Annex 1–22

Telecoms Access Review

Non-confidential version for publication

Consultation

Published 20 March 2025
Closing date for responses: 12 June 2025

For more information on this publication, please visit ofcom.org.uk

Contents

Annex

A1. Responding to this consultation

How to respond

A1.1 Ofcom would like to receive views and comments on the issues raised in this document, by 5pm on 12 June 2025.

A1.2 You can download a response form from the consultation webpage. You can return this by email or post to the address provided in the response form.

A1.3 If your response is a large file, or has supporting charts, tables or other data, please email it to tar2026consultation.responses@ofcom.org.uk, as an attachment in Microsoft Word format, together with the cover sheet. This email address is for this consultation only and will not be valid after 12 June 2025.

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

Telecoms Access Review 2026
Networks & Communications
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

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

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

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

A1.7 We do not need a paper copy of your response as well as an electronic version. We will acknowledge receipt of a response submitted to us by email.

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

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

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

Confidentiality

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

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

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

A1.14 To fulfil our pre-disclosure duty, we may share a copy of your response with the relevant government department before we publish it on our website.

A1.15 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's intellectual property rights are explained further in our Terms of Use.

Next steps

A1.16 Following this consultation period, Ofcom plans to publish a statement in March 2026.

A1.17 If you wish, you can register to receive mail updates alerting you to new Ofcom publications.

Ofcom's consultation processes

A1.18 Ofcom aims to make responding to a consultation as easy as possible. For more information, please see our consultation principles in Annex 2.

A1.19 If you have any comments or suggestions on how we manage our consultations, please email us at consult@ofcom.org.uk. We particularly welcome ideas on how Ofcom could more effectively seek the views of groups or individuals, such as small businesses and residential consumers, who are less likely to give their opinions through a formal consultation.

A1.20 If you would like to discuss these issues, or Ofcom's consultation processes more generally, please contact the corporation secretary:

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

A2. Ofcom's consultation principles

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

Before the consultation

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

During the consultation

2. We will be clear about whom we are consulting, why, on what questions and for how long.
3. We will make the consultation document as short and simple as possible, with an overview of no more than two pages. We will try to make it as easy as possible for people to give us a written response.
4. When setting the length of the consultation period, we will consider the nature of our proposals and their potential impact. We will always make clear the closing date for responses.
5. A person within Ofcom will be in charge of making sure we follow our own guidelines and aim to reach the largest possible number of people and organisations who may be interested in the outcome of our decisions. Ofcom's Consultation Champion is the main person to contact if you have views on the way we run our consultations.
6. If we are not able to follow any of these principles, we will explain why.

After the consultation

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

A3. Consultation coversheet

Basic details

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

Confidentiality

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

- Nothing ☐
- Name/contact details/job title ☐
- Whole response ☐
- Organisation ☐
- Part of the response ☐

If you selected 'Part of the response', please specify 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)?

Yes ☐ No ☐

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 aims to publish responses at regular intervals during and after the consultation period. 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)

Please tell us how you came across about this consultation.

- ☐ Email from Ofcom
- ☐ Saw it on social media
- ☐ Found it on Ofcom's website
- ☐ Found it on another website
- ☐ Heard about it on TV or radio
- ☐ Read about it in a newspaper or magazine
- ☐ Heard about it at an event
- ☐ Somebody told me or shared it with me
- ☐ Other (please specify)

A4. Consultation questions

Volume 2, Market definition and SMP assessment

Question 2.1:

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

Question 2.2:

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

Question 2.3:

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

Question 2.4:

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

Question 2.5:

Do you agree with our provisional conclusions on product market definition for WLA? Please set out your reasons and supporting evidence for your response.

Question 2.6:

Do you agree with our provisional conclusions on geographic market definition for the wholesale local access market? Please set out your reasons and supporting evidence for your response.

Question 2.7:

Do you agree with our provisional conclusion on the application of the three criteria test to the wholesale local access market? Please set out your reasons and supporting evidence for your response.

Question 2.8:

Do you agree with our provisional findings on SMP in the wholesale local access market? Please set out your reasons and supporting evidence for your response.

Question 2.9:

Do you agree with our provisional conclusions on product market definition for leased lines? Please set out your reasons and supporting evidence.

Question 2.10:

Do you agree with our provisional conclusions on geographic market definition for the leased line access market? Please set out your reasons and supporting evidence for your response.

Question 2.11:

Do you agree with our provisional conclusion on the application of the three criteria test to the leased line access market? Please set out your reasons and supporting evidence for your response.

Question 2.12:

Do you agree with our provisional findings on SMP in the leased line access market? Please set out your reasons and supporting evidence for your response.

Question 2.13:

Do you agree with our provisional conclusions on product market definition for the inter-exchange connectivity market? Please set out your reasons and supporting evidence.

Question 2.14:

Do you agree with our provisional conclusions on geographic market definition for the inter-exchange connectivity market? Please set out your reasons and supporting evidence.

Question 2.15:

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

Question 2.16:

Do you agree with our provisional conclusions that BT has SMP at BT Only exchanges and BT+1 exchanges, but not at BT+2 exchanges for the wholesale IEC market? Please set out your reasons and supporting evidence.

Volume 3, Non-pricing remedies

Question 3.1:

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

Question 3.2:

What are your views in relation to our initial thinking on how we might identify excluded premises? Please set out your reasons and supporting evidence for your response.

Question 3.3:

Do you agree with our proposed approach to exchange exit? Please set out your reasons and supporting evidence for your response.

Question 3.4:

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

Question 3.5:

Do you agree with our proposed specific remedies in the PIA market? Please set out your reasons and supporting evidence for your response.

Question 3.6:

Do you agree with our proposed specific remedies in the WLA markets? Please set out your reasons and supporting evidence for your response.

Question 3.7:

Do you agree with our proposed specific remedies in the LLA markets? Please set out your reasons and supporting evidence for your response.

Question 3.8:

Do you agree with our proposed specific remedies in the IEC markets? Please set out your reasons and supporting evidence for your response.

Question 3.9:

Do you agree with our proposed approach to geographic discounts and other commercial terms? Please set out your reasons and supporting evidence for your response.

Volume 4, Pricing Remedies

Question 4.1:

Do you agree with our proposed approach in WLA Area 2? Please set out your reasons and supporting evidence for your response.

Question 4.2:

Do you agree with our proposed approach in WLA Area 3? Please set out your reasons and supporting evidence for your response.

Question 4.3:

Do you agree with our proposals for charge controlling LLA services in LLA Area 2 and LLA Area 3 and not introducing a charge control on LLA services in the HNR Area? Please set out your reasons and supporting evidence for your response.

