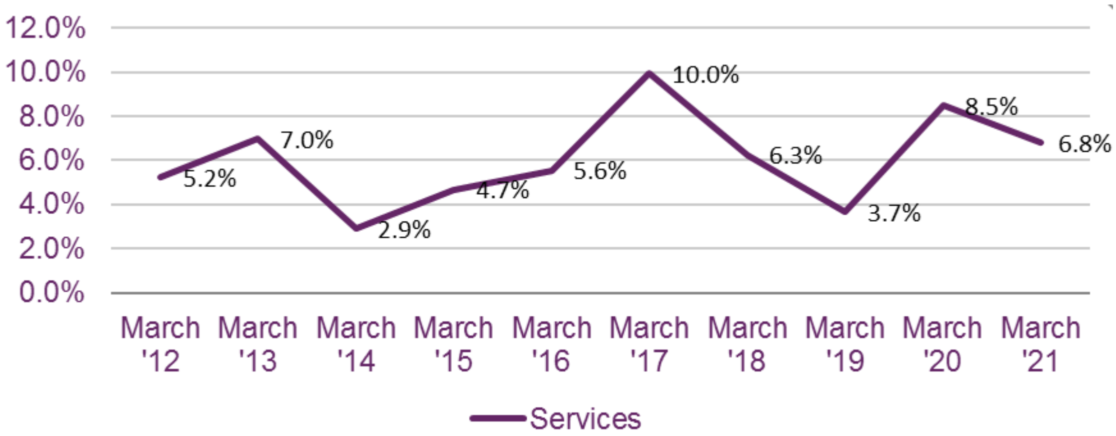
[476] 2016 BCMR Statement, paragraphs A32.177 to A32.191.
[477] Cumulo rates costs are BT's non-domestic rates costs on its network rateable assets.
[478] In July 2016, DECC, was merged into the new Department for Business, Energy, and Industrial Strategy, BEIS.

A15.36 In previous market reviews we have used DECC's forecasts of prices per kilowatt hour for the 'services' sector as an estimate of the electricity price inflation that BT is likely to face.[479]

A15.37 DECC last published its forecasts in November 2015. The new department, BEIS, has told us that until new projections are published, the November 2015 publication remains BEIS's current view.[480] In what follows we therefore refer to the previous DECC forecasts as being BEIS's forecasts. Although updated forecasts are not available for this consultation[481] we consider that using the old projections will not have a significant impact on our non-pay inflation assumption as energy costs contribute [✄] (~0-10%) of total non-pay costs for both sets of Relevant Services.

A15.38 Figure A15.5 below presents our analysis of DECC's November 2015 forecasts.[482]

Figure A15.5: Annual percentage change in retail electricity price for services p/kWh



Source: Ofcom analysis.[483]

A15.39 Figure A15.5 above shows that BEIS's forecasts were for electricity prices to continue to increase quite rapidly over the forecast period. The geometric mean increase over the period from our base year, 2015/16, to the end of the charge control period is 7.0%.

A15.40 We have also cross checked BTs actual unit cost movement per GWh of electricity consumption over the period 2012/13 to 2015/16[484] against historical data published

[479] 2016 BCMR Statement, Annex 32, paragraphs A32.178 to A32.181; 2014 FAMR Consultation, Annex 13, paragraphs A13.188 to A13.191; and June 2014 WBA Statement, Annex 7, paragraphs A7.108 to A7.112.
[480] BEIS response via email from Simon Feraday on 20/02/2017 to Ofcom's question concerning when BEIS would publish its next forecast.
[481] Updated projections will be available for the Statement.
[482] DECC, *Updated Energy & Emissions Projections*, Annex M, November 2015. https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2015 [accessed 27 March 2017]. We have presented the simple average of the high and low forecast scenarios. The DECC forecasts are also based on calendar years and prices are deflated using the ONS' GDP deflator. We have therefore re-inflated the prices using ONS' GDP deflator and converted to a March year end.
[483] Based on DECC UEPs and ONS GDP deflator.
[484] BT's response dated 17 June 2016 to question G1 of the 7th BT WLA s.135.

by DECC. This showed that BTs actual average cost increase of the period was [✂] than the DECC forecast average increase of 4.9% per annum over the same historical period.

A15.41 BEIS's forecasts provide an independent and unbiased view of future relevant electricity price inflation over the charge control period. Consistent with our approach other recent charge controls,[485] we propose to use BEIS's latest forecasts for the Statement as and when these are updated. For this consultation, we are therefore forecasting that energy prices will increase by 7.0% per annum in nominal terms from our base year to the end of the charge control period.

Accommodation costs (including business rates)

A15.42 Operating costs within BT's accommodation sector include rents on buildings, non-domestic rates, electricity costs (as already discussed) and facilities management costs.[486]

Non-domestic rates costs

A15.43 BT pays non-domestic rates on its offices but also on its UK network rateable assets.[487] The UK network rateable assets consist primarily of "passive" infrastructure assets such as duct, fibre, manholes and cabinets, as well as exchange buildings. The rates on BT's network rateable assets are the largest element of BT's rates bill and are usually referred to as BT's cumulo rates costs.

A15.44 For this charge control we propose to forecast BT's cumulo rates costs separately within both the top-down and bottom-up models.[488] The inflation assumptions we adopt for BT's cumulo costs are given in Annex 17. When calculating the inflation rate for all other non-pay operating costs we have given no weight to BT's cumulo rates costs.

Other accommodation costs

A15.45 Consistent with other recent reviews, we propose to assume that all other accommodation costs will increase at 3% per annum.[489] This is the rate at which rental prices increase for those buildings subject to BT's agreement with Telereal Trillium.[490] This agreement covers [✂] the majority of BT's properties and we understand that rental costs account for the bulk of BT's accommodation costs.

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[485] 2016 BCMR Statement, paragraph A32.181.

[486] See the description of Sector BC on page 341 of BT's 2016 AMD.

[487] BT's UK network includes assets in England, Scotland, Wales and Northern Ireland.

[488] Annex 17 provides more details on why we have forecasts BT's cumulo costs separately.

[489] 2016 BCMR Statement, paragraph A32.190; June 2014 WBA Statement, paragraph A7.107; and 2014 FAMR Statement, paragraph A13.195.

[490] See for example: BT Group, *Profit on sale of property fixed assets*, http://www.btplc.com/report/report03/Financialreview/Profitonsaleofpropertyfixedassets.htm [accessed 28 March 2017].

All other non-pay costs

A15.46 Non-pay operating costs other than those specifically mentioned above comprise approximately [✂] (~80-100%) of non-pay operating costs.[491] These are a mix of different types of costs for which the relevant index is not clear. Consistent with our approach in other recent charge controls,[492] we propose to forecast inflation for costs where no specific rate can be reliably identified using forecasts of CPI.

A15.47 The geometric mean of CPI inflation between the base year and the last year of the control period is, according to the forecasts we present below, 2.0% per annum.[493]

A15.48 We also use forecasts of RPI inflation for our asset price inflation assumption for duct and copper assets in the top-down model (see below), for increases in rates in the pound for BT's non-domestic rates costs and when calculating the WACC.

A15.49 We present our forecasts of CPI and RPI in Table A15.6 below. These have been derived from the latest OBR forecasts and converted from calendar to financial years.[494]

Table A15.6: CPI and RPI forecasts used within the model

	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21
CPI	2.7%	2.3%	1.1%	0.1%	1.1%	2.4%	2.5%	2.0%	2.0%
RPI	3.1%	2.9%	2.0%	1.1%	2.2%	3.3%	3.5%	3.1%	3.2%

Source: Ofcom calculations to generate March yearend figures based on numbers supporting Chart 3.18 and 3.19, Economic and fiscal outlook November 2016, Office of Budget Responsibility 2016

Non-pay inflation assumption at 2-3% per annum.

A15.50 We have calculated an overall non-pay inflation assumption by weighting together the different estimates for the different types of non-pay costs. The weights we use have been derived from BT's regulatory accounting information.[495] The calculations are summarised in Table A15.7 below.

[491] BT response to 20th s.135 question D1.
[492] 2016 BCMR Statement, paragraph A32.191.
[493] Ofcom calculations based on numbers supporting Charts 3.18 and 3.19, Economic and fiscal outlook November 2016, Office of Budget Responsibility 2016. We are aware that the OBR has recently published updated forecasts. These are similar to those we have adopted for this consultation. We will be updating our forecasts for the Statement.
[494] Chart 3.20 and 3.21, Economic and fiscal outlook March 2016, Office of Budget Responsibility 2016.
[495] BT's response dated 9 December 2016 to question D1 of the 20th BT WLA s.135

Table A15.7 Summary of non-pay inflation assumptions

Type of cost	Assumption basis	Inflation proposal	Weighting	
			Relevant Services	GEA Relevant Services
Energy	DECC	7.0%	[✂] (~0-10%)	[✂] (~0-10%)
Other Accommodation Costs	Telereal Trillium Contractual rate	3.0%	[✂] (~0-10%)	[✂] (~0-10%)
All other non-pay costs	CPI	2.0%	[✂] (~80-100%)	[✂] (~80-100%)
Weighted average			2.4%	2.4%

Source: Ofcom analysis.[496]

A15.51 Table A15.7 shows that, despite having slightly different weights, our current forecasts of non-pay inflation are very similar for both Relevant Services and GEA Relevant Services at 2.4%. We use this calculated weighted average of 2.4% as the rate per annum for our base case forecasts in both the top-down and bottom-up models, and propose a range of 2-3%. We propose to adopt the above approach to estimate future inflation for non-pay operating costs and will be reviewing the evidence we have to support this assumption for the Statement.

<u>Other uses of our inflation assumptions</u>

A15.52 We use our pay and non-pay price inflation assumptions within our assessment of BT's historical and forecast efficiency later in this Annex. We do so to adopt a consistent approach to inflation throughout our analysis. The values that we have used are consistent with the analysis we have presented above. We explain the values that we have used in the relevant sections.

A15.53 The bottom-up model also uses historic values of inflation of pay and non-pay costs. We present the values we use in that model in Table A15.8 below.

Table A15.8: Inflation assumptions used within the bottom-up model.

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Forecast
Pay	2.1%	2.6%	1.8%	2.4%	1.8%	2.2%	3.1%
Non Pay	2.8%	4.3%	2.8%	2.4%	1.3%	0.6%	2.4%

Source: Ofcom analysis.

Asset price inflation

A15.54 As in the 2014 FAMR Statement and 2016 BCMR Statement, we propose to adopt asset price change assumptions such that duct and copper assets are valued

[496] Weightings from BT's response dated 17 November 2016 to question A1 of the 20th BT s.135 request.

consistently with how they are revalued for CCA purposes in BT's RFS with all other asset prices being assumed to stay constant in nominal terms.

A15.55 These assumptions are inputs to our estimates of forecast capital costs, both capital expenditure and holding gains and losses, within our 2017 top-down Model. The asset price inflation assumptions for the assets in the bottom-up model are described in Annex 12.[497]

A15.56 Within BT's RFS, duct and copper assets are valued using an indexed historic methodology and the Retail Price Index (RPI).[498] For consistency, we propose to adopt the same approach to asset price inflation for these assets within this charge control. We therefore propose to adopt an asset price assumption of RPI for duct and copper assets. When considering efficiency targets for capital expenditure at the end of this annex we observe that there have been some recent large increases in BT's contractual prices for civil infrastructure work. We reflect the impact of these changes in our capex efficiency assumption, not through our asset price inflation assumption.

A15.57 We have analysed historic asset price changes and holding gains and losses using BT RFS data. We first looked at the extent to which BT re-values assets used to support the Relevant Services.[499] BT re-values all its duct and copper assets and a lower proportion [✂] (~40-60%) of the other assets used to provide the Relevant Services. However, because duct and copper account for most of the Relevant Services' assets, this means that [✂] (~80-100%) of the mean capital employed relates to assets that are re-valued.

A15.58 We then weighted these annual price movements by base year GRCs within the charge control model to estimate the average annual asset price change over the last 5 years. The results are shown in Table A15.9 below. This confirms that for assets other than duct and copper, asset price changes have generally been low although with some variation year on year.

Table A15.9: Average asset price change over the last 6 years

	Relevant Services
All non-copper and duct assets	[✂]
Only those non-copper and duct assets subject to revaluation	[✂]

Source: Ofcom analysis.

497 As explained in Volume 2 Section 4, the bottom-up and top-down models are of different networks and largely different network components. The bottom-up model is of a next generation access network, by which we mean an access network comprised wholly or in part by fibre, network constructed as an overlay to an existing current generation, mainly copper, network (which in turn is captured in the top-down model). The bottom-up model uses detailed component level cost information for the NGA network components, as explained in Annex 22.

498 See pages 28 and 29 of BT's 2015/16 AMD.

499 We did this using information on historic asset price changes by class of work, BT response to 7th s.135 Request, Question F1, BT response to 23rd WLA s.135 Question 17, BT response to 20th WLA S.135 Question, E1 and GRC data contained within the base year of the Charge Control model, BT response to 19th WLA s.135 Question 3.

A15.59 We also analysed holding gains and losses that BT reports within its RFS. Holding gains and losses can cover a variety of adjustments but largely occur when the value of an asset held by BT increases (or decreases) in value. If holding gains and losses were significant, it might suggest large changes to BT's asset prices and therefore cast doubt on our previous asset price assumption of no nominal change to asset prices for assets other than duct and copper. Our analysis shows that on average holding gains/losses were -1.3%[500] of mean capital employed for non-current assets for the Relevant Services[501] over the last 6 years, suggesting overall asset prices increases of around 1.3% per annum.

A15.60 BT's published RFS do not distinguish between holding gains or losses on duct and copper assets and those on other assets. It is likely that the revaluation of duct and copper assets, in line with RPI, will have driven most of these holding gains. Further, the 1.3% above has been calculated by comparing holding gains and losses to mean capital employed, which reflects net replacement costs, NRCs (i.e. after the deduction of accumulated depreciation).[502] As BT calculates holding gains and losses with respect to gross replacement costs (GRCs), a better indication of price changes may be to compare holding gains and losses with GRCs. GRCs are not published in BT's RFS but are higher than NRCs and so such a calculation would result in a lower value. This analysis therefore provides some evidence to support our assumption of minimal asset price inflation for Relevant Market assets other than duct and copper.

A15.61 Based on the above analysis we propose the following asset price inflation assumptions:

- duct and copper prices will increase by RPI; and
- all other asset prices will stay constant, i.e. flat in nominal terms.

Cost and Asset Volume Elasticities (CVEs and AVEs)

Introduction

A15.62 We would expect changes in volumes for services to have an impact on the costs and assets associated with providing those services. However, where a firm incurs fixed or common costs, costs may not change by the exact proportion as volumes. Therefore, when we forecast costs we need to appropriately reflect the underlying (sometimes complex) relationship between forecast changes in volumes and assets/costs.

A15.63 As set out in Volume 2, Section 4, the impact that forecast changes in volumes have on forecast costs in the top-down model (before considering efficiency

500 Negative costs indicate holding gains and therefore price increases. BT publishes information on holding gains and losses in different markets in its RFS. See for example pages 25 and 26 of BT's 2016 RFS, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/CurrentCostFinancialStatements2016.pdf.

501 This analysis was based on the results for the WLA and WFAEL markets that are reported in BT's RFS. Since 2014/15 Assets in the WLA market have included assets relating to GEA services.

502 [✂]

improvements) is determined by Cost Volume Elasticities (CVEs) and Asset Volume Elasticities (AVEs).

A15.64 We set out our proposed methodology and analysis for deriving CVEs and AVEs below. In general, we propose estimating AVEs and CVEs for use in the Charge Controls using the same methodology that we adopted in the 2016 BCMR Statement[503]. The discussion is structured as follows:

- we start by explaining our rationale for using LRIC to FAC ratios

- we explain how we have produced CVE and AVE estimates based on BT's LRIC model outputs.

LRIC to FAC ratios as a proxy for CVEs and AVEs

A15.65 As we set out in Annex 11, we propose to base our modelling of costs for the top-down model on "component" costs extracted from BT's regulatory financial reporting systems. Therefore, the relevant costs and volumes that the CVEs and AVEs[504] are applied to are component costs and volumes. For example, to forecast pay operating costs for a particular component we use the following formula:

Pay(t) = Pay(t-1) * [1 – eff] * [1 + IPC(t)] * [1 + %volume change(t) * CVE]

where Pay (t) is the pay operating costs in the year t, 'eff' is efficiency, IPC(t) is the input price change in year t and CVE is the assumed pay operating cost volume elasticity (i.e. incremental cost that would change with volumes) for that component.

A15.66 The pay CVE for a component should be estimated to capture the extent to which pay operating costs for that component are expected to change over the control period given the forecast change in component volumes, but holding all else (such as efficiency cost savings) constant. The same is also true for non-pay operating costs[505] and (fixed) assets.[506] CVEs and AVEs should therefore capture the marginal costs associated with the component volume change over the control period.

A15.67 In the short run, marginal costs can be lumpy, perhaps because of costs which are incurred when a particular level of output is reached, but then are fixed for a particular output range.

A15.68 However, in the long run, marginal costs are less lumpy because of inputs that, in the short run, may have been fixed for certain output ranges being treated as fully variable and scalable. For the purposes of charge controls, we focus on the long-

[503] 2016 BCMR Statement, paragraphs A32.85 to A32.143.
[504] We do not use AVEs to estimate changes in net current assets. The treatment of net current assets over the control period is discussed in Annex 11.
[505] Note that non-pay operating costs exclude depreciation. Depreciation is separately modelled within the top-down model.
[506] AVEs measure the extent to which asset volumes (measured at gross replacement cost) change with movements in component volumes. AVEs are therefore used to estimate capital expenditure driven by changes in volumes.

run marginal costs, which therefore abstract from a degree of the lumpiness that may be observed in the short run.[507]

A15.69 On this basis, the CVEs (and AVEs) are intended to measure the long-run elasticity of total component costs with respect to changes in component output. Algebraically this can be expressed as:[508]

$$\mathrm{CVE} = \frac{\%\Delta\mathrm{LRTC}}{\%\Delta\mathrm{Q}}$$

where: $\%\Delta\mathrm{LRTC}$ is the % long-run change in total component cost, and $\%\Delta\mathrm{Q}$ is the change in total component volumes.

A15.70 Alternatively, this can be expressed as:

$$\mathrm{CVE} = \frac{\Delta\mathrm{LRTC}/\mathrm{TC}}{\Delta\mathrm{Q}/\mathrm{Q}}$$

Or

$$\mathrm{CVE} = \frac{\Delta\mathrm{LRTC}/\Delta\mathrm{Q}}{\mathrm{TC}/\mathrm{Q}}$$

A15.71 As $\Delta\mathrm{LRTC}/\Delta\mathrm{Q}$ is the long-run marginal cost ('LRMC') and TC/Q is the unit cost or average total cost (ATC), the CVE is equivalent to the ratio of LRMC to ATC:

$$\mathrm{CVE} = \frac{\mathrm{LRMC}}{\mathrm{ATC}}$$

A15.72 Granular information identifying BT's component level long-run marginal costs is not readily available. When setting charge controls, therefore, we have historically used BT estimated CVEs and AVEs based on information from BT's LRIC model. Specifically, we have used BT information on the ratio of LRIC to FAC.[509] As the algebra above demonstrates, in general, if LRIC is a good proxy for LRMC, and

[507] 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.

[508] The algebra relates specifically to CVEs but it can also be applied for AVEs.

[509] Note that here we specifically refer to LRIC as opposed to DLRIC. In the past BT's regulatory accounts have reported a 'LRIC floor' which generally has related to the DLRIC cost concept. The distinction between LRIC and DLRIC is explained in BT's LRIC Relationships and Parameters documentation available for example at https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/LRICModelRelationshipsandParameters2015-16.pdf [accessed 17 March 2017]. DLRIC involves adding an element of fixed and common cost to the LRIC of a component. For the purposes of estimating CVEs and AVEs, LRIC is therefore a more relevant cost measure than DLRIC as it is closer to the marginal costs that are of interest in the context of CVEs and AVEs.

FAC is a good proxy for ATC, then LRIC to FAC ratios can provide a good proxy for CVEs (and AVEs).[510]

A15.73 Given we forecast pay and non-pay operating costs separately in the top-down model we need separate CVEs for pay and non-pay operating costs. We therefore apply separate pay and non-pay CVEs for each component[511] we are forecasting. This is consistent with the approach we adopted in the June 2014 FAMR Statement, and the 2016 BCMR Statement.

A15.74 AVEs can be calculated in the same manner as CVEs (i.e. separately for each component). We discussed our approach to the calculation of AVEs in the 2016 BCMR Statement[512]. We concluded it was preferable to adopt a consistent approach to estimating CVEs and AVEs. We propose to calculate AVEs using the same approach that we adopted in the 2016 BCMR Statement by weighting together LRIC to FAC ratios for each cost category[513] within each super-component by the GRCs of that cost category. We discuss how we have estimated component AVEs in more detail below.

Calculating base year CVEs and AVEs

A15.75 To calculate the base year elasticities, we consider it appropriate to use:

- information on the relationship between LRIC and FAC from BT's LRIC model[514] as the basis for our CVEs and AVEs. While we recognise that LRIC data may not be a perfect proxy for LRMC, we consider the estimates it gives to be reasonable and we are not aware of any better proxy. We therefore consider it appropriate to use for setting this control;

- a consistent approach to calculating our CVEs and AVEs. We propose to estimate pay and non-pay CVEs from the ratio of LRIC to FAC for the relevant operating cost categories for each component. We calculate AVEs from the ratio of LRIC to FAC for fixed asset categories for each component; and

- data from BT's LRIC model for the same year as our base year financial information. BT's CCA FAC information is an important component of our base year financial data and a key input to BT's LRIC model. Therefore, we consider it

[510] There may however be occasions where LRIC is not a good proxy for LRMC, for example where there are substantial increment-specific fixed costs. We investigated whether there were any such costs for the components used in the top-down model but were not able to identify any.
[511] 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 are 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, unless explicitly set out to the contrary.
[512] 2016 BCMR Statement, paragraphs A32.102, A32.103 and A32,138
[513] 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's 2016 Long Run Incremental Cost Model: Relationships & Parameters publication.
[514] BT provides detailed super-component LRIC and FAC data, split by cost category, to Ofcom (on a confidential basis) each year within schedules AFI1 and AFI3 as part of the suite of Additional Financial Information (AFI) that accompanies the RFS.

desirable to use information from BT's LRIC model that is consistent with the base year data used in this consultation (i.e. 2015/16).

A15.76 Historically, we have used AVEs and CVEs that have been derived from BT's estimates. In the 2016 BCMR statement, however, we calculated our own CVE and AVE estimates based on BT's LRIC model outputs and propose to adopt the same approach for these charge controls. We discussed some of the weaknesses in BT's historical approach in the June 2015 LLCC Consultation. One of these was that BT had excluded dependent cost categories when calculating AVEs and CVEs on the basis that "*the LRIC values of these cost categories do not reflect a direct relationship between cost and volume*"[515]. However, the AVEs and CVEs that we are seeking to estimate should reflect how the total costs for a component change with component volumes, not just the changes that arise from direct volume relationships. Consistent with our approach for the 2016 BCMR Statement we therefore propose to include the cost of dependent cost categories when estimating AVEs and CVEs for these charge controls.

A15.77 Lastly, in the 2016 BCMR statement we calculated AVEs using GRC weights[516]. This followed a discussion in the November 2015 LLCC consultation[517]. We propose to adopt the same approach for these charge controls. As the resulting AVEs are applied to GRCs under our modelling approach we consider that using GRC weights to calculate AVEs is more internally consistent than using NRC weights.

Base year AVE and CVE estimates

A15.78 Using the broad principles explained above we have estimated pay and non-pay CVEs and an AVE for each component that is part of the top-down model as follows:

- we have calculated LRIC to FAC ratios (including costs from both independent and dependent cost categories) for each super-component using outputs from BT's 2015/16 LRIC model for:
  - o all non-pay operating cost categories[518] (excluding depreciation categories) to estimate non-pay CVEs;
  - o all pay operating cost categories to estimate pay CVEs; [519] and
  - o fixed asset cost categories as the first stage in estimating AVEs.[520]

[515] See Paragraph A8.116 of the June 2015 BCMR Consultation. The other weaknesses were firstly that not all the AVEs and CVE lay in the range 0 to 1 and secondly that different approaches were adopted for estimating AVEs and CVEs.
[516] For example, paragraphs 5.14 and 5.194 to 5.199 of Volume 2 of the 2016 BCMR statement.
[517] For example, paragraphs 5.23 to 5.33 of the November 2015 BCMR Consultation.
[518] 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's 2016 Long Run Incremental Cost Model: Relationships & Parameters publication. Each cost category has a unique code associated with it.
[519] i.e. those cost categories within BT's LRIC model with codes starting "PLOPPYZZ".
[520] i.e. those cost categories within BT's LRIC model with codes starting "CEFA".

- we derive AVEs for each super-component by weighting together the LRIC to FAC ratios for each cost category for that super-component by the GRCs of that cost category; and

- we then apply the super-component estimates to each component within the super-component (as BT's LRIC model does not report at the component level).

A15.79 We have excluded cumulo costs when calculating non-pay CVEs.[521] We forecast cumulo rates costs separately within the charge control and do not use CVEs to do so.[522] We therefore exclude cumulo costs from BT's LRIC model outputs when calculating non-pay CVEs.

A15.80 Using the above approach, we have derived CVE and AVE estimates for all the super-components relevant to the services within the top-down model. All the initial super-component pay and non-pay CVEs, with one exception, lay in the range of 0 to 1. The exception was the non-pay CVE for CL185 Pair gain, where the calculated CVE was 1.01. We have investigated the cause of this and found that it was caused by some small negative costs for which the LRIC/FAC ratio was less than 1. Excluding these costs reduced the CVE to 0.99. We have therefore overridden the non-pay CVE for this component and set it to be 1.

A15.81 Whilst all our initial AVEs were between 0 and 1, there were a few exceptions for the results for individual asset sectors,[523] notably the 'Other network equipment' and 'Other' asset sectors.[524] These sectors contribute minimal costs to the top-down model. For completeness, we have investigated these anomalies and found that they were caused by the treatment of two cost categories: "Fixed Assets, Apparatus"[525] and "Other Fixed Assets, Public Payphones".[526]

A15.82 We sought further information from BT on these two cost categories.[527] This showed:

- Fixed Assets, Apparatus – most of the costs within this cost category were attributed to the retail residual business and were therefore not within the scope of the top-down model. However, there were some costs that related to a corporate provision for "fixtures and fittings" that was allocated using property related activity groups and therefore attributed across a much wider range of components. Approximately 64% of this provision was attributed to network components in 2015/16. It was the attribution of this provision (negative balances) that led to some initial "Other" Sector AVEs being greater than 1. We would not expect the size or attribution of the corporate provision to change significantly with volumes.

[521] BT's cumulo costs are recorded under the cost category Opex, Non-pay, Other, Plant Support, Rates on installations. The cost category code is PLOPNPOTZZBKJ4ZZ.
[522] The way we treat cumulo costs within this charge control is discussed in Annex 17.
[523] The asset sectors that BT uses are described in its 2015/16 AMD. See section A.1.3, pages 343 to 350.
[524] "Other network equipment" covers assets in sectors DG, DI, DJ and DK. "Other" covers assets in sectors DH, DL, DM, DT, EA, ED, EF, E4 and F3.
[525] The code for this cost category within BT's LRIC model is CEFAZZZZZZDMZZZ
[526] The code for this cost category within BT's LRIC model is CEFAZZZZZDLZZZZ
[527] BT's response dated 13 January 2017 to question 7 and 8 of the 23rd BT s.135 request

- Fixed Assets, Public Payphones – most of the costs within this cost category are attributed to retail residual business or to public payphone operations. However, BT explained that in 2015/16 there was a mapping error which led to small attributions of costs to some access network and inland private circuit components[528]. The AVE anomalies we observed however seem to have been the result of small attributions of negative costs to some components. BT explained that

  > "the negative balances are caused by small anomalies in the allocation of Gross Book value by component, compared with the corresponding accumulated depreciation allocations by component. The relevant assets are around 99% depreciated and the small anomalies in allocation result in some small negative balance for some components".[529]

A15.83 As these explanations make only a small contribution to mean capital employed within the top-down model we have excluded these two cost categories from BT's LRIC model results when calculating AVEs. The resulting AVEs for all asset class categories lay between 0 and 1.

A15.84 When reviewing the outputs from the top-down model we observed some unexpected cost movements for component CL133, WLA Tie Cables, for which our calculated AVE was quite low, around 0.3. The great majority of the capital costs for this component are associated with copper assets, the LRIC estimates for which are calculated by applying the local lines copper cost volume relationship (CVR). This CVR is supposed to apply to "the E-side and D-side of the access copper network"[530] and has a high proportion of fixed common costs because of applying a minimum network assumption "of 100 pair cable on the E-side and 10 pair on the D-side".[531]

A15.85 We do not believe this is an appropriate CVR to apply to Tie Cable Assets. Subject to some short term modulatory effects we would expect the main copper assets to be fully variable with volumes in the long run: the number of tie cables required would increase linearly with volumes. That is the approach we adopted when modelling these assets and cables in the Single Jumpering Dispute[532]. We have therefore reset BT's estimated LRIC for the copper assets within this component to be equal to the fully allocated costs. This increased the AVE for this component to 0.87.

[528] BT's response dated 13 January 2017 to question 8 of the 23rd BT s.135 request
[529] BT's response dated 13 January 2017 to question 8 of the 23rd BT s.135 request.
[530] See the description of CV002 on page 39 of BT's 2016 Long Run Incremental Cost Model: Relationships & Parameters, available at https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/LRICModelRelationshipsandParameters2015-16Annex1.xlsx.
[531] BT's 2016 Long Run Incremental Cost Model: Relationships & Parameters, page 40.
[532] The dispute between TalkTalk and Openreach relating to single jumpered MPF, paragraphs A3.60 to A3.66, http://webarchive.nationalarchives.gov.uk/20160702162827/http://stakeholders.ofcom.org.uk/enforcement/competition-bulletins/closed-cases/all-closed-cases/cw_01109/.

A15.86 Our final proposed CVE and AVE estimates for the super-components within the 2017 Top Down model are presented in Table A15.10.

Table A15.10: CVE and AVE estimates for super-components relevant to the top-down model

	Super-component	AVE	Pay CVE	Non-Pay CVE
CL171	E side copper capital	0.25	0.56	0.72
CL172	E side copper current	0.82	0.41	0.71
CL173	D side copper capital	0.26	0.58	0.79
CL174	D side copper current	0.81	0.49	0.63
CL175	Local exchanges general frames capital	0.23	0.87	0.69
CL176	Local exchanges general frames current	0.81	0.98	0.80
CL177	Analogue line test equipment	0.55	0.97	0.96
CL178	Dropwire capital & analogue NTE	0.99	0.91	0.52
CL180	Analogue line drop maintenance	0.81	0.98	0.91
CL183	Analogue line cards	0.51	0.56	0.69
CL185	Pair gain	0.51	0.96	1.00
CL575	OR Service Centre - Assurance WLR PSTN/ISDN2	0.87	0.80	0.96
CN853	Combi Card and MSAN Access - Voice	0.54	0.67	0.77
CP502	Openreach sales product management	0.87	0.93	0.95
CL144	Wholesale Access specific	0.89	0.90	0.83
CL160	Routeing & records	0.83	0.98	0.81
CL161	MDF Hardware jumpering	0.81	0.97	0.85
CL570	OR Service Centre - Provision WLR PSTN/ISDN2	0.87	0.79	0.97
CL139	Local Loop Unbundling systems development	0.89	0.90	0.83
CL572	OR Service Centre - Provision LLU	0.87	0.80	0.87
CL590	Ext LLU SLG	0.88	0.98	1.00
CF187	LLU Line Testing Systems	0.53	0.71	0.82
CL577	OR Service Centre - Assurance LLU	0.87	0.80	0.84
CL131	Co-mingling set up	0.48	0.58	0.85
CL132	Co-mingling rentals	0.48	0.55	0.74
CL133	WLA tie cables	0.87	0.58	0.79
CT134	Co-mingling power & vent	0.82	0.58	0.71
CW900	Openreach copper (Revenue Receivables)	1.00	1.00	1.00
CL600	Other WLA	0.03	0.66	0.83
CO801	Ofcom Licence Fee Openreach	0.86	0.73	0.06

Source: Ofcom analysis of BT data.

Dynamic AVEs and CVEs after the base year

A15.87 Historically we have assumed that our estimate elasticities remain constant over the charge control period. However, in the 2016 BCMR Statement we adopted a dynamic elasticities approach for both Ethernet and TI services. For example, for Ethernet Services we said:

> "… where volume changes are significant, assuming that the elasticities are constant may be inconsistent with our assumption that fixed and common costs remain constant. We note that there is significant volume growth in Ethernet services predicted over the forecasting period"[533].

A15.88 Our forecasts of volume growth for the Relevant Services are, in general, low. For this charge control we are therefore proposing to keep AVEs and CVEs constant and not adopt a dynamic elasticities approach. We do not consider this a critical assumption for this set of controls.

Efficiency

Introduction

A15.89 As set out in Volume 2, Section 4, forecasting the cost savings we expect BT to be able to achieve over the period of our proposed charge control in the top-down model through efficiency assumptions or targets is an important component of forecasting costs overall.

A15.90 In reaching a view about an appropriate range within which to set efficiency targets, we consider a range of evidence from several different sources of data, each of which has its own advantages and disadvantages. This section sets out our analysis and proposals.

Summary of approach to efficiency

A15.91 The approach we have adopted to set our efficiency targets is like that used in the 2016 BCMR Statement for Ethernet and TI services. The targets we propose for use within the top-down model for the Relevant Services are 3.5-6.5% with a base case of 5.5% for operating costs and 1-5% for capital expenditure.

A15.92 To arrive at our proposed operating cost efficiency targets we have:

- reviewed efficiency assumptions adopted in recent charge controls set by Ofcom and considered their relevance;
- analysed the last few years' regulatory accounting information from BT. We have analysed movements in component costs using the operating cost forecasting formulae within the top-down model;
- analysed both historical and forecast BT management accounting information for various BT divisions;
- reviewed information originating from outside BT. This included various benchmarking studies undertaken for BT together with various telecoms specific and economy wide studies; and
- reviewed other public information about BT's cost performance such as public statements made by BT.

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533 Paragraph 5.216 of Volume 2 of the 2016 BCMR Statement. The discussion on the use of dynamic elasticities for TI services is given in paragraphs 6.165 to 6.171 of Volume 2 of the 2016 BCMR Statement.

A15.93 We have assessed efficiency on capital expenditure separately from that on operating costs.

Efficiency gains

A15.94 We apply our efficiency target every year between our base year 2015/16 in our top-down model and the last year of the proposed charge control 2020/21. We therefore need to estimate an annual average achievable efficiency target over this period.

A15.95 The efficiency rate needs to be consistent with its application within the formulae within the charge control model. The way in which the efficiency assumption is used within the top-down model is described in Annex 11. It is applied separately to both pay and non-pay operating costs and to both steady state and additional capital expenditure for network components. For example, the operating costs for a component in any year are derived from the previous year's costs for that component by applying the relevant CVE to the component volume growth as well as the relevant inflation rate and the efficiency assumption. The costs for steady state capex are calculated in a similar way from the previous year's steady state capex but with no reference to volume changes. Growth capex is calculated using a formula that is similar to that for operating costs but relates to the previous year's gross replacement costs.

A15.96 This means that our proposed efficiency targets:

- are estimates of how costs may change after taking account of changes in volumes and changes in input prices;
- are applied only to cash payments: capital expenditure and all pay and non–pay operating costs, excluding depreciation;
- capture the effects of all means of delivering cost savings. It will therefore include the savings that might be achieved by doing things less often (e.g. through reduced fault visits) or more quickly (e.g. through reduced task times); and
- will reflect the overall reduction in cash costs which will include costs incurred to deliver future cost savings.

A15.97 Our objective is to set a challenging target, in the interests of promoting efficiency, which however "*should be capable of being met and exceeded*".[534]

A15.98 We have in the past analysed efficiency in terms of two separate components, 'catch up' and 'frontier shift'[535]. But, as we noted in the 2016 BCMR Statement,[536] the data required to undertake this analysis has not been available for some time

[534] Competition Commission, Case 1111/3/3/09, August 2010, Paragraph 2.191 (the Competition Commission is now the Competition and Markets Authority).

[535] 'Catch-up' is the change in costs required to bring an operator in line with those of an efficient benchmark comparator. 'Frontier shift' is the movement in efficiency expected by the efficient benchmark operator given technological progress.

[536] 2016 BCMR Statement, Paragraph A29.32.

and we have not been able to identify another source to replace it.[537] We do, however, review sources of data from outside BT, including some benchmarking data.

A15.99 An analysis of efficiency into catch up and frontier shift components is one way of establishing appropriate efficiency targets. We have considered and used others, as set out below. Our main approach has been to analyse data sources that primarily relate to BT's historical and forecast performance. We believe that this, too, provides a reliable way of establishing reasonable levels of cost savings that BT may achieve over the period of the proposed charge control.

A15.100 In previous reviews, we have said that our efficiency measure can be thought of as a measure of BT's total factor productivity over time.[538] By that we meant that we consider the potential for cost savings across all the factors of production, capital and labour. However, we apply our efficiency assumptions separately to operating costs (excluding depreciation) and to capital expenditure. We do not apply the assumption to all capital costs: we do not apply it to depreciation or net replacement costs. We consider evidence that is based on analysis of changes to wider measures of capital costs will therefore be less relevant.

A15.101 When analysing cost data to assess historical cost savings we have assumed that BT's performance on quality of service has remained similar from year to year. If quality of service performance had reduced significantly in a year, then that might have led to lower costs. Similarly, if performance had increased dramatically then that might have increased costs and led to lower cost savings. In practice, efficiency initiatives may lead to a reduction in actual fault visits or higher standards could lead to higher costs. We make proposals for future quality of service targets in other parts of this consultation. We therefore need to ensure that we treat the potential for cost savings and changes in quality of service in a consistent manner. We discuss the impact of changes to quality of service targets briefly when summarising our results on operating costs below.

A15.102 In the remainder of this section we present our proposals on efficiency targets for operating costs, followed by proposals for capital expenditure. For operating costs, we discuss the evidence in the following order:

- review of assumptions adopted in other recent charge controls;
- analysis of regulatory cost data;
- analysis of BT's historical and forecast management accounting information;
- benchmarking and other external studies; and
- other public information.

[537] The data we refer to related to Local Exchange Carriers (LECS) in the US. Actions taken by the Federal Communication Commission (FCC) taken in the AT&T Cost Assignment Forbearance Order, the ARMIS Forbearance Order, and the ARMIS Financial Reporting Forbearance Order, resulted in major revisions to ARMIS data filed for reporting year 2008. Since then the data used in these studies has not been available. The available data is therefore now over 8 years old.

[538] 2016 BCMR Statement, Paragraph A29.27.

Efficiency assumptions in other charge controls

A15.103 Past decisions provide a context against which to assess our proposals but are not part of the evidence that we use to make efficiency proposals for this control. As we go on to explain, we consider a range of evidence when deciding appropriate efficiency targets. The approach we propose adopting here is in some cases different from that we adopted in previous controls.

A15.104 The efficiency assumptions we adopted in recent fixed telecoms charge controls are summarised in Table A15.11 below.

Table A15.11: Efficiency assumptions used in recent telecoms charge controls

Charge control	Efficiency assumption	Charge control Period covered	Comments
June 2014 WBA Statement	5.0%[539]	2014/15 - 2016/17	Applied to operating costs only. Based largely on estimates of TSO's and BT Wholesale's efficiency.
2014 FAMR Statement	5.0%[540]	2014/15 - 2016/17	Applied to operating costs and capital expenditure. Based largely on estimates of Openreach's efficiency.
2016 BCMR Statement: TI services	4.5% on Operating costs[541]	2016/17-2018/19	Applied to operating costs only. Based on estimates of Openreach, TSO and BT Wholesale's efficiency. No assumption for Capital expenditure.
2016 BCMR Statement: Ethernet services	5.0% on Operating Costs & 4.0% on Capex [542]	2016/17-2018/19	5% applied to operating costs and 4% applied to capital expenditure. Based on estimates of Openreach, TSO and BT Wholesale's efficiency.

Source: Ofcom analysis.

A15.105 Table A15.11 shows that we have adopted similar operating cost efficiency targets in the range 4.5-5% per annum in recent charge controls. There has, however, been greater variation for capital expenditure targets.

A15.106 BT commissioned Ernst and Young (EY) to consider the concern expressed by some stakeholders about the level of BT's returns in regulated markets. In its report EY stated that:

> "Over the past 10 years, BT has made operating expense ("OPEX") savings of around 5% per annum. The level of efficiency which BT had achieved includes both the efficiency targets set by Ofcom, which BT would have to meet in order to ensure costs are in line with

[539] June 2014 WBA Statement, paragraphs A7.191 to A7.197
[540] 2014 FAMR Statement, paragraphs A16.101 to A16.111
[541] 2016 BCMR Statement, paragraph A29.4.
[542] 2016 BCMR Statement, paragraph A29.4.

prices, and additional efficiency which BT has realised which has meant it “outperformed” charge controls”.[543]

A15.107 EY are therefore of the view that BT has outperformed the targets we set and that it has historically achieved efficiency savings of around 5% per annum. This therefore provides us with some comfort that the targets that we have set in the past have not been unreasonable.

A15.108 The targets we set in the 2014 FAMR Statement were primarily based on assessment of performance for one BT division, Openreach.[544] In contrast when assessing information for WBA markets for the June 2014 WBA statement we considered cost data for two BT divisions, TSO and BT Wholesale. For the recent 2016 BCMR Statement we considered costs within Openreach, TSO and BT Wholesale when setting targets for Ethernet and TI services.

A15.109 For this Consultation, BT provided information that showed which of its divisions contributed costs to the Relevant Services.[545] BT’s information showed that whilst Openreach accounts for most of the costs BT’s TSO division also contributes a not insignificant proportion.[546] We therefore believe that it would be inappropriate to base our efficiency target for the top-down model on estimates of Openreach’s efficiency alone. We therefore propose to consider the potential for cost savings from both Openreach and TSO. As noted above we refer to these two divisions in this annex as the “Relevant Divisions”.

Regulatory cost analysis

A15.110 We have estimated BT’s historical efficiency on operating costs for the services within the top-down model by analysing cost data from BT’s regulatory accounts. The basic methodology that underpins our analysis is the same as that we used in the 2016 BCMR Statement: we have estimated how much of the annual movement in component operating costs was due to inflation and how much was due to changes in volumes and then assumed that efficiency accounts for any remaining movement.[547]

A15.111 We have not been able to use this method to assess efficiency on capital expenditure as our ability to analyse BTs historical capital expenditure in a way that is consistent with the modelling approach is limited.[548] In its response to the BCMR Consultation, BT agreed that:

> “the financial accounts do not tend to be sufficiently detailed to separately identify the purpose of capital expenditure, i.e. whether it was aimed at replacing existing assets or as a result of meeting new demand”. [549]

[543] EY report commissioned by BT, “BT’s Regulatory Profitability response”, 3rd October 2016, Page 9, paragraph 4.12.https://www.ofcom.org.uk/__data/assets/pdf_file/0024/93642/BT-Annex-EY.pdf.
[544] 2014 FAMR Statement, paragraph A16.1.
[545] BT’s response dated 17 June 2016 to question D1 of the 7th BT WLA s.135 request and BT’s response dated 9 December 2016 to question D1 of the 20th BT WLA s.135 request.
[546] See table A15.16.
[547] 2016 BCMR Statement, paragraphs A29.52 to A29.85.
[548] We discuss our analysis of capital expenditure in the last section of this annex.
[549] 2016 BCMR Statement, paragraph A29.59.

Overview of our analytical approach

A15.112 We have estimated the effects of volumes and inflation using the formulae that underpin the top-down model.

A15.113 We have estimated the effects of volumes using CVEs, applying separate CVEs to pay and non-pay costs respectively. We have calculated pay and non-pay CVEs for each component in each year using the same approach that we have adopted to calculate CVEs in the top-down model[550] as discussed above.

A15.114 We have estimated the effects of inflation by applying different inflation assumptions in each year that reflect the costs covered by the top-down model.[551] We discuss our approach to assessing operating cost inflation above. Table A15.12 provides the values we have used in this analysis.

Table A15.12: Inflation assumptions used for our regulatory cost accounting efficiency analysis

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Pay	2.1%	2.6%	1.8%	2.4%	1.8%	2.2%
Non Pay	2.9%	4.2%	2.9%	2.4%	1.4%	0.7%

Source: Ofcom analysis.

A15.115 A potential issue with this analysis is that there may have been changes in the way costs have been attributed within BT's regulatory accounting system and how they have been reported. For example, new components and services may have been introduced that affect attributions. Reported component costs may therefore have changed from year to year for reasons other than changes in volumes, inflation or efficiency.

A15.116 As in the 2016 BCMR Statement we have sought to mitigate the impact of these other effects by undertaking a series of "pairwise comparisons". We compare the results for the two years reported in each RFS and thus take advantage of the restatements that BT provides.[552] These restatements will generally be made for major changes in methodologies and changes in market definitions, but do not necessarily remove all the inconsistencies between different years results. For example, BT does not restate results for relatively small changes in methodology and is not able to restate results if, for example, there have been changes in data sources. Despite this, we believe this analysis provides a good insight into the historical cost savings BT has achieved for the services we are modelling and in a way that replicates how we are modelling operating costs.

[550] WE have derived these using LRIC and FAC data from Additional Financial Information (AFI) schedules 1-4 that BT provides to us annually.

[551] Because of the way we have applied our inflation assumption we do not believe this is a critical assumption. Non-pay costs do not include depreciation.

[552] BT is required to restate the prior year comparatives to be consistent with current year figures. Ofcom General Financial Reporting statement, May 2014, Annex 2, SMP conditions, Page 123, paragraph 11 http://stakeholders.ofcom.org.uk/binaries/consultations/bt-transparency/statement/financial-reporting-statement-may14.pdf.

A15.117 We have analysed cost and volume data that BT supplied to us that covered the period 2009/10 to 2015/16.[553] [554] For each component we have calculated the implied efficiency or cost savings for each of these 6 sets of "pairwise comparisons" using the cost and volume data supplied by BT and our CVE and inflation assumptions. We have estimated cost savings for the Relevant Services by weighting the component results by the total Relevant Services' volumes for that component and then adding the results across all components. The result is total cost savings for the Relevant Services for each set of pairwise comparisons.

Adjustments

A15.118 We have made some adjustments to certain components notably:

- We have excluded Network Features, Openreach time related charges, Special Fault Investigations, iNode features and EVOTAM Testing Systems as the costs for these components are not included within the top-down model;

- We have excluded Administrative components including, but not limited to, "sales product management" and "OR Service Centre - Assurance WLR PSTN/ISDN2" as for these components 'it is not possible to derive meaningful component unit costs as the component is comprised of a number of services, each with different units of measure'.[555] The net result was to exclude less than [✂] of HCA operating costs in any year. The average across the years was [✂]; and

- We have combined components "Combi card voice" and "PSTN line cards" given these components both deliver the same capability for the same market.

A15.119 We have also investigated the results for components for which we estimated there had been very large positive or negative cost savings in any year and which therefore may have had an undue impact on our efficiency estimates. In some cases, this analysis revealed various inconsistencies in the underlying data[556] and so we have also made the following adjustments:

- added the costs of "Local Loop Unbundling room build" for the published RFS 2011/12 to component "Local Loop Unbundling hostel rentals power & vent". This was done to reverse a methodology change which occurred in 2011/12 but was too small to be reflected in the restated 2010/11 numbers[557];

- corrected 2009/10 volumes for "MDF Hardware Jumpering" as an incorrect usage factor for cease related MDF Hardware Jumpering activities was identified;

[553] BT's response dated 17 June 2016 to question A1 of the 7th BT WLA s.135 request and BT's response dated 17 November 2016 to question A1 of the 20th BT WLA s.135 request.

[554] It is not possible to use the component data that BT publishes each year in its RFS as it is not sufficiently detailed. Data is published on super-components not components but more importantly HCA depreciation costs are not separately identified within other operating costs.

[555] BT's response dated 12 August 2016 to the follow up question of the 7th WLA s.135 request question 1.

[556] BT's response dated 17 June 2016 to question A1 of the 7th BT WLA s.135 request and BT's response dated 17 November 2016 to question A1 of the 20th BT WLA s.135 request.

[557] BT's response dated 2 December 2016 to question I1 of the 20th BT WLA s.135 request.

- overwrote the Volumes for "Local Loop Unbundling tie cables" in the published RFS 2011/12 to enable a like for like comparison with the 2010/11 restated volumes;[558] and

- adjusted the restated 2014/15 costs relating to lung provision. Under the 2016 Change Control Notification, published on 27 June 2016, these were correctly reallocated to retail residual in BT's 2015/16 RFS but were not material enough to be corrected in the restated 2014/15 numbers.[559]

A15.120 We have not made any adjustments to reflect the changes to allocations we have made to our base year data for this control that are described in Annex 11 or indeed to revise historical attributions of corporate overheads, property or electricity costs that we made for the 2016 BCMR Statement. We do not think this would be proportionate given the complexity of the exercise would risk introducing errors into our analysis. Such an exercise is unlikely to have a significant impact because our analysis looks at the changes in costs between years not the absolute level of those costs.

A15.121 We have also excluded the costs of cumulo rates[560] from this analysis. Non-domestic rates are part of BT's business costs and we would normally expect to include any movement in these costs within our assessment of future cost savings. However, the large increases projected in BT's cumulo costs means that they are being forecast separately within this charge control and so are not subject to our efficiency assumption. We have therefore removed the cumulo costs from all the component cost data that we have analysed.

Results of regulatory cost analysis

A15.122 In the 2016 BCMR Statement, we observed that estimates of efficiency based on the 2012/13 RFS pairwise comparison were very different from those in other years.[561] This observation is consistent with our findings from the analysis on the relevant markets for this charge control. BT made several significant changes to its attribution methodology in 2012/13, resulting in large cost increases in fixed access markets. BT did not restate its results for many of these methodology changes. We therefore have not included the 2012/13 RFS pairwise comparison results in our estimates below. We have also not included the pairwise comparison results for years preceding this, given that in general we place lower weight on older data and these pairwise comparisons relate to periods up to seven years ago.

A15.123 The results of our analysis are set out in Table A15.13 below. These are shown as average changes over the three "pairwise comparisons" since the 2012/13 RFS[562].

[558] Comparative volumes provided in BT's response dated 12 August 2016 to the follow up question of the 7th WLA s.135 request question 1

[559] BT's response dated 16 September 2016 to question 1 of the 15th BT WLA s.135 request.

[560] We describe what BT's cumulo costs are and how we have modelled them in Annex 17.

[561] 2016 BCMR Statement, paragraph A29.82.

[562] The three pairwise comparisons cover 2013/14 costs compared to restated 2012/13 costs in the 2013/14 RFS, 2014/15 costs compared to restated 2013/14 costs in the 2014/15 RFS and 2015/16 costs compared to restated 2014/15 costs in the 2015/16 RFS.

Table A15.13: Ofcom efficiency estimates of Operating Costs from analysis of Regulatory Cost Accounting data

Market	2012/13 to 2015/16 (Average pa over 4 years)
Relevant services	6.6%

Source: Ofcom analysis.

A15.124 There were variations in the results for different years. For example, the above results have been influenced by quite large efficiency gains in 2015/16. Gains in other years were sometimes small. Excluding the results for 2015/16 lowers the average annual efficiency gain over the 3 year period to 2014/15 to 4.4% pa. Including all pairwise years except for 2012/13[563] changes the average only slightly to 6.7% pa. The relative robustness of these results gives us reassurance over the output of this analysis.

A15.125 Our provisional conclusion from our analysis of regulatory cost information is that it provides evidence of historical efficiency gains of 4.4% to 6.7% - for our Relevant services.

Analysis of BT Management accounting data and forecasts

A15.126 In previous charge controls we have analysed historical and forecast "PVEO" analyses provided by BT for its divisions.[564] These analyses included cash costs reported by a division within its management accounts: operating costs, capital expenditure, costs incurred by the division itself and costs transferred in from other divisions.

A15.127 In the 2014 FAMR Statement,[565] we analysed BTs internal PVEOs for the Openreach division. We recognised the need to adjust these PVEOs so that both volume and price affects were in line with how they were being modelled in the charge control model. Openreach provided revised PVEOs to reflect volume inconsistencies it had highlighted in the July 2013 FAMR Consultation and for differences in inflation. We accepted Openreach's revised estimates of volume effects but made other adjustments, including our own view of Inflation.[566]

A15.128 For the June 2015 LLCC Consultation we identified three divisions whose costs we needed to analyse. We developed a methodology to weight different divisional PVEO results together using RFS weighting data.[567] We noted that volume[568] and price[569] effects should be estimated in a way that was consistent with the charge control model. We adjusted the PVEOs to use the same inflation measures as were

[563] Including 2012/13 produces a pa average efficiency rate of 6.4% per annum.
[564] When discussing our approach to pay cost inflation, we explained that a "PVEO" analysis breaks down annual movements in costs into changes due to Price (Inflation), Volume effects, Efficiency (or Cost Transformation) and Other.
[565] 2014 FAMR Statement, Annex 16.
[566] 2014 FAMR Statement, paragraphs A16.47 to A16.49.
[567] June 2015 LLCC Consultation. The methodology was similar to that we had used to estimate efficiency in WBA markets for the 2014 WBA Statement.
[568] June 2015 LLCC Consultation, paragraphs A8.201 to A8.203.
[569] June 2015 LLCC Consultation, paragraphs A8.204 to A8.207.

used in the model. However, we used the unadjusted volume effects estimated by each BT division and noted this required further investigation.

A15.129 In the 2016 BCMR Statement we refined our approach to address concerns raised by stakeholders, in particular BT,[570] by:

- analysing actual performance against the PVEOs. We found little evidence that the PVEO cost forecasts reflected "stretch" targets;[571]
- ensuring that costs to achieve efficiencies were reflected in our analysis;
- calculating volume effects for each division using a methodology consistent with our approach to modelling volumes in the charge control;[572]
- taking steps to eliminate double counting of efficiency savings across divisions;[573]
- re-weighting divisions' costs to reflect the cost mix for the markets we were reviewing;[574] and
- adopting estimates of inflation consistent with our own modelling assumptions, as in previous controls.

A15.130 In this consultation, we adopt the same approach to analysing BTs management accounting data as we used in the 2016 BCMR Statement but with one exception. We have analysed BTs historical and forecast divisional management accounts, not BT's PVEO analyses. We explain the reasons for this change below.

A15.131 Our methodology however still undertakes PVEO style analysis of each Relevant Division's operating costs, both historical and forecast. We analyse the effects of inflation, volume, and other[575] in a way that seeks to replicate the way these are modelled in the charge control model, with efficiency or cost savings being the balancing item. We then weight the Relevant Divisions' results together so that the cost mix reflects that of the Relevant Services to estimate historical and future efficiency gains.

A15.132 Before reporting the results of our analysis, we discuss the key steps in our analysis. We have:

- analysed historical and forecast management accounting data for the Relevant Divisions;
- excluded some costs from our analysis but included costs incurred to achieve efficiency savings;
- eliminated double counting of efficiency savings across divisions;

[570] More details on BT's criticisms are given in Annex 29, paragraphs A29.93 to A29.97 of the 2016 BCMR Statement.
[571] 2016 BCMR Statement, paragraphs A29.106 to A29.110.
[572] 2016 BCMR Statement, paragraphs A29.126 to A29.131.
[573] 2016 BCMR Statement, paragraphs A29.114 to A29.117.
[574] 2016 BCMR Statement, paragraphs A29.118 to A29.121.
[575] BT's response dated 24 June 2016 to question B6 of the 7th BT s.135 request.

- taken steps to reflect differences in efficiencies across products;
- calculated volume effects that are consistent with our approach in the top-down model;
- taken account of inflation in a way that is consistent with our approach in the top-down model; and
- combined the results for the Relevant Divisions.

Historical and forecast management accounting data

A15.133 In previous charge controls we have analysed historical and forecast "PVEO" analysis of management accounting data for BT divisions.[576] For this charge control we have not used BT's PVEOs as the raw inputs for these calculations. Instead we propose to base our historical analysis on BT's reported divisional management accounts and our forward-looking estimates on forecasts prepared by BT's Relevant Divisions as part of BT's business planning process.

A15.134 We propose this change because we encountered several data issues with the PVEOs including:

- a lack of a consistent set of PVEOs for the BT Relevant Divisions for all years. TSO no longer produces PVEO analyses that cover all costs, though it used to undertake PVEO type analyses of labour costs.[577] It is therefore likely to become increasingly difficult to base our estimates on PVEO analyses in the future;[578]
- BT has not always been able to provide us with PVEOs for the Relevant Divisions that show the movement in costs reported in one year to those reported in another year; and
- PVEOs for many of the cost transfer lines were limited in that inflation, volume and efficiency effects were small or zero.

A15.135 Using BT's reported historical divisional management accounts also addresses BTs concerns that its PVEOs presented costs that reflected stretch targets which are or were not realistic.[579] It does not necessarily address the concern that any forecasts may be over-stretching although, as noted above, our analysis in the 2016 BCMR Statement of historical forecast PVEOs provided little support for that claim.[580] We will however continue to monitor BT historical divisional forecast costs against performance.

A15.136 Using our formal powers, we requested historical management accounting data from BT covering the period 2012/13 to 2015/16[581] and forecast management accounting data covering the period 2016/17 to 2017/18.[582] We have not considered

576 2016 BCMR Statement, paragraph A29.103.
577 See our discussion of BT management accounting pay costs in our analysis of pay cost inflation.
578 See also the discussion in paragraph A29.140 of the 2016 BCMR Statement.
579 2016 BCMR Statement, paragraph A29.94.
580 2016 BCMR Statement, paragraphs A29.106 to A29.10.
581 BT's response to Section B of the 7th BT s.135 request.
582 BT's response dated 17 June 2016 to section C of the 7th BT WLA s.135 request and BT's response dated 27 January 2017 to question 11 of the 23rd BT WLA s.135 request.

data from before 2012/13. There are practical issues with obtaining consistent data before 2012/13 given that TSO was created in 2012/13.

A15.137 BT raised some concerns about the reliability of its most recent forecast cost data:

> "The most recent BT Group Business planning process under which BT divisions submitted their cost forecasts …. [was] approved in March 2016. These cost forecasts were updated and submitted as part of the October 2016 BT Group Business planning process …… the submitted forecasts remain subject to change and BT Board approval. This year, in particular, there are likely to be significant changes between the October forecasts and the next update of the costs forecasts."[583]

A15.138 We have used the most recent Openreach forecasts within our analysis as they are the latest that we have and likely to be more reliable than those produced in March 2016. We have however used the TSO forecasts from March 2016 to be consistent with the weighting data that we use.[584] TSO's October 2016 BUR submissions include costs that reflect revised activities because of the acquisition of EE but the costs of these activities are not included within the 2015/16 RFS data that we use to weight cost lines together. As we need the weighting data to be consistent with the management forecasts we have not used TSO's latest October 2016 forecasts in our analysis but have instead reverted to TSO's March 2016 forecasts. We do not consider this critical to our analysis for this consultation as the previous paragraph has noted some concerns about the reliability of the October forecasts.

Cost exclusions and treatment of costs required to achieve efficiency savings

A15.139 To be consistent with our general modelling approach we have made some adjustments to BT's historic and forecast management accounting data. We remove:

- cumulo rates costs[585] as we forecast these separately within the top-down model and do not apply our efficiency target to them. This approach is consistent with our analysis of BT regulatory accounting data; and
- POLOs (Payments to other Licenced Operators). These costs are not relevant to the Relevant Services.

A15.140 In its response to the June 2015 LLCC consultation, BT argued that we had not reflected the costs required to deliver future efficiencies. We have included the change in costs incurred to achieve cost savings within the overall change of costs for each division, as we did for the 2016 BCMR Statement. We have not subtracted costs required to achieve efficiencies from costs savings as to do so would be inconsistent with how these costs are treated in the top-down model. The base year costs for the top-down model include costs such as restructuring, leaver costs and property provisions. This model forecasts how all costs will change over the change control period. If we had deducted, say, leaver costs from the cost savings in any year, then this would mean that BT received the benefit of these costs twice: once via the base year costs and again via the efficiency assumption.

[583] BT's response dated 27 January 2017 to question 11 of the 23rd BT WLA s.135 request.

[584] See also the discussion below about how we have combined results for the Relevant Divisions.

[585] BT's response dated 17 June 2016 to question B10 of the 7th BT WLA s.135 request.

A15.141 We have therefore adopted the same approach to costs required to achieve efficiencies in this analysis as we did in the regulatory cost analysis we describe above. The regulatory cost data we analysed included attributions of restructuring and other costs to achieve efficiencies. We analysed changes in total operating costs which therefore included any changes in the level of these costs.

Ensuring no double counting of efficiency savings

A15.142 We have explained why we have considered the costs from our Relevant Divisions, Openreach and TSO. We therefore need to combine the results for these divisions to estimate historical and forecast cost savings for the cost base for the Relevant Services. However, as BT divisions' management accounts include both directly incurred costs and transfers from other divisions there is a risk that we might double count or exclude some cost savings. We may double count cost savings made in one division if these are then passed through in transfer charges to another division. We may exclude some cost savings if costs savings achieved by one division are not reflected in the final transfer charges to other divisions.

A15.143 In the 2016 BCMR Statement we explained that one option to eliminate double counting would be to restrict our analysis to consider only costs incurred in the originating division by removing all costs that had been transferred in. However, our ability to do this was limited by the data available. We also did not feel it would be appropriate to exclude all transfer charges between all BT divisions because this might exclude some major legitimate cost items, like, for example, accommodation charges, which are transfers to BT divisions from BT Group Property.

A15.144 Our proposed approach is to remove the risk of double counting of cost savings associated with transfer charges by removing internal transfers that occur between the two Relevant Divisions from the costs of the receiving division. This ensures that no double counting occurs and the costs and associated cost savings are only recognised in the division where they are incurred.[586] [587]

Reflecting differences in efficiencies between products

A15.145 In the 2016 BCMR Statement we recognised that differences in cost mix may lead to different levels of potential cost savings for different products.[588] For example, if savings in accommodation costs are likely to be low then products with a higher than average proportion of accommodation costs are likely to experience lower than

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[586] BT provided on 17 June 2016, in its response to question B10 of the 7th s.135 request, details of all the major historical "transfers out" and "transfers in" for the Relevant BT Divisions. These covered over 80% of the total transfers within each division. Differences between these and the transfers within the management accounts were generally small. For each Relevant Division, we removed the transfers in from other Relevant Divisions from the management accounts. We did not make any adjustments for "transfers out" as these can be separately identified and removed from the management account data.

[587] For management account forecasts after 2015/16 we had information on total transfers but no breakdown of this by division. For these years we have used the split of transfers from 2015/16. This is the same approach we have adopted in other areas where forecast data is not available. We do not believe this is a critical assumption as transfer charges from 2013/14 to 2015/16 were broadly similar.

[588] 2016 BCMR Statement, paragraphs A29.118 to A29.121

average cost savings. This led us to propose that we should reflect differences in the cost mix of different services within our analysis.

A15.146 We received data from BT for 2013/14, 2014/15 and 2015/16 which showed how Openreach, TSO, and all other divisions' pay and non-pay costs, split by several major cost sectors, had been allocated to the Relevant Services, all other regulated markets and all unregulated markets.[589] We reconciled this data to the management accounting data we had received for the Relevant Divisions.[590] This allowed us to weight together the results for each of the cost groupings within each Relevant Division's management accounts in each year so that the cost mix better reflected that of the Relevant Services.[591] By doing this we have taken steps to address differences in cost savings between products.

Calculating volume effects consistent with the top-down model

A15.147 Within the top-down model, we apply our efficiency assumption to operating costs after taking account of inflation and changes in volumes.

A15.148 It is important that we reflect the effect of changes in volumes in a way that is consistent with our overall modelling approach when we estimate historical and forecast cost savings or efficiencies from any evidence. One of BT's criticisms in response to our June 2015 LLCC Consultation was that by using BT's estimated volume effects (its "V"s) given in its divisional PVEO analyses we had not done so.

A15.149 The Relevant Divisions' costs within their historical and forecast management accounts are not broken down by product or service. We therefore propose to estimate the effects of changes in volumes by applying a CVE to an estimate of the volume growth for each Relevant BT Division in each year. This divisional growth rate needs to reflect volume growth across all the products and services supported by activities within that division. This is the same approach we adopted in the 2016 BCMR Statement.

A15.150 Due to data availability, we have used different approaches to estimate these divisional volume growth rates:

- For **Openreach,** we have weighted together average volume growth in each market by prior year revenues using weights derived from the Openreach Income Statements published within BT's RFS.[592] We have calculated volume growth in each RFS regulated market in each year by analysing revenue growth and removing the impact of price changes. We did this by comparing revenues in the prior year with current year volumes multiplied by prior year prices. We have also undertaken some further analysis to reflect the impact of growth in VULA

[589] BT's response dated 17 June 2016 to question D1 of the 7th BT WLA s.135 request and BT's response dated 9 December 2016 to question D1 of the 20th BT WLA s.135 request.

[590] We provide more details of the reconciliation process below when we explain how how we have combined the results for the Relevant Divisions. See paragraph A15.158.

[591] The weights we have applied in years after 2015/16 reflect the weights we calculated for 2015/16.

[592] BT's 2016 RFS, page 115. These schedules show Openreach revenues for various regulated markets. Other schedules within BT's RFS provide further splits of market revenues by product and service for both current and prior years together with information on average prices and volumes.

services.[593] Finally, we have undertaken two further calculations as a cross check on these estimates.[594] Our estimates of volume growth over the last three to four years were broadly consistent in that they all suggested small positive growth.

- For **TSO** we have estimated volume growth using information on TSO transfer charges to other divisions.[595] We calculated an overall volume growth rate by weighting volume growth rates for each division by its TSO transfer charge.[596] [597]

A15.151 Table A15.14 below shows our calculated volume growth rates for the two Relevant Divisions.[598]

Table A15.14: Ofcom estimates of historical volume growth for Relevant Divisions

Market	2013/14	2014/15	2015/16
Openreach	[✂]	[✂]	[✂]
TSO	[✂]	[✂]	[✂]

Source: Ofcom analysis of BT data.

A15.152 Lastly we have applied a standard CVE of [✂] across all cost categories and all divisions in all years. We have calculated this CVE from BT LRIC and FAC

[593] Prior to BT's 2014/15 RFS, revenues and costs for VULA services were reported within Wholesale Residual Markets. In the 2014/15 RFS these costs and revenues were reported within the WLA market but not separately identified. To assess how VULA services contribute to Openreach volume growth we have assumed that Other WLA service revenues reported in the 2015/16 and 2014/15 RFS for 2013/14, 2014/15 and 2015/16 are predominantly VULA services [✂] and used this revenue growth as a proxy for volume growth. Before 2014/15 we have estimated VULA services volume growth from BT published KPI data on fibre connections and used this to infer VULA service revenues in prior years. Finally, we have removed these estimated VULA service revenues from "Other Openreach Markets and Activities" and assumed revenue growth is a reasonable proxy for volume growth for the remaining non-VULA services.

[594] Firstly, we analysed the change in Openreach reported revenues (see for example http://www.btplc.com/Sharesandperformance/Quarterlyresults/2016-2017/Q3/Downloads/KPIs/q317KPIs.pdf) [accessed 27 March 2017] and estimated volume growth by removing the effect of price increases by deflating these by a price index (Business Telecom Services Producer Price Index published by ONS). Secondly we analysed internal product transfer costs made by Openreach to other BT divisions (BT response dated 17 June 2016 to question B10 of the 7th s.135). We weighted our estimated volume growths for these products from our analysis of RFS market data by prior year transfer charges.

[595] BT's response dated 17 June 2016 to question B10 of the 7th BT WLA s.135 request. TSO sends transfer charges to most BT divisions including Global Services, BT Retail and BT Consumer.

[596] The growth rates we used for Openreach are those that we describe above.

[597] We estimated volume growth in BT Wholesale, BT Retail, BT Consumer, BT Business and Global Services these divisions from the change in published revenues deflated by a price index (using BT KPI reports e.g. http://www.btplc.com/Sharesandperformance/Quarterlyresults/2016-2017/Q3/Downloads/KPIs/q317KPIs.pdf) [accessed 27 March 2017]. We used the Service Producer Prices Index, series K8U1, to deflate BT Business and Global Services revenues and CPI Index 08.2, Telephone and Telefax Equipment and Services, series D7EM, to deflate BT Retail and BT Consumer revenues.

[598] We have used the 2015/16 forecasts in years post 2015/16. That is consistent with the approach we have adopted in other areas where we do not have forecast data.

operating cost (excluding depreciation) data[599] in a similar way to how we have calculated CVEs for the top-down model except that we have aggregated the results across all network components. The resulting CVEs were very similar for each of the four years we analysed: 2012/13, 2013/14, 2014/15 and 2015/16.[600]

Applying inflation assumptions consistent with the top-down model

A15.153 It is important that we adopt a consistent approach to inflation in the analysis of efficiency and in our modelling approach given the interaction between our inflation and efficiency assumptions. It is also important as efficiency is calculated as any remaining differences in costs after taking account of inflation and changes in volumes.

A15.154 Historical changes in costs will have been affected by inflation. When undertaking our analysis of BT's historical management accounts data, we have therefore input our own historical estimates of the effects of inflation, (the "P" in our PVEO style analyses) in the same way that we have input the effect of volumes, (the "V").

A15.155 It is less clear whether this is the correct approach for our analysis of forecast costs as it may be inconsistent with the way these forecasts have been prepared. For example, if divisional cost forecasts are prepared for accommodation transfers assuming no inflation, then it would be wrong to input our estimate of inflation for these costs. However, as we do not have any evidence to suggest that the cost data that we have been provided has been prepared assuming zero inflation we propose to input the "P" effects within our analysis of forecast costs in the same way that we do for our analysis of historical costs discussed above.

A15.156 Our proposed approach is consistent with how we deal with the effects of inflation in our other analyses, such as our analysis of regulatory cost data, and with our modelling assumptions. We apply different inflation assumptions to different types of costs in each year. Table A15.15 provides the values we have used in this analysis.[601]

Table A15.15: Inflation assumptions used in our management account efficiency analysis

	2013/14	2014/15	2015/16	2016/17 to 2018/19
Pay	2.4%	1.8%	2.2%	3.1%
Property	3.0%	3.0%	3.0%	3.0%
Energy	2.9%	4.7%	5.6%	7.0%
Other External	2.3%	1.1%	0.1%	2.0%
Transfers	2.3%	1.1%	0.1%	2.0%

[599] LRIC and FAC data came from the Additional Financial Information schedules that BT provides to us each year. LRIC data was taken from the AFI1 and AFI2 schedules, the comparable FAC data was taken from the AFI3 and AFI4 schedules.

[600] The constant CVE assumption is a simplification but one we consider is not inappropriate given the range of costs that the CVE is being applied to and the low volume growths we have calculated. We do not consider it a critical assumption to our efficiency estimates.

[601] We discuss our approach to assessing operating cost inflation earlier in this Annex.

Source: Ofcom analysis.

Combining results for the Relevant Divisions

A15.157 We obtained information from BT for 2013/14[602], 2014/15[603] and 2015/16[604] that shows how costs for Openreach, BT TSO and all other divisions are allocated to the Relevant Services, split by cost sector.[605]

A15.158 We have made a number of adjustments to make this "weighting" data consistent with the management accounts cost data that we have used to assess efficiency for the Relevant Divisions. In particular, we have[606]:

- aligned the RFS weighting data with the management accounts data. This process largely consists of reversing out internal transfers that have been captured in the management accounting data but not the RFS data or vice versa;
- mapped the RFS cost sectors through to the main management account cost groupings;[607] [608]
- removed internal transfers between the two Relevant Divisions in the same way that we adjusted the divisional cost data;
- excluded cumulo rates and POLO costs;
- excluded costs attributed to divisions other than Openreach and TSO[609]; and
- excluded all capital costs including depreciation (as this part of our analysis focuses on operating costs).

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602 BT's response dated 17 June 2016 to question D1 of the 7th BT WLA s.135 request.

603 BT's response dated 17 June 2016 to question D1 of the 7th BT WLA s.135 request.

604 BT's response dated 9 December 2016 to question D1 of the 20th BT WLA s.135 request.

605 With energy separately identified from the accommodation cost sector and cumulo separately identified from the Plant support cost sector. A description of the operating cost sectors that BT uses within its RFS is given in BT's 2016 AMD pages 348 to 342.

606 As in our regulatory cost analysis we have not made any changes to this weighting data to reflect the allocation changes we have made to our base year data for this control. Such an exercise would have been complex and would have run the risk of introducing errors into our analysis.

607 BT's response dated 1 July 2016 to question D4 of the 7th BT WLA s.135 request and BT's response dated 9 December 2016 to question D4 of the 20th BT WLA s.135 request.

608 The management account cost groupings that we have used are; Network Maintenance, Provision and Installation, Property (excluding Electricity), Electricity, Cumulo, Computing and IT, Transport, OOI, POLOs, Depreciation and All other Operating costs. These groupings were selected by Ofcom as they separately identify the largest costs in the two divisions.

609 These costs are a small proportion of costs for the Relevant Services and are mostly costs associated with BT Group Functions (BT response to 7th s.135 request, question D1 provided 17 June 2016). We do however include Group Function transfers such as accommodation costs. These are in both the Openreach and TSO divisional management accounts and the regulatory "weighting" data.

A15.159 Table A15.16 below shows the shares of the Relevant Services costs by division[610] in 2013/14, 2014/15 and 2015/16 considering the above adjustments. We have used these cost shares to weight the divisional analyses to estimate efficiency improvements for the Relevant Services.

Table A15.16: Relevant Services combined operating costs by division for 2013/14, 2014/15 and 2015/16

	Year	Openreach	TSO
Relevant services	2015/16	[✂] (~80-100%)	[✂] (~0-20%)
	2014/15	[✂] (~80-100%)	[✂] (~0-20%)
	2013/14	[✂] (~60-80%)	[✂] (~20-40%)

Source: Ofcom analysis.[611]

A15.160 Table A15.16 shows that Openreach's share of the Relevant Services' costs has been [✂] over the period 2015/16. We apply the 2015/16 shares in our analysis of all data post 2015/16.

A15.161 As we explain above TSO's October 2016 BUR submissions include costs that reflect revised activities because of the acquisition of EE but the costs of these activities are not included within the 2015/16 RFS weighting data. As we need the weighting data to be consistent with the management forecasts we have not used TSO's latest October 2016 forecasts in our analysis but have instead reverted to TSO's March 2016 forecasts. We will update our analysis for the Statement.

A15.162 We have used the resulting adjusted weighting data for two purposes. Firstly, we have weighted the Relevant Divisional management accounts together in proportion to the total operating costs[612] in each division. Secondly, we have re-weighted the cost lines within each Relevant Division's management accounts so that the mix of costs reflects that used to supply the Relevant Services.

Summary of our revised approach to analysis of BT Management Accounting data

A15.163 To summarise, our analysis of historical and forecast BT divisional management accounting data has taken the following steps:

- obtain two sets of input cost data: firstly, BT management accounting data for each Relevant Division and secondly, RFS data that shows how costs split by BT division and market;

- undertake a reconciliation exercise to ensure that the two sets of input cost data for the Relevant Divisions are comparable;

[610] Shares calculated so that the two Relevant Divisions total to 100% i.e. all other divisions contributing to relevant services costs are not factored into this weighting.

[611] BT's response dated 17th June 2016 to section D of the 7th BT s.135 request; BT's response dated 20th September 2016 to question 28 of the 14th BT s.135 request; BT's responses dated 12th and 13th December 2016 to section D of the 20th BT s.135 request; and BT's response dated 20th February 2017 to questions 5, 6, and 7 of the 24th BT s.135 request.

[612] Excluding depreciation.

- remove transfer charges into each Relevant Division from the other Relevant Divisions in both sets of data;
- adjust management accounting data for each Relevant Division such that they reflect the cost mix for those services consistent with the adjusted RFS data;
- input estimates of price ("P") and volumes ("V") effects with assumptions that are consistent with those we adopt in the top-down model; and
- combine the adjusted Relevant Divisions' results to produce overall management account PVEO analyses using the final adjusted RFS data.

Estimates of divisional efficiency from BT management accounting data

A15.164 Table A15.17 shows the efficiency estimates of divisional efficiency we have calculated from following the above process. We show the results separately for average historical efficiency over the period 2012/13 to 2015/16 and forecast efficiency over the period 2015/16 to 2017/18.

Table A15.17: Ofcom estimates of efficiency gains on operating costs

BT division	Average gain 2012/13-2015/16	Average gain 2015/16-2017/18
Openreach	6.1% pa	4.9% pa
TSO	7.1% pa	5.7% pa

Source: Ofcom analysis.[613]

Results of management accounting analysis

A15.165 Table A15.18 shows historical and future forecast efficiency estimates for the Relevant Services' operating costs based on our analysis of BT's management accounting data and Business Unit Review forecasts. These reflect the results of weighting the annual estimates of historical specific divisional efficiency for the Relevant Services by the divisional shares given in Table A15.16. These support setting efficiency targets of 4-7% per annum for our Relevant services.

Table A15.18: Historical and future forecast estimates of efficiency gains for the Relevant Services' operating costs[614]

	2012/13-2015/16	2015/16-2017/18
Range	6.0-7.5% pa	4.4-5.9% pa
Average Gain	6.6% pa	5.1% pa

Source: Ofcom analysis.[615]

[613] BT management account data supplied in response dated 17th June 2016 to section B of the 7th BT s.135 request; BT Business Unit Review data supplied in response dated 17th June 2016 to questions C1 and C2 of the 7th BT s.135 request; and BT Business Unit Review data supplied in response dated 28th January 2017 to question 11 of the 23rd BT s.135 request.

[614] These estimates reflect that there is no contribution to cost savings from cumulo rates costs.

[615] BT management account data supplied in response dated 17th June 2016 to section B of the 7th BT s.135 request; BT Business Unit Review data supplied in response dated 17th June 2016 to questions C1 and C2 of the 7th BT s.135 request; and BT Business Unit Review data supplied in response dated 28th January 2017 to question 11 of the 23rd BT s.135 request.

Benchmarking and external studies

A15.166 We consider appropriate benchmarking data and wider economic studies of efficiency can provide a potentially informative source of evidence. We have therefore reviewed several benchmarking studies - some recent studies as well as some which we have considered during previous market reviews - and some wider external studies that include estimates of efficiency for the economy and/or the telecoms sector as a whole.

A15.167 An advantage of evidence from benchmarking data and data originating from outside BT is that it can be used to assess BT's relative efficiency performance. It therefore complements most of our other evidence, which is more focussed on historical and forecast cost savings data for BT only.

A15.168 However, there can be issues with interpreting the results from these studies. It is sometimes difficult to make comparisons on a like-for-like basis, and to take account of relevant exogenous factors such as population density.

A15.169 We also need to assess the relevance of the results from these studies by considering the extent to which they have calculated efficiency in a way that is consistent with our modelling approach. For example, have the effects of changes in volumes and inflation been reflected in a similar way? Has the efficiency estimate been made with respect to the same scope of costs – for example, capital costs – to which we apply our efficiency assumption?

A15.170 Benchmarking studies can be used to support estimates of catch-up or frontier shift efficiency. Ideally comparisons to estimate catch-up should be against that for an efficient comparator.

A15.171 In the rest of this section we consider evidence from various benchmarking and external studies. We first consider previous benchmarking studies provided to us by BT, then new studies provided by BT, before finally reviewing the alternative sources of evidence.

A15.172 In its responses to the June 2015 and November 2015 LLCC Consultations, BT referred to several historical efficiency studies that had either been commissioned by itself or had been undertaken for previous charge controls. These generally estimated lower levels of efficiency compared with those we were proposing as part of the June 2015 LLCC consultation. We briefly review these studies below.

2015 Deloitte study

A15.173 This study was the most recent study commissioned from Deloitte by BT. We had largely rejected the results of a previous study, undertaken by Deloitte in 2013, in our 2014 FAMR and WBA Statements.[616]

A15.174 The purpose of the 2015 Deloitte study was to demonstrate the magnitude of the difference between average growth of Total Factor Productivity (TFP) in a selection of fixed line operators and the estimate of efficiency growth then proposed for the forthcoming charge control.[617] The study calculated TFP growth for nine telecommunications operators (including BT) over the period 2002 to 2014. Deloitte

[616] 2016 BCMR Statement, paragraph A29.191.

[617] Annex G, BT Response to the June 2015 LLCC Consultation.

estimated average TFP growth across its sample to be 0.5-0.7% per annum or 1.1-1.3% if the results from KPN and Magyar Telecom were omitted[618]. Deloitte's estimate for BT was 1.1-1.2% per annum.

A15.175 In the 2016 BCMR Statement we reported our concerns about this study.[619] In particular, we did not believe it provided reasonable estimates of the cost savings that we were trying to capture within the charge control. We also noted some issues with Deloitte's input and output indices. For example, it was not clear that the broadband output measure reflected the change in mix from standard ADSL services to much higher bandwidth SFBB services. The input index did not cover the same range of costs for which we wished to estimate cost savings and was therefore not consistent with our modelling approach.

A15.176 We gave little weight to Deloitte's report when assessing efficiency targets for the 2016 BCMR statement. For the same reasons as those outlined above, we also give no weight to it when assessing efficiency targets for this charge control. We also note that Deloitte's estimate of BT's historical efficiency is much lower than EY's more recent assessment of 5% that we noted when discussing efficiency assumptions in other charge controls above.

NERA and KPMG studies

A15.177 The NERA studies analysed data from 1996 to 2006, while the KPMG study considered data from 1987 to 2006.[620] In the 2016 BCMR Statement we said:

> "We think it would be wrong to rely on studies that analysed changes in costs over periods that long ago, preceding the start of the relevant control period. It is doubtful that such changes are relevant to how costs may change over the charge control period even assuming the studies analysed cost in ways that are consistent with our charge control modelling approach."[621]

A15.178 We continue to place no weight on the results of these studies when considering efficiency targets for this charge control.

Other evidence

A15.179 BT provided a study that had been undertaken by [✂ third party][622], as well as a benchmarking study into IT costs presented annually to the Gartner European Telco CIO forum.[623]

A15.180 Using our formal powers, we asked BT to provide us with copies of benchmarking studies it held or had commissioned since the 2016 BCMR Statement. BT provided

[618] Deloitte also reported results excluding KPN and Magyar Telecom as "the significant negative results for these operators could also be the results of changes in reporting in the annual statement across years", p23 of Annex G, BT Response to the June 2015 LLCC Consultation.
[619] More details of our review of the 2015 Deloitte study are given in paragraphs A29.182 to A29.188, Annex 29 of the 2016 BCMR Statement.
[620] BT response to the June 2015 LLCC Consultation – Annex E, August 2015, page 5, Table 1.
[621] 2016 BCMR Statement, paragraph A29.191.
[622] [✂].
[623] 2016 BCMR Statement, paragraph A29.172.

[✂] and the most recent Gartner European Telco CIO forum. We discuss each of these in turn.

[✂third party] study

A15.181 BT provided us with details of a [✂] study [✂][624] The study [✂]

A15.182 We have used this study [✂][625] [✂]

A15.183 [✂][626] [✂][627] [✂]

A15.184 [✂]. Different companies are run and organised in different ways and there will be different ways of achieving efficiencies and cost savings. [✂]

A15.185 However, when we did so we encountered some issues. [✂][628] [✂].

A15.186 We questioned the accuracy of these driver volumes with BT, which said that:

> "Both BT and [✂ third party] are aware of the issues raised and we are working jointly to resolve" and that "BT is working with [✂ third party] to provide revised results. [✂][629] BT also noted in one of its responses to us that "[✂ third party] had written to Openreach requesting we review some of our data submissions".[630]

A15.187 We will be aiming to resolve these data issues for the Statement, but for this consultation we do not think it would be right to place any weight on results that use these driver volumes for [✂].

A15.188 We therefore re-ran both our analyses, [✂], excluding the costs of activities for which the driver was [✂] The results of our analysis are presented in Table A15.19 below.

Table A15.19: [✂]

		[✂]	[✂]	[✂]	[✂]
Operating Costs	[✂]	[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]	[✂]	[✂]
Capex	[✂]	[✂]	[✂]	[✂]	[✂]

624 BT response of 22 December 2016 to question B3 of the 20th WLA x.135 request.
625 BT response of 31 January 2017 to question B4 of the 20th WLA s.135 request.
626 [✂] provided in BT's response dated 31st January 2017 to question B4 of the 20th BT s.135 request.
627 [✂]
628 [✂] provided in BT's response dated 22nd January 2017 to question B3 of the 20th BT s.135 request.
629 BT's response dated 20th February 2017 to question 4 of the 24th BT s.135 request.
630 BT's response dated 22nd December 2016 to question B3 of the 20th BT s.135 request.

	[✂]	[✂]	[✂]	[✂]	[✂]
	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis.[631]

A15.189 We make some further observations on the study and our analysis:

- [✂]
- [✂]
- [✂]

A15.190 However, given the data issues outlined above, we give low weight to the results from this study.

<u>2016 Gartner CIO European Telco Benchmarking Exercise</u>

A15.191 BT provided us with the results of a benchmarking exercise undertaken by Gartner for nine European telecoms operators.[632] The benchmarking exercise compared [✂].[633]

A15.192 Whilst this study might provide useful insight for BT and [✂] we have not taken it into account when formulating our efficiency proposals for this charge control. There are several reasons for this. Firstly, [✂] which accounts for a relatively small proportion of BT's costs covered by this charge control. Secondly [✂]. Lastly the use of [✂] makes it hard to interpret the results in a way that is consistent with our modelling approach. [✂].