Question 4.4:

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

Question 4.5:

Do you agree with our proposals for charge controlling in the PIA market? Please set out your reasons and supporting evidence for your response.

Question 4.6:

Do you agree with our proposed approach for ancillaries? Please set out your reasons and supporting evidence for your response.

Question 4.7:

Do you agree with our proposals on charge control design? Please set out your reasons and supporting evidence for your response.

Question 4.8

Do you have any comments on the drafting (non substantive) amendments to the charge control conditions described above and set out in Volume 7?

Volume 5, Quality of Service

Question 5.1:

Do you agree with our proposal to retain a QoS SMP condition in all wholesale fixed telecoms markets in which we provisionally determine that BT has SMP and where we propose to apply transitional arrangements? Please set out your reasons and supporting evidence for your response.

Question 5.2:

Do you agree with our proposals for QoS regulation in WLA markets for this review period? Please set out your reasons and supporting evidence for your response.

Question 5.3:

Do you agree with our proposal to keep the same QoS regulations in place for LLA and IEC markets for this review period? Please set out your reasons and supporting evidence for your response.

Question 5.4:

Do you agree with our proposal not to impose specific QoS standards or transparency requirements in the physical infrastructure market? Please set out your reasons and supporting evidence for your response.

Volume 6, Regulatory financial reporting

Question 6.1:

Do you agree with our proposal to retain the accounting separation and cost accounting remedies on each of the proposed SMP markets? Please set your reasons and supporting evidence for your response.

Question 6.2:

Do you agree with our proposals in relation to the published performance schedules set out in Section 4? Please set out your reasons and supporting evidence for your response.

Question 6.3:

Do you agree with our proposals in relation to the preparation and assurance of the RFS set out in Section 5? Please set out your reasons and supporting evidence for your response.

Question 6.4:

To what extent do you think it is necessary to require BT to publish in the reconciliation report the impact on current year figures of each methodology change reported in the CCN (which includes the impact of each change on prior year figures)?

Question 6.5:

Do you agree with our proposals in relation to information provided to Ofcom set out in Section 6? Please set out your reasons and supporting evidence for your response.

Annex 21, Impact Assessments

Question A21.1:

Do you agree with our assessment of the potential impacts on specific groups of persons? Please provide reasons for your response, with any supporting evidence.

Question A21.2:

Do you agree with our assessment of the potential impacts on Welsh language? Please provide reasons for your response, with any supporting evidence.

A5. Regulatory framework

Regulatory framework

A5.1 This Annex provides an overview of the regulatory framework relevant to the market review process, to give some additional context to the matters discussed in this document, including the legal instruments published in draft form in Volume 7.

A5.2 Market review regulation is technical and complex, and requires us to apply legislation. We may also have regard to a number of relevant recommendations and guidelines. This overview identifies some of the key aspects of materials relevant to this market review but does not purport to give a full and exhaustive account of all materials that we have considered in reaching our provisional view for these markets.

A5.3 The regulatory framework relevant for market reviews is set out in Part 2 of the Communications Act 2003 (the "Act"). In particular, sections 45 to 48C and sections 78 to 86 set out the procedure for imposing conditions based on a finding of significant market power (the "SMP conditions"), sections 87 to 93 set out specific rules for each type of SMP condition.

Market review concept

A5.4 A market review is a process by which, at regular intervals, we identify relevant markets and carry out analyses of these markets to determine whether they are effectively competitive. Where an operator has significant market power ("SMP") in a market, we impose appropriate remedies, known as SMP obligations or conditions, to address this. We explain the concept of SMP below.

A5.5 In carrying out this work, we act in our capacity as the sector-specific regulator for the UK communications industries, including telecommunications. As mentioned above, our functions in this regard are to be found in Part 2 of the Act. The Act requires Ofcom to carry out reviews of competition in communications markets[1] to ensure that SMP regulation remains appropriate and proportionate in the light of changing market conditions.

A5.6 Each market review normally involves three analytical stages:

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

Market definition

Relevant markets

[1] Section 84(A) of the Act.

A5.7 The Act provides that, before making a market power determination[2], 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. [3]

A5.8 In identifying or analysing markets, the Act provides that we may have regard to certain recommendations or guidelines published by the European Commission, and guidelines published by BEREC (the Body of European Regulators for Electronic Communications) ("EECC materials") relating to market identification and analysis[4], such as the Commission Recommendation on relevant product and service markets 2020 ("2020 EC Recommendation").[5]

A5.9 We may only identify a market for the purpose of assessing market power where we consider the three criteria set out in section 79(2B) of the Act (the "three criteria test") are met.

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[6], 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 we identify product and service markets that meet the three criteria test does not automatically mean that regulation is warranted. Market definition is not an end in itself but rather one input into assessing effective competition.

Sufficiency of competition law

A5.12 In considering the third limb of the three criteria test, that competition law alone is insufficient to adequately address the identified market failure(s), we bear in mind the specific characteristics of the relevant markets we have defined. Generally, the case for *ex ante* regulation is based on the existence of market failures which, by themselves or in combination, mean that the establishment of effective competition might not be possible if the regulator relied solely on *ex post* competition law powers which are not specifically tailored to the sector. Therefore, it may be appropriate for *ex ante* regulation to be used to address such market failures along with any entry barriers that might otherwise prevent effective competition from becoming established within the relevant markets we have defined. By imposing *ex ante* regulation that promotes competition, it may be possible to

[2] 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.
[3] Section 79(1) of the Act.
[4] Section 79(2ZA). Section 79(6A) of the Act defines EECC materials as "recommendations or guidelines published by the European Commission, and guidelines published by BEREC, under the Framework Directive or EECC Directive (including those published after IP completion day)" i.e. after 31 December 2020.
[5] Commission Recommendation of 18 December 2020 on relevant product and service markets within the electronic communications sector susceptible to *ex ante* regulation in accordance with Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Code.
[6] Such time period as we determine to be appropriate in relation to the review.

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

A5.13 *Ex post* competition law is also unlikely in itself to bring about (or promote) effective competition, as it prohibits the abuse of dominance rather than the holding of a dominant position itself. In contrast, *ex ante* regulation is normally aimed at actively promoting the development of competition through attempting to reduce the level of market power (or dominance) in the identified relevant markets, thereby encouraging the establishment of effective competition.

A5.14 We generally take the view that *ex ante* regulation provides additional legal certainty for the market under review and may also better enable us to intervene in a timely manner. We also consider that certain obligations are needed as competition law would not remedy the particular market failure, or that the specific clarity and detail of the obligation is required to achieve a particular result.