<u>Economy wide TFP and labour productivity studies</u>

A15.193 We have also considered whether we could use measures of efficiency for the UK economy as benchmarks to help us determine our efficiency targets. We have considered the following:

- The Office for National Statistics (ONS) presents estimates of historical multi-factor productivity (MFP)[634] for all sectors of the economy and by sector. MFP estimates can be considered as measures of frontier shift. The results for Sector J, Information and communications, vary significantly by year. The average over the period 1998 to 2014 was 2.8% per annum. The average since 2010 is much lower, at 0.9%.

- The IMF published a paper that contained estimates of historical labour productivity in the UK. The IMF estimated that information and communications TFP fell from 3.5% per annum over the period 2006 to 2008 to 1.3% per annum over the period 2009 to 2014.

[631] BT's response dated 31 January 2017 to question B4 of the 20th BT s.135 request.
[632] BT's response dated 16 December 2016 to question B1 of the 20th BT s.135 request.
[633] [✂].
[634] Office for National Statistics, Multi-factor productivity estimates: Experimental estimates to 2014, 06 May 2016 (ONS 2016). https://www.ons.gov.uk/economy/economicoutputandproductivity/productivitymeasures/articles/multifactorproductivityestimates/experimentalestimatesto2014.

- The OBR produces estimates of forecast labour productivity growth. Its November 2016 forecasts are that productivity per hour across the economy should increase from 1.8% in 2019, to 2.0% in 2020, and 2.0% in 2021.

A15.194 However, these studies do not estimate efficiency in a way that is consistent with our modelling approach or have other issues that make them not relevant to our assessment of efficiency targets for this charge control. For example

- The ONS studies use data on gross value add that include measures of historical capital investment whereas we apply our efficiency assumption only to (new) capital expenditure.

- The treatment of volume growth in all the studies appears different to how we model the effects of volume growth.

- The ONS studies show efficiency or productivity growth will vary by sector, with telecoms being one of the higher performing sectors. Estimates for the whole economy are therefore unlikely to be relevant when setting efficiency targets for BT. Even the ONS results for Sector J cover a wider range of activities including software publishing (division 58), motion picture and sound recording activities (division 59), radio and TV broadcasting and programming activities.

A15.195 Given the above concerns we do not believe it is appropriate to use these studies when determining our efficiency targets.

Efficiency targets from benchmarking and wider efficiency studies

A15.196 External efficiency benchmarks and wider efficiency studies can provide useful evidence to complement our “internal” estimates of BT’s scope for cost reductions based on BT data. However, whilst we have considered such evidence from a range of different studies, we found issues of timeliness, reliability, and relevance with practically all the evidence we have reviewed.

A15.197 We have therefore placed no weight on this evidence in proposing our efficiency targets for this charge control with the exception that we give a small weight to results from the [✂ third party] study when considering our target ranges for efficiency on both operating costs and capex. We will be reviewing further evidence for the Statement and hope to resolve some of the data issues that we encountered when analysing data from [✂ third party]

Review of public information

A15.198 We have reviewed public statements by BT and other external views on BT’s cost transformation programmes.

A15.199 As in previous market reviews we have reviewed a number of recent sources of public information on BT’s cost performance. We have already noted the report BT commissioned from EY which stated that “BT has made operating expense (“OPEX”) savings of around 5% per annum”.[635] We have not been able to find any further analyst reports that comment on BT’s cost transformation opportunities

[635] See paragraph A15.106. EY report commissioned by BT, “BT’s Regulatory Profitability response”, 3rd October 2016, Page 9, paragraph 4.12, https://www.ofcom.org.uk/__data/assets/pdf_file/0024/93642/BT-Annex-EY.pdf.

beyond those we reviewed for the June 2015 LLCC Consultation. These are now somewhat out of date as they followed a cost transformation teach-in that BT held in December 2014.[636]

A15.200 The information we have reviewed is:

- a presentation that BT made to an investor meeting to discuss its Q2 2016/17 results in November 2016; and
- a transcript from BT's presentations at its capital markets day held in May 2016.

BT investor meeting on Q3 2016/17 results - presentation

A15.201 The presentation included several slides[637] on BT's cost transformation programme. Slide 28 showed that cost savings made across the group over the 7 year period from 2008/09 to 2015/16 totalled c£4.7bn on operating costs and c£0.8bn on capital expenditure.[638] [639] This is a reduction of roughly 4.7% for opex and 4.1% for capex per annum in nominal terms; reductions in real terms would therefore have been around 6.9% for opex and 6.2% for capex per annum.[640] [641]

A15.202 A note on Slide 28 said that there were "*still well in excess of £1bn gross cost saving opportunities in the next 2 years*". This was repeated on Slide 29 which also provided examples of cost transformation initiatives. In our view, several of these activities would contribute to savings in regulated markets and the Relevant Services, for example:

- product/customer journeys;
- people and organisation - spans and layers;
- IT and networks; data centre rationalisation, centralised IT and automated code review; and
- improving efficiency; pan-BT reviews of TLC, SG&A, discretionary spend, procurement tail.

A15.203 Slide 30 showed that net labour costs reduced across the group by roughly 20% over the period 2009/10 to 2015/16, again in nominal terms. These 20% reported savings are not consistent with the way we apply efficiency within the top-down model as they make no allowance for changes in volumes or inflation. However, we believe that if anything the 20% will understate costs savings if they were restated

[636] Further information on these analysts' reports are given in paragraphs A8.234 to 8.235 of Annex 8 of the June 2015 LLCC consultation.
[637] Slides 27-37, http://www.btplc.com/Sharesandperformance/Quarterlyresults/Investormeetingpack.pdf.
[638] This analysis was presented on a pre EE basis.
[639] BT notes in its slides that this c£0.8bn excludes £229m grant funding deferral in 2015/16.
[640] Converted to real terms using ONS CPI table http://www.ons.gov.uk/economy/inflationandpriceindices/timeseries/d7bt/mm23.
[641] At the previous year's investor meeting following the Q3 2015/16 results total savings over the six-year period from 2008/09 to 2014/15 were presented as being c£5.5bn. This suggests that cost savings in 2015/16 were c£0.1bn.

to reflect our modelling approach.[642] If nothing else the slides again demonstrate BT's ability to reduce its labour costs.

A15.204 Slide 32 of the presentation noted that BT is confident of cost "synergies" as a result of its recent merger with EE. BT estimated that "Total opex and capex synergies in 4th full year post completion" would be c. £400m, an increase from the c.£360m forecast in February 2016. Slide 35 provides further details on the business areas where synergies are expected by 2019/20 and includes network, IT and support functions. It seems likely that some of these synergies will lead to lower costs across regulated markets over the charge control period.

A15.205 Finally, slide 106 noted Openreach's plans to transform its costs. Slide 110 noted that Openreach plans to improve its service in several ways including by "smarter working".

BT's capital markets day May 2016

A15.206 In his presentation at the BT Capital Markets Day, held May 2016, Tony Chanmugam stated "As of today we still have visibility of well over £1 billion of gross cost savings to be delivered over the next 2 years….and [these cost savings] excludes EE integration savings."[643]

A15.207 Tony Chanmugam further went on to state: "The trend in relation to gross cost transformation savings for the last two or three years compared to moving forward is not materially different." [644]

Provisional conclusions on other public information

A15.208 We acknowledge that the above public statements are not specific to the Relevant Services and that any cost savings reported do not reflect changes in volumes consistent with our modelling approach. However, BT's more recent statements confirm that BT has cut costs through its cost transformation programmes and that it believes there are still significant opportunities to continue to do so over the charge control period and at a similar rate to those in the past. We therefore consider that these statements provide qualitative evidence that cost savings are likely to materialise for the Relevant Services at levels not dissimilar to those achieved in the past. We give this evidence a low to moderate weight to inform our estimates of potential efficiency gains.

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[642] Inflation is small but positive. The analysis of volume growth we describe above when estimating efficiency from BT internal Management Accounting data suggests low but positive volume growth across the Group.

[643] BT Capital Markets Day transcript, 5th May 2016, http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/Q4/Downloads/Webcast/q416-transcript.pdf Page 5.

[644] BT Capital Markets Day transcript, 5th May 2016, http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/Q4/Downloads/Webcast/q416-transcript.pdf page 22.

Proposed efficiency targets

Operating costs

A15.209 We have looked at a range of different evidence when considering our efficiency targets on operating costs. Our final proposals reflect the different weights we give to each evidence to reflect its relevance (in terms of the services we are considering and the time period we are seeking to forecast), reliability (in terms of our consideration of the robustness of the analysis and evidence) and compatibility with the modelling approach we adopt in the top-down model.

A15.210 We give the **past efficiency assumptions used on recent telecommunication charge controls** little weight. We consider that it is appropriate to give more weight to more recent and relevant evidence. We do though note the EY view, based on its own analysis, that BT had outperformed past charge controls. Given that the efficiency targets within these controls had been set at 4-5% per annum this statement provides some support for the results from the various analyses that we have undertaken to estimate efficiency savings that BT has achieved historically.

A15.211 We give our **regulatory cost analysis** a high weight. The advantage of this analysis is that it is consistent with the way we model costs within the top-down model. The drawback is that, as it only provides historical estimates of efficiency, it does not provide any view of forecast efficiency. Whilst the estimates vary from year to year the averages across different time periods were more stable. We also gave this type of analysis a high weight in the 2016 BCMR Statement. This analysis suggests targets in the range 4.4-6.7%.

A15.212 We believe our analysis of BT's historic and forecast **internal management accounting data** should provide relevant and reliable evidence for proposing efficiency assumptions for the duration of the charge control periods. This analysis provides a view of both BT's recent past efficiency achievements and its forecast internal efficiency and cost transformation targets out to 2017/18. However, the absence of updated BT internally agreed cost forecasts for 2016/17 and 2017/18 means we currently give this analysis lower weight than we have done in other recent charge controls. This analysis suggested setting efficiency targets of 4-7% for our Relevant Services. We note that the results are similar to those from our regulatory cost analysis**.**

A15.213 We consider **benchmarking data and other external studies** can provide a potentially informative source of evidence. However, in addition to the normal issues associated with interpreting these type of studies - for example whether comparisons are like-for-like and take account of relevant exogenous factors – we had further concerns about all of 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. That said, the [✂] not only on operating costs but also on capex. Our analysis suggests these [✂] but as there are some data issues with this study we currently give these results relatively low weight. We would revisit our assessment if those data issues could be resolved.

A15.214 Our review of public statements by BT confirmed that BT has reduced costs through its cost transformation programmes and that BT believes there are still significant opportunities to do so going forward and 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 at levels not dissimilar to those achieved historically. 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. We attach low to medium weight to this evidence.

A15.215 Lastly we also have to consider the impact of the actions we have taken on quality of service. As we noted earlier our efficiency analysis generally assumes that quality of service has remained fairly static. In this charge control we propose two specific quality of service amendments which we have chosen to exclude from our consideration of efficiency.

A15.216 Firstly, based on plans provided by BT, we have reduced in our proposed charge control the underlying fault rate for the operation of the copper access network. We consider this lower fault rate to represent an efficient network as discussed in Section 2. BT's fault rate has remained largely flat in recent years, therefore to the extent that past efficiency serves as a benchmark for our proposed efficiency rate, improvements in the fault rate are not a relevant consideration. Secondly we make a specific increase in the resources required to service the network, at the minimum quality standards we have set, we also exclude this increase from our assessment of efficiency to maintain the consistency of our overall approach. This is covered in more detail in Section 4 of the 2017 QoS Consultation.

A15.217 We have looked at the evidence in the round when proposing our efficiency target. We agree with the CMA that in a system of incentive-based regulation, our objective should be to set a target which is "capable of being met and exceeded". We have sought to identify a challenging but achievable target, which is not easy to meet, but which is nevertheless capable of being exceeded. In deriving our efficiency targets we have placed most weight on the regulatory cost analysis and management cost accounting data for the reasons stated above. We have used these to form the basis for our range of 3.5 to 6.5% annum. Other sources help inform the lower bound and where our base case might lie within that range.

A15.218 We have extended the bottom end of the range because the analysis we have undertaken has been affected by strong efficiency performance in 2015/16: analysis on data prior to 2014/15 would have suggested a slightly lower range. We note that by the time we come to prepare the Statement, we should have access to (at least) more robust forecast management accounting data together with another year's RFS data.

A15.219 The evidence we have currently points towards the top end of our range and so the base case we assume when modelling costs assumes an operating cost efficiency target of 5.5% per annum for our Relevant Services. We consider this is consistent with our objectives. It is within the range of BT's past and forecast efficiency and so we consider it can be met. It is higher than the bottom of the range suggested by analysis of BT's past and forecast efficiency, so we consider it is appropriately challenging to promote efficiency, in the interests of citizens and consumers. As it is not at the top of the range, we consider that it is achievable and capable of being exceeded.

Efficiency estimates for capital expenditure

A15.220 In the 2014 FAMR statement, we applied a single efficiency target to both operating costs and capital expenditure when forecasting efficiency gains in the provision of WLR and LLU services.[645]

A15.221 In the 2016 BCMR Statement, we applied different efficiency targets to operating costs and capital expenditure.[646] That was because we were unable to undertake analysis on capex similar to that we had undertaken on operating costs. BT agreed that it was not possible to use regulatory cost accounting data to analyse capex efficiency.[647]

A15.222 We have found the same issues when analysing capex for this charge control. The analysis we describe above to establish appropriate efficiency targets using regulatory costs, or management accounting data cannot be extended to analyse BT's capex in a way that is consistent with our modelling approach.

A15.223 That is because our forecasts of capital expenditure in the top-down model are the sum of steady state capex and growth capex.[648] We have not been able to identify capex data that allows us to estimate cost savings in a way that is consistent with the way we model capital expenditure. BT, like most other companies, does not keep separate records on capital expenditure that is required to meet growth, steady state or reinstatement requirements.[649]

A15.224 We have therefore had to assess an appropriate efficiency target for capex separately and in a different way from how we have set the target for operating costs.

Historical capital expenditure

A15.225 Table A15.20 below provides our estimates of which divisions incur capex on the Relevant Services.[650] This shows that Openreach accounted for most expenditure.

[645] 2014 FAMR Statement, paragraph A16.3.

[646] 2016 BCMR Statement, paragraph A29.250.

[647] 2016 BCMR Statement, paragraph A29.59.

[648] We forecast growth capex using component growth rates and asset volume elasticities. We forecast these elements separately but both are subject to our assumptions on efficiency and asset price inflation. We do not apply our efficiency assumption to other capital costs such as depreciation or mean capital employed.

[649] This is true for both BT's regulatory accounting and management accounting data.

[650] 2013/14 and 2014/15 data from BT's response dated 17 June 2016 to question D1 of the 7th BT WLA s.135 request. 2015/16 data from BT's response dated 9 December 2016 to question D1 of the 20th BT WLA s.135 request. Shares calculated from capex incurred in the two Relevant Divisions. There was a small amount of capex spend on the Relevant Services incurred in other BT divisions however this has not been included within this review.

Table A15.20 Breakdown of capital expenditure by division for the Relevant Services

Year	Openreach	TSO
2015/16	[✂] (~80-100%)	[✂] (~0-20%)
2014/15	[✂] (~80-100%)	[✂] (~0-20%)
2013/14	[✂] (~80-100%)	[✂] (~0-20%)

Source: Ofcom analysis.[651]

A15.226 We requested data from BT on different types of capital expenditure for the Relevant services for each of our Relevant Divisions. Tables A15.21 and A15.22 summarise the data we received for the period 2013/14 to 2015/16.[652]

Table A15.21: Breakdown of Openreach capital expenditure for Relevant Services in 2013/14, 2014/15 and 2015/16

Year	Capitalised Pay	Sub-Contractors	Civil Engineering	Stores
2015/16	[✂] (~20-40%)	[✂] (~20-40%)	[✂] (~0-20%)	[✂] (~0-20%)
2014/15	[✂] (~20-40%)	[✂] (~20-40%)	[✂] (~0-20%)	[✂] (~0-20%)
2013/14	[✂] (~20-40%)	[✂] (~20-40%)	[✂] (~0-20%)	[✂] (~0-20%)

Source: BT's response dated 16 December 2016 to question G1 of the 20th BT s.135 request.

Table A15.22: Breakdown of TSO capital expenditure for Relevant Services in 2013/14, 2014/15 and 2015/16

Year	Capitalised Pay	Sub-contractors	Other
2015/16	[✂] (~0-20%)	[✂] (~0-20%)	[✂] (~60-80%)
2014/15	[✂] (~0-20%)	[✂] (~20-40%)	[✂] (~60-80%)
2013/14	[✂] (~0-20%)	[✂] (~0%)	[✂] (~80-100%)

Source: BT's response dated 16 December 2016 to question G1 of the 20th BT s.135 request.

A15.227 We have considered the potential for efficiency gains for each of these different types of capex in each Relevant Division. We have then weighted these efficiency estimates together by the proportion that each type of capex contributes to the total Relevant Services' capex for that division.

Efficiency on Capitalised Pay

A15.228 Capitalised pay costs reflect the capitalisation of pay costs for BT employees. They account for 30-40% in the years 2013/14 to 2015/16 of capex on the Relevant Services.[653] In general, we would expect labour efficiency on capital activities to be

[651] Data provided in BT's response dated 24th June 2016 to question D1 of the 7th BT s.135 request; and in BT's response dated 12th December 2016 to question D1 of the 20th BT s.135 request.
[652] BT's response dated 16th December 2016 to question G1 of the 20th BT s.135. Openreach "Capital Labour" was labelled as "Direct Labour" but BT explained that this "*relates to the capitalisation of pay costs for Openreach employees*". Openreach "Stores" include a very small amount of costs originally categorised as "Other". The TSO "Other" category includes a small amount of "Stores" costs.
[653] BT's response dated 16th December 2016 to question G1 of the 20th BT s.135 request; BT's response dated 17th June 2016 to question D1 of the 7th BT s.135 request; and BT's response dated 9th December 2016 to question D1 of the 20th BT s.135 request.

similar to that on operating costs especially for engineering activities, as they would be subject to similar initiatives on process improvements and work scheduling.

A15.229 We have taken the TSO and Openreach labour efficiencies estimated from our analysis of management accounting operating pay costs and have then reduced these to ensure our assumptions are consistent with our asset price inflation assumptions.

A15.230 We calculated our operating pay cost efficiency assumptions after taking account of changes of volumes but also assuming pay inflation of c3%.[654] Capitalised pay covers work on a range of different assets. It includes installing copper lines which is subject to our asset price inflation assumption of RPI. (It does not include work on duct, which is also subject to the RPI asset price inflation as this is captured within spend on civil engineering which we discuss below). It will also include work on assets for which (as set out above) we assume zero inflation. Our implicit asset price inflation assumption on capitalised pay would therefore be a mix of RPI, for the work on installing copper lines and 0%, for work on other assets. There is then a potential inconsistency if we were to use operating cost efficiencies without any adjustment when estimating capital efficiency. The net effect of this inconsistency is likely to be small and is hard to estimate with any precision. But we consider it appropriate to reduce the pay cost efficiencies we use to estimate capex efficiency by c.1% per annum.[655]

Efficiency on civil engineering capex

A15.231 BT's TSO division does not spend capex on civil engineering type work. As BT stated, Openreach's civil engineering capex covers

> "costs for work undertaken by external 3rd parties to complete civil engineering activity. In Openreach the costs allocated to this cost type mainly relate to spend against a Capital Class of Work where the activity is associated with duct construction. Costs that are reported in this category do not cover work undertaken by BT employees".[656]

A15.232 We propose to estimate efficiency for this type of capex as the difference between changes in unit costs and our asset price inflation assumption. We consider this is broadly consistent with our general approach to estimating efficiency under which efficiency is measured as any remaining difference in costs having first removed the impact of inflation and changes in volumes. We remove the impact of inflation by adopting our asset price inflation assumption. Volume growth across all the Relevant Services is generally quite low so the impact of changes in volumes due to economies of scale on unit costs for capex on the Relevant Services is likely to be small.

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[654] Table A15.15 gives the pay inflation assumptions we have assumed in each year.

[655] We have reduced the efficiencies by the difference between the operating cost pay assumption and asset price inflation assumption in that year. The latter has been calculated as RPI multiplied by the proportion of the capex in that year which relates to duct and copper (calculated from BT's AFI3 schedule) for the components that are used by the Relevant Services.

[656] BT's response dated 16 December 2016 to question G1 of the 20th BT s.135 request.

A15.233 We have estimated historical changes in unit costs from 2013/14 to 2015/16 for this cost category from analysis of unit costs for the top 15 civil engineering activities.[657] We have then weighted together the price movements for these 15 activities by the relative contribution that each activity makes to total spend in each year across the Relevant Services. This produced an estimate of average price movement for Openreach civil engineering activities in each year for our Relevant Services.

A15.234 There were large increases in unit costs in 2015/16 as a result of contract renegotiations with Openreach's suppliers. The unit cost increases we have calculated in 2015/16 reflected a mixture of the old and the new rates that applied in that year. We have estimated changes in unit costs after 2015/16 by analysing the change in spend assuming all 2015/16 volumes were supplied at the revised rates. We use this as an indication of likely changes in unit costs for 2016/17 and as an upper bound for unit cost changes after that.[658]

A15.235 The results of our analysis are presented in Table A15.23 below. All changes are positive and therefore reflect cost increases, not cost savings

Table A15.23: Summary of efficiency estimates for Openreach Civil Engineering activities for the Relevant Services

Year	2014/15	2015/16	Forecast
Difference in unit costs net of our asset price inflation assumption	[✂] (~0-20%)	[✂] (~20-40%)	[✂] (~0-20%)

Source: Ofcom analysis.[659]

Efficiency on capitalised sub-contractor and stores costs

A15.236 Sub-Contractor capex covers

> "external 3rd party labour related costs for completing the same type of work as Openreach/TSO employees".[660] Stores capex covers the "cost of capital stores purchased/managed via BT Supply Chain. This category description applies to Openreach and TSO spend".[661]

A15.237 We have not been able to identify a reliable source of data on which to base our estimates of efficiency for these types of capex. For both, we requested similar information on changes in unit costs as we had requested on civil engineering activities but BT was unable to supply information in a suitable format mainly due to the way costs were recorded on BT's systems and the wide range of activities that

[657] Openreach refers to these activities as "synthetics". Limiting the analysis to the top 15 activities provides a reasonable coverage of civil engineering capex for the Relevant Services of ([✂]).
[658] This might seem to over-state changes in unit costs in the future give the large changes in 2015//6 and that the rates we are forecasting are higher than historical rates we have calculated. However, whilst many contract rates were reviewed in 2015/16 there are still many different contracts that are due to be renegotiated over the charge control period.
[659] Data provided in BT's response dated 3rd January 2017 to question G2 of the 20th BT s.135 request.
[660] BT's response dated 16 December 2016 to question G1 of the 20th BT s.135 request.
[661] BT's response dated 16 December 2016 to question G1 of the 20th BT s.135 request.

were covered.[662] We therefore propose to adopt some simple efficiency assumptions for these types of capex.

A15.238 For stores capitalised costs we propose to assume no efficiency savings. As TSO has very little “stores capex” this is not a critical assumption for TSO capex efficiency. Stores capex is a higher proportion of Openreach capex so if BT was able to achieve efficiency gains on stores capex then adopting this assumption could lead to understating capex efficiency for Openreach. However, absent appropriately granular data providing evidence for a different assumption, we consider using no efficiency saving to be the most reasonable approach.

A15.239 For sub-contractor capex we have estimated potential cost savings under two scenarios. The first scenario assumes that there are no efficiency savings on this type of capex. The second assumes that these should be subject to the same efficiency improvements as assumed for capitalised pay. The rationale for the latter assumption is that, as noted above, this spend covers “labour related costs for completing the same type of work as Openreach and TSO employees”. One therefore might expect this type of capex to be subject to the same process and task time improvements as capitalised labour. We have considered the outputs from both scenarios when making our proposals.

Efficiency on other capitalised costs

A15.240 Other capex covers “other costs that do not map to categories outlined above. This is applicable to Openreach and TSO”. [663] We propose to assume that that there are no efficiency savings on this type of capex. As Openreach has very little “Other” capex this is not a critical assumption for Openreach capex efficiency. Other capex is a much higher proportion of TSO capex so, if TSO was able to achieve efficiency savings on “Other” capex, this assumption may lead to us understating potential TSO capex efficiency. However, the proportion that TSO “Other” capex makes of all Relevant Services’ capex is small so we do not think the extent of any overall understatement would be material.

Consistency between capex efficiency targets and asset price inflation assumptions

A15.241 In response to the June 2015 LLCC Consultation, BT argued that we were double counting the scope for capex savings through the efficiency assumption and again through asset price changes.[664] In the 2016 BCMR Statement we explained why we did not agree, though we did recognise the importance of adopting a consistent approach.[665]

A15.242 As explained above, we have reflected our asset price inflation assumptions when estimating efficiency on capitalised pay, civil engineering and sub-contractor capex. We do not believe there will be any double counting of efficiency on the remaining types of capex, stores and other. Our proposal assumes these will be subject to minimal efficiency improvements. In any case our asset price inflation assumption for these types as capex will also be close to zero as most of the spend on copper and duct assets, which is subject to RPI increases, will be on other types of capex such as civil engineering and capitalised pay.

[662] BT’s response dated 3 January 2017 to question G2 of the 20th BT s.135 request.

[663] BT’s response dated 16 December 2016 to question G1 of the 20th BT s.135 request.

[664] April 2016 BCMR Statement, paragraph A29.256.

[665] 2016 BCMR Statement, paragraphs A29.256-258.

Estimates of Capex Efficiency

A15.243 We have estimated capex efficiency savings for the Relevant Services by weighting together our estimates of efficiency for each type of capex for each Relevant Division by the shares of Relevant Services capex for that division and type of capex as given in Tables A15.21 and A15.22. For periods after 2015/16 we use the same cost shares as applied in 2015/16. The results of this process are given in Table A15.24 below.

Table A15.24: Efficiency estimates for Relevant services' capital expenditure

Using efficiency estimates and weighting data >>>	From 2012/13-2015/16	From 2015/16-2017/18
Efficiency per annum - Sub-Contractor efficiency assumed Zero	1.0% pa	2.6% pa
Efficiency per annum - Sub-Contractor efficiency assumed same as Pay)	3.6% pa	3.7% pa

Source: Ofcom analysis.

A15.244 Our analysis suggests that our efficiency target for Relevant Services' capex should be slightly lower than that for operating costs and in the range 1-5% per annum.

Other analysis of capital expenditure

A15.245 We have undertaken further analysis on capex efficiency using Openreach PVEO analyses.[666] BT provided us with historical PVEOs for Openreach capex showing the movements between 2013/14 and 2014/15, 2014/15 and 2015/16 and a forecast PVEO showing the movement between 2015/16 and 2016/17.[667] These capex PVEOs were also broken down between NGA[668] and Non-NGA capex, with non-NGA capex further broken down by all major programmes with spend over £20m in the year and spend on Ethernet and leased line programmes separately identified.

A15.246 We asked BT to explain how it had calculated its Price and Volume effects within its PVEO analyses. BT explained that the "price" element mainly related to pay inflation with some supplier inflation in some years. The volume element was calculated at a programme level [✂].[669]

A15.247 Our estimates of efficiency on capex need to be made having first taken account of the changes in inflation and volumes. However, the way BT calculated its volume and price effects in these Capex PVEOs is unlikely to be consistent with how we reflect these in our modelling. We have therefore analysed the changes in annual capex but used our own assumptions to estimate the effect of inflation and volume changes and then assumed any residual changes are due to efficiency savings: this is the same approach that we have used to estimate efficiency on operating costs. We have assumed that inflation is the same as our asset price inflation assumption

[666] As noted above, TSO no longer produces PVEO analyses.
[667] BT's response dated 27 January 2017 to questions 13 and 14 of the 23rd BT s.135 request.
[668] NGA refers to an access network comprised wholly or in part of fibre. NGA capex generally relates to capex required to provide GEA services.
[669] BT's response dated 27 January 2017 to questions 13 and 14 of the 23rd BT s.135 request.

in the relevant year (ensuring consistency with that assumption) and that the effects of changes of volumes are minimal.[670]

A15.248 Using this approach, we have analysed the changes in capex for two sub-sets of Openreach's capex. The results are summarised in table A15.25 below. The first considered total non-NGA capex excluding Ethernet and leased line capex and spend on the "OR Repayments Capital" [671] and "OR Newsites" programmes.[672] We have labelled this as "Non-NGA and LL" capex in the table below. The second considered spend on all non-NGA programmes with spend greater than £20m in the year, again excluding Ethernet and leased line capex and spend on the "OR Repayments Capital" and "OR Newsites" programmes. We have labelled this as "Selected programmes" in the table.

Table A15.25: Efficiency estimates for Openreach capex from programme level data

Capex movements >>>	From 2013/14 to 2014/15	From 2014/15 to 2015/16	From 2015/16 to 2016/17	CAGR
Non NGA and LL capex	[✂] (~5-10%)	[✂] (~0-5%)	[✂] (~(-5-0)%)	[✂] (~0-5%)
Selected programmes	[✂] (~5-10%)	[✂] (~(-5-0)%)	[✂] (~(-5-0)%)	[✂] (~0-5%)

Source: Ofcom analysis. Numbers in brackets are inefficiencies.

A15.249 The above estimates only consider Openreach's capex not TSO's. However, they provide some further support for estimates in the range 1-5% and for a lower efficiency target on capex than on operating costs.

A15.250 The other evidence we have on capex is [✂] that we have estimated from the analysis of [third party] study. That evidence suggested [✂] for capex though we have noted that there are some data issues still to be resolved with the underlying data. We therefore currently give this evidence a lower weight than our other analysis of capex.

Capex efficiency targets

A15.251 We have analysed efficiency on capital expenditure separately from that on operating costs. Our analysis leads us to propose a target for our Relevant Services of 1.0-5.0%. We adopt the mid-point of 3% per annum in our base case modelling. We will consider further evidence when making our final decision for the Statement. Capex efficiency is not a critical assumption for our modelling as it only applies to a relatively low proportion of BT's cash costs within the 2017 top-down model.

A15.252 Our final decision will reflect our views on the robustness of the data and achieving the right balance between setting a target that is challenging, in order appropriately

[670] Assuming the effects of changes in volumes is very small is a simplification though not necessarily unreasonable given that volume growth across all Relevant Services is low. On that basis any growth element to capex should also be small.

[671] Repayments works are generally accounted for separately with BT's RFS and are not within the Relevant Services.

[672] BT explained, in its response dated 27 January 2017 to question 13 of the 23rd BT s.135 request, that the Newsites programme was not a copper-only programme and that "*efficiency is largely NGA driven. However historically Newsites, were mainly copper*". We have therefore excluded the Newsites programme as we are considering efficiency for non-NGA products and we do not know what proportion of this programme relates to copper services.

to promote efficiency, with one that BT can exceed. Consistent with our position in previous charge controls, our intention will not be to set a target that will be easy to meet, nor to set a target that would be impossible to outperform.

A15.253 Our proposed capex efficiency target is lower than that for operating costs. Some support for this is provided by BT's response to the June 2015 LLCC Consultation. BT, via Deloitte, commented that "Efficiencies linked to capex may be significantly lower than for opex".

A15.254 BT also noted that:

> "All BT managers interviewed agreed that the scope for cost reduction initiatives for capex is consistently much smaller than for operating costs. This is because a large proportion of capex is related to contracts with external contractors for construction works. These contracts often cannot be renegotiated and, to the extent they are, have generally seen a price increase rather than decrease in line with the general trend of construction prices". [673]

[673] BT response (via Deloitte) to the June 2015 LLCC Consultation, annex G, page 2.

Annex 16

Cost of capital

Introduction and summary

A16.1 When setting a charge control, we are concerned with estimating the weighted average cost of capital (WACC) on a forward-looking basis. As described in Volume 2 Section 2, we propose using a glidepath to align charges with costs in 2019/20 and 2020/21 (the final year of the control period). Therefore, for modelling purposes, we require an estimate of the WACC in both 2019/20 and 2020/21.[674]

A16.2 The cost models for the WLA charge controls are based on projections of nominal costs without explicit modelling of tax, therefore we require a forecast of the pre-tax nominal WACC.

A16.3 The WACC combines the cost of funding from debt and equity according to the gearing, i.e. the value of outstanding debt relative to total financing (i.e. value of debt and equity combined). For gearing, g, and corporate tax rate, t, the pre-tax WACC is defined as follows (since debt finance benefits from a tax shield whereas equity does not):

$$WACC = \frac{Ke * (1-g)}{1-t} + Kd * g$$

A16.4 In this formula, we calculate the cost of equity, Ke, using the Capital Asset Pricing Model (CAPM), such that 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):

$$Ke = RFR + ERP * \beta e$$

A16.5 Our approach to calculating the cost of debt combines the same RFR assumption as used to estimate the cost of equity and adds to the RFR a debt premium (i.e. the corporate debt rate above benchmark risk-free assets), such that:

$$Kd = RFR + dp$$

A16.6 For this consultation, we propose to adopt the same three-way disaggregation used in the 2016 BCMR Statement. We also propose to update some of the WACC parameters from those used in the 2016 BCMR Statement. In particular, we propose to reduce our real RFR assumption from 1.0% to 0.5% and increase our real ERP assumption from 5.1% to 5.5% (such that the overall real TMR (total market return) is 6.0% (compared to 6.1% in the 2016 BCMR Statement). We propose to maintain the same asset beta for Openreach copper access (0.55) as used in the 2016 BCMR Statement but to increase the Other UK telecoms asset beta from 0.70 to 0.75. We also propose to recognise the deficit associated with BT's defined benefit pension scheme in our approach to gearing.

[674] The differences between the 2019/20 and 2020/21 WACCs relate to the inflation and corporate tax assumptions.

A16.7 Our proposed calculations of the WACC for BT Group, Openreach copper access, Other UK telecoms and the Rest of BT (RoBT) in the final year of the charge control are shown in Table A16.1. For this consultation, we propose to apply:

- the Openreach copper access pre-tax nominal WACC of 8.0% to WLA copper access services in the final year of the charge control (previously 8.6% in the 2014 FAMR).[675]
- the Other UK telecoms pre-tax nominal WACC of 9.4% to NGA services in the final year of the charge control (previously other UK Telecoms was calculated as 9.8% in the 2016 BCMR Statement).

Table A16.1: BT WACC, consultation proposals (2020/21)

WACC component	BT Group	Openreach copper access	Other UK telecoms	RoBT	Source
Real RFR	0.5%	0.5%	0.5%	0.5%	Ofcom estimate
RPI inflation*	3.2%	3.2%	3.2%	3.2%	OBR
Nominal RFR	3.7%	3.7%	3.7%	3.7%	= (1+ RFR)*(1 + inflation) - 1
Nominal ERP	5.7%	5.7%	5.7%	5.7%	Ofcom estimate
Debt beta (βd)	0.10	0.10	0.10	0.10	Ofcom estimate
Asset beta (βa)	0.76	0.55	0.75	1.08	Ofcom estimate
Asset beta weight	100%	20%	65%	15%	Ofcom estimate
Gearing (forward looking) (g)	35%	35%	35%	35%	Ofcom estimate
Equity Beta (βe)	1.12	0.79	1.10	1.61	=(βa - βd*g)/(1-g)
Cost of equity (post-tax) (Ke)	10.1%	8.2%	10.0%	12.9%	= Nominal RFR + ERP *βe
Cost of equity (pre-tax)	12.2%	9.9%	12.0%	15.5%	= Ke / (1-t)
Debt premium (dp)	1.0%	0.9%	1.0%	1.1%	Ofcom estimate
Corporate tax rate (t)*	17.0%	17.0%	17.0%	17.0%	HMRC
Cost of debt (pre-tax) (Kd)	4.7%	4.6%	4.7%	4.8%	= Nominal RFR + dp
WACC (pre-tax nominal)	9.6%	8.0%	9.4%	11.8%	=(Ke*(1-g))/(1-t)+(Kd*g)

Source: Ofcom. For comparison purposes, the UKRN annual update report tends to report real vanilla WACCs for UK regulators (where the vanilla WACC represents the post-tax cost of equity and the pre-tax cost of debt). The real-vanilla WACC (with respect to CPI inflation of 2%) is 6.1%, 4.8%, 6.0% and 7.9% for BT Group, Openreach copper access, Other UK telecoms and RoBT respectively.
**These inflation and corporate tax rate assumptions relate to 2020/21. As explained in this annex, when estimating a WACC for 2019/20 we have used inflation and corporate tax rate assumptions relevant to this year; all other input parameters remain the same.*

A16.8 We will update all parameters for the statement, taking account of stakeholder responses to this consultation. In recognition that the value of some parameters could change between now and the statement, in our sensitivity analysis set out in

[675] We are only proposing to impose a charge control on MPF services, though the Openreach copper access WACC would apply to all copper access products, such as WLR.

Annex 14 of this consultation we have used a range for the pre-tax nominal WACC of 1% either side of the central estimate, that is:

- a range of 7.0% to 9.0% for the Openreach copper access pre-tax nominal WACC of 8.0%;
- a range of 8.4% to 10.4% for the other UK telecoms pre-tax nominal WACC of 9.4%.

A16.9 In the remainder of this annex we first 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. We also explain that the Other UK telecoms WACC includes BT's operations related to NGA services and mobile (i.e. EE).

BT Group WACC

A16.10 We need to estimate several parameters to calculate a WACC for BT Group. These are:

- Real RFR;
- Inflation (to estimate a nominal RFR);
- Equity risk premium (ERP);
- Equity beta, asset beta and gearing;
- Debt beta;
- Debt premium; and
- Corporation tax.

A16.11 The rest of this section sets out our proposals for each of these parameters.

Real RFR

A16.12 We have updated our analysis of historical yields on index-linked gilts and forward rates on those gilts. We have also considered other recent regulatory decisions. We propose to reduce our estimate of the real RFR from 1.0% to 0.5%.

Yields on index-linked gilts

A16.13 We have updated our analysis of movements in historical averages of yields on index-linked gilts to 31 December 2016. Table A16.2 compares the latest data to that presented in the 2016 BCMR Statement (which used data to 30 November 2015) for both five- and ten-year gilts. Yields on five- and ten-year index-linked gilts remain negative over averaging periods of five years or less and do not approach yields of around 1% until we reach a 15 to 20-year averaging period.

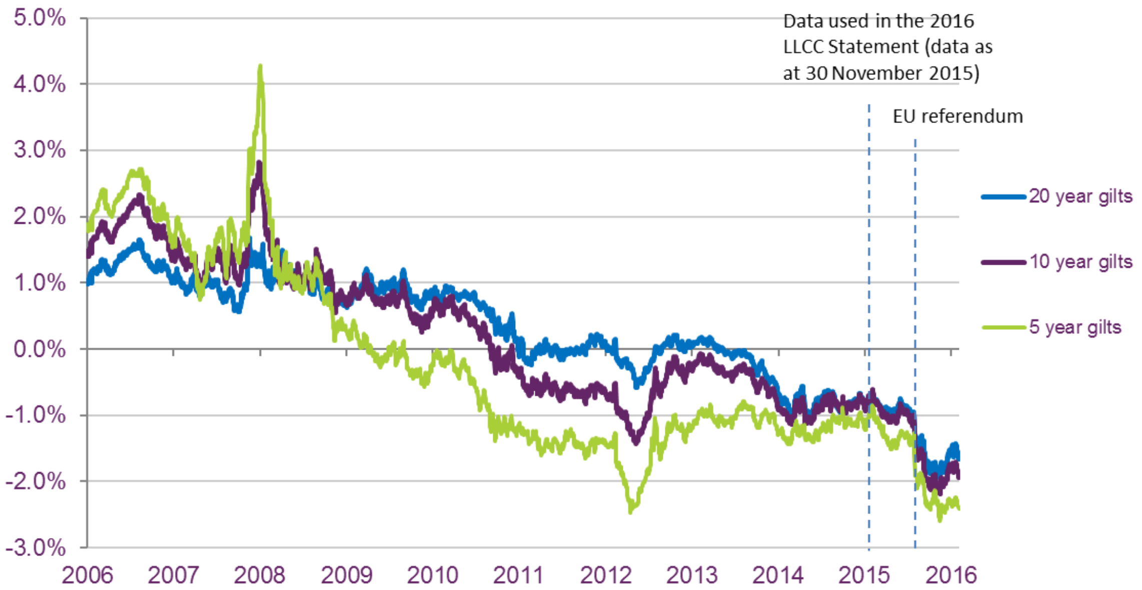
Table A16.2: Yields on index-linked gilts

Averaging period	Five year gilts		Ten year gilts	
Data as at:	30 Nov 2015 2016 BCMR Statement	31 Dec 2016 March 2017 WLA Charge Control Consultation	30 Nov 2015 2016 BCMR Statement	31 Dec 2016 March 2017 WLA Charge Control Consultation
Spot rate	-1.2	-2.4	-0.9	-1.9
1 month	-1.1	-2.3	-0.8	-1.8
3 months	-1.1	-2.4	-0.8	-1.9
1 year	-1.2	-1.8	-0.9	-1.4
2 years	-1.1	-1.5	-0.6	-1.2
5 years	-1.2	-1.4	-0.5	-0.8
10 years	0.1	-0.3	0.4	0.1
15 years	0.8	0.4	1.0	0.7
20 years	1.3	1.0	1.4	1.2

Source: Ofcom analysis of Bank of England data

A16.14 Figure A16.3 below illustrates that spot yields on five, ten and 20-year index-linked gilts have reduced since the November 2015 data considered in the 2016 BCMR Statement. In particular, there was a marked fall in gilt yields following the EU Referendum in June 2016.

Figure A16.3: Spot rates on five, ten and 20-year index-linked gilts



Source: Bank of England, Ofcom analysis. Data as at 31 December 2016.

A16.15 Several factors could be affecting real gilt yields at present, such as:

- **Credit risk effects**. Following the referendum on whether the UK should remain a part of the EU or leave the EU (the "EU referendum"), ratings agencies downgraded UK Government debt. Such downgrades tend to be associated with higher borrowing costs, which could mean that gilt yields would be expected to rise.[676]

- **Flight to safety**. Where investors move money to less risky assets such as government gilts, the increased demand can raise prices and reduce yields.

- **Bank of England actions**. Quantitative easing, whereby the Bank of England purchases large quantities of government bonds, could act to reduce yields on government debt.[677] In addition, the Bank of England base rate was reduced from 0.5% to 0.25% in August 2016.[678]

- **Pension fund demand**. A June 2016 report by Schroders (the June 2016 Schroders report) states that "UK private sector defined benefit schemes already own an estimated 80% of the long-dated index-linked gilt market and potential demand is almost five times the size of the market".[679] This scarcity issue could raise gilt prices and reduce yields.[680]

- **Measures of inflation**. Index-linked government gilts are linked to RPI and yields may be affected by issues with RPI as a measure of inflation.

A16.16 It is difficult to know which of the above factors have the most impact on real yields, but given that gilt yields remain negative and that yields fell following the EU referendum, this could imply that any potential credit risk effects are more than offset by the other factors (which will drive up gilt prices and reduce yields).