Forward look

A5.15 Market definition is not a mechanical or abstract process. It requires an analysis of any available evidence of past market behaviour and an overall understanding of the mechanics of a given market sector. The Act requires that Ofcom must conduct a forward-looking assessment of the market, taking into account expected or foreseeable developments that may affect competition in the market.[7]

Approach to market analysis and modified Greenfield

A5.16 When identifying and analysing markets, we apply the following two principles.

A5.17 First, when identifying wholesale markets for the purposes of section 79(1) of the Act, we start with an analysis of corresponding retail (or other downstream) market(s). We do not formally define the retail market(s), but consider if it is (they are) prospectively competitive in the absence of wholesale regulation based on a finding of SMP, and therefore whether any lack of effective competition is durable.[8]

A5.18 If the underlying retail market(s) is (are) prospectively competitive under these circumstances, we would conclude that regulation is no longer needed at the wholesale level. If the underlying retail market(s) is (are) not prospectively competitive, then we identify the corresponding wholesale market(s). Where wholesale markets are vertically linked, we identify and analyse the most upstream market first, followed by a subsequent analysis of the markets that are downstream, to determine whether they would be effectively competitive in the presence of regulation upstream.

A5.19 Second, when identifying and analysing a market, we assume that no SMP regulation exists in that particular market. This avoids the risk of circularity in our assessment – i.e. a finding of no SMP in a market which is predicated on pre-existing *ex ante* regulation of that market (this is often referred to as the 'modified Greenfield approach').[9]

[7] S79(1A) the Act.
[8] Our analysis takes into account the effects of other types of (sector-specific) regulation, decisions or legislation applicable to the relevant retail and related wholesale market(s) during the relevant period.
[9] Hutchison 3G UK Ltd v The Office of Communications [2009] EWCA Civ 683, paragraphs 64-66.

A5.20 We note that this approach is consistent with that set out in the European Commission's SMP Guidelines.[10]

Product and geographic dimensions

A5.21 We use competition law methodologies in the market review analysis. In particular, there are two dimensions to the definition of a relevant market: (i) the relevant products to be included in the same market; and (ii) the geographic extent of the market.

A5.22 The boundaries between markets are determined by identifying competitive constraints on the price setting behaviour of firms. There are two main constraints to consider:

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

A5.23 The hypothetical monopolist test is a tool used to identify good demand-side and supply-side substitutes. In this test, a product is considered to constitute a separate market if the hypothetical monopolist supplier could impose a small but significant non-transitory increase in price ("SSNIP") above the competitive level without losing sales to such a degree as to make this price rise unprofitable. If such a price rise would be unprofitable, because consumers would switch to other products or because suppliers of other products would begin to compete with the hypothetical monopolist, then the market definition should be expanded to include the substitute products.

A5.24 The starting point for the application of hypothetical monopolist test can be referred to as the 'focal product',[11] and typically starts from the narrowest potential market definition.[12]

A5.25 We may consider both demand-side substitution and supply-side substitution possibilities to consider whether either provide additional constraints on the pricing behaviour of the hypothetical monopolist. In this assessment, supply-side substitution is considered to be a low-cost form of entry which can take place within a reasonable timeframe (e.g. up to 12 months). For supply-side substitution to be relevant not only must suppliers be able, in theory, to enter the market quickly and at low cost by virtue of their existing position in the supply of other products or geographic areas, but there must also be an additional competitive constraint arising from such entry into the supply of the service in question.

A5.26 In relation to defining the relevant geographic markets, this comprises an area in which the undertakings concerned are involved in the supply and demand of the relevant products or services, in which the conditions of competition are sufficiently homogeneous, and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different. Areas in which the conditions of competition are heterogeneous do not constitute a uniform market.

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[10] Guidelines on market analysis and the assessment of significant market power under the EU regulatory framework for electronic communications networks and services (2018/C 159/01) ("EC SMP Guidelines"), paragraphs 15-18.

[11] This reflects the terminology used by UK competition authorities (see OFT, Market definition Guidelines, December 2004, OFT403, which has subsequently been adopted by the CMA Board).

[12] 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".

A5.27 Our approach to market definition follows that used by the UK competition authorities.

Relationship with *ex post* competition law

A5.28 While competition law methodologies are used in identifying the relevant markets *ex ante*, the markets identified will not necessarily be identical to markets defined in *ex post* competition law cases, especially as (i) the markets identified *ex ante* are based on an overall forward-looking assessment of the structure and the functioning of the market under examination, and (ii) as noted above, in carrying out an *ex ante* assessment, we assume there is no SMP regulation in place in the market under examination. Accordingly, the economic analysis carried out for the purpose of this review, including the markets we have identified, is without prejudice to any analysis that may be carried out in relation to any investigation pursuant to the Competition Act 1998 (relating to the application of the Chapter I or II prohibitions) or the Enterprise Act 2002.

Market analysis

Effective competition

A5.29 The Act requires that we carry out market analyses of identified markets for the purpose of making or reviewing market power determinations. The Act requires that such analyses are normally to be carried out within five years from the publication of a previous market power determination relating to that market. Exceptionally, the five-year period may be extended for up to one additional year.[13]

A5.30 In carrying out a market analysis, the key issue for Ofcom is to determine whether any one or more operator(s) has SMP.

A5.31 The definition of SMP is equivalent to the concept of dominance as defined in competition law.[14] 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.

A5.32 The Act provides that, in considering whether to make or revise a market power determination, we may have regard to EECC materials relating to market analysis or the determination of what constitutes significant market power, such as the EC SMP Guidelines.[15]

A5.33 The EC SMP Guidelines consider the specific application of competition law principles to the electronic communications sector. They reflect our understanding of the factors driving competitive conditions in the markets we are reviewing. We have therefore had regard to the EC SMP Guidelines in considering whether to propose to revise market power determinations in this Consultation.