A16.17 In its November 2016 Financial Stability Report (November 2016 FSR)[681], the Bank of England noted that nominal yields on gilts had risen since the EU Referendum but that real yields had fallen. The Bank of England said "ten-year real yields…remain close to their lowest levels on record, with market contacts suggesting that falls since the referendum in part reflect increased perceptions of downside risks to the longer-term growth outlook".[682]

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676 An August 2016 paper by Frontier Economics considered that the referendum result could affect gilt yields in two ways: credit risk effects (which could increase yields) and capital market effects (such as a flight to safety and quantitative easing which could reduce yields). Frontier Economics, '*Paying the Full WACC?'*, 10 August 2016, https://www.frontier-economics.com/publications/paying-full-wacc/.

677 On 4 August 2016 the Bank of England announced that it would extend its quantitative easing programme by purchasing an additional £60bn of government bonds and £10bn of corporate bonds, taking the total amount of asset purchases to £435bn. http://www.bankofengland.co.uk/publications/Pages/news/2016/008.aspx.

678 http://www.bankofengland.co.uk/boeapps/iadb/Repo.asp.

679 Page 1, Schroders; *Pension funds and index-linked gilts: A supply/demand mismatch made in hell*; June 2016; http://www.schroders.co.uk/en/SysGlobalAssets/schroders/sites/ukpensions/pdfs/2016-06-pension-schemes-and-index-linked-gilts.pdf.

680 Page 3 of the June 2016 Schroders report said that this mismatch between demand and supply suggests that "long-dated index-linked gilt yields are likely to remain suppressed for the foreseeable future".

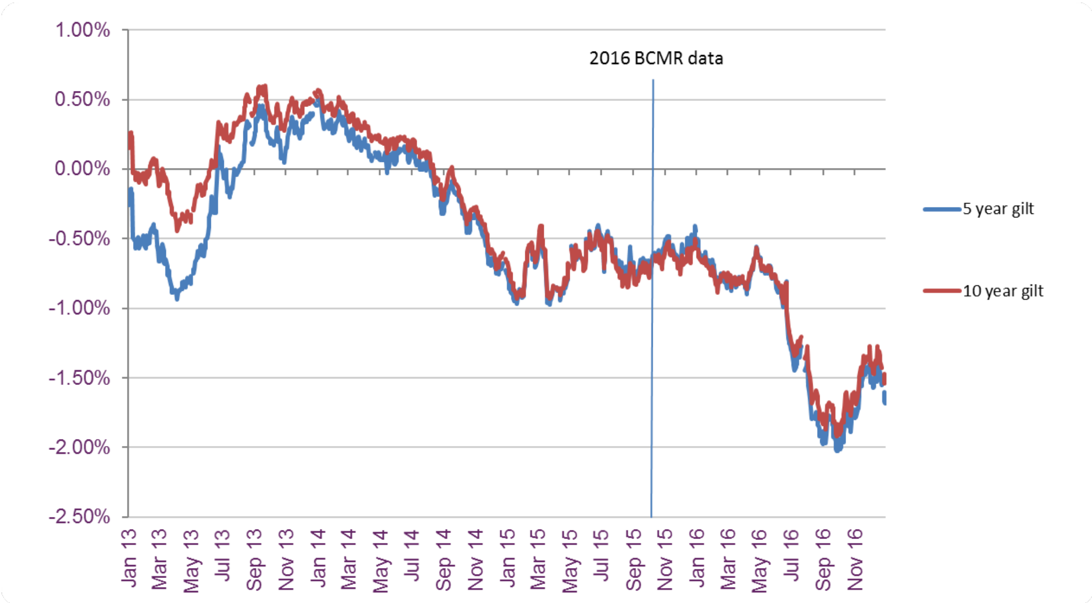
681 http://www.bankofengland.co.uk/publications/Pages/fsr/2016/nov.aspx.

682 Page 5, November 2016 FSR.

Forward rates on index-linked gilts

A16.18 Forward rates can indicate what investors currently expect to happen to real gilt rates in the future. Figure A16.4 below illustrates that forward rates on five and ten year gilts taken out in the last year of the charge control are lower than at the time of the 2016 BCMR Statement.[683]

Figure A16.4: Forward rates on 5 and 10 year gilts taken out in the last year of the charge control



Source: Bank of England, Ofcom analysis. Data as at 30 December 2016. The 5 and10 year lines represent forward rates on 5 and 10 year gilts taken out in December 2020.

Recent regulatory decisions on the real RFR

A16.19 Table A16.5 summarises the real RFR used in recent regulatory decisions. The table also reports the real ERP and real TMR since these are often considered together. This is because there may be an inverse relationship between the real RFR and ERP such that the TMR is more stable.[684] This could imply that, when

683 The forward rates represent the implied future yield on an investment in a five- or ten-year index-linked gilt made in the final year of the charge control. They are calculated using the following formula:

$$f_{t,T} = \left[\frac{(1+r_T)^T}{(1+r_t)^t}\right]^{\frac{1}{T-t}} - 1$$

For example, for a five-year gilt calculation, r_t would denote the annual yield in the first three years, so t=3 and r_T would denote the annual yield in the first eight years, so T=8 in this example. In other words, for the forward five-year gilt calculation we are solving for the future yield required to equalise the difference between the yields on a gilt taken out today with three years to maturity (the proceeds of which can then be reinvested at a future yield for a further five years) and the yield on a gilt taken out today with eight years to maturity.

684 The 2003 Smithers & Co report recommended that the cost of equity is derived from estimates of the TMR, with any changes in the real RFR or ERP offsetting each other. See pages 48 and 49, Smithers & Co, *A study into certain aspects of the cost of capital for the regulated utilities in the UK*, 13 February 2003 ('2003 Smithers & Co report'). http://www.ofcom.org.uk/static/archive/oftel/publications/pricing/2003/cofk0203.htm.

estimating the cost of equity, the assumption made about the TMR has a greater impact on the cost of equity than the relative balance of the RFR and ERP, especially where the equity beta is close to 1. However, the level of the RFR is also an important input to the calculation of the cost of debt (where we combine the RFR with the estimated debt premium).

A16.20 The CMA said in its 2014 NIE Determination that "historically, the market return has tended to be less volatile than the ERP (as measured, for example, by the ratio of standard deviation to mean) and there is some evidence of the ERP being negatively correlated with treasury bill rates over the short term".[685]

Table A16.5: Recent regulatory decisions on the real RFR, ERP and TMR

Organisation	Date (control period)	Real RFR	ERP	TMR	RPI
CMA (NIE)	Mar 14 (Jan 13 – Sep 17)	1 – 1.5%	4 – 5%	5 – 6.5%	3.25%
CAA (Airports)	Feb 14 (2014 – 2018/21)	0.50%	5.75%	6.25%	2.8%
CAA (NERL)	Jun 14 (2015 – 2019)	0.75%	5.5%	6.25%	2.8%
OFGEM	Nov 14 (8Y March 2023)	1.6%	5.25%	6.85%	3.1%
OFWAT	Dec 14 (5Y March 2020)	1.25%	5.5%	6.75%	2.8%
CMA (BW)	Oct 15 (5Y Mar 2020)	1.25%	5.25%	6.5%	2.5% - 2.7%

Source: CAA: 'Estimating the cost of capital: technical appendix for the economic regulation of Heathrow and Gatwick from April 2014: Notices granting the licences'686 and page 10, NERL RP2687, Ofgem, ED1688, Ofwat, Page 41 Price control 2015-20 (A7 risk and reward)689. CMA Paragraph 13.23 and 13.161 2014 NIE Determination and paragraph 10.62, 10.117, 10.186 2015 Bristol Water Decision

Proposal for the real RFR

A16.21 We continue to believe that caution is required in interpreting the evidence available. Given that we are attempting to estimate a forward-looking real RFR appropriate for the end of the charge control period, it would be inappropriate to simply adopt the current low rates on index-linked gilts without considering the reasons why they could be depressed.

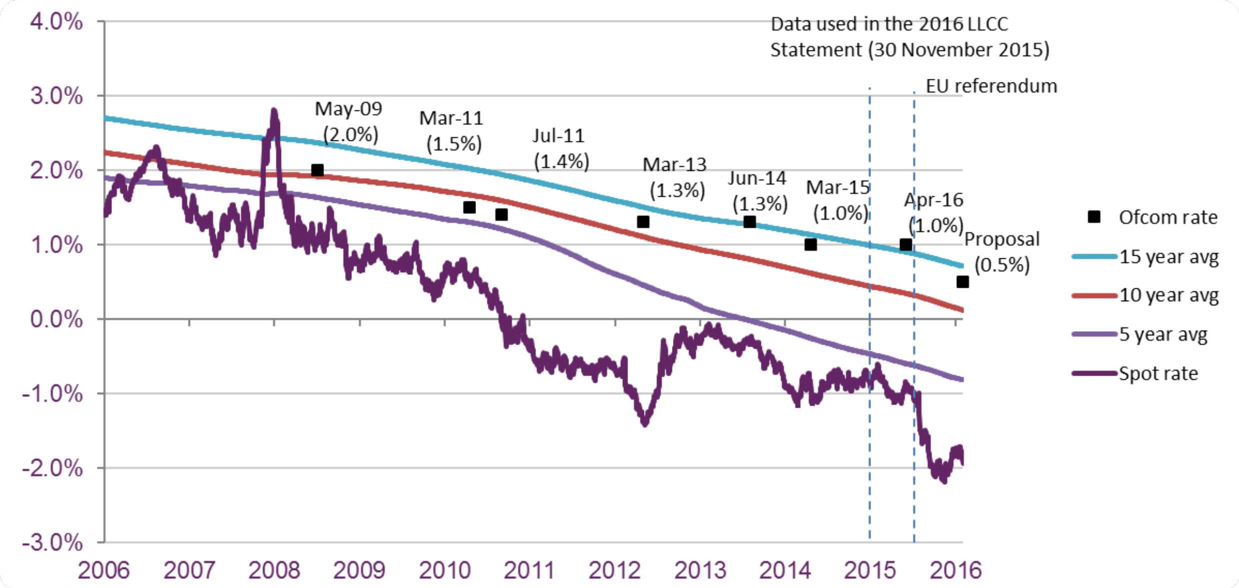
A16.22 Rather than seek to make a mechanistic adjustment to the real RFR for these factors, our revisions to the real RFR are taken in the round, considering

[685] Paragraph 13.148, page 13-30, 2014 NIE Determination, https://assets.digital.cabinet-office.gov.uk/media/535a5768ed915d0fdb000003/NIE_Final_determination.pdf
[686] https://publicapps.caa.co.uk/docs/33/CAP1155.pdf.
[687] FAB, Performance Plan UK-Ireland FAB, Second reference period (2015-2019), June 2014. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/325428/uk-ireland-rp2-performance-plan.pdf.
[688] OFGEM, RIIO-ED1: Final determinations for the slow-track electricity distribution companies, 28 November 2014. https://www.ofgem.gov.uk/ofgem-publications/91564/riio-ed1finaldeterminationoverview.pdf.
[689] OFWAT, Setting price controls for 2015-2020, Final price control determination notice: policy chapter A7 – risk and reward, December 2014. http://www.ofwat.gov.uk/pricereview/pr14/det_pr20141212riskreward.pdf.

information on longer-term average yields as well recognising the low observed yields in more recent years.

A16.23 Figure A16.6 shows Ofcom's decisions on the real RFR compared to yields on ten-year gilts over different averaging periods – spot rates, five year averages, ten year averages and 15 year averages. As can be seen from this figure, our real RFR assumptions have more closely followed the longer-term averages. We have placed less weight on spot yields which may not be typical for the forward-looking period for which the WACC is set and may not reflect the long-term features underlying the return required by investors.

Figure A16.6: Yields on 10-year gilts and Ofcom decisions on real RFR



Source: Bank of England, Ofcom analysis. Data as at 31 December 2016.

A16.24 Since we reduced our estimate of the RFR to 1% in 2015[690], spot rates were initially stable for a period before falling following the EU referendum. Longer-run averages have continued to decline, picking up the overall decline in gilt yields since the financial crisis. However, we do not consider that the real RFR is actually zero or negative (even if financial market proxies such as yields on index-linked gilts are negative).

A16.25 Given the continued reduction in yields on index-linked gilts, but taking account of the fact that yields are typically positive over most averaging periods for the last century or more[691], we propose a reduction in our estimate of the real RFR from 1.0% to 0.5%. Combined with our proposed RPI inflation forecast for 2020/21 of 3.2% (see below), the projected nominal RFR is 3.7%.

A16.26 This proposed reduction in the real RFR, combined with our proposed increase in the ERP does not have a significant impact on the cost of equity. However, combined with our proposed debt premium, it does reduce the estimated cost of debt. In proposing to reduce our estimate of the real RFR we have taken account of this impact on the cost of debt, recognising that yields on BT debt and corporate

[690] As part of the March 2015 MCT Statement.

[691] The Credit Suisse Global Investments Returns 2017 S Yearbook (2017 Yearbook) says that the real return on government bonds was 2.7% over the period 1900-2016 and on treasury bills it was 1.2%.

bonds are now below our previously estimated cost of debt. We explain our revised estimate of the cost of debt in the next section.

Cost of debt

A16.27 In the 2016 BCMR Statement we estimated BT Group's cost of debt by adding our estimate of the debt premium to the nominal RFR. This approach is consistent with how we have estimated the cost of debt in previous charge controls and means that we take a consistent view of components that are common to different elements of the WACC (the RFR underpinning the cost of debt and cost of equity). We also compared our estimated cost of debt with the cost of debt that would be derived by considering the weighted average of BT's existing debt and new debt expected to be issued during the charge control period.

A16.28 We propose using the same approach for this market review.

Debt premium

A16.29 Approximately 30% of BT's outstanding listed debt is sterling denominated, with 30% US dollar denominated and the remaining 40% euro denominated.[692]

A16.30 As at 31 December 2016 we estimate that BT's fixed rate listed debt (all currencies) had an outstanding tenor of around [✂] (~(6-8)) years while for sterling denominated debt it was slightly higher at around [✂] (~(7-9)) years.[693]

A16.31 We have estimated a debt premium for BT by considering the observed yields on sterling denominated debt for BT Group relative to benchmark nominal gilt yields with the same maturity. We would expect spreads on BT's sterling bonds to give a reasonable estimate of the debt premium since the outstanding maturity on sterling bonds is similar to the outstanding maturity on all BT's debt. As a cross-check, we have also considered spreads on an index of BBB bonds over government gilts with a maturity of 5 to 10 years because BT's debt is BBB+ rated.[694]

A16.32 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

A16.33 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 A16.7 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 1 and 2 years.

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692 Derived from page 211 of BT's 2016 annual report. Similar ratios can be derived from BT responses dated 12 August 2016 and 26 September 2016 to question B9 of the 12th section 135 notice. This includes BT's listed debt as at March 2017 and includes a bank loan due in December 2017.

693 Derived from BT responses dated 12 August 2016 to question B9 of the 12th section 135 notice.

694 This is the Bloomberg composite rating which is a blend of the ratings from Moody's, S&P, Fitch and DBRS.

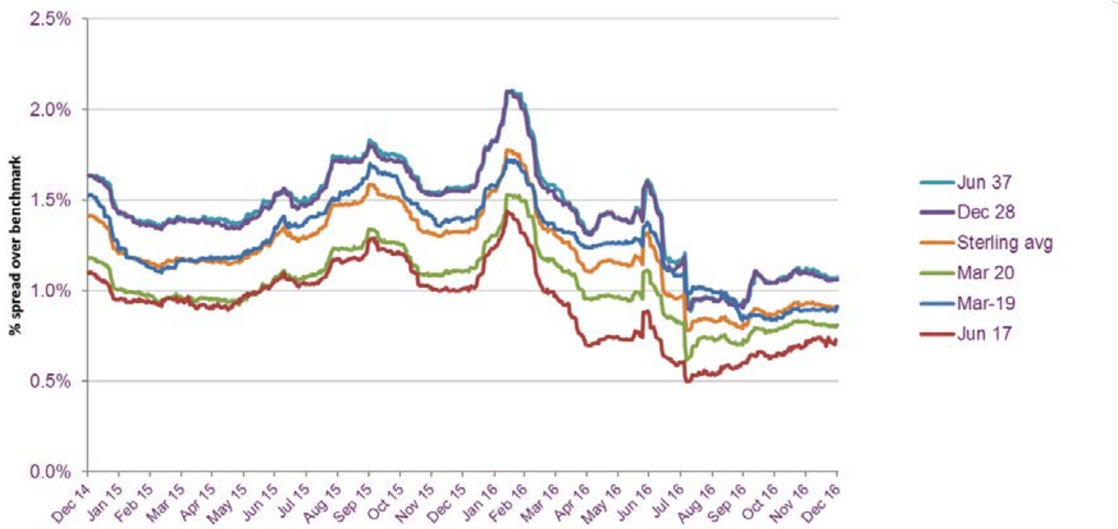
Table A16.7: Spread of BT's sterling denominated debt over UK gilts

		1 year					2 year					Current
Maturity	Tenor (years)	Avg	Min	Max	Lower quartile	Upper quartile	Avg	Min	Max	Lower quartile	Upper quartile	Dec-16
Jun-17	0.5	0.8%	0.5%	1.4%	0.6%	1.0%	0.9%	0.5%	1.4%	0.7%	1.1%	0.7%
Mar-19	2.2	1.2%	0.8%	1.7%	0.9%	1.4%	1.3%	0.8%	1.7%	1.1%	1.4%	0.9%
Mar-20	3.2	1.0%	0.6%	1.5%	0.8%	1.1%	1.0%	0.6%	1.5%	0.9%	1.1%	0.8%
Dec-28	11.9	1.3%	0.9%	2.1%	1.1%	1.5%	1.4%	0.9%	2.1%	1.3%	1.6%	1.1%
Jun-37	20.5	1.3%	0.9%	2.1%	1.1%	1.6%	1.4%	0.9%	2.1%	1.3%	1.6%	1.1%
Average	8.4	1.1%	0.8%	1.8%	0.9%	1.3%	1.2%	0.8%	1.8%	1.1%	1.3%	0.9%

Source: Bloomberg, Ofcom analysis. Spread over nominal gilt yields. Average tenor is a weighted average. All of these bonds have a Bloomberg Composite credit rating of BBB+. Data to 31 December 2016.

A16.34 The figure below shows the spread of BT's sterling debt over the last two years.

Figure A16.8: Spread of sterling denominated debt over UK gilts for BT



Source: Bloomberg, Ofcom analysis. Data to 31 December 2016.

A16.35 The preceding table shows that the sterling debt premium for BT Group averaged across all maturities has been between 0.8% and 1.8% over the last year averaging 1.1%. The two-year range is also 0.8% to 1.8% with an average of 1.2%. The interquartile ranges are 0.9% to 1.3% over the last year and 1.1% to 1.3% over the last two years.

BBB index

A16.36 Figure A16.9 shows the spread of an index of BBB bonds over UK gilts with maturities of 5 and 10 years.

A16.37 Over the last year the 5 year BBB index spread has ranged from 1.0% to 2.1% (1.1% to 1.5% inter-quartile) with an average of 1.4% and the 10 year BBB index spread has ranged from 1.1% to 2.4% (1.2% to 1.7% inter-quartile) with an average of 1.5%. Over the last two years the 5 year BBB index spread has ranged from 0.9% to 2.1% (1.1% to 1.5% inter-quartile), with an average of 1.3% and the 10 year BBB index spread has ranged from 1.1% to 2.4% (1.2% to 1.7% inter-quartile) with an average of 1.5%. We note that the composite BBB index spreads are slightly higher than BT's actual debt spreads over the same period.[695]

Figure A16.9: Spread over nominal gilts of an index of 5 and 10 year BBB bonds

Source: Bloomberg, Ofcom analysis. Data to 31 December 2016

Weighted average of existing debt and new debt

Existing debt

A16.38 We asked BT to provide a breakdown of the interest rate on its fixed and floating rate debt, taking account of any hedging effects, for the 2015/16 financial year.[696] According to its 2016 annual report, fixed rate debt represented around 85% of BT's total debt, with floating rate debt the remainder.[697]

A16.39 The relevant cost of existing fixed debt is uncertain and could be estimated in a number of ways, for example as of today, as at the end of the charge control period (2020/21) or 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.[698]

A16.40 Excluding debt that has matured since March 2016, we estimate that the interest on BT's existing fixed debt is [✂].[699]

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695 The BBB index includes bonds with ratings of BBB-, BBB and BBB+. Since BT's debt is currently rated at BBB+, we would expect its actual debt spreads to be lower than the spreads for the index (since the index also includes spreads for bonds with a lower credit rating).

696 On page 215 of its 2016 annual report BT gives an effective interest rate on fixed debt, after hedging, of 6.0% (average for the 2015/16 financial year). BT provided us with details of this calculation and also an equivalent calculation for its floating rate debt.

697 Using data from page 215 of BT 2016 annual report.

698 BT response dated 26 September 2016 to follow up question B9d of the 12th section 135 notice.

699 The lower number is the rate as at March 2017 and the higher number is the estimated rate in 2020/2021, taking account of debt that is due to mature over the next three years (where cheaper debt is generally due to mature first).

A16.41 The relevant cost of floating rate debt is also uncertain, although it represents a smaller amount of total debt than fixed rate debt. Excluding floating rate debt that has been repaid since March 2016[700], we estimate that the interest on BT's floating rate debt is currently around [✂]. Given that a part of BT's floating rate debt is represented by its index-linked bond due in 2025, and RPI inflation to which it is linked is generally expected to increase from current levels[701], it is possible that the floating rate debt cost could increase from current levels. To allow for this possibility we assume a floating rate debt range of [✂].[702]

A16.42 Combining these estimates and weighting by the estimated relative amounts of fixed and floating debt as at March 2017, we estimate that the cost of BT's existing debt is between [✂].[703]

New debt

A16.43 BT issues debt in different currencies and hedges that debt using swaps where the debt is issued in currency other than sterling. Sterling debt may also be swapped to fixed or floating rates depending on BT's financing strategy.

A16.44 All of BT's listed debt is currently rated BBB+. To estimate the cost of new debt issued during the charge control period we have considered historic and forward yields on an index of BBB rated debt. We have considered bonds with maturities of around 5 to 10 years because, as noted above, BT's average tenor is around [6-8] years across all currency denominations, and BT's most recently issued debt (March 2016) was for three tranches with maturities of 5, 7 and 10 years.

A16.45 Figure A16.10 shows yields over the last two years for an index of BBB bonds with 5 and 10 year maturities. The average yield over the last year was 2.0% and 2.8% respectively while over two years the average was 2.3% and 3.1% respectively.

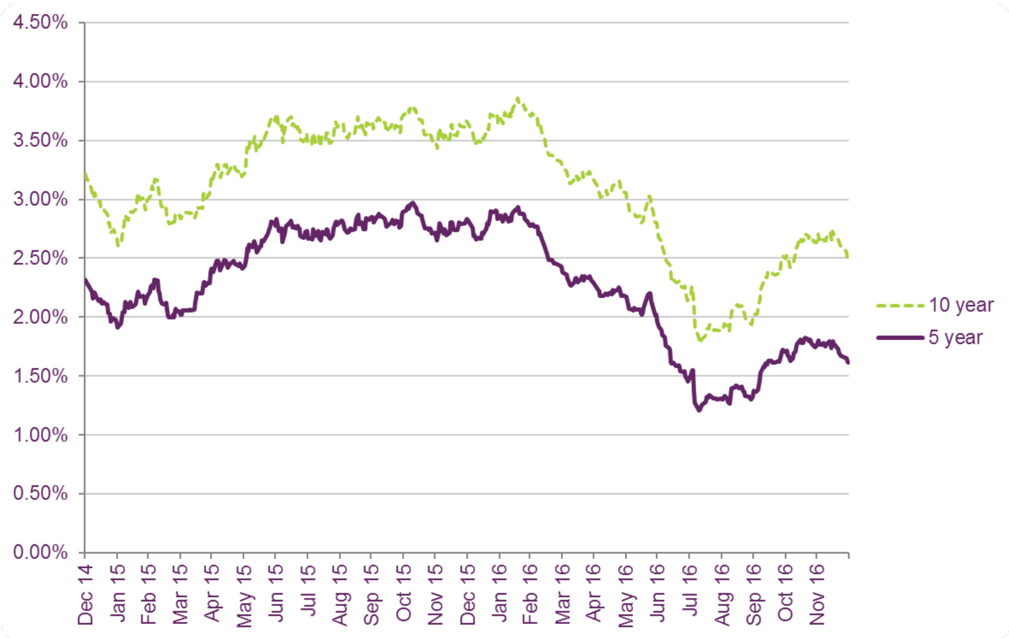
[700] For example, slide 27 of BT's Q2 2016/17 results pack says that BT repaid the outstanding £181m on its EE acquisition facility. http://www.btplc.com/Sharesandperformance/Quarterlyresults/2016-2017/Q2/Downloads/Slides/q216-slides.pdf [accessed 26 March 2017].

[701] RPI was 1.6% in March 2016 according to ONS (i.e. as at the time of BT's annual report) while the most recent OBR forecast for the end of the charge control period is 3.2%. We estimate that the index linked note represents about [✂]% of BT's floating debt.

[702] This reflects the expected increase in RPI inflation multiplied by the proportion of floating rate debt represented by the index-linked bond.

[703] We have assumed that the amount of floating debt as a proportion of total debt remains at estimated March 2017 levels.

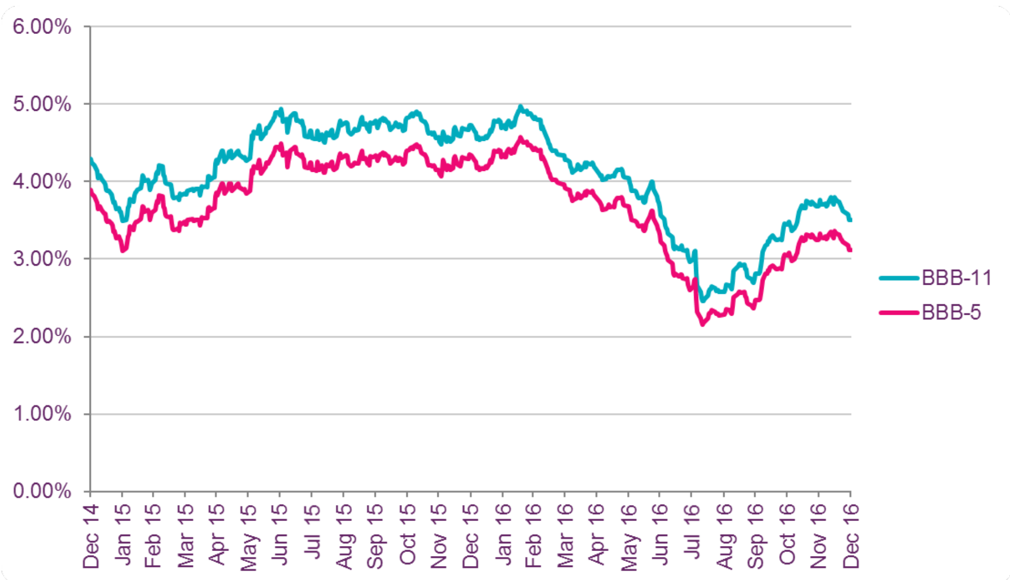
Figure A16.10: Yields on indices of 5 and 10 year BBB bonds



Source: Bloomberg, Ofcom analysis. Data to 31 December 2016

A16.46 Forward rates on BBB bonds can also be calculated. Figure A16.11 shows forward rates on 5 and 11 year BBB bonds for the final year of the charge control.[704] As at December 2016, forward rates were between 3.1% and 3.5%. Therefore, forward yields on BBB rated debt are currently higher than yields observed over the last couple of years.

Figure A16.11: Forward yields on indices of 5 and 11 year BBB bonds at the end of the charge control period



[704] The end of the charge control is in 2020/21, which is in 4 years' time. On Bloomberg, information on BBB indices exist for 4-year, 9-year and 15-year periods. A forward rate can therefore be estimated for 5-year and 11- year periods where the 5-year forward rate is estimated from the 4-year and 9-year indices and the 11-year rate is estimated from the 4-year and 15-year indices.

Source: Bloomberg, Ofcom analysis. Data to 31 December 2016. In December 2016 the lines represent forward rates on 5 and 11 year BBB bonds in December 2020. The 11-year line represents the forward rate implied by the Bloomberg 4-year and 15-year BBB indices.

A16.47 Given that we are concerned with new debt to be issued over the period of the charge control, we have put more weight on forward rates. The tenor of new debt issued by BT is uncertain, though its most recent debt issuance was for periods between 5 and 10 years. Based on recent forward rates we consider a range of 3.0% to 3.5% is a reasonable estimate of the cost of new debt.

Weighting of existing debt and new debt

A16.48 Approximately 35% 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 35% 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 6 to 8 years and this is a 3-year charge control ending in 2020/21, we might expect up to 50% of debt to be new. However, we do not know with certainty how much of its existing debt BT will refinance, given its objective to reduce net debt.[705] To allow for this uncertainty, we have assumed that new debt will represent between 25% and 50% of debt by the end of the charge control period.

A16.49 Applying these weightings to the estimated cost of existing debt and new debt would imply an average cost of debt for BT of 3.9% to 4.6%.

A16.50 It may be appropriate to uplift this estimate to include an allowance for debt issuance costs since these costs are not included in operating costs within BT's Regulatory Financial Statements (RFS), so would not be explicitly included in charge controls based on BT's cost data.[706] We asked BT for details of the issuance costs associated with the three tranches of debt it issued in March 2016 and on an annualised basis these ranged from [✂].[707] In its Bristol Water decision, the CMA allowed for a 10 basis points uplift in the cost of debt for a notional company.[708] We also propose to include an allowance of 10 basis points which would mean that the cost of debt for BT under a weighted cost of debt approach would be 4.0% to 4.7%.

Proposed cost of debt

A16.51 We consider that an appropriate range for the debt premium is 0.9% to 1.3%. This is consistent with the inter-quartile average spread on BT's sterling bonds over the last one and two years, and avoids placing weight on the highest and lowest spreads over this period. We propose placing less weight on the BBB composite indices, and prefer to rely on it as a cross-check, noting that the composite indices include bonds with lower credit ratings than BT.

A16.52 The midpoint of this proposed range is 1.1%. However, we do not consider that this mid-point represents an appropriate central estimate for the BT Group debt premium because average sterling spreads on BT's debt have been below this rate since mid-2016 and we are mindful of the range implied by the weighted average of

[705] See page 31 of BT's 2016 annual report.
[706] BT response dated 12 August 2016 to question B8(b) of the 12th section 135 notice.
[707] Derived from BT response dated 12 August 2016 to question B8(a) of the 12th section 135 notice.
[708] See Appendix 10, para 48, CMA Bristol Water (October 2015), https://assets.digital.cabinet-office.gov.uk/media/5627997640f0b60368000001/Appendices_5.1_-_11.1_and_glossary.pdf.

existing debt and new debt. We therefore consider that a value below the midpoint of the range would be appropriate and propose to use a debt premium for BT Group of 1.0%.

A16.53 The resulting pre-tax nominal cost of debt for BT Group is 4.7%, representing the sum of the nominal RFR of 3.7% and the debt premium of 1.0%.

RPI inflation

A16.54 We consider that it is appropriate to calculate the nominal RFR and ERP by reference to RPI because the data used to inform our estimates is typically in real terms with respect to RPI (for example index-linked gilts are linked to RPI and the historical yields from the 2017 Yearbook are in real terms with respect to RPI for much of the period). We propose using RPI forecasts from the OBR consistent with other parts of the charge control.

A16.55 In November 2016, the OBR published an RPI forecast of 3.1% for 2019/20 and 3.2% for 2020/21.[709] We therefore propose to use these RPI forecasts in our WACC calculations for 2019/20 and 2020/21 respectively.

TMR and ERP

A16.56 Estimating the ERP directly is difficult since it is not directly observable and depends on the weight placed on different estimates.[710] While the TMR is also not directly observable, the TMR has been historically less volatile than the ERP.[711] Therefore, we first consider historical ex-post and historical ex-ante estimates of the TMR, and subtract our proposed RFR to obtain an estimate of the ERP. We then cross-check this estimate against other evidence on the ERP.

Historical ex-post estimates of the TMR

A16.57 Historical ex-post approaches assume that the average realised real TMR is a good proxy for the expected real TMR. Datasets from the 2017 Yearbook and 2016 Barclays Equity Gilt Study (2016 Barclays EGS) are the main source of evidence for historical returns.

A16.58 Table A16.12 shows arithmetic average real returns over the period 1900 to 2016 from the 2017 Yearbook and the period 1900 to 2015 from the 2016 Barclays EGS, assuming different holding periods for equity.

Table A16.12: Arithmetic average real return on equity, 1900-2015

Holding period:	1 year	2 year	5 year	10 year	20 year
2017 Yearbook	7.3%	7.2%	7.0%	6.9%	7.0%
2016 Barclays EGS	6.8%	6.7%	6.4%	6.3%	6.3%

709 OBR, Economic and Fiscal Outlook, November 2016

710 ERP estimates can also be based on different types of risk-free instrument which may not be consistent with how we have estimated the RFR.

711 From Table 72 of the 2017 Yearbook the ratio of standard deviation to arithmetic mean for the nominal TMR is 1.9; lower than the equivalent ratio for the nominal ERP calculated for equities against bonds (3.5) and equities against bills (3.2).

Source: Ofcom calculations based on Table 75 of the 2017 Yearbook and page 92 of the 2016 Barclays EGS. The averages shown are averages of rolling averages – e.g. for a 10-year holding period the average shown is the average annual return for 10-year holding periods for each year from 1909 to 2016.

A16.59 Table A16.12 indicates that the real historical ex-post average annual return on equity for holding periods of between one and twenty years lies somewhere between 6.3% to 7.3%, with returns falling the longer the holding period.

Historical ex-ante estimates of the TMR

A16.60 In previous charge controls we have considered two historical ex-ante approaches to estimating the real TMR.

A16.61 First, we considered Fama and French's approach of estimating the real TMR from the sum of average real dividend yields and the average real rate of dividend growth.[712] Data from the 2016 Barclays EGS suggests that the average real dividend yield has been 4.5% over the period 1900 to 2015 while the average real rate of dividend growth was 1.2%. This suggests a long run real TMR of around 5.7%.[713]

A16.62 Second, in the 2017 Yearbook, Dimson, Marsh and Staunton (DMS) try to infer what returns investors may have been expecting in the past by separating the historical equity premium into elements that correspond to investor expectations and those that relate to non-repeatable good or bad luck. DMS take into account dividend income, real dividend growth, expansion of valuation ratios and changes in the real exchange rate.[714] DMS infer that globally diversified investors expect an arithmetic average ERP over treasury bills of 4.5% to 5%.[715] Given the average long run real return on global treasury bills (which is the DMS preferred measure of risk free returns[716]) is 0.9%[717] this implies an expected real TMR of 5.4% to 5.9%.

ERP

A16.63 We have looked at evidence from:

- historical premia of UK equities over UK gilts;
- forward looking estimates of the ERP; and
- recent regulatory precedents.

[712] Fama, E. F. and French, K. R., 'The Equity Premium', Journal of Finance Vol. LVII, No. 2, April 2002.
[713] In its 2014 NIE Determination the CMA noted that current dividend yields were below the historical average which might suggest that expected returns are currently lower than 5.5%. See paragraph 13.144.
[714] See for example pages 32 to 37 of the 2017 Yearbook.
[715] Page 37 of the 2017 Yearbook.
[716] See page 26 of the 2017 Yearbook
[717] See page 229 of the 2017 Yearbook. The equivalent long run real return on UK treasury bills is 1.2% from page 212 of the 2017 Yearbook.

Historical premia of UK equities over gilts and treasury bills

A16.64 The 2017 Yearbook reports that the average (arithmetic) equity premium over bonds for the UK between 1900 and 2016 was 4.9%.[718] The average equity premium over treasury bills was 6.1% (arithmetic mean) for the same period.

A16.65 The Barclays 2016 EGS indicates that the average (arithmetic mean) premium of equities over bonds for the UK between 1900 and 2015 was 5.0%.[719] The average equity premium over treasury bills was 6.1% (arithmetic mean) for the same period.[720]

A16.66 These sources suggest that the nominal ERP is between 4.9% and 6.1% depending on whether the equity premium is measured relative to Government gilts (in which case it is closer to 5%) or treasury bills (in which case it is closer to 6%). The corresponding figure is slightly less in real terms. Taking the long-run view of inflation in the 2017 Yearbook consistent with the period of estimation for equity returns (which gives long-run inflation at 3.9%[721]), the range for the real ERP would be 4.7% (against gilts) to 5.9% (against treasury bills).

Forward looking estimates of the ERP (surveys and the dividend growth model)

A16.67 The 2016 survey of academics and investment professionals by Fernandez et al[722] gives a mean ERP for the UK of 5.3% and median of 5.0%. This mean is slightly higher than reported for the UK in the equivalent 2014 and 2015 surveys (5.1% and 5.2% respectively).[723]

A16.68 We place limited weight on survey evidence. This is for much the same reasons as previously articulated by the CMA, which said "*the results of such surveys tend to depend on the identity and outlook of the respondents and how they interpret the questions being asked. Some surveys do not clarify the time frame over which the parameters are to be estimated (the long-term equilibrium ERP or a shorter-term estimate); whether an arithmetic or geometric averaging approach should be used; or whether the ERP is over bonds or bills or some other instrument. In this report we have preferred to consider the underlying data on which survey respondents presumably base their views*."[724] In addition, it is not clear from the survey whether the ERPs provided by respondents are in nominal or real terms.

A16.69 Using the dividend growth model (DGM) it is possible to calculate an implied ERP using current market values, forecasts for earnings/dividends and an assumption about the RFR. We have previously placed less weight on such methods because

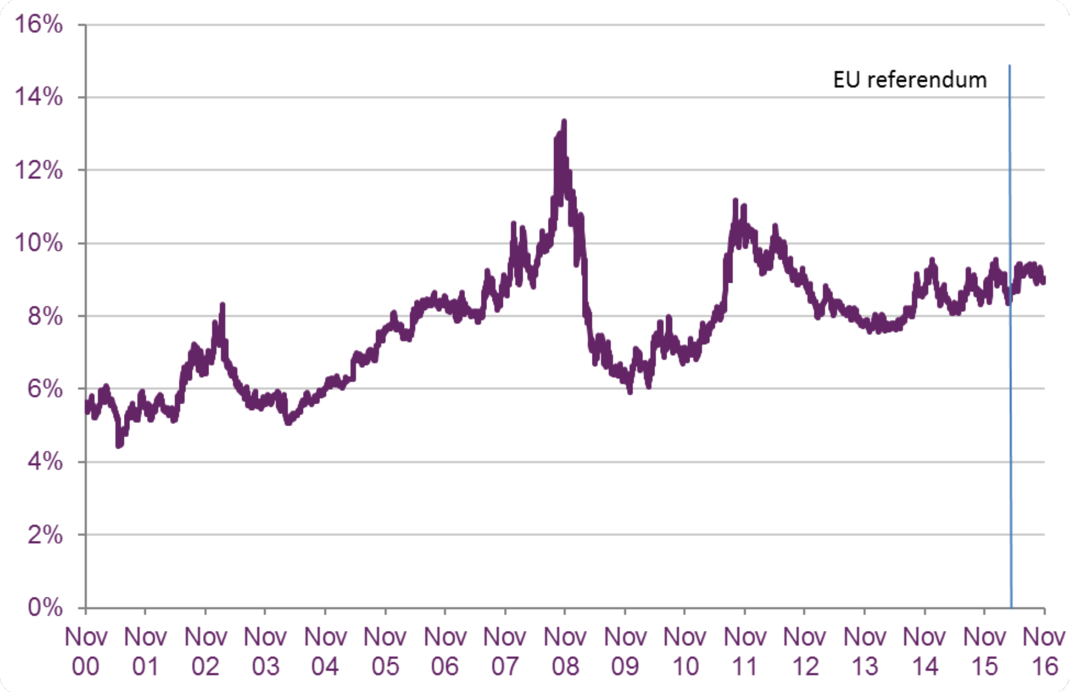
[718] Table 72, page 212, 2017 Yearbook.
[719] Derived from tables on page 73, 92 and 94 of the Barclays 2016 EGS.
[720] Derived from tables on page 73, 82 and 92 of the Barclays 2016 EGS.
[721] Table 72, page 212, 2017 Yearbook. Long-run inflation is 4.1% calculated using the Barclays 2016 EGS.
[722] Fernandez, P., Ortiz, A., Acin, I.F., 'Market Risk Premium used in 71 Countries in 2016: a survey with 6,932 answers'', 9 May 201. The survey was sent to "finance and economic professors, analysts and managers" (page 2).
[723] Ibid, see Table 4.
[724] Paragraph 13.156, page 13-31, 2014 NIE Determination.

they require the use of subjective input parameters such as analyst expectations and an assumption of future dividend growth rates.[725]

A16.70 In its November 2016 FSR the Bank of England said that "*the equity risk premium for the FTSE All-Share index rose following the referendum and has remained elevated in October and November [2016]*".[726] Figure A16.13 below shows the Bank of England's estimates of the nominal ERP derived using a DGM, indicating a moderate increase in the ERP since the referendum.[727]

A16.71 The chart below shows that the range of ERP estimates obtained from a DGM is wide, broadly ranging from around 4% to 13% over the ten-year period shown in the chart. However, in the last five years the ERP estimates have tended to fall within a narrower range of 8% to 10%.

Figure A16.13: Bank of England ERP estimates derived from a DGM



Source: Bank of England. Data to 30 November 2016. This is a modified version of Chart A.23 shown in the Bank of England's November 2016 FSR. The original chart showed the standard deviation of the ERP relative to the average.

[725] See for example paragraphs A8.27 and A8.28 of Ofcom's, A New Pricing Framework for Openreach, statement, 22 May 2009 (http://stakeholders.ofcom.org.uk/binaries/consultations/openreachframework/statement/statement.pdf) and also paragraphs A10.56 to A10.60 of the March 2015 MCT Statement.

[726] Page 13, November 2016 FSR.

[727] The ERP derived from the BoE DGM is nominal because it has been estimated by reference to nominal gilts. In the 2015 MCT Statement we considered ERP estimates produced by the Bank of England and said that we favoured these estimates over those produced by other organisations such as Bloomberg (footnote 171, 2015 MCT Statement). We understood that the Bank of England's results were derived from the FTSE All Share index while Bloomberg's results were based on the FTSE100 index. We favoured the Bank of England's results because the FTSE All Share reflects a more diversified portfolio of equities.

Recent regulatory precedents

A16.72 Table A16.14 below summarises the ERP used in decisions by UK regulators. ERP estimates from recent regulatory decisions, in real terms, are typically between 5% and 5.5%, although these ERP estimates should be viewed in conjunction with the real RFR and TMR used in the relevant decisions.

Summary of empirical and regulatory estimates of the ERP

A16.73 The table below summarises the preceding evidence on the ERP.