A5.34 We consider that market shares provide a useful first indicator of competitive conditions in the market, and that they should however be interpreted in light of the relevant market

[13] Section 84A of the Act.
[14] Section 78(1) of the Act. References in section 78 to dominance of a market are to be construed, so far as it is appropriate to do so, in the same way as the reference in section 18(1) of the Competition Act 1998 to a dominant position in a market.
[15] Section 79(2BA) of the Act.

conditions.[16] According to established case law, a market share in excess of 50% is itself evidence of a dominant position, save in exceptional circumstances.[17] On this point, we have had regard to the judgment of the Competition Appeal Tribunal in BCMR 2019. The Tribunal confirmed that the existence of a high market share is to be a trigger for a full assessment, but not to be determinative in itself.[18]

A5.35 The EC SMP Guidelines set out, additionally to market shares, criteria that can be used to measure the power of an operator to behave to an appreciable extent independently of its competitors, customers, and consumers, including:

- barriers to entry;
- barriers to expansion;
- absolute and relative size of the undertaking;
- control of infrastructure not easily duplicated;
- technological and commercial advantages or superiority;
- absence of or low countervailing buying power;
- easy or privileged access to capital markets/financial resources;
- product/services diversification (for example, bundled products or services);
- economies of scale and economies of scope;
- direct and indirect network effects;
- vertical integration;
- a highly developed distribution and sales network;
- conclusion of long-term and sustainable access agreements;
- engagement in contractual relations with other market players that could lead to market foreclosure; and
- absence of potential competition.[19]

A5.36 A dominant position can derive from a combination of these criteria which when taken separately may not necessarily be determinative.

Remedies

Powers and legal tests

A5.37 Section 87(1) of the Act provides that where we have made a determination that a person has SMP in an identified services market, we shall set such SMP conditions authorised by

[16] EC SMP Guidelines, paragraph 54.
[17] And this is consistent with the position taken in the EC SMP Guidelines, paragraph 55.
[18] *TalkTalk Telecom Group plc and Vodafone Limited v Ofcom (BCMR 2019)*, Judgment of 5 March 2020 [2020] CAT 8, at paragraphs 163-171 and 282-283.
[19] EC SMP Guidelines, paragraph 58.

section 87 as we consider appropriate to apply to that person in respect of the relevant network or relevant facilities.[20]

A5.38 The Act identifies a number of SMP obligations, including transparency, non-discrimination, accounting separation, access to and use of specific network elements and facilities, price control and cost accounting.[21]

A5.39 For each and every SMP condition, we explain why it satisfies the requirement in section 47(2) of the Act that the obligation is:

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

A5.40 As part of ensuring that an SMP condition meets this requirement, we consider whether it is based on the nature of the competition problem(s) we have identified in our market analysis.

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

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

- our analysis indicates a risk that the telecoms provider concerned might fix and maintain prices at an excessively high level or impose a price squeeze so as to have adverse consequences for end-users of public electronic communications services;
- we consider the setting of the obligation is appropriate for the purposes of –
  i) promoting efficiency;
  ii) promoting sustainable competition;
  iii) conferring the greatest possible benefits on the end-users of public electronic communications services having regard where relevant to the market analysis, to the long term interests of end-users in the use of next-generation networks; and
  iv) where relevant to the market analysis, promoting the availability and use of new and enhanced networks.[22]
- In setting such an SMP condition we also take account of:
  i) the extent of investment by the telecoms provider in the matters to which the SMP obligation relates;
  v) where the condition involves price controls on the provision of network access to existing network elements, the benefits of predictable and stable wholesale prices in ensuring:

[20] Section 84(4) of the Act provides that where Ofcom determines that an undertaking to whom any SMP conditions apply is no longer a person with significant market power in that market, Ofcom must revoke every SMP condition applied to that person by reference to the market power determination made on the basis of the earlier analysis.
[21] Sections 87 and 88 of the Act.
[22] Section 88(1) of the Act.

efficient market entry; and
sufficient incentives for all undertakings to bring into operation new and enhanced networks.[23]

A5.43 Where an obligation to provide third parties with network access is considered appropriate, we take into account factors including:

b) the technical and economic viability, having regard to the state of market development, of installing and using facilities that would make the network access unnecessary;
c) the feasibility of the provision of the proposed network access;
d) any technological developments that, in our opinion, are likely to affect the design and management of the relevant network or facilities;
e) the need to ensure that the provision of the proposed network access does not have the effect of favouring one form of technology over another in relation to the design and management of the electronic communications networks;
f) the investment of the network operator who is required to provide access (taking account of any public investment made);
g) the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long term and to support innovative business models that support sustainable competition; and
h) any rights to intellectual property that are relevant to our proposals.[24]

A5.44 In this Consultation, we demonstrate the application of the relevant requirements to the SMP obligations that we are proposing to impose. In doing so, we also set out our initial assessment of how, in our opinion, the performance of our general duties under section 3 of the Act would be secured or furthered by our proposed regulatory intervention, and that it would be in accordance with the six requirements in section 4 of the Act (see below). This is also relevant to our assessment of the likely impact of implementing our proposals.

Ofcom's general duties – section 3 of the Act

A5.45 Under the Act, our principal duty in carrying out our functions is to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A5.46 In doing so, we are required to secure a number of specific objectives and to have regard to a number of matters set out in section 3 of the Act.

A5.47 In performing our duties, we are also required to have regard to a range of other considerations, as appear to us to be relevant in the circumstances. For the purpose of this review, we consider that a number of such considerations are relevant, in particular:

- the desirability of promoting competition in relevant markets;
- the desirability of encouraging investment and innovation in relevant markets;
- the desirability of encouraging the availability and use of high-speed data transfer services throughout the UK; and

[23] Section 88(2) of the Act.
[24] Section 87 of the Act.

- the desirability of ensuring that relevant markets facilitate end-to-end connectivity in the interests of consumers in those markets.

A5.48 We are also required to have regard to the principles under which regulatory activities should be transparent, accountable, proportionate, consistent, and targeted only at cases in which action is needed, as well as to the interest of consumers in respect of choice, price, quality of service and value for money.

A5.49 However, we have a wide measure of discretion in balancing our statutory duties and objectives. In doing so, we will take account of all relevant considerations, including the responses we will receive during our consultation process, in reaching our conclusions.

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

A5.50 Section 4 of the Act requires us, when carrying out our market review functions, to act in accordance with six requirements for regulation which are in summary:

i) to promote competition in the provision of electronic communications networks and services, associated facilities and the supply of directories;
ii) to promote the interests of all members of the public in the United Kingdom;
iii) 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);
iv) to encourage, to such extent as Ofcom considers appropriate the provision of network access and service interoperability for the purpose of securing: efficient and sustainable competition; efficient investment and innovation; and the maximum benefit for customers of telecoms providers and of persons who make associated facilities available;
v) to encourage compliance with certain standards in order to facilitate service interoperability, end-to-end connectivity, and secure freedom of choice for the customers of telecoms providers; and
vi) to promote connectivity and access to very high capacity networks[25] by members of the public and businesses in the United Kingdom.