Table A16.14: Summary of evidence on the real ERP

Basis	Nominal/ real	ERP %
Historical premia of UK equities over gilts and treasury bills	Nominal	4.9% - 6.1%
Academic/user surveys	Unknown	c.5%
Dividend growth model	Nominal	8% - 10%
Recent regulatory precedent	Real	5% - 5.5%

Provisional conclusion on the TMR and ERP

A16.74 In the 2016 BCMR Statement we used a real ERP of 5.1% which, combined with our real RFR of 1.0%, gave a real TMR of 6.1%.

A16.75 For the same TMR, our proposal in this consultation for a real RFR of 0.5% would imply a real ERP of 5.6%, 0.5 percentage points higher than the 5.1% used in the 2016 BCMR Statement. While we propose to increase our estimate of the real ERP, we propose increasing it to only 5.5%. This reflects our consideration that the relationship between the TMR and ERP may not be one-for-one. In particular, as the real RFR reduces, this could imply a reduced TMR, even if there were an increased ERP. Therefore, we propose to round down the ERP to 5.5%, giving a real TMR of 6.0%.

A16.76 Applying our proposed inflation forecast of 3.2% for 2020/21, the nominal ERP is 5.7%, to which we then apply the estimated equity beta within the CAPM framework.

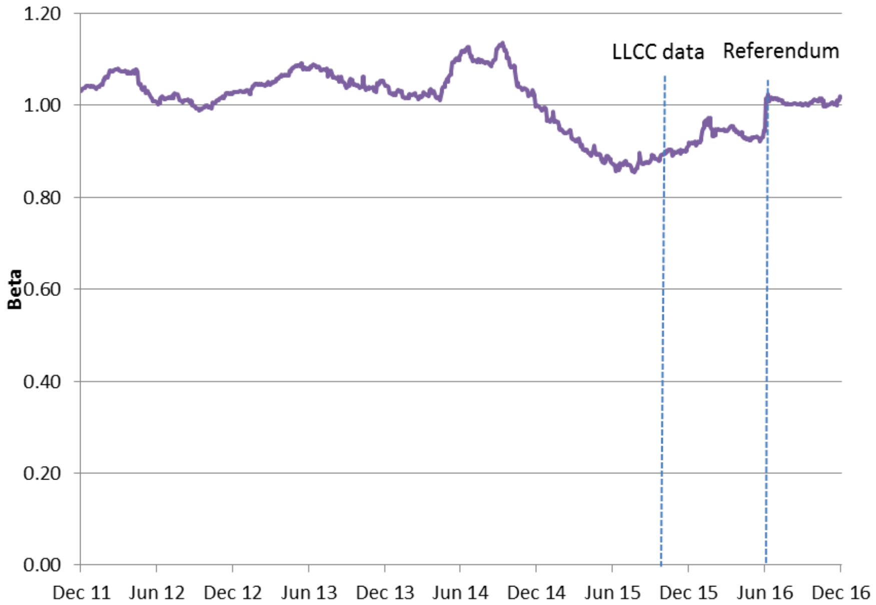
Equity beta and asset beta – BT Group

A16.77 In the 2016 BCMR Statement we used an asset beta for BT Group of 0.72, which was based on the 2-year asset beta against the FTSE All Share calculated by NERA.[728] Using data from Bloomberg we have considered how the BT Group equity and asset beta have changed since October 2015 (the data cut-off used in the 2016 BCMR Statement).

[728] We place most weight on equity betas calculated against the FTSE All Share index because it reflects what might be termed the 'home bias' of investors towards domestically listed companies. We also place most weight on equity betas calculated over a 2-year period of daily returns because we consider it provides the most appropriate balance between a short enough estimation period to remain relevant on a forward-looking basis whilst having enough data points to be sufficiently statistically robust.

A16.78 Figure A16.15 below shows the 2-year equity beta for BT Group measured against the FTSE All Share. As at 31 December 2016 the 2-year equity beta was 1.02 when measured against the FTSE All Share.

Figure A16.15: BT Group's 2-year equity beta against the FTSE All Share



Source: Bloomberg, Ofcom analysis. Chart shows 2-year daily equity beta against the FTSE All Share.

Asset beta

A16.79 The asset beta is calculated from the equity beta using average gearing over the same 2-year period used to estimate the equity beta and assuming a debt beta of 0.10 (consistent with our proposal on the debt beta below).[729]

A16.80 In Ofcom's previous WACC decisions we have estimated the gearing rate used to derive the asset beta by considering short term debt and long term debt as a proportion of enterprise value.[730] In this consultation, we have considered whether the deficit associated with BT's defined benefit pension scheme should also be taken into account when estimating financial gearing. [731]

A16.81 The liabilities of a defined benefit pension scheme are funded by the assets of the scheme and if the assets are not sufficient to cover the liabilities, the resulting deficit represents a claim on the company's cash flows by the pension scheme. A defined

[729] Asset betas are calculated using the following formula:

$$\beta\ asset = Gearing * \beta\ debt + (1 - Gearing) * \beta\ equity$$

[730] Where enterprise value is the sum of market capitalisation and short and long term debt, so that

$$Gearing = \frac{Short\ term\ debt + long\ term\ debt}{Short\ term\ debt + long\ term\ debt + market\ capitalisation}$$

[731] A 2009 paper by Oxera also considered that the effect of defined benefit pension deficits should be included in the gearing calculation when estimating the WACC. See 'Defined benefit pension plans: defining the cost", December 2009, http://www.oxera.com/Oxera/media/Oxera/downloads/Agenda/Pension-Plans_1.pdf?ext=.pdf [accessed 26 March 2017].

benefit pension scheme can therefore affect the financial risk faced by investors much like debt.

A16.82 In our 2010 Pensions Statement we said that BT's investors bear the risks of the defined benefit pension scheme and concluded that it was appropriate to include the associated systematic risk in the WACC (via the beta).[732] The main source of risk considered in our pensions review was the impact on the asset beta of BT Group, given that the beta of the pension scheme was likely to differ from that of the operating company and the assets (and liabilities) of the pension scheme were large in relation to BT's overall enterprise value. If, in addition, a pension deficit is viewed by investors as adding to financial risk – much like other sources of gearing – then as explained above, this will amplify the risk borne by investors.

A16.83 While in principle we consider that pension deficits are likely to add to financial risk, this is only likely to be a material consideration in estimating the risk faced by investors if the deficit is large.

A16.84 Defined benefit pension deficits can be estimated in several ways and it is uncertain how an investor would value the deficit for the purposes of assessing the impact on financial gearing. Methodologies for estimating the deficit typically differ in terms of the discount rate used to estimate the present value of pension liabilities for comparison against the value of pension assets, where the discount rate reflects an assumption about the future growth of pension assets.

A16.85 Possible approaches to estimating pension liabilities based on publicly available information include the 'best' estimate, the accounting valuation, and the actuarial valuation:

- The discount rate used in the 'best' estimate valuation is based on returns expected from the actual assets of the pension scheme. Although this is not regularly reported, BT has in the past published its own estimates that indicate that its pension scheme could be in surplus.[733]

- The discount rate used in the accounting valuation is based on the yield on high quality corporate bonds as required under International Accounting Standard (IAS) 19.[734] For BT, this approach currently gives an estimate of the pension deficit of £11.1bn.[735] The pension deficit estimated under IAS 19 is regularly reported in company accounts and we understand that this is also the measure used by credit rating agencies when assessing ratings.

- Another method of valuing the deficit is the actuarial valuation. This is undertaken every three years and takes into account the pension trustee's views on the

[732] 2010 Pensions Statement is available here: https://www.ofcom.org.uk/__data/assets/pdf_file/0019/47701/statement.pdf.

[733] Slide 126 of BT's investor meeting slide pack dated 'November and December 2016' shows that as at the end of 2013/14 BT's best estimate was that the pension scheme was in surplus by £0.5bn.

[734] Page 203 BT's 2016 annual report says that the discount rate is based on AA-rated corporate bonds.

[735] December 2016 Q3 results, http://www.btplc.com/Sharesandperformance/Quarterlyresults/index.htm.

strength of the employer covenant. The last actuarial valuation for BT in 2014 gave a similar estimate of the size of the deficit to the accounting valuation.[736]

A16.86 If an investor placed weight on the best estimate approach this might suggest that no adjustment to the gearing would be required to take account of the pension scheme since, under this approach, the pension scheme is not in deficit.[737] However, if an investor placed weight on the accounting valuation and/or the actuarial valuation approaches, this would increase BT's gearing. A higher gearing would imply a lower asset beta for a given equity beta, unless offset by a higher debt beta.

A16.87 Figure A16.16 shows BT Group's gearing both including and excluding the pension deficit as measured under IAS 19 (accounting valuation approach). BT's current gearing is around 40% including this measure of the pension deficit, while it is around 30% if there were no contribution to BT's financial gearing from the pension scheme.

Figure A16.16: BT Group market cap and gearing with and without the IAS 19 pension deficit

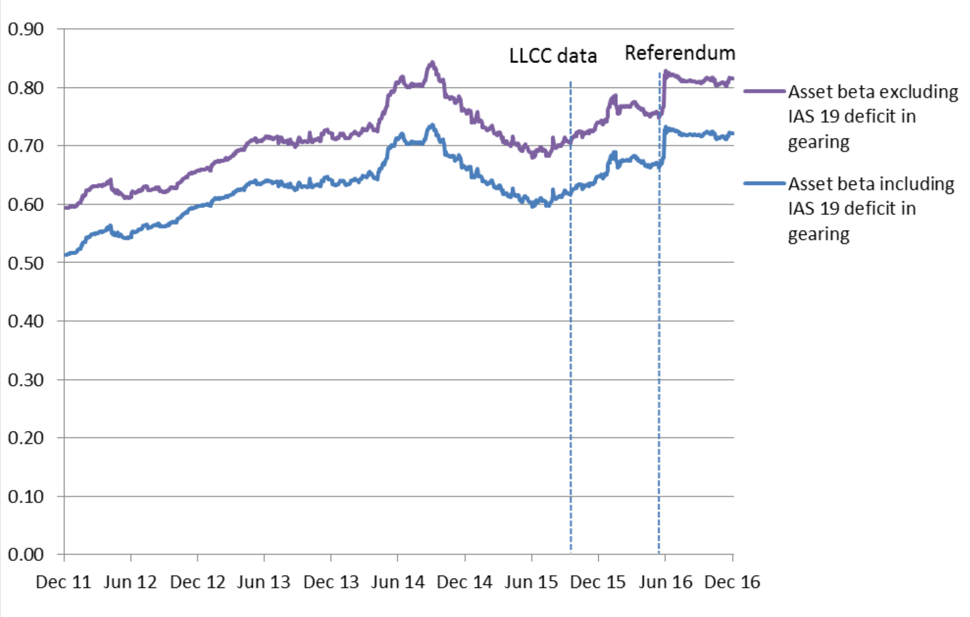
Source: Bloomberg, Ofcom analysis

A16.88 Figure A16.17 below shows the two-year asset beta for BT Group both including and excluding the pension deficit as measured under IAS 19. As at 31 December 2016 the asset beta is 0.81 when estimated using a gearing rate excluding this measure of the deficit (with average gearing over the last two years of 22%), while it is 0.72 when including this measure of the pension deficit in the gearing (with average gearing over the last two years of 32%). On either measure, the asset beta has increased since October 2015 (the data used to inform the 2016 BCMR Statement).

[736] See slide 106 of BT's investor meeting slide pack dated 'February and March 2017': http://www.btplc.com/Sharesandperformance/Quarterlyresults/Investormeetingpack.pdf

[737] If there were a large enough surplus, this could imply a reduction in financial risk borne by investors and a reduction in gearing reflecting this.

Figure A16.17: BT Group asset beta on a two-year rolling average of daily returns



Source: Bloomberg, Ofcom analysis. Asset beta is estimated using a debt beta of 0.10 and the FTSE All Share index.

A16.89 As explained above, it is uncertain how an investor would take account of any deficit from the defined benefit pension scheme when assessing BT's financial gearing. If an investor assumed the scheme was not in deficit, then we consider an asset beta of 0.81 would be appropriate. However, if an investor considered the scheme was in deficit, and thus assumed a higher level of financial gearing, then we consider an asset beta of 0.72 might be appropriate if the debt beta were not higher as a result of the additional financial risk.

A16.90 Given this uncertainty, we propose to use an asset beta between the two estimates above and for the purposes of this consultation have used an asset beta for BT Group of 0.76. Note also, that if the debt beta (discussed below) were increased slightly to reflect the impact of higher gearing due to a pension scheme deficit, we would also obtain an asset beta of 0.76, or close to this.[738]

A16.91 This asset beta of 0.76 is measured against the FTSE All Share index. Later in this annex we also present asset betas for comparator companies against the FTSE All Europe and FTSE All World indices. To enable comparison, Table A16.18 below shows our proposed BT Group asset beta against the FTSE All Europe and FTSE All World indices, following the same approach used above to estimate the asset beta against the FTSE All Share index.

Table A16.18: BT Group 2-year asset beta against different indices

	FTSE All Share	FTSE All World	FTSE All Europe
Excluding pension deficit reported in company accounts	0.81	0.86	0.68
Including pension deficit reported in company accounts	0.72	0.76	0.60
Consultation proposal	0.76	0.81	0.64

[738] For example, increasing the debt beta from 0.1 to 0.15 increases the BT Group asset beta from 0.72 to 0.74; increasing the debt beta to 0.2 increases the asset beta to 0.76.

Source: Bloomberg, Ofcom analysis

Forward-looking gearing

A16.92 To estimate a forward-looking equity beta from this asset beta, we need to estimate BT's forward looking gearing. In the 2016 BCMR Statement we used a forward looking gearing of 30%. As explained above, we propose to reflect some effect from a pension deficit in our gearing assumption, but recognise that the presence and size of this effect is uncertain.

A16.93 As can be seen in Figure A16.16 above, BT's gearing increased in January 2016 following its acquisition of EE.[739] Since then, gearing has increased further as BT's market capitalisation reduced (especially following the EU referendum). As at December 2016, BT's gearing including an estimate of the pension deficit based on the IAS 19 method stands at around 40%. Without any adjustment for the pension deficit (which would be consistent with a best estimate approach to valuing pension liabilities) BT's gearing stands at 27%. We also note that on 18 July 2016 the European Commission (EC) 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%.[740]

A16.94 We consider that a reasonable forward looking gearing level for BT Group would lie between 25% and 50%. The lower end of this range approximately reflects the average gearing for BT over the last two years (excluding the pension deficit). The upper end of the range is around the level of the most highly geared UK utilities[741] and the maximum level proposed in the 2016 Brattle report. 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%.[742]

A16.95 As noted above, it is uncertain how an investor would take account of any debt associated with the defined benefit pension scheme when assessing BT's financial gearing. Given this uncertainty, 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.

[739] BT took on the debt that had previously been issued by EE.

[740] See page 84 of "Review of approaches to estimate a reasonable rate of return for investments in telecoms networks in regulatory proceedings and options for EU harmonization", 18 July 2016, http://bookshop.europa.eu/en/review-of-approaches-to-estimate-a-reasonable-rate-of-return-for-investments-in-telecoms-networks-in-regulatory-proceedings-and-options-for-eu-harmonization-pbKK0416408/?CatalogCategoryID=CXoKABst5TsAAAEjepEY4e5L.

[741] As with the UK and European telecoms operators, this result is not sensitive to the treatment of pension deficits for these companies since where deficits are reported in company accounts they tend to be relatively small.

[742] Of the 14 UK and European telecoms companies we have considered, 9 had gearing levels in this range over the last year, and 8 had gearing levels in this range over the last two years. This result is not sensitive to the treatment of pension deficits for these companies since where deficits are reported in company accounts they tend to be relatively small in comparison to that for BT Group.

Estimate of forward-looking equity beta

A16.96 Combining an asset beta of 0.76, a forward looking gearing of 35% and a debt beta of 0.10 (see next section) we derive a forward-looking equity beta for BT Group of 1.12. This is calculated using the following formula, where the term "Gearing" refers to forward gearing:

$$\beta equity = \frac{\beta asset - \beta debt * Gearing}{1 - Gearing}$$

Debt beta

A16.97 We have considered the following sources of evidence on debt betas:

- Brealey, Myers and Allen in their textbook *Principles of Corporate Finance* estimate that debt betas of large firms are in the range of 0 to 0.20[743];
- the CMA used a debt beta of:
  - 0.05 in the NIE Determination[744];
  - 0.10 in its 2007 Heathrow and Gatwick review and its 2010 Bristol Water review[745]; and
  - zero in its 2015 Bristol Water review;[746] and
- The 2016 Brattle report which suggests a debt beta of 0.10 for firms with a BBB credit rating[747] while a debt beta of 0.05 would be appropriate for firms with an A rating.

A16.98 We have used a debt beta of 0.10 in recent charge control decisions. We would associate a higher debt beta with relatively higher debt premiums and gearing levels, and vice versa. The table below shows the gearing levels and debt premia we have used alongside our debt beta assumptions in recent decisions.

Table A16.19: Ofcom's recent debt beta, debt premium and gearing decisions

Year	Decision	Debt beta	Gearing	Debt premium range
2016	BCMR Statement	0.10	30%	1.1% - 1.5%
2015	MCT Statement	0.10	40%	1% - 1.6%

743 Page 436, Brealey, Myers and Allen, 2013, *Principles of Corporate Finance, 11th Edition*.
744 Paragraph 13.175c, page 13-36, NIE Determination.
745 CC report on Heathrow and Gatwick, Appendix F, paragraph 106. http://webarchive.nationalarchives.gov.uk/20140402141250/http://www.competition-commission.org.uk/our-work/directory-of-all-inquiries/heathrow-and-gatwick-quinquennial-review/final-report-and-appendices-glossary and CMA Bristol Water Determination, Annex N, paragraph 151, http://webarchive.nationalarchives.gov.uk/20121212135622/www.competition-commission.org.uk/our-work/directory-of-all-inquiries/bristol-water-plc-water-price-limits-determination.
746 CMA noted that its choice of "debt beta has very little impact on the cost of capital if Bristol Water's gearing level is similar to the comparators used". Paragraph 10.150, Bristol Water 2015
747 Applies to firms with a credit rating of BBB-, BBB and BBB+.

2014	FAMR Statement	0.10	32%	1% - 1.5%
2013	BCMR Statement	0.15	40%	1.7% - 2.3%
2011	MCT Statement	0.10	30%	1% – 2%

Source: Ofcom[748]

A16.99 As explained above, if financial gearing were higher because of a pension deficit this might suggest a higher debt beta. For example, in the 2013 LLCC Statement when gearing was 40%, we used a debt beta of 0.15. As noted above, reflecting the full accounting value of the pension deficit could imply gearing at around this level, but we do not propose making an adjustment to the full amount implied by the accounting value of the pension deficit.

A16.100 In relation to the debt premium, we have proposed a range for BT Group of 0.9% to 1.3%. This is similar to the range we used in the 2014 FAMR Statement (i.e. 1% - 1.5%), when gearing was also similar (then 32%, now a proposed gearing of 35%) and a debt beta of 0.10 was used.

A16.101 We therefore propose to use a debt beta of 0.10 for this consultation. If the full amount of the pension deficit as measured under the accounting approach were reflected in gearing, then a somewhat higher debt beta could be appropriate – which would increase the estimated asset beta (for an observed level of the equity beta).

Corporate tax rate

A16.102 According to the HM Treasury, "at Summer Budget 2015, the government announced legislation setting the Corporation Tax main rate (for all profits except ring fence profits) at 19% for the years starting the 1 April 2017, 2018 and 2019 and at 18% for the year starting 1 April 2020. At Budget 2016, the government announced a further reduction to the Corporation Tax main rate (for all profits except ring fenced profits) for the year starting 1 April 2020, setting the rate at 17%".[749] For 2019/20 we therefore propose to use the expected corporate tax rate of 19% while for 2020/21 (the final year of the control period) we propose to use the expected corporate tax rate of 17%.

Disaggregation of BT Group asset beta

A16.103 In the 2016 BCMR Statement Ofcom split the BT Group asset beta three ways: Openreach copper access[750], Other UK telecoms[751] and the Rest of BT (RoBT) which primarily included BT's Global Services ICT division. This is illustrated in Figure A16.20, which shows the asset betas Ofcom used in the 2016 BCMR

[748] March 2011 MCT Statement, March 2015 MCT Statement (Table A10.1), 2013 LLCC Statement, and June 2014 FAMR Statement (Table A16.1 and Table A16.2), 2016 BCMR Statement (Table A30.1).

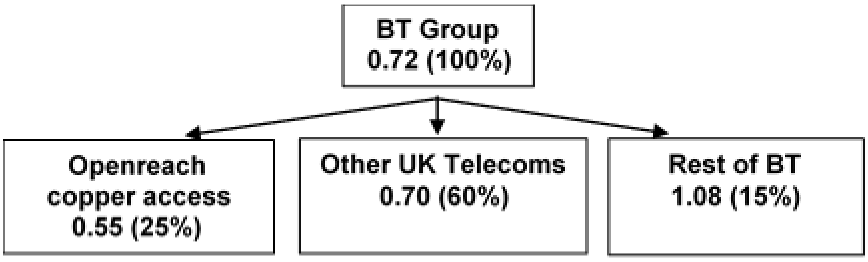
[749] https://www.gov.uk/government/publications/rates-and-allowances-corporation-tax/rates-and-allowances-corporation-tax.

[750] 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).

[751] Other UK telecoms included BT's wholesale and retail leased lines, fixed voice, broadband and bundled services

Statement and the relative weights put on each disaggregated part of BT (so that the weighted sum of each disaggregated asset beta equals the BT Group asset beta).

Figure A16.20: Asset betas and weights used in the 2016 BCMR Statement



Source: Ofcom.

A16.104 In estimating asset betas for the disaggregated parts of BT we therefore need to exercise judgement, considering evidence from both benchmark operators that are similar (albeit not pure-play comparators) and the overall BT Group asset beta. In the rest of this section we set out our proposals for disaggregating the BT Group asset beta as follows:

- Comparator company asset betas;
- Openreach copper access asset beta;
- other UK telecoms and RoBT asset beta;
- NGA asset beta.

Comparator company asset betas

A16.105 Our disaggregation of the BT Group asset beta is informed by the asset betas for comparator companies. Using data to 31 December 2016 we have estimated two-year asset betas for the following comparators: UK network utilities, UK telecoms operators, European telecoms operators and international ICT companies. While some comparators considered below have defined benefit pension schemes, any associated pension deficits reported in company accounts tend to be relatively small compared to that for BT Group. Where there is a material difference in the average asset betas for comparator firms when including the pension deficit as reported in company accounts, we have reported this difference. Otherwise, the asset betas presented below do not include an adjustment to the gearing for a pension deficit when deriving asset betas.

<u>Comparator companies for Openreach copper access</u>

A16.106 We would expect Openreach copper access services to face lower systematic risk than BT Group, and so we therefore place weight on the asset betas for UK network utilities when estimating the asset beta for Openreach copper access.

A16.107 As at 31 December 2016 the two-year asset beta for five UK network utilities[752] ranged from 0.40 to 0.66, with an average of 0.46.[753] This average is the same as that presented in the 2016 BCMR Statement (which considered data to 31 October 2015).[754]

Table A16.21: Asset betas for UK network utilities

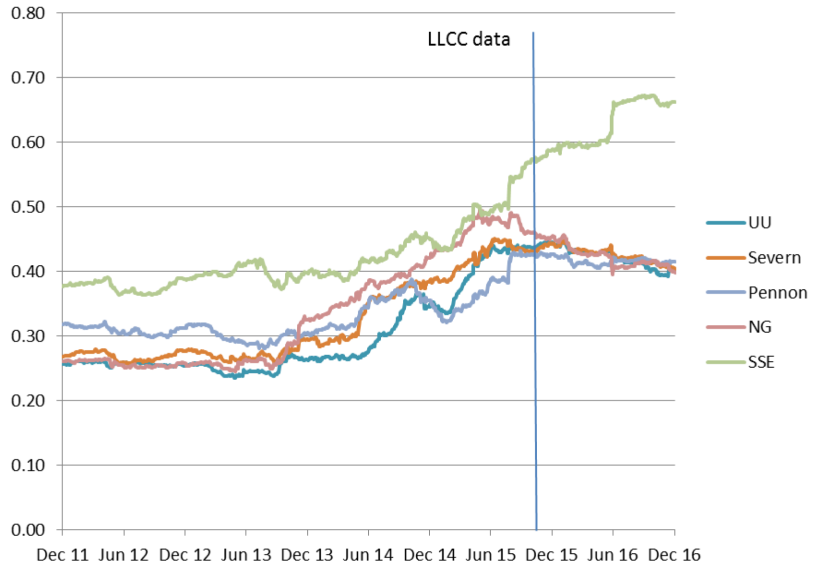
	Asset beta vs FTSE All Share		Average gearing	
	1 year	2 year	1 year	2 year
National Grid	0.33	0.40	43%	44%
Severn Trent	0.35	0.40	48%	48%
Pennon Group	0.38	0.41	48%	47%
United Utilities	0.33	0.40	52%	51%
SSE	0.67	0.66	32%	31%
Average	0.41	0.46	45%	44%

Source: Bloomberg and Ofcom analysis. Calculated using a debt beta of 0.1 and data up to 31 December 2016.

A16.108 As can be seen from Figure A16.22, the 2-year asset beta for most UK utilities has reduced slightly since the data considered in the 2016 BCMR Statement, although SSE has seen its 2-year asset beta increase significantly.[755]

[752] The five network utility comparators all have significant regulated assets. According to 2016 annual reports, National Grid, United Utilities and Severn Trent generate more than 90% of profits from regulated activities, while for Pennon Group the proportion is around 80%. SSE generates around half of its profits from regulated activities.
[753] The average 2-year asset beta is 0.45 when including pension deficits reported in company accounts in the gearing.
[754] Paragraph A30.199, 2016 BCMR Statement.
[755] This may be because SSE generates less profit from regulated activities.

Figure A16.22: Two-year asset betas for UK network utilities against the FTSE All Share



Source: Bloomberg, Ofcom analysis. Calculated using a debt beta of 0.1 and data up to 31 December 2016.

A16.109 We also take account of the asset betas for UK telecoms operators. 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.

A16.110 As at 31 December 2016 the two-year asset beta for Sky and TalkTalk measured against the FTSE All Share is 0.65 and for Vodafone[756] it is 0.57, with the overall average UK telecoms asset beta at 0.62.[757] This average is slightly below the average presented in the 2016 BCMR Statement of 0.66.[758]

Table A16.23: Asset betas for UK fixed telecoms operators

	Asset beta vs FTSE All Share		Asset beta vs FTSE All World		Average gearing	
	1 year	2 year	1 year	2 year	1 year	2 year
Sky	0.70	0.65	0.79	0.70	35%	33%
TalkTalk	0.64	0.65	0.67	0.69	27%	22%
Vodafone	0.52	0.57	0.47	0.53	49%	46%
Average	0.62	0.62	0.64	0.64	37%	34%
BT		*0.76*		*0.81*		

Source: Bloomberg and Ofcom analysis. Calculated using a debt beta of 0.1 and data up to 31 December 2016.

756 We recognise that Vodafone has historically been predominantly a mobile operator, but with the acquisition of Cable & Wireless Worldwide in 2012 it has fixed telephony assets in the UK.
757 The average 2-year asset beta remains at 0.62 when including pension deficits reported in company accounts in the gearing.
758 Table A30.15, 2016 BCMR Statement.

A16.111 Figure A16.24 shows that the asset beta for Sky and TalkTalk has increased since the data used to inform the 2016 BCMR Statement, in particular around the time of the EU referendum. On the other hand, the asset beta for Vodafone has reduced and is now the lowest among UK telecom operators.

Figure A16.24: Two-year asset betas for UK telecoms operators against the FTSE All Share

Source: Bloomberg, Ofcom analysis. Data as at 31 December 2016.

Comparator companies for Other UK telecoms

A16.112 When considering the asset beta for Other UK telecoms, we take account of the asset betas of UK and European telecoms operators. The asset betas for UK telecoms operators was set out above.

A16.113 In relation to European telecoms operators, as at 31 December 2016 the two-year asset betas against the FTSE All Europe index ranged from 0.37 to 0.66, with an average of 0.54 (the same average as presented in the 2016 BCMR Statement[759]). Against the All World index, the range is 0.42 to 0.86, with an average of 0.69 (slightly higher than the average of 0.65 reported in the 2016 BCMR Statement[760]).[761]

Table A16.25: Two-year asset betas for European telecoms operators

	Asset beta vs FTSE All Europe	Asset beta vs FTSE All World	Average gearing
Telefonica	0.60	0.77	54%
Deutsche Telecom	0.48	0.73	45%
Proximus (was Belgacom)	0.54	0.69	20%

[759] Paragraph A30.202, 2016 BCMR Statement

[760] Paragraph A30.202, 2016 BCMR Statement.

[761] The average 2-year asset beta against the FTSE All World is 0.68 when including pension deficits reported in company accounts in the gearing.

KPN	0.55	0.71	41%
Orange	0.55	0.71	47%
Telecom Italia	0.50	0.61	66%
Illiad	0.66	0.86	12%
Orange Belgium (was Mobistar)	0.37	0.42	28%
Telenor	0.54	0.69	25%
Tele2	0.64	0.80	22%
Swisscom	0.47	0.61	25%
Average	0.54	0.69	35%
BT	0.64	0.81	

Source: Bloomberg and Ofcom analysis. Calculated using a debt beta of 0.1 and data up to 31 December 2016.

A16.114 When compared against a consistent market index, the two-year BT Group asset beta is one of the highest amongst European telecom comparators, with only Iliad having a higher asset beta (against both the FTSE All Europe and FTSE All World indices). In general, the asset beta measured against the FTSE All World is currently higher than that against the FTSE All Europe; on average across the European telecom comparators the ratio is 1.29 while for BT it is similar at 1.27.

Comparator companies for RoBT

A16.115 Under our three-way disaggregation, the RoBT primarily represents BT's ICT operations in Global Services.

A16.116 In the 2016 BCMR Statement we commissioned NERA to identify suitable comparators for BT's ICT operations. NERA identified that BT's Global Services ICT division provides 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 identified two tiers of comparators:

- "Tier 1" comparators that are active across all three main business areas in Global Services; and
- "Tier 2" comparators that are active in two of the three main business areas in Global Services.

A16.117 We have updated the two-year asset betas for these ICT comparators against the FTSE All World index. Some of these comparators, in particular Unisys, report large pension deficits in their accounts, resulting in lower asset betas where these deficits are included in the gearing. Table A16.26 shows the two-year asset betas including and excluding the deficit reported in company accounts.

Table A16.26: ICT company asset betas against the FTSE All World and gearing

	Asset beta (including deficit)	Asset beta (excluding deficit)	Average gearing (including deficit)	Average gearing (excluding deficit)	Tier 1
IBM	0.76	0.82	28%	22%	✓
Unisys	0.45	1.16	78%	34%	✓
Amdocs	0.74	0.74	1%	1%	✓

Computer Science	0.89	0.92	30%	28%	✓
Teletech	0.86	0.86	8%	8%	✓
Indra Sistemas	0.80	0.80	40%	40%	✓
Cancom	0.98	0.98	9%	9%	✓
Atos SE	0.81	0.90	24%	14%	✓
Cdw	0.70	0.70	32%	32%	
Cognizant	1.22	1.22	3%	3%	
Xerox	0.72	0.84	50%	41%	
Sopra Steria Group	0.63	0.71	39%	29%	
Cap Gemini	0.94	1.00	25%	19%	
Tieto	0.76	0.76	1%	1%	
CGI Group	0.67	0.67	12%	11%	
Average - all	0.79	0.87	25%	19%	
Average - Tier 1	0.79	0.90	27%	19%	

Source: Bloomberg and Ofcom analysis. Estimated assuming a debt beta of 0.10. Note that one of the ICT companies considered by NERA, Engineering Spa, has been delisted since the 2016 BCMR Statement.

A16.118 Figure A16.27 shows the min-max range and average asset betas for the ICT comparators as well as the UK and European comparators discussed earlier. For ICT companies, the figure shows the asset betas both including and excluding the pension deficit reported in company accounts because it is more material for ICT companies than for the UK and European comparators (except BT). Asset betas are shown against the FTSE All World index since this is our preferred basis of comparison for companies listed in different jurisdictions.[762]

Figure A16.27: Asset beta comparisons against the FTSE All World index

Source: Bloomberg and Ofcom analysis. Green bar represents the min-max range and the black square is the average asset beta.

[762] See section 2.2 of the NERA report at Annex 31 of the 2016 BCMR Statement.

A16.119 As in the 2016 BCMR Statement, the evidence suggests that, on average, a telecoms operator is likely to exhibit a lower asset beta than an ICT business. The average two-year asset beta for UK and European telcos is around 0.65 (0.69 for European telcos and 0.64 for UK telcos) against the FTSE All World index whereas for ICT businesses the average asset beta is between 0.79 and 0.90 (depending on how the pension deficit is treated) and at least 13 of the 15 ICT comparators have an asset beta above 0.65.[763] While the ranges overlap to some extent, the range for the ICT comparators in particular is wide, which implies some uncertainty in coming to a point estimate for these companies.

A16.120 Recent statements from BT indicate that the outlook for UK public sector and international corporate markets (which incorporate a lot of its ICT operations) have deteriorated.[764] This may support a view that returns in its ICT operations are more volatile and face greater systematic risk than other parts of its business.

Openreach copper access asset beta

A16.121 In the 2016 BCMR Statement we used an asset beta of 0.55 for Openreach copper access. This was below the BT Group asset beta of 0.72 and above the average utility asset beta of 0.46 at the time. It was also below the UK telecoms comparator average of 0.66 at the time.

A16.122 Given that there has not been a significant change in the average asset betas for UK Utilities or UK and European telecoms comparators we consider that an asset beta of 0.55 for Openreach copper access remains appropriate.

A16.123 In the 2016 BCMR Statement we assigned a weighting of 25% to the Openreach copper access business (compared to 33% used in the 2014 FAMR statement). Table A16.28 below reports weightings for 2014/15 and 2015/16 based on EBITDA and NRC/EV for Openreach copper access as a proportion of BT Group.[765]

Table A16.28: Weightings for Openreach copper access

	2014/15	2015/16
EBITDA	28%	28%
Regulatory NRC/EV	22%	17%

Source: Ofcom.[766]

[763] If no adjustment is made for pension deficits at ICT companies then all of the 15 ICT companies have an asset beta above 0.65.
[764] For example, its news release dated 24 January 2017 ‘Update on investigation into BT’s Italian business and on BT Group outlook’: http://www.btplc.com/Sharesandperformance/Quarterlyresults/2016-2017/update/Downloads/Newsrelease/q317-italia-release.pdf.
[765] In the 2016 BCMR Statement we also reported MCE weightings but placed no weight on this.
[766] 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 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 the 2015/16 percentage assumes that EE was owned for the entire financial year. NRC is taken from the cost model supporting the 2014 FAMR Statement and this consultation divided by BT’s average enterprise value

A16.124 In estimating the relevant weightings, we propose to consider the same period as used for estimating the BT Group asset beta – i.e. the last two years, although we recognise there is a mismatch between the available financial data (two years to March 2016) and the beta estimation period (two years to December 2016). We are also mindful that BT completed its acquisition of EE on 29 January 2016, which means we might expect BT's Openreach copper access activities to represent a lower proportion of BT's economic value than previously. However, BT only owned EE for around half of the period over which we have estimated the asset beta (the two-year period ending 31 December 2016).

A16.125 In light of the above, we propose to use a weighting of 20% for Openreach copper access, placing weight on more recent ratios that indicate a reduction in the proportion of BT's economic value that relates to Openreach copper access.

Other UK telecoms and RoBT asset beta

Other UK telecoms asset beta

A16.126 BT completed the acquisition of EE in January 2016, meaning that it now has significant mobile operations. Before determining a reasonable asset beta range for Other UK telecoms, we have assessed whether it would be appropriate to include EE within Other UK telecoms by considering evidence on whether the systematic risk of mobile operators is materially different from fixed telecoms operators.

A16.127 We commissioned a report from NERA to consider this issue.[767] After considering qualitative and quantitative indicators of differences in systematic risk, NERA concludes that "at present, we do not find evidence of differences in systematic risk between fixed and mobile telecoms operators".[768]

A16.128 We therefore consider that it is reasonable to include EE within the Other UK telecoms disaggregated part of BT Group.

A16.129 In the 2016 BCMR Statement we considered that a reasonable range for the asset beta of Other UK telecoms would be 0.55 to 0.75 (against the FTSE All Share). Based on evidence from comparator telecoms operators we have considered whether this range remains appropriate.

A16.130 As explained above, our preferred asset beta measure for BT Group uses the FTSE All Share. A range of 0.55 to 0.75 would capture the two-year asset betas of UK telecoms comparators measured against the FTSE All Share (which range from 0.57 to 0.65, averaging 0.62).

A16.131 From Table A16.23 above we observe that the two-year asset betas for BT Group and UK telecoms operators measured against the FTSE All Share and FTSE All World are similar (though the asset beta measured against the FTSE All World currently tends to be a little higher[769]). Given the similarity of these asset betas, we have additionally considered the asset betas for European telecoms operators

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).

767 NERA's report 'Differences in the beta for fixed vs mobile telecommunications operators' can be found in Annex 21.

768 Page 28, Annex 21.

769 Around 3% higher on average across the four companies (BT, Sky, TalkTalk and Vodafone).

measured against the FTSE All World. As shown in Table A16.25 above, the asset betas for 7 of the 11 European telecoms comparators fall within a range of 0.55 to 0.75.

A16.132 Therefore, we propose that 0.55 to 0.75 remains a reasonable range for the asset beta for Other UK telecoms.

A16.133 Within this range, we propose to use an asset beta for Other UK telecoms of 0.75, which is higher than the value of 0.70 used in the 2016 BCMR Statement. This is for three reasons. First, it reflects the fact that the BT Group asset beta is higher than that considered in the 2016 BCMR Statement. Second, the asset betas of Sky and TalkTalk (which are more UK-focused than Vodafone, the third UK telco comparator) have also increased since the 2016 BCMR Statement. Third, an asset beta of 0.75 for Other UK telecoms implies a more reasonable asset beta for the RoBT (i.e. BT's ICT activities) given the weightings we propose for the three lines of business into which we disaggregate BT.

ICT weighting

A16.134 In the 2016 BCMR Statement we applied a weighting of 15% to the RoBT, reflecting the proportion of BT Group represented by BT's Global Services ICT division.

A16.135 Table A16.29 shows the proportion of BT Group EBITDA that related to each division in 2014/15 and 2015/16. We consider that this data would continue to support a weighting of around 15% for BT's Global Services division.

Table A16.29 Proportion of total EBITDA represented by each BT division

	2014/15	2015/16
Global Services	17%	13%
Openreach	41%	34%
BT Consumer	16%	13%
BT Business	17%	14%
BT Wholesale	9%	7%
EE	-	20%
Other	0%	-1%
Total	100%	100%

Source: 2014/15 data from BT's 2016 annual report. 2015/16 data from pro-forma results published by BT on 29 June 2016 (http://www.btplc.com/Sharesandperformance/Quarterlyresults/2015-2016/RestatedhistoricalfinancialinformationJune2016/Downloads/Proforma/ProformahistoricalfinancialsJune2016.pdf).

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 copper access business alone

A16.136 We note that on 1 April 2016 BT reorganised its divisions.[770] The UK-focused parts of Global Services moved into a new "Business and Public Sector" division (which also includes the old BT Business division) while multinational and international

[770] See press release dated 1 February 2016: http://www.btplc.com/news/#/pressreleases/bt-announces-new-structure-1304769.

clients continued to be served from Global Services.[771] We consider that an ICT asset beta would apply to the ICT services provided from both of these BT divisions (i.e. UK-focused ICT services in Business and Public Sector and internationally focused ICT services in Global Services).[772]

RoBT asset beta

A16.137 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%. Given the estimated asset betas for Openreach copper access (0.55) Other UK telecoms (0.75) and BT Group (0.76), the implied asset beta for BT's ICT services would be 1.08 (by reference to the FTSE All Share Index).[773] Converting this to a FTSE All World asset beta based on the ratio of the FTSE All World to FTSE All Share asset beta for BT Group (0.81/0.76), the asset beta for BT's ICT services is 1.15 against the FTSE All World.

A16.138 We recognise that this RoBT asset beta is above the average ICT asset betas and close to the top end of the asset beta range for ICT comparators shown in Figure A16.27 above. However, the ICT asset beta range is wide and there is significant uncertainty about where BT's ICT operations would lie within this range.[774] In light of this, we do not propose further revising the asset betas for the disaggregated lines of business, in particular, the regulated activities in Openreach copper access and in Other UK telecoms.

NGA asset beta

A16.139 In this section we consider the appropriate asset beta to apply to NGA services.

A16.140 In theory, it would be appropriate to identify a separate asset beta for BT's NGA operations. In practice, the absence of a pure-play NGA operator makes this difficult.[775]

A16.141 A priori, we would expect the systematic risk of NGA services to be higher than the Openreach copper access services. Indeed, when assessing compliance with the

[771] Other changes included EE's business division moving into the new 'Business and Public Sector' division so that the EE division focused on the consumer market.

[772] We also note that since BT's 2016 annual report, and after the 31 December 2016 cut-off for our asset beta estimation, BT announced the results of its investigation into its Global Service operations in Italy. BT's revised pro-forma results for 2016 published on 10 February 2017 indicate that Global Services share of EBITDA would reduce by around 1 percentage point as a result of the investigation. See: http://www.btplc.com/Sharesandperformance/Quarterlyresults/2016-2017/BTrevisedproformahistoricalfinancialsFebruary2017/Downloads/Proforma/BTRevisedproformahistoricalfinancialsFebruary2017.pdf.

[773] This is the same as the RoBT asset beta used in the 2016 BCMR Statement.

[774] The asset beta for RoBT is also very sensitive to the weightings used for each part of BT.

[775] At present NGA networks make up a fraction of the revenues and profits of listed telecoms operators. While Cityfibre (AIM listed) operates fibre networks, its shares are not traded as regularly as telecoms operators like BT. This illiquidity issue can reduce the reliability of the measured asset betas. For example, in 2016 the average bid-ask spread (a measure of liquidity) for Cityfibre was 4.3% compared to less than 0.1% for BT, Sky and TalkTalk.

current VULA margin control, the WACC relevant to the BT Consumer business is used (which since the 2016 BCMR Statement is the Other UK telecoms WACC).[776]

A16.142 The EC has considered the question of the systematic risk associated with NGA services, and commissioned a report from Brattle, which was published in July 2016. In its report, Brattle considered that NGA networks would face higher systematic risks than legacy networks for three main reasons:

- systematic demand risks;
- capital leverage; and
- long term pay-offs.

A16.143 'Legacy' services in the 2016 Brattle report appear to include all services provided over the copper network. Brattle was therefore comparing systematic risks of services provided over fibre (i.e. NGA) to those provided over copper (legacy). In contrast, we have we have previously distinguished between access and usage services in our cost of capital determinations – and propose to maintain that approach in this review.

A16.144 In our view, the distinction between access and usage remains a more helpful framework for analysis of systematic risk, since the basic access line remains the building block of all fixed telephony services (both from the customer's perspective and from a network perspective). To this can be added different usage services depending on the end-customers' requirements: i.e. fixed voice, standard broadband and now superfast broadband.[777]

A16.145 The usage services delivered over the basic fixed line can all be augmented in some way depending on consumer demand (e.g. call package allowances, download speeds, download limits, as well as various content services – such as IPTV). Therefore, we would expect demand for usage to vary more with incomes, than the basic access decision (i.e. whether to subscribe to a fixed line or not). Therefore, we would expect there to be more systematic risk inherent in usage than in access.

A16.146 Notwithstanding this, the three factors identified by Brattle (systematic demand risks, capital leverage and long term pay-offs) seem just as relevant within an access/usage framework, as they do in an NGA/legacy network framework.

A16.147 To determine an appropriate asset beta for NGA services, we have therefore considered whether we would expect there to be, and whether evidence exists to support, differences in systematic risk between NGA and i) copper access and ii)

[776] Paragraph 6.78 of the 'Fixed Access Market Reviews: Approach to the VULA margin' statement, 19 March 2015, https://www.ofcom.org.uk/__data/assets/pdf_file/0015/72420/vula_margin_final_statement.pdf. Prior to the 2016 BCMR Statement the appropriate WACC would have been the RoBT WACC derived from a two-way disaggregation.

[777] In relation to NGA (i.e. superfast broadband services), these are typically delivered by FTTC, which is an overlay to BT's copper access services). This is not universally the case, i.e. FTTP by-passes any copper connection between the customer and the relevant exchange, however, a small minority of lines are expected to be FTTP over this review period.

other telecoms usage services such as leased lines, voice, broadband and bundled products which are included in the Other UK telecoms disaggregated part of BT.

Systematic demand risks

A16.148 Brattle considered that NGA networks may be a 'luxury' product and more sensitive to changes in income than legacy networks resulting in greater systematic risk and a higher asset beta.[778]

A16.149 We are not aware of any recent empirical studies on the income elasticity of fibre broadband compared to other telecoms services but previous reports have argued that usage (such as voice calls) is more income elastic than access.[779] For example, in its 2005 report for Ofcom, PwC said that "*it seems reasonable to anticipate that call volumes [i.e. usage] will fluctuate more in response to changing economic circumstances, because businesses and individuals are more likely to react to changes in business activity and incomes by altering their immediate pattern of consumption of telecommunications services than by changing their consumption of access*".[780]

A16.150 For this reason, we consider that demand risk facing NGA services is likely to be higher than copper access.

A16.151 Data from BT on the monthly volume variability and forecast accuracy of different types of products supports this hypothesis[781], though there are limitations with this evidence.[782] This data are shown in Tables A16.30 and A16.31 and indicates that:

- Openreach copper access rental volumes showed almost no monthly variability and could be forecast by BT with a good degree of accuracy;
- the variability of call volumes and rental volumes for other regulated services (e.g. ISDN2, ISDN30, leased lines) and mobile is higher than Openreach copper access services and slightly more difficult to forecast. The variability and forecast accuracy of these services is broadly similar;
- Fibre broadband volumes are more variable and harder to predict. This could indicate that it is a growing business rather than an indicator that it faces higher systematic risk than BT's fixed voice and copper broadband services. Indeed, this variability has reduced over time which could indicate that demand risk has reduced as fibre broadband becomes more established.

[778] Page 99, 2016 Brattle Report.

[779] The income elasticity of demand measures the responsiveness of demand to changes in income. Services with low income elasticity would be expected to exhibit lower systematic risk compared to services with higher income elasticity.

[780] Page 11, Disaggregating BT's Beta, June 2005.

[781] We would expect services with lower demand risk to be associated with lower volume variability and be easier to forecast.

[782] We considered similar data in the 2016 BCMR Consultation and Statement. Limitations of the evidence are that it can only give an indication of total risk (i.e. systematic and company specific risk combined.

Table A16.30: Ratio of monthly maximum to monthly minimum volume in a given year for BT rental and call volumes

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Average
Copper lines (PSTN, WLR, LLU)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Other copper lines (incl ISDN2)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
ISDN30	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Leased lines	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
WBA	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Fibre Broadband	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Call minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EE mobile minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EE mobile subscribers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
BT TV subscribers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis of BT response dated 15 August 2016 to question 2 of Annex 2 to the 11th s135 notice

Table A16.31: Ratio of actual to forecast annual rental and call volumes

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16
Copper lines (PSTN, WLR, LLU)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Other copper lines (incl ISDN2)	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
ISDN30	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Leased lines	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
WBA	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Fibre Broadband	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
Call minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EE mobile minutes	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
EE mobile subscribers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]
BT TV customers	[✂]	[✂]	[✂]	[✂]	[✂]	[✂]

Source: Ofcom analysis of BT response dated 15 August 2016 to question 1 of Annex 2 to the 11th s135 notice.

A16.152 Evidence considered in this Consultation also suggests that systematic demand-risk facing NGA services has reduced over time. For example:

- **Use of high bandwidth services is becoming more common**. Higher broadband speeds facilitate simultaneous use of high bandwidth services which are becoming more common. For example, residential broadband research found that 70% of households conducted simultaneous use of high bandwidth services either ‘a lot’ or ‘sometimes’.[783] Since NGA services support the use of high bandwidth services, the greater use of higher bandwidth services could indicate that demand for NGA will remain robust in the event of a fall in incomes. Indeed, in Annex 8 we explain that NGA demand risk was primarily driven by uncertainty around the timing of growth

[783] Volume 1, Section 8.

in demand for higher bandwidths, rather than the question of whether it would materialise at all.[784]

- **Consumers have shown limited propensity to downgrade**. The evidence suggests that the large majority of customers who have upgraded to a SFBB product do not tend to revert to SBB.[785]

A16.153 Overall, we consider that the systematic risk for NGA services stemming from the income elasticity of demand is likely to be greater than for copper access. While the systematic demand risk of NGA services may have been higher in the past, it is likely to have reduced over time and we consider that it is reasonable to assume it is now comparable to that of other telecoms usage services.

Capital leverage

A16.154 Capital leverage refers to the relative proportion of fixed costs within the total costs of a project. Higher capital leverage (i.e. relatively higher fixed costs) will tend to increase the asset beta since the volatility of returns are magnified.

A16.155 Brattle said that an NGA network involves a commitment to make large capital investments over several years which must be made regardless of revenues.[786] Due to the presence of sizeable and relatively fixed capital obligations, Brattle argued that a fall in revenues will prompt a disproportionately larger fall in the project NPV.[787] The size of this effect will depend on the extent to which operators can vary capital investments in response to variations in demand.[788]

A16.156 In the UK, NGA is largely delivered using FTTC which uses existing 'legacy' infrastructure such as duct, copper and property.[789] Incremental capital expenditure to deliver NGA may not therefore have driven a significant difference in capital leverage between legacy networks and NGA to the degree suggested in the 2016 Brattle report. In Annex 8 we explain that given the small number of FTTP lines, BT did not incur any significant degree of risk associated with FTTP investments.[790]

A16.157 In Annex 8 we also explain that the risk of BT's NGA investment was mitigated by the ability to stagger investments through time. In relation to its initial investment, we noted that BT's internal documents said that it would start with operational trials before moving to a geographically targeted market deployment and then a national deployment, assessing at each stage if conditions were right to continue. We consider that this implies that BT had flexibility to halt the project before the initial investment had been spent if conditions had turned out to be worse than expected.[791] The fact that BT could stagger the rollout to some degree means that the risk of subsequent tranches of investment would have declined significantly as demand and costs became better understood.[792]

[784] Paragraph A8.17
[785] See paragraphs 3.32 to 3.40, Volume 1
[786] Page 96, 2016 Brattle Report.
[787] Page 97, 2016 Brattle Report.
[788] Page 98, 2016 Brattle Report.
[789] See also paragraph A8.11.
[790] Paragraph A8.11
[791] Paragraph A8.16.
[792] Paragraph A8.14.

A16.158 Going forward, we consider that capital leverage effects are unlikely to result in significant differences in the asset beta for NGA activities compared to other telecoms usage services.

Long term payoffs

A16.159 Brattle said that long-lived investments with payoffs extending far into the future are likely to face higher systematic risk. This is because the value of the investment is more volatile and will vary more strongly with macroeconomic conditions.[793]

A16.160 While the expected payback period may have resulted in a higher asset beta for NGA activities at the time of the initial investment, we consider that BT would have expected payback on its initial investment to occur within the period spanned by the current review.[794] In Volume 1, Section 8, we also explain that BT continued to invest beyond its initial investment and the payoffs from NGA investment are now apparent. For example, BT can charge a premium over standard broadband and take-up is expected to account for around three-quarters of broadband connections by the end of this review period.[795]

A16.161 Going forward, we do not consider that the issue of long-term payoffs will contribute to a material difference in risk between BT's NGA services and other telecoms usage services.

Provisional conclusion on NGA asset beta

A16.162 In light of the above, we consider that NGA services are likely to face higher systematic risks than copper access services but are likely to share similar risk characteristics to other telecoms usage services going forward.

A16.163 We recognise that, in principle, the asset beta for BT's NGA operations may further differ from that of other businesses within our definition of Other UK telecoms. For example, the 2016 Brattle report also proposed estimating the asset beta of NGA based on detailed bottom-up financial modelling of NGA and 'legacy' networks.[796] However, such a bottom-up model would need to include assumptions on the relationship between changes in income and changes in demand. In our view, developing a detailed bottom-up models for legacy and NGA networks to estimate a single WACC parameter (an NGA asset beta) is unnecessarily complex and would only be as good as the assumptions and judgments on key parameters, many of which cannot be robustly quantified. Therefore, a more granular disaggregation would be difficult based on the evidence available at present.

A16.164 We therefore propose to apply the Other UK telecoms asset beta of 0.75 to NGA services.

Disaggregation of BT Group debt premium

Introduction

A16.165 Consistent with previous 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

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793 Page 99, 2016 Brattle Report.

794 See paragraph 8.20, Volume 1.

795 See paragraph 8.26, Volume 1.

796 Page 103 to 107, 2016 Brattle report.

higher systematic risk. This implies that BT's business with lower systematic risk (i.e. Openreach copper access) would face a lower cost of debt than the RoBT (at the same level of gearing).

A16.166 In the 2016 BCMR Statement we considered two approaches to disaggregating the BT Group debt premium. First, we applied the lower end of the BT Group debt premium range to Openreach copper access (based on our analysis above, this would be 0.9%), the BT Group debt premium to Other UK telecoms (which we now estimate at 1.0%) and the top end of the BT Group debt premium range to the RoBT (which we now estimate at 1.3%). Second, we considered what the debt premium for the different parts of BT could be based on inferred credit ratings, while noting that it is difficult to assess precisely what rating the different parts of BT would achieve.

Inferred credit ratings

A16.167 The credit ratings of UK utilities currently generally range from BBB- to A- compared to BT Group at BBB+.[797] While on the face of this evidence BT Group's rating sits within the range of UK utilities, the utilities are all more highly geared than BT Group (with the exception of SSE which, for a similar level of gearing as BT, has a higher credit rating).

A16.168 To estimate the potential difference in the debt premium for Openreach copper access, we have begun by comparing the spreads between BBB-rated debt and A-rated debt with maturities of 10 years (as at 31 December 2016), which is shown in the table below.[798] This suggests that the spread between A-rated debt and BBB-rated debt is between 0.22% and 0.56%; 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 0.07% to 0.19% relative to BT Group.[799]

Table A16.32: Spread between BBB and A-rated benchmark indices (10 years)

	1-year average	2-year average
BBB vs A ratings	0.52%	0.56%
UK Utilities BBB vs A ratings	0.22%	0.22%

Source: Bloomberg, Ofcom analysis using data to 31 December 2016. 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.

A16.169 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. An adjustment somewhere between the utility range and that for other companies might imply a debt premium for Openreach

797 Long-term credit ratings from S&P: Severn Trent (BBB-), United Utilities (BBB+), National Grid and SSE (A-).

798 There are effectively three ratings notches between BBB rated debt and A rated debt.

799 There are three ratings notches between BBB rated debt and A rated debt, so one-notch estimates have been derived by dividing the figures in the table by three.

around 0.1% lower than for BT Group – i.e. around 0.9% compared to BT Group's 1.0%.

A16.170 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, and similar levels of gearing,[800] implying that the Other UK telecoms activities might have a debt premium similar to that of BT Group; i.e. the 1.0% debt premium estimated above.[801]

A16.171 In order to estimate the debt premium for the RoBT under a three-way disaggregation, we can use the weightings from the asset beta disaggregation. On this basis, the weightings imply a RoBT debt premium of 1.1%.[802]

A16.172 Table A16.18 compares the result of this credit ratings approach to the approach of applying the range of the BT Group debt premium.

Table A16.33: Summary of alternative approaches to the debt premium

Approach	BT Group	Openreach copper access	Other UK telecoms	RoBT
BT debt premium range	1.0%	0.9%	1.0%	1.3%
Credit rating approach	1.0%	0.9%	1.0%	1.1%

Source: Ofcom calculations, all values rounded to 1 decimal place

Proposed disaggregated debt premium

A16.173 We propose to use a debt premium of 0.9% for Openreach copper access and 1.0% for Other UK telecoms, noting that these values are the same under both approaches described above. For presentation purposes, we have used a debt premium of 1.1% in calculating the WACC for the RoBT. This would be consistent with placing more weight on the credit rating approach and disaggregation weightings, rather than applying the BT Group range. We think the credit rating approach is likely to better approximate differences in the risk of debt as seen by credit rating agencies.[803]

Proposal for the WACC

A16.174 Table A16.34 summarises our proposed pre-tax nominal WACC for BT Group and the three-way disaggregation for 2019/20 and 2020/21. The differences in the WACCs between these years are due to different assumptions for RPI inflation and

[800] Over the last two years BT Group's average gearing has been between 22% and 32% (depending on the treatment of the pension deficit) while for UK and European telcos average gearing was 34% and 37% respectively.
[801] S&P rates 11 of the 14 UK and European telecoms companies listed earlier in this annex. Six of these have BBB ratings (similar to BT), three have A ratings and two have BB ratings.
[802] 0.9% x 20% [Openreach copper access] + 1.0% x 65% [Other UK Telecoms] + 1.1% x 15% [RoBT] = 1.0% [BT Group].
[803] We note that this represents a refinement to the approach adopted in the 2016 BCMR, when we used the credit rating approach as a cross-check. Whether the credit rating or the ranges approach is adopted here would not matter for regulated charges since the Openreach copper access and Other telecoms debt premia are the same under each approach and we do not use the resulting RoBT figure in determining a benchmark rate of return for any regulated activities.

corporate tax rates, as explained above. We propose to apply the Openreach copper access WACC to WLA copper access services and the Other UK telecoms WACC to NGA services in this review.

Table A16.34: BT pre-tax nominal WACC estimates

	BT Group	Openreach copper access	Other UK telecoms	RoBT
2020/21	9.6%	8.0%	9.4%	11.8%
2019/20	9.6%	8.1%	9.5%	11.9%

Source: Ofcom. Due to rounding the BT Group WACC is the same in both 2019/20 and 2020/21

Annex 17

Cumulo rates

Summary of our proposals:

A17.1 In this annex we set out our proposals for how we will forecast BT's cumulo costs and attribute these to services in both the top-down and bottom-up models.

A17.2 We propose to:

- forecast BT's cumulo costs separately to take account of the more than fourfold increase in BT's Rateable Values (RVs) that are currently planned to come into effect from 1 April 2017. These forecasts also reflect:
  - the transition scheme that will apply in England;
  - the effects of increasing demand for MPF and GEA-FTTC lines on BT's RVs over the charge control period;
- attribute cumulo costs in three steps:
  - estimate the cumulo costs attributable to GEA services by assuming each GEA rental connection attracts an RV of £18 per annum in each year;
  - attribute all cumulo costs attributable to GEA services to GEA rental services; and
  - attribute all non-GEA cumulo costs across non-GEA network components using a profit weighted net replacement cost (PWNRC) approach.

Introduction

A17.3 Cumulo rates are the non-domestic (business) rates that BT pays on its rateable assets within its UK network. The rateable assets consist primarily of passive assets such as duct, fibre, copper, cabinets, manholes and junction boxes, as well as exchange buildings. Active assets, such as electronic equipment (DSLAMs, MSANs, multiplexors and modems) are in general non-rateable.

A17.4 BT's cumulo costs are part of its operating costs and our previous charge controls have allowed BT to recover a proportion of BT's cumulo rates bill from the relevant services in that control. For example, we allowed some of BT's cumulo costs to be recovered from MPF and WLR services in the 2014 FAMR Statement and from leased lines in the 2016 BCMR Statement. We similarly propose to allow recovery of appropriate cumulo costs for this charge control.

A17.5 BT's cumulo costs are likely to rise significantly from 2017/18 onwards. That is because in September 2016 the valuation authorities in England, Wales and Scotland published draft assessments for all ratepayers that are due to come into force from 1 April 2017. The draft rateable values for BT's cumulo assessment are much higher than they have been in 2016/17.

A17.6 The new rateable values will apply from 1 April 2017 and will last for at least five years, so they cover the length of our proposed charge control. As the increases in costs are large and difficult to capture within our standard approach to modelling operating costs we propose to model cumulo costs separately. The results feed into both the top-down model and the bottom-up model.

A17.7 The attribution of BT's cumulo costs has been the subject of detailed discussion within several previous charge controls, notably the 2012 LLU WLR Charge Control Statement and the 2014 FAMR Statement. It was the subject of an appeal following the 2012 LLU WLR Charge Control Statement. For this charge control the large increases in costs present further attribution issues on which we wish to seek stakeholder's views.

A17.8 The issue we have had to address in this control is that BT will no longer be able to comply with our current Direction and attribute costs to GEA services as it has done in the last 2 years. Our proposal for this charge control is that cumulo costs should be attributed to GEA services as they have been previously by assuming a fixed contribution to BT's Rateable Value for each GEA line. We explain the reasons for our approach in the latter part of this annex. We believe this has advantages over the alternative we have considered of attributing all cumulo costs together using a PWNRC approach, which we call a Full PWNRC approach, because it leads to a more stable attribution of cumulo costs and would be more consistent with rating methodology. In contrast a Full PWNRC approach produces results that are counterintuitive, with attributions to GEA services below those for MPF and WLR services

A17.9 The rest of this annex therefore has two main parts:

- first, we set out how cumulo rates are calculated and other relevant background before providing our forecasts of BT's cumulo costs over the charge control period; and

- second, we describe how we propose to attribute our forecasts of BT's cumulo costs across services for use within these charge controls. We also summarise the resulting forecasts of cumulo unit costs for the main services over the charge control period.

Forecasts of BT's cumulo costs

Introduction

A17.10 In this section, we provide a brief introduction to non-domestic rates and review how BT's cumulo costs are calculated. We then describe how BT's cumulo rates costs have changed over the last few years before finally explaining how we have forecast BT's cumulo liability to reflect the new rateable values that will come into force from 1 April 2017.

Non-domestic rates and calculation of BT's cumulo costs

A17.11 Non-domestic rates are a property tax. In general, the liability or bill is calculated by multiplying the Rateable Value (RV) for the property 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. The RV is specific to each property or assessment and is a measure of the open market rental value. It attempts to replicate the result of negotiations between a hypothetical tenant, who wishes to rent the assets contained within the assessment, and a hypothetical landlord, who owns those assets. Rates in the pound are set centrally by each nation and are the same for all ratepayers in a nation.[804]

A17.12 BT's cumulo assessment covers all its rateable network assets. Under rating law these assets are valued together, hence why it is called a "cumulo" assessment. The rating authorities assess BT's cumulo RVs using the "receipts and expenditure" (R&E) method. According to the Competition Commission (CC, now the Competition and Markets Authority or CMA):

> "*This approach estimates the profits of a business that uses the rateable assets and seeks to allocate these profits between a notional tenant (i.e. user of the assets) and a notional landlord (i.e. owner of the assets). The notional landlord, for the purposes of the charge control, is the public authority which levies cumulo rates. The notional tenant is BT*".[805]

A17.13 The CC described the VOA's calculation of BT's RVs in the following six steps:

i) The revenues are assessed from the services that use the rateable assets;

ii) A measure of operating costs relating to those services is deducted;

iii) Also deducted are a maintenance charge for the landlord's assets and the tenants' own capital expenditure;

iv) This gives a 'divisible balance', being a measure of profit from the business;

v) The tenant's return on its investments is deducted from this; and

vi) The residual is taken to be the RV.[806]

A17.14 RVs are published in each nation's rating lists.[807] These are generally updated every five years. The next revaluation in England, Scotland and Wales will take effect from 1 April 2017 which, unusually, was seven years after the previous revaluation that

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[804] By rate in the pound (sometimes also called the ratepoundage) we mean the standard non-domestic rating multiplier. The standard multiplier is made up of the small business multiplier and the large business supplement multiplier for England and Scotland. In 2016/17 the standard multiplier was 49.7p in England, 48.6p in Wales and 51.0p in Scotland. For an introduction to how rates liabilities are calculated see https://www.gov.uk/introduction-to-business-rates [accessed 13 March 2017]. Northern Ireland is different in that the ratepoundage 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 in each district.

[805] Competition Commission, 2013. British Sky Broadcasting Limited and TalkTalk Telecom Group Plc v Office of Communications, Case1192/3/3/12, Determination 27 March 2013, paragraph 11.7, http://www.catribunal.org.uk/files/1192-93_BSkyB_CC_Determination_270313.pdf [accessed 13 March 2017].

[806] Competition Commission, 2013, paragraph 11.8.

[807] We use the term rating lists to cover lists of RVs (in Northern Ireland the RV is called the net annual value or NAV). In England and Wales this list is called the Rating List. In Scotland, it is the Valuation Roll. For more information, see: SAA, *The Valuation Roll,* https://www.saa.gov.uk/valroll.html [accessed 13 March 2017].

took effect from 1 April 2010. The most recent revaluation in Northern Ireland took place in 2015.

A17.15 RVs may change considerably because of revaluation. In England, there are transition schemes that smooth costs in an attempt to minimise “bill shock”. There have been no such schemes in Scotland or Wales since 2010. The English transition scheme is complex but the effect is to restrict the amount by which a ratepayer’s bill can increase or decrease in a year.[808] For a business whose assessment is under transition, the rates bill may therefore not be the direct result of applying the rate in the pound to the RV.

A17.16 Valuation authorities can change entries in rating lists and ratepayers can appeal their assessments. However, once they have been initially assessed and no appeals have been lodged, RVs generally stay constant over the life of a rating list unless there have been ‘material changes in circumstance’ (MCCs). MCCs are defined under legislation and generally cover physical changes to the assets within the assessment. Changes in economic circumstances do not constitute valid grounds for claiming that there have been MCCs.

BT’s cumulo costs from April 2010 to March 2017

A17.17 As the starting point for our analysis we have reviewed BT’s cumulo costs over the most recent rating list, i.e. since 1 April 2010. We have done this to inform our forecasts and because 2016/17 costs in England determine what BT will pay after 2017/18 under the 2017 English transition scheme.

A17.18 BT’s RVs in the United Kingdom declined from £286m in April 2010 to £197m in October 2016. This is shown in Figure A17.1 below.[809] For the previous market review the VOA told us that these changes in RVs were associated with two main MCCs: reductions in RVs because of increasing MPF volumes[810], partially offset by

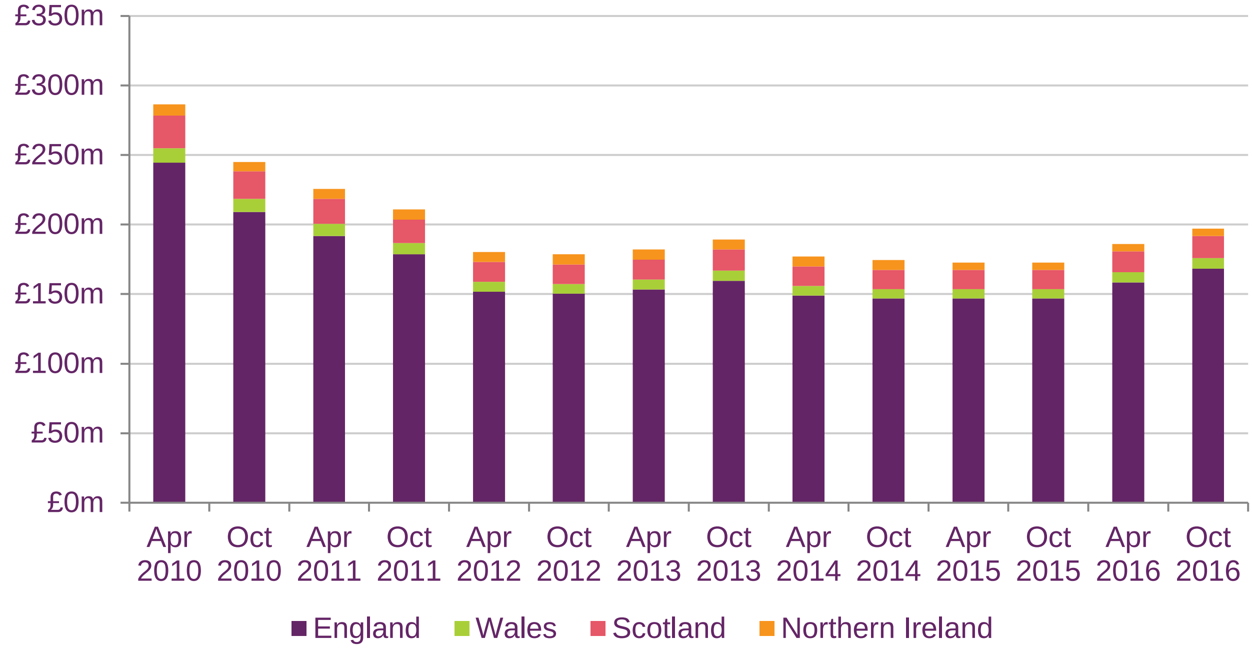
[808] In September 2016 DCLG consulted on the transition scheme to apply after 2015, the summary of responses and result was published in November 2016, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/572823/Transitional_Relief_consultation_response.pdf [accessed 13 March 2017]. The draft secondary legislation can be found here: http://www.legislation.gov.uk/uksi/2016/1265/pdfs/uksi_20161265_en.pdf [accessed 13 March 2017]. The legislation that applied for the 2010 rating list in England can be found here: http://www.legislation.gov.uk/uksi/2009/2269/pdfs/uksi_20092269_en.pdf [accessed 13 March 2017].

[809] These RVs have been extracted from the rating authorities’ websites. BT’s cumulo RVs in England and Wales have been taken from https://www.gov.uk/government/publications/the-central-rating-list-2010 [accessed 13 March 2017]. Those in Scotland from https://www.saa.gov.uk/search/?SEARCHED=1&ST=advanced&SEARCH_TABLE=valuation_roll_cpsplit&TYPE_FLAG=CP&STREET=&TPTLA=&POSTCODE=&ASSESSOR_ID=&CLASS=&CORE=&CORE2=&FEFFECTIVE_DATE=&TEFFECTIVE_DATE=&MIN_RV=&MAX_RV=&AS_UARN=Z99655%2F0067&DISPLAY_COUNT=10&ORDER_BY=PROPERTY_ADDRESS&H_ORDER_BY=SET+DESC&SEARCH_TERM=&DISPLAY_MODE=FULL&UARN=Z99655%2F0067&PPRN=67173845&ASSESSOR_IDX=12#results [accessed 13 March 2017]. BT’s most recent NAV can be found for each Northern Ireland council by searching “BT Telecoms Network” in the “Street” field on the Northern Ireland Department of Finance (DoF) website https://lpsni.gov.uk/vListNDN/search.asp?submit=form [accessed 13 March 2017].

[810] The loss of RV from increasing MPF is due to reduced profits from downstream services, notably wholesale calls and wholesale broadband access. We confirmed with the VOA that changes to BT’s

increases in RVs due to growing volume of fibre access connections, both FTTC and FTTP.[811]

Figure A17.1: BT's UK cumulo RVs from April 2010 to March 2017 (£m, nominal)



Source: Ofcom analysis using compiled RVs from rating agencies: VOA, SAA and DoF.

A17.19 Using publicly available information, we have calculated BT's cumulo costs in each financial year from 2010/11 to 2016/17 by:

- taking the above published RVs in each year in each nation, noting when the RVs were changed;
- applying the rates in the pound in each country and the transition scheme that applied in England from 1 April 2010; and
- calculating the costs in each year using the RVs that applied in that year and reflecting any prior year rebates where appropriate.

A17.20 We have assumed that there will be no further changes to BT's RVs for the 2010 list. We understand that BT currently has no outstanding appeals on BT's RVs in England and Wales but note that there is an appeal listed as being outstanding in Scotland.[812]

RVs aim to capture this effect. See paragraph A26.16 of the 2014 FAMR Statement and A14.15 of the July 2013 LLU WLR CC Consultation.

[811] June 2013 FAMR Consultation, A14.30.

[812] SAA, Valuation reference number Z99655/0067.https://www.saa.gov.uk/search/?SEARCHED=1&ST=advanced&SEARCH_TABLE=valuation_roll_cpsplit&TYPE_FLAG=CP&STREET=&TPTLA=&POSTCODE=&ASSESSOR_ID=&CLASS=&CORE=&CORE2=&FEFFECTIVE_DATE=&TEFFECTIVE_DATE=&MIN_RV=&MAX_RV=&AS_UARN=Z99655%2F0067&DISPLAY_COUNT=10&ORDER_BY=PROPERTY_ADDRESS&H_ORDER_BY=SET+DESC&SEARCH_TERM=&DISPLAY_MODE=FULL&UARN=Z99655%2F0067&PPRN=67173845&ASSESSOR_IDX=12#results [accessed 13 March 2017].

Any changes that are subsequently made to BT's listed RVs would affect BT's costs in 2016/17 or, depending when those changes were made, 2017/18.

A17.21 BT's RV changed in England on 31 March 2010, i.e. the last day of the previous rating list. This had minimal impact on costs in 2009/10 but affected BT's payments in England from 2010/11 to 2012/13 under transition. In our calculations, we assume BT's RV in England will not change late in March 2017.

A17.22 The results of this process are given in Table A17.2 below. We have cross checked the results against the costs BT has recorded in its accounts.[813] Our estimates are very similar [✂].

Table A17.2: BT's liability costs for financial years 2010/11 to 2016/17 (£m, nominal)

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17
Liability	132.6	107.4	88.0	88.2	85.5	85.4	95.7

Source: Ofcom analysis.

Forecasts of BT's cumulo liability from 2017/18

A17.23 New rating lists will come into force in England, Wales and Scotland from 1 April 2017. The draft RVs that have been published are over four times higher than those at 1 October 2016.[814] This suggests BT's cumulo bill will rise significantly because of this revaluation. The draft published RVs are given in Table A17.3 along with BT's total NAV[815] in Northern Ireland.

Table A17.3: BT's cumulo RVs in each nation (£m, nominal)

	Oct 2016	Apr 2017
England	168.26	714.87
Wales	7.69	28.19
Scotland	15.86	64.00
Northern Ireland	5.30	5.30
Total	197.11	812.36

Source: Compiled RVs from rating agencies: VOA, SAA and DoF.

A17.24 We have forecast BT's cumulo costs by adopting a similar approach to that we used to estimate costs over the period 2010/11 to 2016/17. We have:

- taken the above RVs and forecast these by adopting various assumptions that we outline below;

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[813] BT's response dated 17 November 2016 to question H1 of the 20th BT s.135 request and BT's response dated 20 December 2016 to question A2 of the 22nd BT s.135 request.

[814] VOA, September 2016, *The central rating list – 2017,* https://www.gov.uk/government/publications/the-central-rating-list-2017 [accessed 7 February 2017] and SAA, *Z99655 / 0067 Telecommunications Network Scottish*, https://www.saa.gov.uk/search/?SEARCHED=1&ST=advanced&SEARCH_TABLE=valuation_roll_cpsplit&STREET=&TPTLA=&POSTCODE=&ASSESSOR_ID=&CLASS=&CORE=&CORE2=Type+here+to+search+core+descriptions&FEFFECTIVE_DATE=&TEFFECTIVE_DATE=&MIN_RV=&MAX_RV=&AS_UARN=Z99655%2F0101&DISPLAY_COUNT=10 [accessed 7 February 2017].

[815] In Northern Ireland the RV is called the net annual value (NAV). See paragraph A17.14.

- taken the published rates in the pound that will apply in each country in 2017/18 and forecast these; and
- calculated costs in each year in each nation by multiplying the RVs by the relevant rates in the pound and applying the transition scheme that will apply in England from 1 April 2017.

A17.25 We describe each of these steps in turn below.

Forecasts of RVs

A17.26 The April 2017 RVs shown in Table A17.3 are draft figures and may change. The 2017 rating revaluation has prompted several comments[816] and BT has already noted that it intends to challenge its assessments.[817] Any such challenge may take time to be resolved. We will be monitoring for any changes made public prior to the publication of the Statement.

A17.27 Even if BT does not make a successful challenge to its assessment, it is likely that BT's RVs will change because of MCCs. Experience from the 2010 rating list suggests the most likely MCCs are those associated with growth in GEA fibre rental (both FTTC and FTTP) and MPF rental volumes but there may be others.

A17.28 Figure A17.1 shows that BT's RVs have increased since October 2015 owing to fibre access services; these services more than outweigh any reduction in RVs owing to growth in MPF connections. We expect RVs will continue to increase post April 2017. Our volumes model forecasts suggest that the growth in GEA rental volumes will be much higher, over 3.06 times that of the growth in MPF rental volumes over the period 2017/18 to 2021/22.[818] We also forecast that growth in MPF rental volumes per annum will be around 35% lower than it has been over the period 2010/11 to 2016/17. However, forecasting how much BT's cumulo RVs will change because of increasing fibre access and MPF volumes is not straightforward.

A17.29 Any changes made to BT's cumulo RVs post 1 April 2017 will be assessed using a new valuation model and so may be different to those that were made over the 2010 rating list. Further uncertainty is introduced by the announcement in the Government's autumn statement that there will be "a new 100% business rates relief for new full-fibre infrastructure for a 5-year period from 1 April 2017".[819] We are not aware of any further information in the public domain that indicates precisely to which services and assets and to which operators this relief would apply.[820]

[816] See, e.g., The Guardian, 20 February 2017, *Business rates row: senior ministers write to Tory MPs to head off revolt*, https://www.theguardian.com/business/2017/feb/20/business-rates-revaluation-row-javid-gauke-write-tory-mps-revolt [accessed 27 February 2017].

[817] BBC, 30 September 2017, *Business rate rise to push up cost of broadband, BT says*, http://www.bbc.co.uk/news/business-37517561 [accessed 27 February 2017].

[818] Paragraphs A17.90-A17.91 explain why we forecast to the year 2021/22.

[819] HM Treasury, November 2016, *Autumn Statement 2016*, Sub-heading 4.7 https://www.gov.uk/government/publications/autumn-statement-2016-documents/autumn-statement-2016 [accessed 7 February 2017].

[820] The government has though published a bill, February 2017, *Local Government Finance Bill (HC Bill 142)*, Schedule 3, https://www.publications.parliament.uk/pa/bills/cbill/2016-2017/0142/cbill_2016-

A17.30 In the 2014 FAMR Statement we estimated the change in BT's RVs for every extra MPF connection during the 2010 rating list. We analysed the changes in BT's RVs against changes in MPF and GEA volumes. The results were volatile but we considered that the average reduction to BT's RVs might be around £25-30 for every extra MPF connection during the 2010 rating list.[821]

A17.31 We have updated this analysis to include the most recent revisions to BT's RVs in England, Scotland, and Wales.[822] The resulting changes in BT's RVs for every extra MPF connection at each revision were again quite volatile: the average reduction in the RVs during the 2010 rating list was around £35. The average over the last 3 years has been lower at around £25.

A17.32 We have forecast BT's RVs by assuming:

- there will be no change to BT's draft RVs as published in September 2016 and due to come into force on 1 April 2017;[823]
- any future business rates relief on "full fibre infrastructure" will not apply to GEA-FTTC lines as these are provided in part using copper assets;
- BT's RVs will increase because of increasing demand for fibre, mainly GEA-FTTC services. The increase will be a fixed amount for every extra FTTC connection.[824] We assume that each new GEA rental increases BT's RVs by £18, consistent with the VOA's 2010 rating list guidance.[825] We discuss the rationale for this in more detail when discussing the attribution of BT's cumulo rates bill below;
- BT's RVs will decrease due to increasing demand for MPF rentals. We assume the decrease will be a fixed amount of £30 for every extra MPF line; and
- the net changes to BT's RVs are distributed across England, Wales, Scotland, and Northern Ireland in proportion to the draft RVs published in April 2017.

20170142_en_1.htm [accessed 13 March 2017]. Section 8 covers provisions for Relief on telecommunications infrastructure.

[821] 2014 FAMR Statement, A26.69 to A26.73. We assumed that each FTTC connection might increase BT's RV by £18 and each FTTP connection by £20 (these figures were taken from *the VOA's 2010 Rating Manual Section 873: Practice Note 2010: Next Generation Access Telecommunications Networks (NGA)*) and that any remaining change was due to changes in MPF volumes.

[822] We have used MPF volumes and Openreach fibre base volumes as published in BT's KPI documents, (see for example the Q3 2016/17 KPIs available at https://www.btplc.com/Sharesandperformance/Quarterlyresults/2016-2017/Q3/Downloads/KPIs/q317-KPIs.xlsx [accessed 13 March 2017]), RVs published in England, Scotland and Wales as described above and assumed that each fibre connection will increase BT's RV by £18. We have not made any changes to BT's assessment in Northern Ireland as there have been no changes to BT's NAVs there as a result of MCCs since 2011.

[823] This may not be that critical an assumption given the size of the proposed increase and the impact of transition schemes. We discuss this further in paragraph A17.43 below.

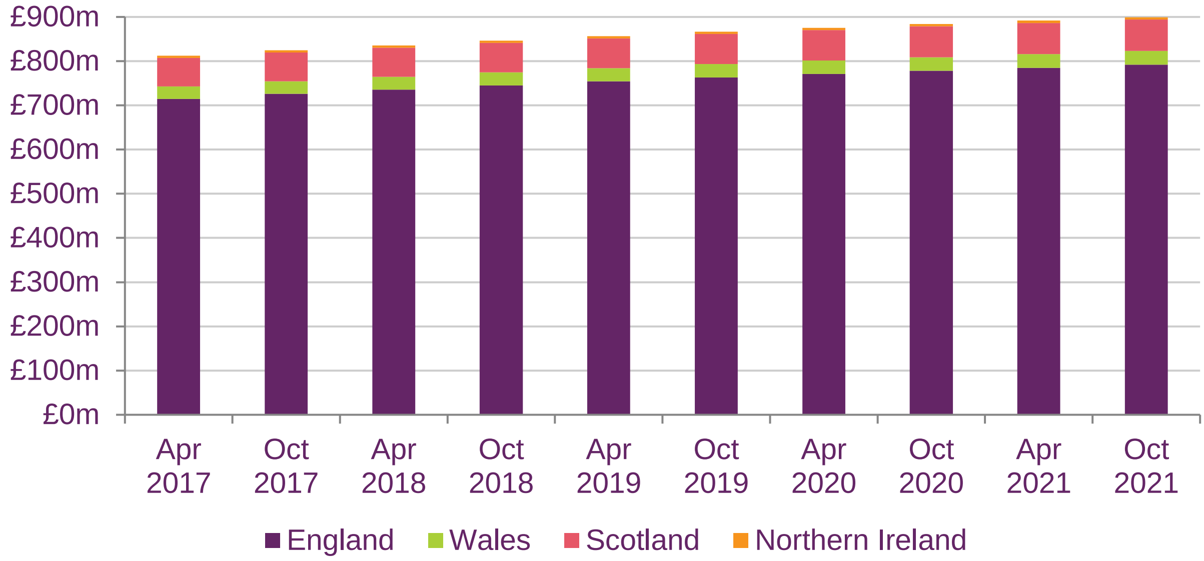
[824] This is consistent with what happened to BT's RVs over the life of the 2010 list. See paragraph A17.58.

[825] The VOA's 2010 Rating Manual Section 873: Practice Note 2010: Next Generation Access Telecommunications Networks (NGA). This no longer appears to be accessible from the VOA's web-site.

However, we make no changes to Northern Ireland's NAV: there have been no MCC changes to BT's NAV in NI since 2011/12.

A17.33 Our forecasts of BT's RVs, applying these assumptions, are shown in Figure A17.4 below.

Figure A17.4: Ofcom forecasts of BT's RVs (£m, nominal)



Source: Ofcom analysis.

Forecasts of rates in the pound

A17.34 The governments in England[826], Wales[827] and Scotland[828] have published the rates in the pound that will apply in 2017/18. These rates, which are the standard non-domestic rating multipliers,[829] are 47.9p, 49.9p and 49.2p respectively. Information on the 2017/18 Northern Ireland rate in the pound has not yet been announced.

A17.35 Historically, rates in the pound have generally increased in England and Wales with the change in the RPI index from the prior September.[830] However, the government

[826] DCLG, November 2016, *Consultation on the transitional arrangements for the 2017 business rates revaluation*, Paragraph 2, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/572823/Transitional_Relief_consultation_response.pdf [accessed 7 February 2017].
[827] House of Commons Library, January 2017, *Business rates: the 2017 revaluation briefing paper No 07722,* Section 1.2, page 4, http://researchbriefings.files.parliament.uk/documents/CBP-7722/CBP-7722.pdf [accessed 7 February 2017].
[828] Local Government and Communities Directorate, December 2016, *Local Government Finance Circular No. 9/2016*, Paragraph 25 and 26, http://www.gov.scot/Resource/0051/00512271.pdf [accessed 7 February 2017].
[829] For the avoidance of doubt these rates include the small business multiplier and the large business supplement in England and Scotland as it is this combined rate that will be used to calculate BT's cumulo costs in these countries.
[830] House of Commons Library, February 2017, *Business Rates briefing paper No 06247*, Section 1.2, page 6, http://researchbriefings.files.parliament.uk/documents/SN06247/SN06247.pdf [accessed 13 March 2017].

has recently announced that indexation will change to CPI from 2020/21.[831] The Scottish government has set its small business rate in the pound to be the same as that in England in recent years though the supplement that applies to large assessments has been different since 2016/17.[832] Rates in the pound in Northern Ireland have two components: a national rate and a regional rate.[833] These tend to be more variable but, overall, have increased at a rate similar to those in England, Wales, and Scotland.

A17.36 We assume that the small business multiplier in England and Scotland, the standard rate in the pound in Wales and the aggregate rate in the pound that applies to BT's cumulo assessment in Northern Ireland,[834] will increase in line with our forecasts of RPI until 2019/20 and by CPI from 2020/21 onwards.[835] We also assume that the supplement for large assessments in England and Scotland will remain at the 2017/18 values of 1.3p and 2.6p respectively.

A17.37 Table A17.5 below summarises the ratepoundages we have used in our calculations.