A5.51 We consider that the first, second, third, fourth and sixth of those requirements are of particular relevance to the matters under review and that no conflict arises in this regard with those specific objectives in section 3 of the Act that we consider are particularly relevant in this context.

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

A5.52 Section 4A of the Act provides that in carrying out certain of our functions (including, among others, our functions in relation to market reviews), we may take account of recommendations issued by the European Commission under Article 19(1) of the

[25] A "*very high capacity network*" is set out in section 4(12A) of the Act as meaning "an electronic communications network which—
(a) consists wholly of optical fibre elements at least up to the distribution point at the serving location; or
(b) is capable of delivering, under usual peak-time conditions, network performance that, in OFCOM's opinion, is similar, in terms of available downlink and uplink bandwidth, resilience, error-related parameters and latency and its variation, to the network performance of a network falling within paragraph (a)."

Framework Directive[26] or Article 38(1) of the EECC Directive[27] if the recommendations appear to us to be relevant to those functions.

Impact assessment – section 7 of the Act

The regulatory framework in relation to impact assessments under section 7 of the Act is set out in Annex 21. The assessment is also set out in that Annex.

Equality impact assessment

A5.53 The regulatory framework in relation to equality impact assessments under the Equality Act 2010 and the Northern Ireland Act 1998 is set out in Annex 21. The assessment is also set out in that Annex.

Welsh language impact assessment

A5.54 The regulatory framework in relation to the Welsh language impact assessment is set out in Annex 21. The assessment is also set out in that Annex.

UK Government's Statement of Strategic Priorities

A5.55 Under section 2B(2) of the Act, when exercising our functions relating to telecoms, management of radio spectrum and postal services, we are required to have regard to the previous government's Statement of Strategic Priorities (SSP).[28] The current SSP for telecommunications, the management of radio spectrum, and postal services was designated on 29 October 2019, having been laid in draft before Parliament on 18 July 2019. In Volume 3, Section 1, we set out how we have had regard to the current SSP in formulating our proposals in this consultation.

A5.56 If the current UK Government were to designate a replacement SSP before we issue our Final Statement, we will be required to have regard to that (rather than the current SSP) in reaching our final decisions.

The desirability of promoting economic growth

A5.57 In exercising our regulatory functions, we are also required to have regard to the desirability of promoting economic growth (the "growth duty").[29] In particular, we must consider the importance for the promotion of economic growth of exercising the regulatory function in a way which ensures that regulatory action is taken only when it is needed, and any action taken is proportionate. Section 110(3) of the Deregulation Act 2015 requires us to have regard to the "Growth Duty: Statutory Guidance" (revised by Government in May 2024). See Volume 3, section 1.

[26] Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services, as amended by Directive 2009/140/EC of the European Parliament and of the Council.
[27] Directive (EU) 2018/1972 of the European Parliament and of the Council of 11 December 2018 establishing the European Electronic Communications Code (Recast).
[28] Statement of Strategic Policies.
[29] Section 108 of the Deregulation Act 2015, which was extended to Ofcom's regulatory functions by The Economic Growth (Regulatory Functions) (Amendment) Order 2024.

Regulated entity

A5.58 The power in the Act to impose an SMP obligation by means of an SMP 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").[30]

A5.59 We consider it appropriate to prevent a dominant provider to whom an SMP 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.

A5.60 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".

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

A6. Overview of telecoms networks

A6.1 This annex provides an overview of access, backhaul, and core networks – how they are configured, and the technologies used to connect end-users or customers so they can access their mobile and fixed telecoms services. Although this annex mainly focuses on fixed networks, covering fixed broadband for residential/SME customers and leased lines for business customers, it also includes a section on wireless technologies covering fixed wireless access (FWA) and satellite broadband.[31]

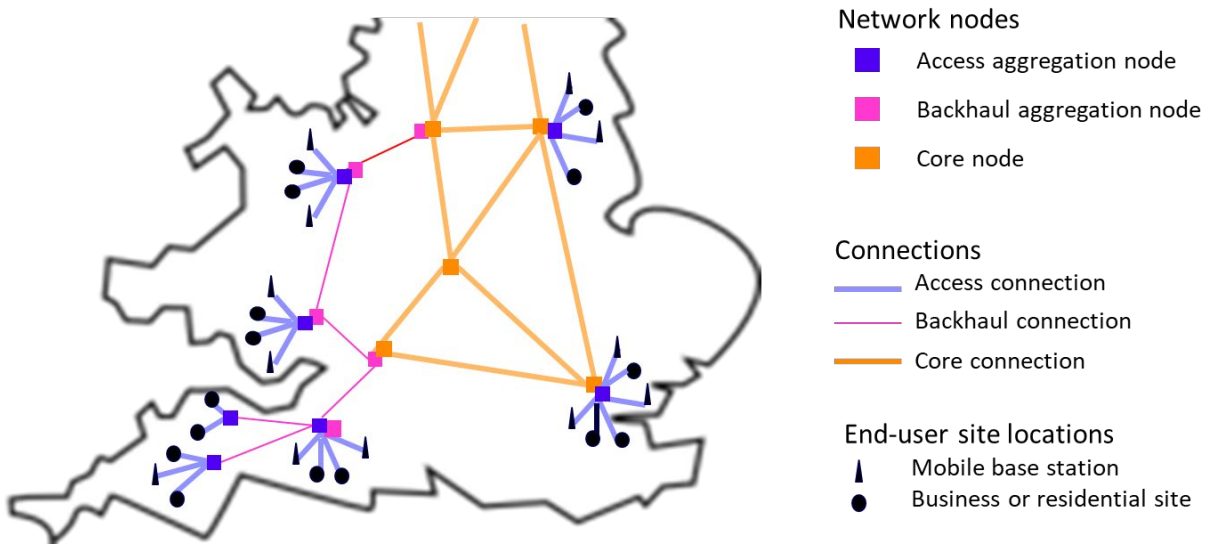
General overview

A6.2 A communications network provides the services that enable end-users or customers to exchange information and is comprised of several elements:

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

A6.3 Figure A6.1 below sets out a high-level view of how the different network nodes and logical connections can be used to create a national communications network. It also shows where the different types of network nodes may be located (or co-located) geographically. These connections and network nodes are described in more detail in the following sections.

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



Source: Ofcom. 2025.

[31] SME stands for small and medium enterprises.

A6.4 Each end-user is connected to one of the network's access aggregation nodes.[32] This is referred to as the 'access connection'. Each access aggregation node is connected to at least one core node, either directly or indirectly, via a backhaul aggregation node using a backhaul connection.[33] Core nodes are then connected to one or more core nodes to form a core network.[34] In general, there are more access aggregation nodes than backhaul aggregation nodes and more backhaul aggregation nodes than core nodes.