Table A17.5: Forecasts of standard non-domestic poundage rates (nominal)

	England	Wales	Scotland	Northern Ireland
2017/18	47.9p	49.9p	49.2p	58.7p
2018/19	49.5p	51.7p	50.8p	60.8p
2019/20	51.0p	53.3p	52.3p	62.7p
2020/21	52.0p	54.4p	53.3p	64.0p
2021/22	53.0p	55.5p	54.3p	65.2p

Source: Ofcom analysis based on sources cited above.

The transition scheme in England

A17.38 England is the only nation that will have a transition scheme that will affect BT's cumulo rates costs after 1 April 2017.[836] This has a major impact on BT's payments because, as can be seen from Table A17.3, England accounts for around 88% of BT's RVs in the UK in April 2017.

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831 House of Commons Hansard, 12 December 2016, *Draft Non-Domestic Rating (Chargeable Amounts) (England) Regulations 2016*, https://hansard.parliament.uk/Commons/2016-12-12/debates/ad338f57-5b31-491c-b8c1-339086794e25/DraftNon-DomesticRating(ChargeableAmounts)(England)Regulations2016?highlight=non%20domestic%20rating#contribution-66D86025-25B4-4DEE-AA0C-B9A817F8A52C [accessed 7 February 2017].

832 Eric Young & Co, *Rating: Rate Poundage,* http://www.eyco.co.uk/ratingRatePoundage/index.html [accessed 7 February 2017]

833 DoF, *Poundages 2016 – 2017*, https://www.finance-ni.gov.uk/articles/poundages-2016-2017 [accessed 7 February 2017].

834 We have calculated the 2017/18 aggregate rate in the pound for BT's cumulo assessment in Northern Ireland by weighting the district and regional rates by the Net Annual Values (NAVs) in each of the 11 districts.

835 The forecasts we have adopted for RPI and CPI are given in Annex 15.

836 Legislation, 2016, *Rating and Valuation, England The Non-Domestic Rating (Chargeable Amounts) (England) Regulations 2016 SI No. 1265*, Part 2, http://www.legislation.gov.uk/uksi/2016/1265/pdfs/uksi_20161265_en.pdf [accessed 13 March 2017].

A17.39 The scheme is complex but essentially limits increases on a ratepayer's bill before inflation to a maximum of 42% in 2017/18, 32% in 2018/19, 49% in 2019/20, 16% in 2020/21 and 6% in 2021/22. Given the large increase to its RVs, BT's cumulo rates costs in England are likely to remain in transition in 2020/21 and possibly also in 2021/22. This depends on whether any appeals BT may make to its 1 April 2017 RVs are successful, and the magnitude of any resulting changes.

A17.40 Changes to RVs post April 2017 because of MCCs are not subject to transition arrangements.[837] Therefore the increases that we forecast to BT's RVs are not subject to transition and would have an immediate impact on BT's cumulo costs.

Forecasts of BT's cumulo costs

A17.41 We have derived our forecasts of BT's cumulo costs by applying our forecast rates in the pound and the 2017 English transition scheme to our forecasts of BT's cumulo RVs. In Table A17.6 we present the results for two cases:

- the first is the base case that we are assuming when modelling BT's cumulo costs for this consultation; it reflects the forecasts of RVs given in Figure A17.4 that increase due to FTTC driven MCCs;
- the second case assumes there are no changes to the draft RVs that have been published. The difference between these two illustrates the impact of assumptions made in relation to MCCs.

Table A17.6: Forecasts of BT's total cumulo costs (£m, nominal)

	2017/18	2018/19	2019/20	2020/21	2021/22
Assuming RVs increase to reflect GEA MCCs	178.9	234.8	333.8	389.9	423.7
Assuming no change to published RVs	175.9	220.6	308.4	354.8	379.5

Source: Ofcom analysis.

A17.42 Our forecasts suggest that BT's cumulo costs will more than quadruple by 2020/21 compared to our estimate of 2015/16 costs of £85.4m given in Table A17.2.

A17.43 Some of our assumptions have a material impact on the above forecasts, others less so. Some alternative assumption could result in higher or lower forecast costs. For example, if we assume BT's 1 April 2017 RVs will be reduced, we would forecast lower costs. However, such an assumption would be mitigated by the effect of transition scheme arrangements in England. A reduction in the BT's 1 April 2017 RVs of 10% in England, Wales and Scotland would only decrease our cost forecasts in 2020/21 by 1.5%.[838]

[837] Section 13 in Part 2 in Rating and Valuation of the Legislation, 2016. *Rating and Valuation, England The Non-Domestic Rating (Chargeable Amounts) (England) Regulations 2016 SI No. 1265*, Part 2, http://www.legislation.gov.uk/uksi/2016/1265/pdfs/uksi_20161265_en.pdf [accessed 13 March 2017].

[838] A reduction in the BT's 1 April 2017 RVs of 20% in England, Wales and Scotland would only decrease our forecasts of costs in 2020/21 by 3.7%.

A17.44 However, we would forecast higher costs if we assume that BT's RV will increase in March 2017 in England.[839] An increase of 5%, which is roughly the increase in BT's RV between April and October 2016, would increase BT's forecast costs in 2020/21 by 3.8%. We would also forecast higher costs if we assume that BT's NAV will be increased by the NI authorities, taking account of the revaluation exercise in England, Scotland, and Wales.

A17.45 The results in Table A17.6 represent our best estimate of BT's future cumulo costs, and we welcome stakeholders' views on our approach to forecasting these costs.

Attributions of BT's cumulo costs

Introduction

A17.46 Having estimated BT's cumulo costs, the next stage of our analysis is to attribute these costs across different services. To achieve this, we first review the way BT's cumulo costs have been attributed within BT's RFS, set out the outcome of relevant previous appeals and the decisions we have made and summarise the current attribution. We then go on to consider future attributions of BT's cumulo costs, our proposed approach for this charge control and the resulting forecasts.

General historical approach to attribution of cumulo costs

A17.47 It would be desirable to link the attribution of BT's cumulo costs to the valuation model used to support the VOA's assessment. However, that is not straightforward. In the 2012 LLU WLR Charge Control statement we noted that Openreach had told us that "it is impossible to allocate costs to products based on information from the R&E calculation used by the valuation authorities"[840] and we concluded that "we believe that it is neither feasible nor appropriate, due to the level of complexity, to replicate the VOA's calculations".[841] In the subsequent appeal the CC noted that "both Ofcom and Sky/TalkTalk recognised that the VOA's aggregate calculations could not practically be used in its exact form as an allocation methodology".[842]

A17.48 In the 2014 FAMR Statement we noted that the VOA had told us that:[843]

> "*the BT valuation model was created for the specific purpose of informing a rating valuation and was not constructed to allocate costs between service or asset types. The VOA confirmed that the calculations were generally done at an aggregate level and said that it did not consider that a disaggregation of the existing valuation model by product was possible*".

[839] See paragraph A17.21 above concerning the effect of transition schemes and changes to BT's English RV on 31 March 2010.

[840] 2012 Charge control review for LLU and WLR services Annexes, paragraph A4.74, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/50355/annexesmarch12.pdf [Accessed 22 March 2017].

[841] 2012 Charge control review for LLU and WLR services Annexes, paragraph A4.75.

[842] Competition Commission, 2013, paragraph 11.97.

[843] 2014 FAMR Statement, paragraph A26.12.

A17.49 [✂][844] Therefore, we do not currently consider it possible to derive an attribution basis from the BT valuation model.

A17.50 For several years BT's cumulo costs have been attributed within BT's RFS using variants of a "profit weighted net replacement cost" (PWNRC) methodology. This methodology attributes BT's cumulo costs across the rateable assets in proportion to the share of the net replacement costs (NRC) of the asset times the return for that asset (the profit weight).[845] The return is the ratio of profit to capital employed, which is measured by NRC in BT's regulatory accounts. Multiplying the return by the NRC produces an estimate of the relative "profit" for that rateable asset. An advantage of this approach is then that it is broadly consistent with the approach adopted by the rating authorities when valuing BT's assets.

A17.51 We applied this method of allocation in our 2012 LLU WLR Charge Control Statement.

Appeal of the cumulo attribution within the 2012 LLU WLR Charge Control Statement

A17.52 Sky/TalkTalk appealed the 2012 LLU WLR Charge Control Statement's cumulo rates allocation to MPF and WLR.[846] Sky/TalkTalk alleged that Ofcom had erred in using the PWNRC method to allocate cumulo rates between different services. The appellants argued that this method of allocating BT's cumulo costs to MPF and WLR services did not reflect cost causality and was not sufficiently simple or transparent. Sky/TalkTalk proposed alternative methodologies which they considered better approximated the principles of the aggregate calculation of BT's cumulo rates to individual services.

A17.53 The CC found that Ofcom did not err in allocating the costs of BT's cumulo rates, stating that the PWNRC approach was, to a sufficient degree, consistent with cost causality; and that the approach was relatively easy to understand, logical and not unduly reliant on confidential data.[847]

A17.54 Further, the CC agreed with Ofcom that a broadly equal allocation between MPF and WLR should be expected given the similarity of these services in their use of the rateable assets and their regulated returns. The CC considered that allocations should be stable, that the methods proposed by Sky/TalkTalk were not suitable, and, ultimately, that we had not erred in allocating cumulo rates between different services using a method based on PWNRC.[848]

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[844] [✂]

[845] We directed BT to apply the relevant Weighted Average Cost of Capital (WACC) in 2015. See paragraphs A17.59 and A17.60. Prior to that BT applied returns that were reported in the RFs. See for example p56 of BT's 2012 Detailed Attribution Methodology available at: https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2012/DAM_2012.pdf [accessed 13 March 2017].

[846] The main points of the appeal are summarised in July 2013 LLU WLR CC Consultation, Annex A14, paragraphs A14.16 to A14.28. BT also appealed on a point of fact which we are not discussing here as it is not directly relevant.

[847] Competition Commission, 2013, paragraphs 11.97, 11.98, and 11.112.

[848] CC, Determination 27 March 2013, paragraphs 11.112 to 11.116.

2014 FAMR Statement and subsequent Ofcom direction

A17.55 In the 2014 FAMR Statement we discussed the attribution of BT's cumulo costs.[849] We reviewed alternative methodologies such as:

- variants of the PWNRC approach;
- an approach suggested by TalkTalk and Sky that attempted to mimic at a service level the method used by the VOA to determine BT's assessment; and
- a further approach suggested by TalkTalk and Sky described as an "observed effects" model.

A17.56 As part of this 2014 review we considered the principles that should apply when recovering BT's cumulo costs.[850] Thus, we said that the allocation method should:

- result in broadly equal per line allocations of cumulo costs to MPF and WLR lines;
- result in allocations that are broadly stable over time;
- be based primarily on the use of rateable assets, to be consistent with the rating methodology, to follow cost causality and to avoid counterintuitive results;
- be transparent, logical, and not unduly reliant on confidential data; and
- pass the benefits of projected reductions in cumulo costs to customers through the charge control, in a way which does not rely on a spuriously precise forecast of cumulo costs.

A17.57 We concluded that we would continue to use the PWNRC method but with attributions determined by us because it was the most consistent with the principles set out above.[851] We did not "consider that BT's 2011/12 allocation of cumulo costs to MPF and WLR services is reasonable".[852] As we noted subsequently:[853]

> *"the way BT allocated rebates led to an increasing proportion of non-NGA Cumulo costs being allocated to Openreach and in particular to MPF Rentals and WLR rentals and that that the current methods would lead to a discontinuity in the way cumulo cost were allocated when there was a new rating list".*

849 2014 FAMR Statement, Annex 26.
850 2014 FAMR Statement, paragraph A26.3.
851 2014 FAMR Statement, paragraph A26.5.
852 2014 FAMR Statement, paragraph A26.58.
853 Ofcom, 2014. *Directions for Regulatory Financial Reporting Consultation*, paragraph 4.49, https://www.ofcom.org.uk/__data/assets/pdf_file/0029/62993/consultation.pdf [accessed 13 March 2017].
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A17.58 As a result of the above we reviewed BT's attribution of cumulo costs in our 2015 Directions for Regulatory Financial Reporting Statement (2015 Directions).[854] We noted the existing methodology that "*BT allocated any incremental rates associated with NGA assets directly to NGA products and services*".[855] In its 2014 Detailed Attribution Methods, BT notes, "*for NGA, the valuation authorities currently apply an incremental fixed rateable value per connection as an MCC*".[856] The contribution of GEA service connections, both FTTC and FTTP, to BT's cumulo RVs was therefore identifiable.[857] We made no change to the attribution of cumulo costs that were attributed to GEA services.

A17.59 However, we directed BT to change the way it attributed all non-NGA related cumulo costs. We said that:[858]

> "*these should be assessed and allocated in the same way, i.e. all non-NGA related costs should be allocated on the same profit weighted Net Replacement Cost basis. The net replacement costs (NRCs) used should be those for the rateable assets in the relevant financial year. The profit weights should be the relevant weighted average cost of capital for each market*."

A17.60 The use of the weighted average cost of capital as the profit weights was consistent with the simple cross check calculations we had undertaken in the 2014 FAMR Statement. We considered the "*amount of cumulo costs which would be recovered from regulated access services would … be consistent with the regulated services earning their cost of capital over the control period*".[859]

A17.61 BT applied this revised methodology for the first time in its 2014/15 RFS. It was this methodology that was used to attribute cumulo costs in the base year for the charge control model for the 2016 BCMR Statement.

Current attribution of BT's cumulo costs in BT's regulatory accounts

A17.62 Using our formal powers, we obtained BT's 2015/16 attribution model.[860] We have confirmed that the current attribution of cumulo costs has the following three steps, as explained in BT's 2016 Accounting Methodology Document (2016 AMD):[861]

i) the incremental cumulo costs associated with GEA services are identified and attributed to Plant Group PG941A, Cumulo Rates NGA. The remaining costs are attributed to Plant Group PG942A, Cumulo Rates non-NGA;

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[854] Ofcom, 2015, *Directions for Regulatory Financial Reporting Statement,* https://www.ofcom.org.uk/__data/assets/pdf_file/0018/59112/statement.pdf [accessed 13 March 2017].
[855] 2015 Directions for Regulatory Financial Reporting Statement, paragraph A4.63.
[856] BT Group plc, 2014. *Detailed Attribution Methods (DAM) 2014*, page 54.
[857] 2015 Directions for Regulatory Financial Reporting Statement, paragraph A4.67.
[858] 2015 Directions for Regulatory Financial Reporting Statement, paragraph A4.64.
[859] 2014 FAMR Statement, paragraph A26.27.
[860] BT's response dated 25 November 2016 to question H2 of the 20th BT WLA s.135 request.
[861] BT, 2016 *Accounting Methodology Document*, pages 67 and 218 to 222. https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2016/AccountingMethodologyDocument2015-16.pdf [accessed 20 March 2017].

ii) the GEA related cumulo costs in Plant Group PG941 are attributed across NGA network components using the PWNRC methodology; and

iii) the non-GEA related cumulo costs in Plant Group PG942 are attributed across non-NGA network components using the PWNRC methodology.

A17.63 These three steps are undertaken in accordance with our 2015 Directions.[862] BT's 2016 AMD provides further details on the attribution and the classes of work that contain the rateable assets. It also notes that "Specialised Buildings" are rateable assets but that these are no longer part of BT's fixed asset base following their sale to what is now Telereal Trillium in 2001. To ensure that Specialised Buildings are reflected within the attribution bases for Plant groups PG941A and PG942A BT estimates the NRC of exchange buildings and attributes these to components "*in accordance with Groups Property's charges for the Occupation of Specialised Buildings*".[863]

Future attribution of BT's cumulo costs

A17.64 BT will be able to comply with our 2015 Directions for the attribution of its cumulo costs in 2016/17. However, it is unlikely to be able to do so from 2017/18 onwards because it will no longer be able to identify its cumulo costs relevant to GEA services from 1 April 2017: this is a necessary first step as discussed above. We were aware this might occur because the VOA no longer appears to publish numerical guidance on potential RVs for next generation access connections within Section 873 of its 2017 Rating manual.[864]

A17.65 We asked BT whether it would be able to comply with our 2015 Directions from 1 April 2017. BT confirmed that "under the new rating valuation the GEA liability is included within the main valuation and will no longer be separately identifiable as a Material Change of Circumstances (MCC)."[865]

A17.66 [✂].[866] [✂][867]

A17.67 As BT will no longer be able to comply with our 2015 Directions, we propose to direct BT to change the way it attributes cumulo rates in its regulatory accounts from 2018/19. We have included a draft direction in Annex 23.

Attributing BT's cumulo costs from 2017/18

A17.68 When determining an appropriate attribution method from 2017/18, we believe the principles we set out in the 2014 FAMR Statement (as described above) still apply. We have considered two options for the attribution of BT's cumulo costs post 2017/18:

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862 BT, 2016 *Accounting Methodology Document*, pages 6 and 218-222.

863 BT, 2016 *Accounting Methodology Document*, pages 218 to 222.

864 VOA, 2017. *Section 837: Rating Manual: 2017: Next generation access telecommunications networks (NGA)* http://manuals.voa.gov.uk/corporate/Publications/Manuals/RatingManual/RatingManualVolume5/sect873/Rat-man%20Vol%205%20Sec873.html [accessed 10 March 2017].

865 Email from Andy Robinson, BT to Francis Harding, Ofcom, sent on 18 January 2017.

866 [✂]

867 Paragraph A17.49.

- a Full PWNRC approach. Amounts attributable to GEA services would not first be identified but would be determined by applying the PWNRC approach to all rateable assets at the same time; and
- a continuation of the current three stage approach under which the amount of the RVs that is attributable to GEA services is first identified.

The Full PWNRC approach

A17.69 A possible way for us to deal with cumulo costs for GEA no longer being identifiable, without making a significant change to our current approach, would be to remove the first step in the current attribution process explained above. This would have the effect that all of BT's cumulo costs would be attributed using the PWNRC methodology, i.e. without first separating out those costs relevant to GEA services. In what follows we refer to this as the Full PWNRC approach.

A17.70 Using the Full PWNRC approach has the benefit of not departing too far from the PWNRC approach. The CC has scrutinised the PWNRC approach and given it some endorsement. As we noted in the 2014 FAMR Statement we would expect "*the amount of cumulo costs to be recovered from regulated access services would … be consistent with the regulated services earning their cost of capital over the control period*".[868] By weighting the NRC of the rateable assets with the relevant WACCs, the Full PWNRC methodology is consistent with this principle. This is particularly important since most of the rateable assets are attributed to regulated markets.[869]

A17.71 However, when we tried re-attributing BT's 2015/16 cumulo costs under a Full PWNRC approach we obtained some unexpected results. We found that attributions to GEA rentals were much lower than those under the current methodology and attributions to other services were correspondingly higher. And when we then applied the Full PWNRC approach to our forecasts of BT's cumulo costs we found that:

- the 2016/17 unit cumulo cost for GEA rentals services fell to levels only slightly above those for MPF and WLR rentals services, whereas under the current attribution methodology MPF and WLR unit cumulo costs are much lower than those for GEA; and
- from 2017/18 onwards the unit cumulo cost for MPF and WLR rentals rose sharply, whilst those for GEA rental services only increased slightly, meaning that by the end of the charge control period the unit GEA cumulo cost would lie well below those for MPF and WLR. This would have led to a considerable increase in the per line cumulo allocation to MPF and WLR.[870]

[868] 2014 FAMR Statement, A26.27.

[869] See for example the attributions to Copper, Fibre and Duct services in schedule 6.2.1 of BT's 2016 RFS.

[870] The cost attributed to non-GEA services will rise because of increases to BT's cumulo costs. This will lead to increased unit costs for WLR and MPF rentals services. Costs attributed to GEA services will also rise but be spread over a greater number of connections, leading to much smaller increases in unit costs. The proportion of BT's cumulo costs attributed to GEA services is unlikely to change significantly under a Full PWNRC approach post 2015/16. That is because, whilst the NRC of rateable assets used to support GEA services has been increasing up to 2015/16, future increases will be smaller as most of the FTTC network has now been deployed (except in certain subsidised areas).

A17.72 Establishing the value of GEA services within the BT cumulo assessment is not straightforward. We have considered several reasons why the Full PWNRC approach produces the results outlined above. The first of these concerns the rateable assets used to deploy GEA-FTTC services. These assets are predominantly associated with duct and fibre from the cabinet to the exchange, mainly in the E-side network, which are shared with other services and the cabinets used to house the electronics. The broadband traffic on GEA-FTTC services is then carried over the D-side copper network. The electronics in cabinets and at the exchange are not rateable assets.

A17.73 A Full PWNRC approach will lead to lower attributions to GEA services because of the way these rateable assets are currently attributed within BT's RFS. GEA services receive an attribution of access fibre spine and distribution costs, some attribution of shared duct costs but no D-side duct or copper costs. The great majority of access duct and copper asset costs are recovered from MPF and WLR services. This approach is analogous to the attribution of costs for SMPF services.

A17.74 The Full PWNRC approach may also not fully reflect the increased economic value of the rateable assets resulting from the introduction of GEA services. For example, it could be argued that GEA-FTTC services have increased the economic value of D-side copper as this now carries SFBB traffic. This increase in value is, however, not captured in the Full PWNRC approach as the value of these assets is measured by NRC. Even if this increase in value was captured within the NRC of D-side copper, none of this increase would be attributed to GEA services under the current attribution methodologies.

A17.75 The above suggests that using the Full PWNRC approach may not be consistent with the principle that RVs can be considered measures of economic value, reflected in the potential profits generated by a hypothetical tenant of the rateable assets. Specifically, we would expect GEA services to be at least as valuable, if not more so, than MPF or WLR services and hence to attract a higher share of cumulo costs.

A17.76 With respect to the principles we set out in the 2014 FAMR Statement, our concerns are therefore that the attribution to GEA services from adopting a Full PWNRC approach may not be consistent with rating methodology; and that a Full PWNRC approach appears to produce counterintuitive results that may not be stable.

Using a predefined allocation of cumulo to GEA

A17.77 Whilst there are issues with adopting a Full PWNRC methodology, if we use the current relative attributions of cumulo costs to GEA services, and hence the attributions to MPF and WLR services, we would need to have a method to estimate what GEA cumulo costs should be in the future. As we note above, "*for NGA the valuation authorities currently apply an incremental fixed rateable value per connection as an MCC*"[871] when assessing BT's cumulo RVs. This has allowed BT to be able to identify its cumulo costs on GEA services, but it has also led to an increasing share of BT's cumulo costs being attributed to GEA services.[872] We estimate that the proportion of BT's cumulo costs attributed to GEA services will be around 58% in 2016/17.[873] This share seems high given that BT generates significant

[871] See also the description of the CUMNORM base in BT's 2012, 2013 and 2014 Detailed Attribution Methodology.

[872] BT's response dated 25 November 2016 to question H2 of the 20th BT WLA s.135 request.

[873] We multiplied the VOA's £18 RV guidance for GEA-FTTC connections (referred to in paragraph A17.32) by the Openreach fibre base volumes published in "Sheet 8. Broadband, TV and lines" in the

cash flows from other parts of its service portfolio, notably its copper services, such as WLR and MPF, and leased lines. This may suggest that the current attribution to GEA services is too high.

A17.78 The consequence of the increasing share of cumulo costs being attributed to GEA services is that less is attributed to other services, such as MPF, WLR and leased lines. As attributions to GEA services have increased, those to these other services have decreased.

A17.79 The only evidence we have on RVs for GEA services is the guidance published by the VOA for the 2010 rating list.[874] This recommended RVs of £18 per annum for each FTTC home connected and £20 for each FTTP home connected, with lower values, varying from £2 to £13 per annum proposed for certain rural networks in the final third. These figures were derived from the VOA's modelling and comparisons with Virgin Media's assessments. The draft RVs for Virgin Media's assessments from 1 April 2017 are significantly higher than those within the 2010 list, indeed the percentage increases appear to be higher than the percentage increase in BT's cumulo assessment.[875] This may suggest that £18 per annum will be an underestimate of the allocation for a GEA line in the future.

A17.80 Conversely, it could be argued that as the £18 was estimated assuming a new network build, it will overstate the relative contribution to BT's valuation. BT's access network is older than Virgin Media's and is used to provide a range of different services. BT provides GEA services using its existing duct network. Some of the fibres used in providing GEA services will be on routes that are shared with other services.

Proposal for attributing BT's cumulo costs from 2017/18

A17.81 We propose not to adopt a Full PWNRC approach. The main reason for rejecting this option is that we do not consider the resulting attributions would be consistent with our general principles. We consider that adopting a Full PWNRC approach would result in attributions to GEA services that would be counterintuitive and may not remain broadly stable over time. For this charge control we therefore propose to attribute BT's cumulo costs from 2017/18 onwards by continuing to use the existing three-stage approach.

A17.82 We also propose to estimate the RVs attributable to GEA services at £18 for each GEA-FTTC line, which is consistent with the VOA's 2010 guidance that we have

KPI data that BT publishes quarterly. We then divided this by BT's total cumulo RVs in Great Britain in 2016/17. The Q3 20161/7 KPI's can be found at: https://www.btplc.com/Sharesandperformance/Quarterlyresults/ [accessed 13 March 2017] [✂]

[874] As noted above, the VOA no longer publishes any numerical guidance on the potential rateable value per line for next generation access connections within Section 873 of its 2017 Rating manual.

[875] Ofcom analysis of draft rating list entries and 2010 rating lists. For example see Virgin Media's Scotland RV increase: SAA, valuation reference Z99655/0101, https://www.saa.gov.uk/search/?SEARCHED=1&ST=advanced&SEARCH_TABLE=valuation_roll_cpsplit&STREET=&TPTLA=&POSTCODE=&ASSESSOR_ID=&CLASS=&CORE=&CORE2=Type+here+to+search+core+descriptions&FEFFECTIVE_DATE=&TEFFECTIVE_DATE=&MIN_RV=&MAX_RV=&AS_UARN=Z99655%2F0101&DISPLAY_COUNT=10 [accessed 13 March 2017]. Values in England and Wales can be obtained via downloads from the VOA web-site available from https://voaratinglists.blob.core.windows.net/html/rlidata.htm [accessed 13 March 2017].

referred to above. Therefore, for reasons of consistency we adopt the £18 RV assumption when estimating the MCC impacts of additional GEA connections on BT's total cumulo costs. We discuss how we implement these proposals within our cost modelling in the next section. We believe that our approach will result in the cumulo unit costs of GEA services remaining stable whilst at the same time smoothing the impact on other services such as MPF and WLR rentals. Under this approach there remains little difference between the cumulo unit costs for MPF and WLR services.

A17.83 Ideally the attribution to GEA services would be informed by knowing the extent of any increase in BT's RVs owing to increasing GEA volumes in the period after 2017/18. However, other than the VOA's 2010 guidance we have no evidence on what that might be and may not obtain any before publishing the Statement. Our £18 assumption is therefore the only evidence that we have but we are aware that there are arguments to consider both higher and lower values.[876]

Implementation of our proposed attribution of BT's cumulo costs

A17.84 The main input for the way we propose to attribute BT's forecast cumulo costs over the charge control period is BT's 2015/16 attribution model.[877] For each network component, this contains:

- NRC split between rateable and non-rateable classes of work (COWs). The rateable COWs are defined within BT's AMD;[878]
- the proportion of each rateable COW's NRC that is rateable, as opposed to non-rateable; and
- attributions of estimates of the NRC for BT's specialised buildings (exchange buildings).

A17.85 The model also categorised network components into those used to support GEA services ("GEA Components") and those not used to support GEA services. For our modelling, we have divided the latter into two types. We call network components used in the top-down model that are not used to support GEA services "Relevant Components". There are, however, other network components, such as those used to support BCMR or WBA services, that do not support GEA services or services covered by the top-down model. We call these "Non-Relevant Components". Each network component can therefore be categorised as a GEA, Relevant or Non-Relevant Component.

A17.86 We have used the data outlined above within BT's 2015/16 attribution model , notably the splits of component NRC, to attribute BT's forecast cumulo costs for the services within the top-down and bottom-up models using the same three-step approach that BT currently applies but for each year until the end of the charge control period:

i) we estimate the cumulo costs attributable to GEA and non-GEA services in each year;

[876] See the arguments in paragraphs A17.79 and A17.80 above.

[877] BT's response dated 25 November 2016 to question H2 of the 20th BT s.135 request.

[878] BT, 2016. *Accounting Methodology Document*, pages 67, and 218-222.

ii) we calculate a per GEA rental cumulo cost for each year. It is these values that are input to the bottom-up model; and

iii) we attribute all non-GEA cumulo costs across Relevant Components using a PWNRC approach.

A17.87 We describe each of these steps in more detail below.

Step 1

A17.88 We calculate the RV attributable to GEA services in each year by multiplying our forecasts of GEA rental volumes by £18. This allows us to calculate a share of the total RV attributable to GEA services in each year which we then multiply by our forecasts of BT's total cumulo costs. This produces the cumulo costs attributable to GEA services and hence those attributable to non-GEA services.

Step 2

A17.89 Our forecasts of cumulo costs attributable to GEA services cover rental connections not just in commercially viable areas but also those in non-commercially viable areas. When we apply our £18 RV assumption we do so irrespective of where the connections are. We therefore calculate GEA cumulo costs per line per annum by dividing the total cumulo costs attributable to GEA services in each year from Step 1 by the total average GEA rental volumes in that year.

A17.90 The above process estimates cumulo costs for each GEA connection in each year out to 2021/22. These values are fed into the bottom-up model.

A17.91 The bottom-up model produces cost forecasts until the year 2028/29. However, we have forecasted BT's cumulo costs only as far as 2021/22. There is likely to be a further revaluation in England, Scotland and Wales that will come into force from 1 April 2022 so there is little value in attempting to model cumulo costs after that with any precision.[879] We have therefore generated cumulo costs per GEA-FTTC rental line in years after 2022/23 by increasing these unit costs by 2% per annum. The 2% reflects that rates in the pound are expected to increase by CPI from 2020/21.

Step 3

A17.92 We attribute forecasts of BT's cumulo costs that are attributable to non-GEA services in four main stages. These are as follows:

- Stage 1: We forecast NRC for the rateable assets for all Relevant and Non-Relevant Components in each year of the charge control period. There are several assumptions we make in producing these forecasts and these are explained in more detail below;

- Stage 2: We multiply these forecasts of NRC for the rateable assets by the appropriate WACC to provide forecasts of PWNRC for each Relevant and Non-Relevant Component in each year. The WACCs we apply are those described in Annex 16: from 2017/18 to 2019/20 we apply 8.1% for components used to support Openreach copper services and 9.5% for Other UK Telecoms components. For 2020/21 and 2021/22 we apply 8.0% for components used to

[879] We will revisit this question as part of the next WLA market review and revise our approach as appropriate.

support Openreach copper services and 9.4% for Other UK Telecoms components.;

- Stage 3: We attribute BT's cumulo costs that are attributable to non-GEA services in each year across Relevant and Non-Relevant Components in proportion to their forecast PWNRC in that year; and

- Stage 4: The cumulo costs attributed to Relevant Components in each year are attributed to services within the top-down model using the same usage factors that apply to those components for all other costs.

A17.93 We forecast NRC for rateable assets for both Relevant and Non-Relevant Components in Stage 1 by applying various growth rates to the NRC by component within BT's 2015/16 cumulo attribution model as follows:

- For Relevant Components, we use the growth in NRC in each year from the base year, 2015/16, for that component as forecast by the top-down model. By doing so we assume that the proportion of rateable assets for each component will remain constant.

- For Non-Relevant Components, we keep the NRC in each year from the base year 2015/16 flat in nominal terms. These components are not covered by the top-down model. We do not consider this a critical assumption as Non-Relevant Components reflect a mix of services, some of which are growing, such as Ethernet Leased line services, and some that are falling, such as older, traditional interface leased lines services and other narrowband services.

- We also keep the Specialised buildings NRC flat in nominal terms from 2015/16. We have limited evidence to support an alternative assumption. The NRC of these buildings was valued at £[✂][880]. This NRC estimate is now updated every year by Telereal Trillium for BT.[881] The valuation used for the 2015/16 model was £[✂].[882] It is difficult to forecast NRC for these buildings with any accuracy. The NRC consists of land and buildings costs. Whereas one might expect buildings costs to decrease due to the impact of depreciation, land values are not depreciated and will be subject to fluctuations of the property market that will vary considerably by location, geographic area and type of building.

- The total forecast NRC for each component in each year is the sum of the Specialised building NRC and the Non-Specialised building NRC.

Outputs and sensitivity analysis

A17.94 The outputs of the above process are to produce unit cumulo costs for each of the main services within the top-down and bottom-up models in each year. In 2020/21 the unit cumulo cost for GEA rental services is £7.70 per line and for MPF rental services is £7.08 per line.

A17.95 For the sensitivity analysis that we present in Annex 14 we have created a high and a low scenario for our cumulo forecasts.

[880] BT's response of 25 November 2016 to question H2(c) of the 20th WLA s.135 request.

[881] See BT's 2016 AMD, page 22.

[882] BT's response of 25 November 2016 to question H2(c) of the 20th WLA s.135 request.

A17.96 For the low scenario, we attribute our forecasts of BT's cumulo costs using the Full PWNRC method. We assume, as in the base case, that BT's cumulo RVs will increase due to increasing demand for fibre and decrease due to increasing demand for MPF. But we assume the increased RV will be £12 for each GEA-FTTC connection (i.e. 33% lower than the £18 assumed in the base case) and the decrease will be £35 for every extra MPF connection (the top end of our estimated range).

A17.97 These changes affect forecasts of BT's cumulo costs and attributions. The effect is to decrease our forecasts of BT's total cumulo costs, decrease cumulo unit costs for GEA services but increase them for MPF services.

A17.98 For the high scenario, we attribute costs in the same way as we have in the base case but change the additional RV per new GEA-FTTC connection to £27 (an increase of 50% on the base case) and the reduction for every extra MPF rental connection to £25, the bottom end of our estimated range.

A17.99 These changes again affect forecasts of BT's cumulo costs and attributions. The effect is to increase our forecasts of BT's total cumulo costs, increase cumulo unit costs for GEA services but reduce them for MPF services.

Annex 18

Sales of copper and sales of property

Introduction

A18.1 In this annex we set out how we propose to address the possibility that BT will sell redundant copper and/or property. We explain the options we have considered and we set out the rationale for proposed assumptions regarding the proceeds from sales of redundant copper, and profits and losses from sales of property. These assumptions will be used within the top-down model.

Sales of copper

Background

A18.2 Over time, BT has received proceeds from sales of copper extracted from its network where it is no longer required or has been replaced.

A18.3 Copper (and other income generating material such as aluminium and lead) might be removed from BT's network for several reasons. In some cases, redundant copper has been recovered to clear congested ducts. In 2013, BT set up a 'Cable Recovery Unit', structuring its extraction of copper from its core network.[883]

A18.4 In the six years since 2010/11, BT has extracted 107,400 tonnes of copper from the core network[884]. BT also extracted 92,000 tonnes of lead and 28,500 tonnes of other metals. The proceeds from the sale of this metal totalled £703m with net proceeds, after contractor and internal BT costs, of £381m .[885] Most of this was from the sale of copper. BT estimates that there are approximately 21,700 tonnes of copper left in the core network.[886] BT has therefore already extracted most of the copper from its core network and the copper that remains in the core network is likely to be the least viable to extract. Further, the proportion of proceeds from the sale of core network copper that might reasonably be attributed to access services is significantly lower than the proportion of the proceeds from the sale of access network copper. We have therefore focussed on the potential future proceeds from the sale of copper in the access network.

A18.5 BT has explained that extracting copper from its access network is less economically viable than extracting copper from the core. The economics depend on the weight of copper that can be extracted in a day. This is in turn depends on average cable sizes. Because the average cable size in the access network, particularly in the D-side network, is likely to be smaller than in the core, that means that cost per tonne of extraction is likely to be higher and net proceeds lower.[887]

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[883] BT's introduction to its response dated 12 August 2016 to the 12th BT s.135 request.
[884] "Core" means copper cables in segments of the BT network located between exchanges, excluding copper cables within the cable chamber within the exchange building and any copper cables on the main distribution frame.
[885] BT's response dated 12 August 2016 to question 4 of the 12th BT s.135 request.
[886] BT's response dated 12 August 2016 to question 6a of the 12th BT s.135 request.
[887] BT's response dated 15 November 2016 to question D2 of the 18th BT s135 request.

A18.6 BT has extracted copper from its access network in the past. BT expects to continue the recovery and sale of small amounts of copper as part of usual business activity but has explained that it has no planned cable recovery programme for any part of its network.

A18.7 In the short term, the volume of copper that can be economically extracted as part of BT's usual business may be relatively low. In the long term, however, we consider that there will be greater opportunity for larger scale extraction as BT moves to fibre broadband delivery and BT closes its traditional telephony network.

Extraction of copper from the access network

A18.8 We consider that the economics of extracting copper are different for the D-side[888] and E-side[889] network and the copper in exchanges.

A18.9 In the D-side network, BT has estimated that there are approximately 152,600 tonnes of copper and approximately 20,100 tonnes of aluminium.[890]

A18.10 However, we do not currently expect that BT will be able to profitably extract a significant proportion of its D-side copper, for the following reasons:

- **Economics:** using data provided by BT we can compare the density of copper cables from the D-side to the E-side. The number of pairs in each cable differs between the E-side and D-side network. Most extraction costs are not dependent on the number of pairs in the cable. Therefore, if there are fewer pairs the profitability of extraction reduces.

- **Uncertainty**: the data BT holds for the cables within the D-side network is incomplete due to BT's system not holding the material types of all cables. We consider it unlikely that BT would commit resource to extracting unknown quantities of unknown metals.

- **FTTC**: the copper cables in the D-side network are used for the provision of FTTC. We therefore do not expect the D-side network to be a part of a large scale copper recovery programme whilst BT continues to provide FTTC services.

A18.11 Considering the above, we do not propose to make any adjustment to BT's costs to reflect future proceeds from sales of copper in the D-side network.

A18.12 Regarding the E-side network, BT has informed us that it has considered recovering copper in the past but has not done so on a large scale. BT explained that it recovers some E-side copper as part of business as usual but the volumes

[888] "D-side" means copper cables in segments of the BT access network located between Primary Connection Points (PCPs) (street cabinets) and Distribution Points (for example, the top of a telegraph pole).
[889] "E-side" means copper cables in segments of the BT access network located between PCPs and exchanges including copper cables within the cable chamber within the exchange building but not including any copper cables on the main distribution frame.
[890] BT's response dated 13 January 2017 to question 6b of the 12th BT s135 request (BT estimate including scaling factor).

recovered are generally quite small; it has informed us that between 2016/17 and 2017/18 it expects to recover around 3,800 tonnes of copper.[891]

A18.13 However, we expect that at some stage most E-side copper cables will become redundant as a result of continuing rollout and take-up of fibre based services; and migration away from traditional PSTN based telephony services to IP-based telephony carried over fibre based broadband. Depending on the rate of migration to fibre based broadband, and the extent to which the E-side copper continues to be used to allow testing of D-side copper in BT's FTTC services from the exchange, this may happen when BT switches off the PSTN, which it expects to do in 2025.[892]

A18.14 Therefore, we expect that, to the extent that BT has not extracted the E-side copper before the PSTN is switched off, it will be able to extract much of it shortly thereafter.

A18.15 We consider that the economics of extracting large volumes of E-side copper from a copper network that is no longer in use are likely to be much better than those when extracting smaller amounts of copper on a business as usual basis; the economics are also better than extracting D-side copper because the E-side average cable size is higher. And, as explained below, we consider that large scale E-side copper extraction is economically viable.

A18.16 We do not consider it possible to value copper cables within exchanges as we have limited information regarding the historical extraction of these cables and no information about the remaining tonnages. BT was unable to provide estimates of the volume of copper remaining in exchanges. In its response, BT noted that it had "no basis for estimating "Within Exchange" copper" but advised us that due to the "years and years of cables building up" within exchanges, removal was very difficult.[893] Moreover, BT has not told us or the industry of any major programme to close exchange buildings in the near future (BT had no forecasts for extraction beyond 2017/18). However, in the "medium term" BT has noted that it expects to move out of most exchanges if customers are served by IP to the premises solutions.[894]

Implications for charge controls

A18.17 In the 2014 FAMR Statement, we said "we do not consider it would be appropriate to take into account the potential scrap value of the E-side copper network when it is replaced by fibre".[895] We explained that that we were using an anchor pricing

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[891] BT's response dated 12 August 2016 to question 5 of the 12th BT s135 request.

[892] BT, *Openreach Summary of Market and Customer Insight on the ISDN2 and ISDN30 Services*, page 1. https://www.ofcom.org.uk/__data/assets/pdf_file/0036/94797/Openreach-Summary-of-Market-and-Customer-Insight-on-the-ISDN2-and-ISDN30-Services.pdf.

[893] BT's response dated 25 August 2016 to question 6 of the 12th BT s135 request.

[894] BT, *BT's response to Ofcom's second consultation document "Review of BT's cost attribution methodologies"* (BT response to Second CAR consultation), page 14. https://www.ofcom.org.uk/__data/assets/pdf_file/0019/85060/bt_response_to_2nd_car_consultation_of_13_november_2015.pdf.

[895] Ofcom, June 2014. *Fixed access market reviews: wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30 – Volume 2: LLU and WLR Charge Controls* (2014

approach and modelling a hypothetical ongoing network, thereby assuming no NGA deployment or redundant copper. We also noted that there was uncertainty around the materiality of any such adjustment.

A18.18 Frontier Economics submitted a response to the 2014 FAMR Consultation on behalf of Sky and TalkTalk. It argued that the scrap value of the copper in the local access network was probably over £1bn.[896] It stated that approximately 80% of the value could be within the E-side network. It argued that if no adjustment was made within the charge control then BT would be set to earn a windfall gain.

A18.19 We consulted on this attribution of the proceeds from the sale of copper as part of our review of BT's cost attribution methodologies (CAR) in June 2015 and again in November 2015. Cartesian, which undertook the review on Ofcom's behalf, noted that most of the proceeds were not attributed to regulated markets.[897]

A18.20 These discussions focussed on cost attribution rather than cost recovery issues. We did not impose regulation for revised attributions of these sales and costs in the 2016 BCMR Statement as there would have been virtually no impact on the costs in BCMR markets.

A18.21 We received several responses from stakeholders to our June 2015 CAR Consultation on this issue, notably Vodafone's and TalkTalk's responses:

- **Vodafone** noted that sales of copper are a "*predictable consequence of the ownership of copper cable assets*" and should therefore be reflected in charges.[898] Vodafone proposed that depreciation should reflect a residual value approach. In response to our November 2015 CAR Consultation Vodafone repeated its previous arguments but further considered that "*it is right that stakeholders are given a clear idea of when the matter will be considered in depth*".[899]

- **TalkTalk** noted that "BT has in the past been able to enjoy £100 millions of windfall gains from the sale of copper – this must not be allowed to happen

FAMR Statement), paragraphs 3.59-3.65. https://www.ofcom.org.uk/__data/assets/pdf_file/0032/78836/volume2.pdf

[896]Frontier Economics, January 2014. *Regulated Costs for BT's Copper Cable*, (Frontier Response to 2014 FAMR), Executive Summary, https://www.ofcom.org.uk/__data/assets/pdf_file/0030/83766/sky_and_talktalk_group_regulated_costs_for_bts_copper_cable.pdf

[897] Cartesian, 8 June 2015. *BT Cost Attribution Review,* (2015 BT CAR – Cartesian Report), Section 6.5, https://www.ofcom.org.uk/__data/assets/pdf_file/0025/83482/ofcom_bt_cost_attribution_review_final_report.pdf.