A6.5 This structure is common to networks used to provide most voice and data telecoms services – including telephony, fixed broadband, mobile, and leased lines. These networks differ in scale (numbers of each type of node), the number of stages of access and backhaul aggregation (typically between one and three), and the structure of the core network.

A6.6 Access aggregation nodes are generally placed where end-users are grouped most closely and can be easily reached (such as the centre of cities, towns, and villages) and are used to connect end-users, using access connections, to the network.[35]

A6.7 For residential broadband services, the point-of-handover at the end-user site is likely to be inside the residential premises.[36] For leased lines, the point-of-handover for the access connection at the end-user or customer site can be located in, for example, the communications room of a business, the basement of a multi dwelling unit (MDU),[37] or within a suitable enclosure at a mobile base station site.

A6.8 Backhaul aggregation nodes have higher capacity than access aggregation nodes as they aggregate traffic from multiple access aggregation nodes (which connect to multiple end-user sites and multiple services) and can act as the point of connection between different access aggregation nodes which can be many kilometres apart.

A6.9 Core connections (and core nodes) transport multiple telecoms services aggregated from all the services provided to customers or end-users and generally have higher capacity than backhaul connections (and backhaul aggregation nodes). Core nodes are used to route (or switch) traffic from backhaul connections onto the core network, or between backhaul aggregation nodes or other core nodes.

A6.10 Core nodes are often located in a city of significant population within the geographic area covered by the network. These can then be linked to other core nodes to create a national

[32] Access aggregation nodes aggregate the traffic from multiple access connections. They may be connected to one or more access aggregation nodes to create a more resilient network in the event of a failure in the network equipment or connection.

[33] Backhaul aggregation nodes combine the traffic from multiple access aggregation nodes onto a single backhaul connection. They are then connected to one or more backhaul aggregation or core nodes depending on the level of resilience required.

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

[35] The access connection may be transmitted over radio (wireless), fibre, coaxial cable or copper.

[36] A point-of-handover at the end-user site is where the end-user can 'plug in' a connection between their own equipment, such as their fixed or wireless router, and the network termination equipment (NTE).

[37] This could be a case where a leased line is purchased by a provider of telecoms services (typically broadband services) within the MDU.

core network. For example, a UK wide network may have core nodes located in key cities such as London, Bristol, Birmingham, Manchester, Leeds, Glasgow, and Edinburgh.[38]

A6.11 Most locations or sites housing core nodes also contain backhaul and access aggregation nodes, the latter for serving the area immediately surrounding the site.[39] Similarly, a site containing a backhaul aggregation node may also contain one or more access aggregation nodes to provide connectivity to the surrounding area. More remote network sites may only contain an access aggregation node.

A6.12 To enable customers or end-users on different networks to communicate with each other or to access services, networks are usually interconnected between or near to core nodes.[40] The network-to-network interconnect may be at a site (point-of-handover) where both networks are present, at a co-location facility such as at a BT exchange, at a data centre, or at an internet peering site.[41] In some instances where two networks are not co-located, interconnect may be achieved using a dedicated point-to-point connection between the two network sites.[42]

A6.13 Access connections (in the form of cables) can be run underground in ducts, buried directly in the ground, or carried overhead via poles. Backhaul and core connections will be typically run underground in ducts except in very exceptional cases (such as in rural areas) where they may be carried overhead.

Data centres

A6.14 Data centres are secure buildings that house computing facilities for cloud-based and other information technology (IT) services such as data storage, application hosting, and data processing. Data centres may also house network nodes which include core and backhaul aggregation functions or they may also be used as a co-location facility with points of interconnect to other networks.

A6.15 Most data centres require reliable high-capacity connections, often to several different telecoms providers. This capacity is needed to support many telecoms services and to support multiple customers across multiple sites.

A6.16 Some data centres have multiple tenants and may be owned and operated by telecoms providers or run by third-party providers. In this latter case they are known as 'carrier-neutral data centres'.

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

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

[40] Interconnect can be used to enable connections between two different telecoms providers, or between a telecoms provider and, for example, a data centre provider.

[41] Internet peering is a method that allows two or more network operators to interconnect and exchange traffic directly without having to pay a third party to carry traffic across the Internet.

[42] For example, Openreach provides products to connect between nodes located within a BT exchange (internal Cablelink) and to connect to other networks nearby (external Cablelink).

A6.17 Other data centres may be owned by a single customer, such as a large enterprise, providing services over a virtual private network at their own customer site rather than in a network operator's operational building. Being dedicated to a single customer, these are generally not used for aggregation and onward routing of third-party traffic.

Fixed broadband and telephony services for residential/SME customers

A6.18 Networks that supply broadband and telephony services to residential premises, small offices/home offices (SOHOs), and small and medium enterprises (SMEs) need to be able to deliver connections to new end-users reasonably quickly on request and for a relatively low cost. So that providers can connect end-users quickly, these networks need to be deployed with network flexibility points close to prospective end-users to minimise costs where infrastructure build may be required to make the final connection.

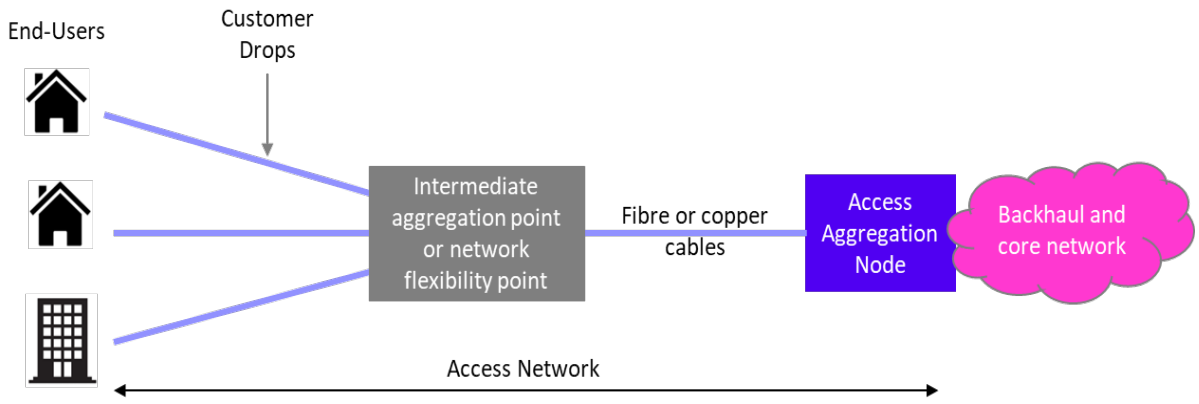
A6.19 A broadband connection can be created by using third-party supplied physical infrastructure (e.g. ducts or poles), with the telecoms provider then adding their own fibre cables and electronics to connect to an end-user or customer.

Access network overview

A6.20 Access networks provide the connection to the customer premises or the end-user site. The connection to the end-user from the access aggregation node may be realised all, or in part, using fixed connectivity (fibre, copper, coaxial cables) or using wireless connectivity (which is elaborated further in this annex under the section on 'Wireless technologies').

A6.21 While there are several different types of access networks, all share certain common attributes which make up the access connection between end-user sites and an access aggregation node, such as customer drops, intermediate aggregation or network flexibility points, and fibre or copper cable links to the access aggregation node. Figure A6.2 below illustrates how these constituent elements relate to one another.

Figure A6.2: Generic fixed access network



Source: Ofcom. 2025.

A6.22 Customer drops, or customer lead-ins, are the dedicated physical bearer (or radio links in the case of wireless networks) connecting an end-user's equipment, called customer premises equipment (CPE) to a network over which the end-user's data is carried.

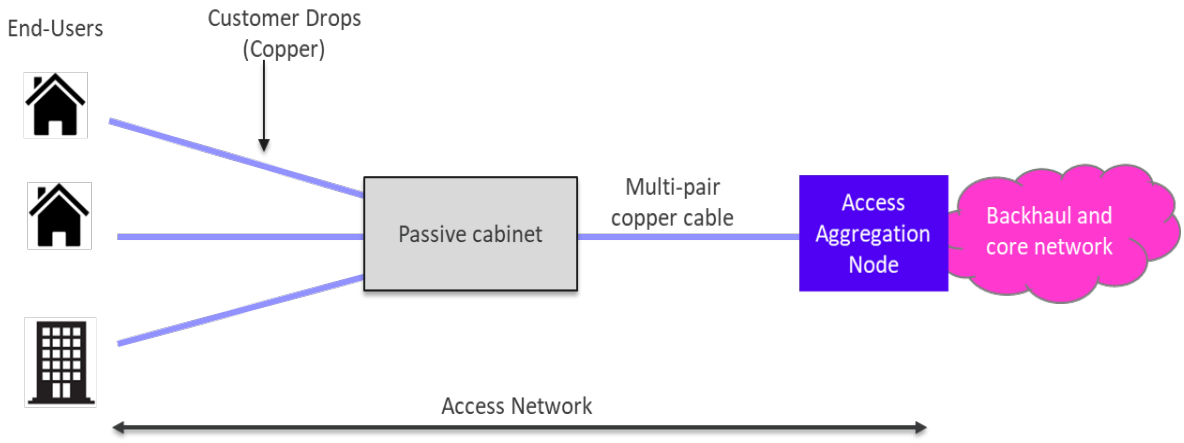
A6.23 Network flexibility points can connect to several customer drops and are sometimes placed near to the end-user's premises. Their purpose is to aggregate these multiple drops into a smaller number of bearers which are then taken back to the access aggregation node within a local area.[43] An access aggregation node is likely be connected to multiple network flexibility points in a given area.

A6.24 In some cases, network flexibility points use active electronics which aggregate traffic from several customer connections. This aggregated traffic is then carried over a dedicated physical connection back to the access aggregation node (see Figure A6.4 showing 'FTTC' network as an example). The alternative is to use a dedicated physical connection (either in a fibre, a coaxial or a copper cable) between each end-user site and the access aggregation node.

Copper access network

A6.25 Access networks were initially deployed using copper connections to the end-user sites as shown in Figure A6.3. These copper networks were initially deployed to provide telephony services using a multi-pair copper cable from an access aggregation node to a passive cabinet, connecting directly to end-users using individual copper connections ('drops').[44]

Figure A6.3: Copper access network



Source: Ofcom. 2025.

A6.26 Initially, broadband services were added by providing broadband equipment, acting as the access aggregation node at the local exchange using ADSL technology.[45] The characteristics of this equipment and the copper line limited the speed available on the network, with speeds of up to 24 Mbit/s using ADSL2+ (end-users typically experience less than this with speeds diminishing with distance). The copper network is also more affected by faults than

[43] Network flexibility points may be linked directly back to an access aggregation node or as part of a 'daisy chain' (such as network flexibility points shown as part of a ring within the access network topology illustrated later in Figure A6.13).

[44] We refer to the cabinet as 'passive' as it uses simple physical copper connections to connect between the multi-pair copper cable and the customer drop rather than using 'active' electronics (which requires an external power source to operate).

[45] ADSL is short for asymmetric digital subscriber line. This is a technology used for transmitting data over copper lines to an end-user and is part of a family of digital subscriber line (DSL) technologies such as ADSL, ADSL2+, SDSL (symmetric DSL), VDSL (very high-speed DSL) and VDSL2.

modern fibre networks, in part because it can be affected by the weather, and because the age of the network can lead to more faults.

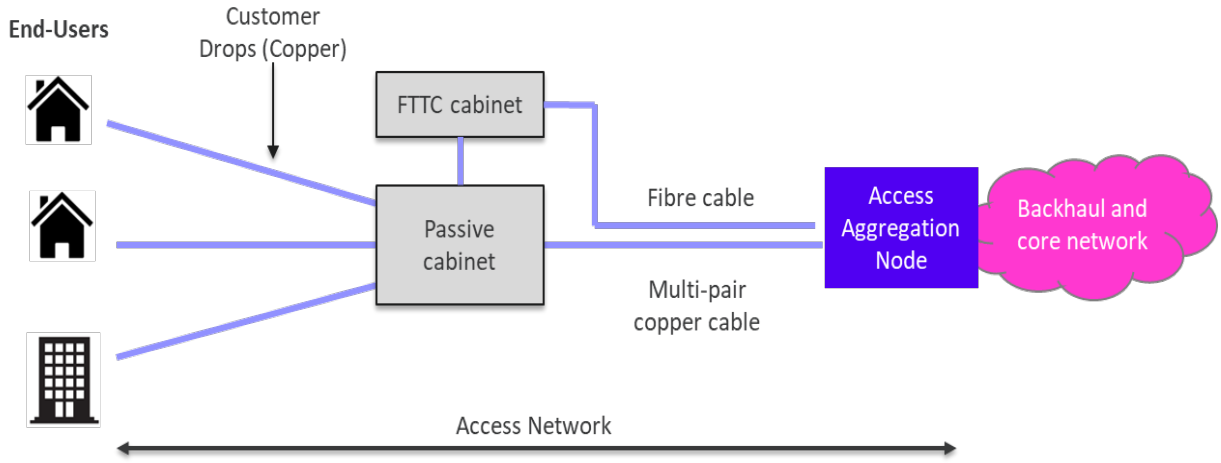
Fibre to the cabinet (FTTC) access network

A6.27 Many copper networks, such as BT's, have been upgraded to support higher speeds by deploying broadband equipment (electronics) nearer to the end-users, at a street cabinet rather than in the exchange (shown as 'FTTC cabinet' in Figure A6.4). The broadband equipment is then connected to the end-user copper connection (customer drop) via the existing 'passive' cabinet (which is located nearby), and to the access aggregation node using a fibre connection. This access network structure is known as fibre to the cabinet (FTTC).