[898] Vodafone, August 2015. *Response to Ofcom's Consultation: Review of BT's cost attribution methodologies's* (Vodafone CAR Response to First Consultation), paragraph 3.18. https://www.ofcom.org.uk/__data/assets/pdf_file/0033/83949/vodafone_response_to_car_consultation_of_12_june_2015.pdf.

[899] Vodafone, December 2015. *Response to Ofcom's Consultation: Review of BT's cost attribution methodologies – Second Consultation's response to Ofcom's* (Vodafone Response to Second CAR consultation), paragraph 5.14. https://www.ofcom.org.uk/__data/assets/pdf_file/0020/85142/vodafone_response_to_2nd_car_consultation_of_13_november_2015.pdf.

again".[900] In response to the November 2015 CAR Consultation TalkTalk agreed that this issue "should be examined within a charge control and/or a separate policy project".[901]

A18.22 As explained above, we now have a better idea of the possible proceeds from the sale of copper and expect that that they could be significant (although are unlikely to be at the level suggested by Frontier).

A18.23 Therefore, we agree with Vodafone that sales of copper are a "*predictable consequence of the ownership of copper cable assets*".

A18.24 As explained in Volume 2 Section 2, our approach to modelling costs is intended to set efficient investment signals while allowing BT the opportunity to recover efficiently incurred costs. The future proceeds from the sale of an asset at the end of the investment life would be considered in any new investment decision. Over the period of the investment, we would expect an asset to depreciate from its purchase price to its expected residual value. It is this amount of depreciation that we would wish to reflect in the prices of regulated services to achieve our goals of setting efficient prices and allowing the opportunity to recover efficiently incurred costs.

A18.25 Ignoring the residual value of the copper at the end of its use results in copper assets being depreciated too quickly, thereby creating a disconnect between the asset's accounting value and economic value. Setting prices to recover the full cost of the assets without taking account of any sale proceeds would result in BT over-recovering its costs and this would not send efficient pricing signals.

A18.26 Therefore, in the remainder of this section we estimate the potential proceeds from the sale of E-side copper.

Our analysis

A18.27 To estimate the future net proceeds from sales of E-side copper we have considered:

- the amount of copper in BT's E-side network;
- the proportion of E-side copper that BT can extract;
- the value of that copper (in today's prices); and
- the cost of extracting that copper (in today's prices).

[900] TalkTalk, August 2015. *Review of BT's cost attribution methodologies - TalkTalk response* (TalkTalk CAR Response to First Consultation), paragraph 3.71. https://www.ofcom.org.uk/__data/assets/pdf_file/0030/83964/talktalk_response_to_car_consultation_of_12_june_2015.pdf.

[901] TalkTalk, December 2015. Review of BT's Cost attribution methodologies Second consultation Nov 2015 (TalkTalk's Response to Second CAR consultation), paragraph 4.13. https://www.ofcom.org.uk/__data/assets/pdf_file/0019/85141/talktalk_response_to_2nd_car_consultation_of_13_november_2015.pdf.

Amount of copper in the access network

A18.28 We asked BT to provide data on its estimates for the volume of copper in the D-side and E-side network. Besides the D-side estimates discussed above, BT also provided estimates for the copper and aluminium remaining in the E-side network. It estimated that there are approximately 228,600 tonnes of copper and approximately 6,300 tonnes of aluminium.[902]

A18.29 We undertook a simple cross check of BT's estimates of tonnages. We applied assumptions about average spare capacity in the access network[903], average distances in the E-side network and average cable gauges to the number of lines in the copper network as given in BT's RFS. This produced a total volume of copper to which we then applied the density of copper. This approach provided tonnages similar to BT's but with a slightly different split between E-side and D-side. Given this cross check, we propose to use BT's estimates of the tonnages of E-side copper in our assessment of future proceeds.

Proportion of extractable E-side copper

A18.30 We do not expect that all the E-side copper can be extracted.

A18.31 BT has informed us that missing and unrecoverable cables meant that it extracted less copper than planned as part of the Copper Recovery Programme.[904] Cables can be missing for a variety of reasons including theft, record error, or might be unrecoverable for reasons such as cable decay and obstructing traffic.[905]

A18.32 To inform our assessment of the proportion of extractable E-side copper, we asked BT to provide data on its historical Missing and Unrecoverable Rates ("MUR"), as set out in Table A 18.1

Table A18.1: National average Missing and Unrecoverable rates

National Averages	2012/13	2013/14	2014/15
Missing	21%	20%	28%
Unrecoverable	22%	26%	29%
Total	43%	45%	57%

Source: BT[906]

A18.33 These historical rates mainly reflect the extraction of copper from the core network. However, BT explained that it expects the unrecoverable rates for E-side copper to be broadly similar to those in the core network as there is a similar likelihood that the E-side cables are unrecoverable. It considered that missing rates should however be much lower on the E-side network compared to the core network. In addition, the records on the E-side network would be better kept because many of the cables are pressurised and therefore monitored. These cables are also subject

[902] BT's response dated 2 December 2016 to question 6a of 12th BT s.135 request.

[903] Copper cables are supplied with a certain number of pairs, from, say, 2 pairs up to around 800. Not all pairs will be used on each cable due to the need to have spare capacity to meet future growth and due to the modularity of these cables.

[904] BT's response dated 12 August 2016 to 12th BT s.135 request.

[905] BT's response dated 12 August 2016 to question 7 of 12th BT s.135 request.

[906] BT's response dated 15 November 2016 to question D1c of 18th BT s.135 request.

to routine testing and BT has developed a system to keep an inventory of local assets.

A18.34 We agree with BT's reasoning and therefore expect the proportion of E-side cables that are unrecoverable will be similar to the rates set out in table A18.1, but there would be slightly lower rates of missing cables. On this basis, we have assumed that BT will be able to recover 60% of its E-side copper.

A18.35 On this basis, we estimate that BT could extract around 137,000 tonnes of copper and 3,800 tonnes of aluminium.

Proceeds from sales of copper

A18.36 To determine the proceeds (per tonne of copper sold), we have taken the average market price over the year and applied a discount to market (DTM) factor.

A18.37 Copper is sold on the London Metal Exchange and is priced in USD ($). Therefore, the copper value in GBP (£) is closely linked to the value of the pound against the dollar. Because of the recent downturn of the pound, the value of copper (in £) has increased significantly.

A18.38 We considered using the most recent market price but this could be distorted by short-term movements in the price of copper and exchange rates; therefore, the recent market price might not be a good indicator of future proceeds. To reduce the impact of any short-term fluctuations in prices and exchange rates, we propose to use a one-year average price.

A18.39 The average price per tonne of copper for the year to the end of February 2017 (converted from dollars into pounds at the daily exchange rate) is £3,863[907].

A18.40 This is the market price for high grade copper; prices for scrap copper will be lower. The DTM is the difference between the pure copper price and the price of scrap copper. This is decided on a per tonne basis by the metal merchant.

A18.41 BT has provided historical discount rates throughout the cable recovery programme. These ranged from 2-14 %.[908] Informed by the weighted average of the historical DTM factors provided by BT, we have applied a 5 % discount to the market price.

A18.42 Based on the above, we estimate BT would receive proceeds of £3,670 per tonne of copper.

Costs of extraction

A18.43 BT provided estimated costs of extracting each tonne of scrap material from the network.[909] This includes the copper but also other waste material e.g. PVC insulation.

A18.44 BT provided a breakdown of costs which included copper extraction charges; planning and field costs; metal merchant charges; traffic management costs; and

[907] Bloomberg. 1 March 2017.

[908] BT's response dated 15 November 2016 to question D2b of 18th BT s.135 request.

[909] BT's response dated 15 November 2016 to question D2 of 18th BT s135 request.

transport costs. BT estimated that the total costs would be around £1,400 per tonne of extracted material.[910]

A18.45 BT estimated that copper represents 50% of the weight of extracted material. On this basis, BT's estimates indicate that extraction would cost around £2,800 per tonne of copper extracted.

A18.46 To check this estimate, we required BT to provide data on the actual costs it had incurred extracting copper.

A18.47 The historical extraction costs per tonne of copper extracted are as below:

Table A18.2: Weighted average cost per tonne of copper extracted

	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Weighted average
Costs/tonne of copper extracted	2,692	2,879	2,763	3,023	8,168	6,215	2,843

Source: Ofcom analysis of BT's data[911]

A18.48 The costs in the last two years are higher than in the previous four. We understand that this is because the volumes extracted decreased significantly and therefore the costs per tonne increased due to fixed costs such as traffic management and internal BT resource. In line with our assumption that BT would undertake the copper recovery programme when the E-side copper network becomes redundant following the PSTN switch-off, we consider that the average costs in the first four years provide a more relevant benchmark for the likely costs of large scale extraction. Therefore, we also consider that the weighted average for the six years might set the upper limit for the average costs. This data would indicate that historically BT's costs of extracting relatively large volumes of copper, in today's prices, have been around £3,000 per tonne of extracted material.

A18.49 Therefore, we consider BT's estimated cost of £2,800 per tonne of extracted copper to be reasonable and we have used this in our calculation of the proceeds.

Net proceeds

A18.50 Based on the above assumptions we estimate that BT could generate net proceeds of around £110m.

A18.51 The average price per tonne of aluminium for the year to the end of February 2017 was £1,280[912] before any DTM. Because of the low tonnage of aluminium estimated to be within the E-side we believe it is likely that the extraction costs would exceed any proceeds.

A18.52 We therefore consider that our top-down model should take account of the potential proceeds from sales of copper. This will reflect our expectation that BT will be able to extract and sell a proportion of its E-side copper network before or shortly after the PSTN is switched off.

A18.53 As discussed in Volume 2, Section 3, we wish to set prices that will send efficient pricing signals. To do this, we adjust BT's accounting data so that our cost

[910] BT's response dated 15 November 2016 to question D2 of 18th BT s135 request.

[911] BT's response dated 12 August 2016 to question 4 of the 12th BT s.135 request.

[912] Standard & Poor. 1 March 2017.

estimates better reflect the forward-looking economic costs of providing network services. To achieve this aim, we make ongoing network adjustments and capture the residual value of copper. We have in the past been concerned that making ongoing network adjustments and capturing the residual value of copper may be inconsistent; however, after careful reflection, we no longer hold this view. As the reason for making ongoing network adjustments is the same as for capturing the residual value of copper (i.e. that prices reflect the economic value of the network), we do not consider that there is any inconsistency between using ongoing network adjustments and including the proceeds from sales of copper in our modelling.

Approach to adjusting costs

A18.54 As noted above, ignoring the residual value of the copper at the end of its use results in copper assets depreciating too quickly, thereby creating a disconnect between the asset's accounting value and economic value.

A18.55 We have considered how best to reflect the residual value of copper in an ongoing network in our cost modelling. One option is to reset the copper assets to a revised depreciation profile that reflects the net realisable value of the asset declining to the residual value rather than to zero. This change reduces the annual depreciation charge, but inflates the MCE, thereby increasing the capital charge included in our cost calculations. Such an approach better reflects the economic value of the assets and is consistent with our modelling approach. However, in practice, this approach is difficult to apply; it also risks overstating the NRC of assets in use if the redundant copper is included in the MCE at its residual value beyond the end of its economic life.

A18.56 We have therefore adopted a simpler approach that approximates the effect of adjusting the revised depreciation profile and economic value of the assets for the economic life of the assets, as follows. We:

- assume the E-side copper is sold after the PSTN switch-off. For our calculation, we have assumed that the sale will be in 2030;
- calculate the future net proceeds by reference to the estimate of net proceeds calculated above, increased in line with RPI (being the inflation factor applied to copper assets, as set out in Annex 11.
- calculate the present value of the future proceeds, using the relevant WACC; and
- include a constant, real terms, annual adjustment (a "negative cost") in our annual cost forecasts, so that the present value of the annual adjustments between the start of the charge control and the projected disposal date is equal to the present value of the future proceeds.

Sales of property

Introduction

A18.57 In this section, we consider whether, and how, our cost calculations should be adjusted to reflect future profits and losses from sales of properties that BT considers surplus to requirements. In summary, we set out:

- that we do not attempt to reflect future proceeds in our cost modelling; and

- how we have adjusted the way BT attributes its proceeds within the RFS in order to set this charge control.

Future profits and losses from the sale of properties

A18.58 Profits and losses from sales of property by BT have, in general, been quite low in the past, and we believe for the reasons set out below that they will continue to be low in the near future.

A18.59 As reported in the press BT sold Keybridge House for £90m in September 2014 [913] and a "profit of £67m on the disposal of a surplus building in London" was reported in BT's 2014/15 statutory accounts.[914] A profit on property disposal of this magnitude however appears to be the exception. We have not found any reference to any other such similar gains reported in BT's statutory accounts since 2012/13.

A18.60 However, in the June 2015 CAR consultation we said "We are not convinced that profits from sales of property will remain low. While it is currently expensive to remove local exchanges from the network, changing technology including fibre deployment in the local network may change the underlying economics".[915]

A18.61 Some network rationalisation of BT's local exchange portfolio seems likely in the long run. Indeed "BT plans to move out of the majority of its exchanges in the medium term. BT has explained that leases on its exchanges typically run until 2031 and that its goal is to serve all voice customers by an IP to the premises solution by 2025 mitigating the need for >4,000 exchanges".[916]

A18.62 We therefore agree with Vodafone's point in its response to our November 2015 CAR consultation that the realisation of profits on disposals of properties is a consequence of any business which has a changing requirement for its property portfolio. As other operators have contributed to the costs of these buildings over time we also believe it is right that they should share in any net proceeds when these assets are sold, similar to our proposals given above for any future proceeds from the selling of copper cables that fall redundant. The question is to what extent those gains or losses are predictable.

A18.63 For several reasons, we believe it is currently difficult to predict future gains or losses from properties with any reliability:

- It is difficult to predict which properties would be sold and when given property price fluctuation and geographic variation in property prices.

- This difficulty is exacerbated by the current contractual arrangements that BT has with Telereal Trillium, which owns the majority of BT's properties. Most of these have a minimum lease term of 30 years from December 2001.[917] Any disposals prior to December 2031 are subject to a profit sharing deal. "*Upon BT's vacation of assets, Telereal Trillium seeks to realise value from the properties, often*

[913] Evening Standard, 2014. http://www.standard.co.uk/business/business-news/bt-eyesore-sold-for-90m-to-be-turned-into-luxury-flats-9714317.html. [accessed 14 March 2017].
[914] BT's Financial Results 2015, page 7. https://www.btplc.com/News/ResultsPDF/q415-release.pdf. [accessed 14 March 2017].
[915] June 2015 CAR Consultation, paragraph 9.35.
[916] 2016 BCMR Statement, paragraph 3.38.
[917] Telereal Trillium website, *Case Study: BT*, http://www.telerealtrillium.com/about-us/case-studies/bt.

enhancing value by obtaining planning permission for change of use or redevelopment. BT is aligned in this objective as value enhancements are shared between the parties".[918] Any profit or loss from these properties may therefore only be a small percentage of the sales and is likely to vary from property to property.

- It is also unclear what arrangements will be in place at the expiry of the current 30 year deal with Telereal Trillium.

A18.64 Given these uncertainties we do not consider it appropriate to attempt to estimate future property sales, an exercise which would at best be highly speculative. We therefore propose to treat any future profits or losses from future sales of properties in a different way from how we propose to treat future proceeds from redundant copper for this charge control. We do not propose to make adjustments to our base data or cost modelling for any future proceeds from sales of properties within this charge control.

A18.65 That does not mean that we would not in future consider making adjustments similar to those we are proposing on sales of copper. For example, if BT were to announce either publicly or to industry an exchange closure programme then that would reduce some of the uncertainties about what properties would be sold and when. It may then be easier to estimate net proceeds.

Attribution of proceeds from the sale of properties

Background

A18.66 Profits or losses from the sale of non-leasehold properties are included within operating costs within BT's Regulatory Financial Statements. All these profits or losses are attributed to the Retail Residual business.[919] BT has said that this is justified because "such profits are not part of the normal cost of managing our property estate and therefore it is not cost causal to allocate them to Group Property and Facility Management AG106."[920]

A18.67 In its June 2015 Report "BT Cost Attribution Review" for us Cartesian raised some concerns about the attribution of sales of property.[921] As a result, we discussed the attribution of sales of property further in both the June 2015[922] and November 2015 CAR Consultations.[923] However, we made no decisions on these attributions as part of the 2016 BCMR Statement.

A18.68 In the June 2015 CAR Consultation we did however note that that "there may also have been 'windfall gains'" as a result of property sales and their treatment within

[918] Buildings which are deemed surplus to operational requirements and which are vacated by BT are then developed and "value enhancements are shared between the parties". Telereal Trillium website, *Case Study: BT*, http://www.telerealtrillium.com/about-us/case-studies/bt.

[919] See the description of the "W" OUC base on page 62 of BT;'s 2016 AMD

[920]Ofcom, November 2015. *Review of BT's cost attribution methodologies* (June 2015 CAR Consultation) Paragraph 9.30. https://www.ofcom.org.uk/__data/assets/pdf_file/0016/81412/review-bt-cost-attribution-method.pdf.

[921] 2015 BT CAR – Cartesian Report, paragraph 5.6.1.

[922] June 2015 CAR Consultation, paragraphs 9.12 to 9.41.

[923] November 2015 CAR Consultation, paragraphs 6.1 to 6.49.

BT's RFS but "that is an issue of cost recovery that may be investigated within any future charge controls".[924] We have therefore decided to review the treatment of profits/losses on the sales of property in this consultation.

A18.69 We first recap the proposals we made in the November 2015 CAR Consultation before providing our analysis and proposals.

The November 2015 CAR Consultation on sales of property

A18.70 In the June 2015 and November 2015 CAR Consultations, we proposed an alternative attribution basis that we considered addressed the key concerns that we had identified in BT's current approach. In summary our concerns were:

- Cartesian noted in its report on cost attribution that "the treatment of income from sale of property is inconsistent."925 Cartesian noted that the treatment of these sales proceeds was a "different approach to the treatment of the provision from existing leased properties (AG414) due to early termination of lease of office space."

- We agreed with Cartesian's assessment that the treatment of profits and losses from Property disposals seemed inconsistent with that under the Property Provision Driver (AG414).[926]

- We also said that it did not seem objective for BT to allocate the proceeds of sales of property in that way, and that BT's chosen allocation method appeared "to benefit BT unfairly"[927] because:

  - properties that have been sold may have been used to provide regulated network services in the past; and

  - operators that have consumed such services, who, through charges they have paid, may then have contributed to the costs of these buildings, but would not benefit from the proceeds of the sale of such property.

A18.71 We considered that proceeds from a building that had only ever been used to supply regulated services should only be attributed to regulated services.[928]

A18.72 Our proposals in both the June 2015 and November 2015 CAR Consultations were that:

- BT should identify the type of building that the profits or losses from disposal relate to, i.e. whether the building is owned by Telereal Trillium or BT, and whether it is a general purpose or operational building; and

- BT should then allocate these disposal proceeds in the same way that the "underlying costs" for that type of property are attributed. We proposed that

[924] June 2015 CAR Consultation, paragraph 9.31.
[925] The Cartesian Report, section 6.3.7.4.
[926] June 2015 CAR Consultation, paragraph 9.26.
[927] June 2015 CAR Consultation, paragraph 9.31.
[928] November 2015 CAR Consultation, paragraph 6.32.

underlying costs should mean rent for Telereal Trillium owned buildings and depreciation for BT owned buildings.[929]

A18.73 We also noted that BT's regulatory accounting system should include information that allows the sales of property and the attribution of these sales to be monitored and reviewed in the context of charge controls.[930]

Responses to the November 2015 CAR Consultation

A18.74 BT and FTI (in its report for BT) said that, while it agreed that the sale of copper and the sale of property should have similar attribution methodologies,[931] it did not agree with Ofcom's view that its current approach was not objective or consistent with its other allocation methodologies.[932] Furthermore, BT and FTI said that Ofcom was adopting an inconsistent approach by dismissing cost recovery considerations and not adopting the same treatment for sales of property as other costs such as its pension deficit payments.[933]

A18.75 BT and FTI claimed that this went against the Regulatory Accounting Principles (RAPs) of 'consistency with regulatory decisions'[934] and, additionally, FTI claimed said that this was contrary to the RAP of 'consistency of the Regulatory Financial Statements as a whole and from one period to another'.[935]

A18.76 Deloitte agreed with FTI's analysis that Ofcom's approach was inconsistent, and suggested that "any current inconsistency in treatment of cost attribution and cost recovery purposes should be corrected". However, Deloitte agreed with Ofcom's approach as being "appropriate" albeit for different reasons.[936]

A18.77 FTI suggested that "Ofcom should treat profits arising on sale of a property as a windfall gain and not allocate any of the costs to regulated services in the RFS or in charge control costs calculations."[937]

A18.78 TalkTalk noted the inconsistency between "BT attributing most of the cost of property and all of the cost of vacant space to regulated products but attributing all

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[929] November 2015 CAR Consultation, paragraph 6.44.
[930] November 2015 CAR Consultation, paragraph 6.31.
[931] Paragraph 112 of BT's response to the 2015 Second CAR Consultation; and paragraph 9.15 of FTI's report *Ofcom's second consultation on BT's cost attribution methodologies – a report for BT*, 14 December 2015, submitted to the November 2015 Second CAR Consultation.
[932] BT's response to the November 2015 CAR Consultation, paragraph 106.
[933] BT's response to the November 2015 CAR Consultation, paragraph 104; and paragraph 9.8 of FTI's report *Ofcom's second consultation on BT's cost attribution methodologies – a report for BT*, 14 December 2015, submitted to the November 2015 CAR Consultation.
[934] BT's response to the November 2015 CAR Consultation, paragraph 104; and paragraph 9.9 of FTI's report *Ofcom's second consultation on BT's cost attribution methodologies – a report for BT*, 14 December 2015, submitted to the November 2015 CAR Consultation.
[935] Paragraph 9.9 of FTI's report *Ofcom's second consultation on BT's cost attribution methodologies – a report for BT*, 14 December 2015, submitted to the November 2015 Second CAR Consultation.
[936] Section 6.4 of Deloitte's report, *Review of Ofcom's proposed changes to BT's cost attribution methodologies: Second consultation - A report for BT*, 16 December 2015, submitted to the November 2015 Second CAR Consultation.
[937] Paragraph 9.10 of FTI's report *Ofcom's second consultation on BT's cost attribution methodologies – a report for BT*, 14 December 2015, submitted to the November 2015 Second CAR Consultation.

of the profits on property sales to unregulated products",[938] and agreed that we should consider this issue as part of a charge control.[939]

A18.79 Vodafone said that it was "inappropriate for profits on disposals of properties to be allocated only to the Retail Residual business", and disagreed with BT's reasoning for doing so.[940] Instead, Vodafone said that "the realisation of occasional profits on disposals of properties is an entirely predictable consequence for any business which has an occasionally changing requirement for a portfolio of property to conduct its operations",[941] and noted that this could arise from a rationalisation of local exchanges following the introduction of new technology in future.[942]

A18.80 Vodafone also disagreed with our views on Keybridge House and that "the correct and consistent approach would be to allocate profits on the sale of Keybridge House using the same rules as are applied to that and similar properties".[943]

Our analysis

A18.81 As in the November 2015 CAR Consultation, we continue to believe that it is important that BT's regulatory accounting system should include information that allows the sales of property and the attribution of these sales to be monitored and reviewed in the context of future charge controls.

A18.82 With respect to the attribution we agree with TalkTalk, Virgin and Vodafone responses to the November 2015 CAR consultation that the allocation method employed by BT for the sale of property is neither objective nor consistent. We also agree with Vodafone that we should adopt the proposals in a consistent matter.

A18.83 We remain of the opinion that the attribution of these profits and losses should be consistent with the way that "underlying costs" are attributed.

A18.84 As discussed in Volume 1 Section 10, in principle, we make this adjustment within the 2015/16 base year model. In the event, however, the adjustment happens to be zero because our analysis of BT's annual report and accounts and AFIs suggest that there were no such sales. Therefore, the adjustment has had no practical effect on our current proposals.

[938] TalkTalk's response to the November 2015 Second CAR Consultation, paragraphs 1.2 and 4.13.
[939] TalkTalk's response to the November 2015 Second CAR Consultation, paragraph 4.13.
[940] Vodafone's response to the November 2015 Second CAR Consultation, paragraph 5.8.
[941] Vodafone's response to the November 2015 Second CAR Consultation, paragraph 5.8.
[942] Vodafone's response to the November 2015 Second CAR Consultation, footnote 32.
[943] Vodafone's response to the November 2015 Second CAR Consultation, paragraph 5.9.

Annex 19

Glossary

21CN: BT's next generation network upgrade.

4G: Fourth generation of mobile telephony systems, including the LTE technology standard.

Access Charge Change Notification (ACCN): BT issues Access Charge Change Notifications whenever BT changes the price for an existing BT service or offers a price for a new BT service, where BT is deemed, by Ofcom, to have Significant Market Power (SMP). The ACCN details the prices that are changing.

Access Network: The part of the network that connects directly to customers from the local exchange.

Additional Financial Information (AFIs): Detailed financial information provided in confidence to Ofcom as part of the Regulatory Financial Statements.

Anchor Pricing: An approach that bases charge control modelling on the cost of existing technology rather than that of any new technology that might be adopted during the control period.

Ancillary Services: Services that relate to the provision of core rental services in which BT has been found to have SMP.

Asset Volume Elasticity (AVE): The percentage increase in capital costs required to expand a network to support a 1% increase in volume.

Asymmetric Digital Subscriber Line (ADSL): A type of digital subscriber line technology, a data communications technology that enables faster data transmission over copper telephone lines rather than a conventional voiceband modem can provide.

Bandwidth: The amount of data that can be transmitted in a fixed amount of time. Usually expressed in bits per second (bps).

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.

BDUK: Broadband Delivery UK.

BEREC: Body of European Regulators for Electronic Communications.

Broadband Boost (BBB): A chargeable investigation product from Openreach.

BT: British Telecommunications plc.

BT Consumer: A division of BT concerned with the consumer retail market.

BT Wholesale & Ventures: The division of BT which provides wholesale services to communications providers.

Business Support Systems (BSS): Computer systems used by telecoms providers to support the provision of wholesale and retail services.

Capital expenditure (Capex): The firm's level of investment in fixed assets over the course of the financial year.

CAT: Competition Appeal Tribunal.

Charge Control: A control which sets the maximum price that a telecoms provider can charge for a particular product or service. Most charge controls are imposed for a defined period.

CMR: Ofcom's Communications Market Reports.

Co-location: The provision of space at a BT MDF site that enables a competing provider to locate equipment within that MDF site in order to connect to the dominant provider and purchase LLU services.

Co-mingling Services: All essential support services which are used by SMPF and/or MPF, including the co-location services (e.g. electricity, ventilation).

Common Costs: Costs which are shared by multiple services supplied by a firm.

Competition Commission (CC): Closed from 1 April 2014, its functions have transferred to the Competition and Markets Authority.

Competition and Markets Authority (CMA): An independent public body that brings together the previous role of the Competition Commission as well as many of the competition and consumer functions of the OFT.

Compound Annual Growth Rate (CAGR): Year-on-year smoothed annualised growth rate.

Connected Nations Report: An annual report published by Ofcom the availability and quality of broadband across the UK.

Consumer Price Index (CPI): The official measure of inflation of consumer prices in the United Kingdom.

Contract Delivery Date (CDD): A date, agreed between Openreach and the customer, by which Openreach must complete MPF provisions.

Copper Rearrangement (CuRe): Re-arrangement of the copper connection between customers and the exchange to provide a new or upgraded PCP, in order to allow those customers to be connected to an FTTC cabinet.

Core Network: The backbone of a communications network, which carries different services such as voice or data around the country.

Cost Orientation: The principle that the price charged for the provision of a service should reflect the underlying costs incurred in providing that service.

Cost Volume Elasticity (CVE): The percentage increase in operating costs for a 1% increase in volume.

Cumulative OCM dep (Cum OCM dep): 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.

Cumulo Rates: The business rates paid by BT on its network business. These relate to the use of public land for assets such as poles, duct, street cabinets and the equipment in exchange buildings.

Current Cost Accounting (CCA): An accounting convention, where assets are valued and depreciated according to their current replacement cost whilst maintaining the operating or financial capital of the business entity.

Customer Premises Equipment (CPE): Also known as consumer equipment or customer apparatus. Equipment on consumers' premises, which is not part of the public telecommunications network and which is directly or indirectly attached to it.

D-side: Distribution side. The segment of BT's access network between the Primary Cross Connection Points (street cabinets) and Distribution Points.

Data Over Cable Service Interface Specification (DOCSIS): An international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV system.

DCMS: Department of Culture, Media and Sport.

Digital Local Exchange (DLE): The telephone exchange to which customers are directly connected, often via a remote concentrator unit.

Digital Subscriber Line (DSL): A family of technologies generically referred to as DSL, or xDSL used to add a broadband service to an existing phone line provided using a pair of copper wires (known as a twisted copper pair).

Digital Subscriber Line Access Multiplexer (DSLAM): A network device, located in a telephone exchange or street cabinet that provides broadband services to multiple premises over the copper access network using DSL technologies.

Disposals (Disp): 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.

Distribution Point (DP): A flexibility point in BT's access network where final connections to customer premises are connected to D-side cables. Usually either an underground joint or a connection point on a telegraph pole where dropwires are terminated.

Downstream BT: BT's downstream operations, by which we mean BT Wholesale & Ventures, BT Consumer or any other downstream operation owned or operated by BT.

Dropwire: An overhead cable, connecting BT's access network to a customer's premises.

Duct and Pole Access (DPA): A wholesale access service allowing a telecoms provider to make use of the underground duct network and the telegraph poles of another telecoms provider.

Ducts: Underground pipes which hold copper and fibre lines.

E-side: Exchange side. The segment of BT's access network between telephone exchanges and Primary Cross Connection Points (street cabinets).

EAB: Equality of Access Board.

EAO: Equality of Access Office.

Early Termination Charge (ETC): The total fee that will be charged for early termination of a contract or agreement.

EC: European Commission.

Equi-proportionate mark-up (EPMU): An approach to allocating common costs to products proportionally to the product's share of total LRIC.

Equivalence Management Platform (EMP): A set of systems and associated processes put in place by Openreach to support the implementation of EOI.

Equivalence of Input (EOI): 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 to all telecoms providers (including BT) of the same commercial information about such products, services, systems and processes.

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' network for the transmission of data services.

EU5: A group of five countries in the European Union: France, Germany, Italy, Spain, and the United Kingdom.

FAMR: Fixed Access Market Review.

FCS: Federation of Communication Services.

Fibre To The Cabinet (FTTC): An access network structure in which the optical fibre extends from the exchange to a street cabinet. The street cabinet is usually located only a few hundred metres from the subscriber's premises. The remaining part of the access network from the cabinet to the customer is usually copper wire but could use another technology, such as wireless.

Fibre To The Premises (FTTP): An access network structure in which the optical fibre network runs from the local exchange to the customer'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), or full-fibre.

Fibre Voice Access (FVA): A voice access service provided by Openreach using its FTTP deployment.

Financial capital maintenance: An alternative 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 functions.

Fixed wireless: An access service where the connection between the network and the equipment located at the customer premises is provided over the radio access medium.

Full Time Equivalent (FTE): A measure of resources or work, defined by reference to the capacity of a full time employee. An FTE of 1 is equivalent to one full time employee.

Fully allocated cost (FAC): 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.

G.fast: A broadband transmission standard that increases the speeds possible over short distances on copper lines, compared to ADSL and VDSL technologies.

Generic Ethernet Access (GEA): BT's wholesale service providing telecoms providers with access to BT's FTTC and FTTP networks in order to supply higher speed broadband services. BT currently meets its obligation to provide VULA using the GEA service.

Gigabit Passive Optical Network (GPON): A fibre access network architecture where part of the network is shared by multiple customers.

Glidepath: A series of steps from a point of origin to a target.

Gross Replacement Costs (GRC): The cost of replacing an existing tangible fixed asset with an identical or substantially similar new asset having a similar production or service capacity.

Handover Distribution Frame (HDF): An internal wiring frame provided within an LLU operator's equipment area where tie cables are terminated and cross connected to the LLU operator's exchange equipment.

Holding gains and losses (HGL): The change in the value of the underlying assets used by the company over the course of the financial year.

Hull Area: The area defined as the 'Licensed Area' in the licence granted on 30 November 1987 by the Secretary of State under Section 7 of the Telecommunications Act 1984 to Kingston upon Hull City Council and Kingston Communications (Hull) plc (KCOM).

Inflation: The general change in prices across the economy.

Input price changes (IPC): Changes in the prices of the underlying inputs to costs. This includes changes to assets prices and changes to operating costs.

Internet Protocol (IP): Packet data protocol used for routing and carriage of messages across the internet and similar networks.

Internet Service Provider (ISP): An organisation that provides internet access services.

ISDN2: A type of digital telephone line service that supports telephony and switched data services. ISDN2 allows a business to handle two phone calls simultaneously. It is primarily used by smaller businesses.

ISDN30: A type of digital telephone line service that provides up to 30 lines over a common digital bearer circuit. These lines provide digital voice telephony, data services and a wide range of ancillary services. It is primarily used by larger businesses.

Latency: The time it takes a packet of data to travel to a third-party server and back.

Leased Line: A permanently connected communications link between two premises dedicated to the customer's exclusive use.

Local Loop: The access network connection between the customer's premises and the local serving exchange, usually comprised of two copper wires twisted together.

Local Loop Unbundling (LLU): A process by which a dominant provider's local loops are physically disconnected from its network and connected to a competing provider's networks. This enables operators other than the incumbent to use the local loop to provide services directly to customers.

Long Reach VDSL (LR-VDSL): LR-VDSL uses VDSL technology but makes use of the frequency ranges assigned to both ADSL and VDSL, and utilises higher signal power. LR-VDSL also uses vectoring to minimise the impact of cross-talk and interference, which would otherwise reduce the speed available to customers.

Long Run Incremental Cost (LRIC): A measure of the change in total costs of the firm that arises from a discrete increment in output in the long run.

LRIC+: Long run incremental costs plus a share of common costs.

Long Term Evolution (LTE): A 4G mobile technology standardised by 3GPP. LTE is the predominant 4G technology used in the UK.

Main Distribution Frame (MDF): An internal wiring frame where local loops are terminated and cross connected to exchange equipment by flexible wire jumpers.

MBORC: Matters beyond our (BT's) reasonable control. A force majeure clause in Openreach's contacts.

MDF Block: The MDF consists of blocks, each MDF block providing the termination points to facilitate the connection of local loops with the required network elements. Each MDF block has a capacity of 100 pairs.

MDF Jumper Cable (Jumper): A jumper is a flexible pair of copper wires. A jumper provides the connection between any two copper pairs being terminated on the MDF blocks. The MDF blocks provide appropriate connectors that facilitate the connection and removal of jumpers.

Mean capital employed (MCE): 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.

Metallic Path Facilities (MPF): 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.

Minimum Contract Period (MCP): The amount of time a telecoms provider or consumer must remain in a contract before being able to cancel it.

Modified Greenfield Approach: An approach to analysing markets, where we consider a hypothetical scenario in which there are no ex ante SMP remedies in the market being considered or in any markets downstream of it.

Multiple Service Access Node (MSAN): A network device which provides telephony and broadband services over copper and/or fibre access networks.

Net Replacement Costs (NRC): Gross replacement cost less accumulated depreciation based on gross replacement cost.

Net Current Assets (NCA): A measure of the amount of capital being used in day-to-day activities by the company. It is equal to the current assets less current liabilities.

Network Terminating Equipment (NTE): Equipment located at the customer premises that is the termination point of the network and provides the customer interface.

Next Generation Access (NGA) Networks: Wired access networks which consist wholly or in part of optical elements and which are capable of delivering broadband access services with enhanced characteristics (such as higher throughput) as compared to those provided over copper access networks. In most cases, NGAs are the result of an upgrade of an already existing copper or co-axial access network.

Next Generation Network (NGN): A network that uses IP technology in the core and backhaul to provide all services over a single platform.

NICC: A technical forum for the UK communications sector that develops interoperability standards for public communications networks and services in the UK. It is an independent organisation owned and run by its members.

NMR: Narrowband Market Review.

NRA: National Regulatory Authority.

Ofcom: The Office of Communications.

Office of the Telecommunications Adjudicator (OTA2): An independent body that facilitates discussion between telecoms providers on operational issues related to new and existing telecoms products and services.

ONS: The Office of National Statistics.

Openreach: The access division of BT established by Undertakings in 2005.

Operating capability maintenance (OCM)**:** 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.

OCM depreciation (OCM dep): The reduction in value (as measured by the GRC) of the assets over the course of the financial year associated with the reduction in the asset's remaining life.

Physical Infrastructure Access (PIA): A regulatory obligation under which BT is required to allow telecoms providers to deploy NGA networks in the physical infrastructure of its access network.

Primary Cross Connection Point (PCP): A street cabinet (or equivalent facility) located between the customer's premises and BT's local serving exchanges, which serves as an intermediary point of aggregation for BT's copper network.

Prioritisation Rate (PR): A throughput or transmission rate agreed upon between a network operator and a customer, for which the network operator provides priority for that customer's traffic over other, lower priority traffic.

Rate of Return (RoR): The ratio of money gained or lost (whether realised or unrealised) on an investment relative to the amount of money invested.

Regulatory Financial Statements (RFS): The financial statements that BT is required to prepare by Ofcom. They include the published RFS and Additional Financial Information provided to Ofcom in confidence.

Return On Capital Employed (ROCE): The ratio of accounting profit to capital employed.

Service Level Agreement (SLA): A contractual commitment provided by Openreach to telecoms providers about service standards.

Service Level Guarantee (SLG): 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.

Service Management Centre (SMC): The contact point in Openreach for telecoms providers requesting LLU, WLR and other services.

Service Maintenance Level 1 (SML1): A repair service contract offered by Openreach for fault repair by the end of the next working day plus one day (excluding Saturday) after the acceptance of faults by Openreach.

Service Maintenance Level 2 (SML2): A repair service contract offered by Openreach for fault repair by the end of the next working day (including Saturday) after the acceptance of faults by Openreach.

Shared Metallic Path Facility (SMPF)/Shared Access: The provision of access to the copper wires from the customer's premises to a BT MDF that allows a competing provider to provide the customer with broadband services, while BT continues to provide the customer with conventional narrowband communications.

Significant Market Power (SMP): 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.

Single Order Generic Ethernet Access (SOGEA): A product planned to be launched by Openreach that enables the provision of wholesale superfast broadband without the need to also purchase WLR or MPF.

Small and Medium Sized Enterprises (SME): Businesses with 249 or fewer employees.

Special Faults Investigation (SFI): A chargeable fault investigation product from Openreach.

Stand Alone Costs (SAC): An accounting approach under which the total cost incurred in providing a service is allocated to that service.

Standard broadband (SBB): A broadband connection that can support a maximum download speed of less than 30Mb/s.

Statement of Requirements (SoR): A mechanism by which telecoms providers can request Openreach to provide a service, which should meet guidelines published by Openreach on information required for it to consider the request.

Strategic Review of Digital Communications: Also referred to as the Digital Communications Review (DCR), is a document Ofcom published in February 2016 which set out a ten-year vision for communications services in the UK.

Sub-Loop Unbundling (SLU): Like local loop unbundling (LLU), except that telecoms providers interconnect at a point between the exchange and the customer, usually at the cabinet.

Superfast Broadband (SFBB): A broadband connection that can support a maximum download speed of between 30Mbit/s and 300Mbit/s.

Telecoms provider: A person who provides an electronic communications network or provides an electronic communications service.

The Act: The Communications Act 2003.

Throughput: A measure of a communication link's performance, expressing the effective amount of data or information being transferred over the link within a specified time period. Typically measured in "bits per second" or "bps".

Tie Cable: A cable that connects equipment to the MDF.

Time-Related Charges (TRCs): Time Related Charges are raised by Openreach to recover costs incurred when Openreach engineers perform work not covered under the terms of the Openreach standard service.

Traffic Prioritisation: The process of characterisation of data packets and allocation to appropriate priority queues, for transmission over a data network, to facilitate the effective use of network resources and the provision of Quality of Service.

UKSA: UK Statistics Authority.

Ultrafast Broadband (UFBB): Broadband services which delivers headline download speeds greater than 300Mbit/s.

USO: Universal Service Obligation.

Vectoring: A performance improvement technique that reduces the effect of crosstalk on copper lines. It is based on the concept of noise cancellation via the co-ordination of line signals.

Very-high-bit-rate digital subscriber line (VDSL): DSL technologies offering superfast broadband speeds. On Openreach's FTTC network which uses VDSL technology, services of up to 80Mb/s downstream and 20Mb/s upstream are currently offered. VDSL, in this Consultation, refers to all generations of the technology.

Virtual Local Area Network: a subdivision of the capacity within the network allowing individual traffic streams to be managed. VLANs are used within Openreach's GEA service to separate each user's data traffic through the Openreach network.

Virtual Unbundled Local Access (VULA): Provides access to BT's FTTC and FTTP network deployments. Telecoms providers connect to the VULA service at a 'local' aggregation point and are provided a virtual connection from this point to the customer premises.

Voice over Internet Protocol (VoIP): The method of carrying voice calls on fixed and mobile networks by packetizing speech and carrying it using IP.

Weighted Average Cost of Capital (WACC): The cost of funds used for financing a business..

Wholesale Fixed Analogue Exchange Line (WFAEL): A narrowband analogue access connection between a customer's premises and a local exchange.

Wholesale Line Rental (WLR): 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.

Wholesale Local Access (WLA): The market that covers fixed telecommunications infrastructure, specifically the physical connection between customers' premises and a local exchange.

WiFi: A short range wireless access technology that allows devices to connect to the internet. These technologies allow an over-the-air connection between a wireless client and a base station or between two wireless clients.

Annex 20

Cartesian report: bottom-up model

A20.1 Please see the separate document published alongside this consultation. This is available here:

https://www.ofcom.org.uk/__data/assets/pdf_file/0036/99639/Annex-20.pdf

Annex 21

NERA report: beta of mobile vs fixed telecoms

A21.1 Please see the separate document published alongside this consultation. This is available here:

https://www.ofcom.org.uk/__data/assets/pdf_file/0028/99640/Annex-21.pdf

Annex 22

Cartesian report: GEA allocations

A22.1 Please see the separate document published alongside this consultation. This is available here:

https://www.ofcom.org.uk/__data/assets/pdf_file/0029/99641/Annex-22.pdf

Annex 23

Draft legal instruments

A23.1 Please see the separate document published alongside this consultation. This is available here:

https://www.ofcom.org.uk/__data/assets/pdf_file/0030/99642/Annex-23.pdf