A6.28 FTTC networks can provide broadband services with download speeds of up to 80 Mbit/s depending on the length of the copper line between the end-user and the street cabinet.[46] These higher speeds are achieved using VDSL technology over shorter copper connections (compared to ADSL technology with broadband equipment based in the exchange).

A6.29 In the FTTC networks, the fibre to the cabinet is shared by all the end-users on the cabinet. Since capacity is shared among multiple end-users, it may not be the case that each end-user can simultaneously receive maximum speeds.

Figure A6.4: Fibre to the cabinet access network



Source: Ofcom. 2025.

A6.30 It is possible to provide even faster speeds over copper connections using G.fast technology.[47] These higher speeds are achieved by placing G.fast equipment close to the end-user, such as at the final distribution point (e.g. a pole or a footway box), to reduce the length of the copper connection. G.fast equipment can also be deployed in street cabinets

[46] For example, Openreach, 2025. Superfast Broadband | Openreach "Superfast broadband" variant showing up to 80 Mbit/s download speed. Accessed on 20 January 2025.

[47] G.fast is a DSL technology designed to deliver higher broadband speeds than earlier DSL technologies (such as VDSL or ADSL) over existing twisted copper wires. A technique known as vectoring can be used to maximise the performance of DSL technologies and to minimise the interference between end-users' circuits. Vectoring is necessary where G.fast is used alongside circuits using VDSL to avoid such interference.

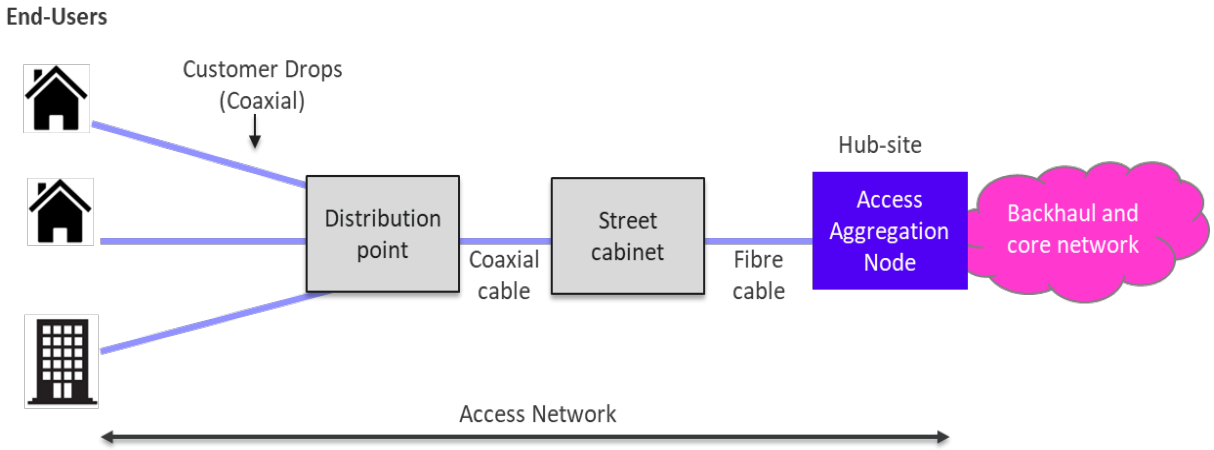
close to the end-users. For example, Openreach has deployed G.fast equipment at selected street cabinets and offers services with download speeds of up to 330 Mbit/s.[48]

Cable access network

A6.31 Virgin Media O2 operates a cable network available across much of the UK, using a hybrid fibre coaxial (HFC) cable system as shown in Figure A6.5. Fibre is used between the hub-site (access aggregation node) and the street cabinet where, using electronics, it is connected to the copper coaxial cable for connection (via a distribution point) to the end-user. Some HFC systems connect fibre to the distribution point before using coaxial cable for the final customer drop.

A6.32 Similar to FTTC networks, in the cable networks, the fibre to the cabinet is shared by all the end-users on the cabinet. Since capacity is shared among multiple end-users, it may not be the case that each end-user can simultaneously receive maximum speeds.

Figure A6.5: Hybrid fibre coaxial 'cable' access network



Source: Ofcom. 2025.

A6.33 The cable network was originally deployed to provide television (TV) services. Broadband services were subsequently introduced by adding broadband equipment supporting Data-Over-Cable Service Interface Specification (DOCSIS). DOCSIS equipment is located at the hub-site which connects to the cable access network. This hub-site also aggregates traffic from other street cabinets within a local area.

A6.34 The speed over a cable connection depends on the version of DOCSIS being used, with gigabit speeds currently available from Virgin Media O2 using DOCSIS 3.1.[49] DOCSIS 3.1 has the potential to support downstream capacity of up to 10 Gbit/s and upstream capacity of up to 1-2 Gbit/s. However, download speeds are expected to be lower than this in practice as it depends on factors such as how the network is configured and the capabilities of the DOCSIS modems installed at the end-user's site. DOCSIS is expected to be upgradable in

[48] For example, Openreach, 2025. Superfast Broadband | Openreach "GFast broadband" variant showing up to 330 Mbit/s download speed. Accessed on 20 January 2025.

[49] For example, Virgin Media O2, 2025. Gigabit Broadband | £0 Setup | October 2024 - Virgin Media. For customers taking the 'Gig 1' service, which can deliver 1130 Mbit/s average download speed. Accessed on 20 January 2025.

the future as new standards become available, such as DOCSIS 4.0 which supports downstream capacity of up to 10 Gbit/s and upstream capacity of up to 6 Gbit/s.[50]

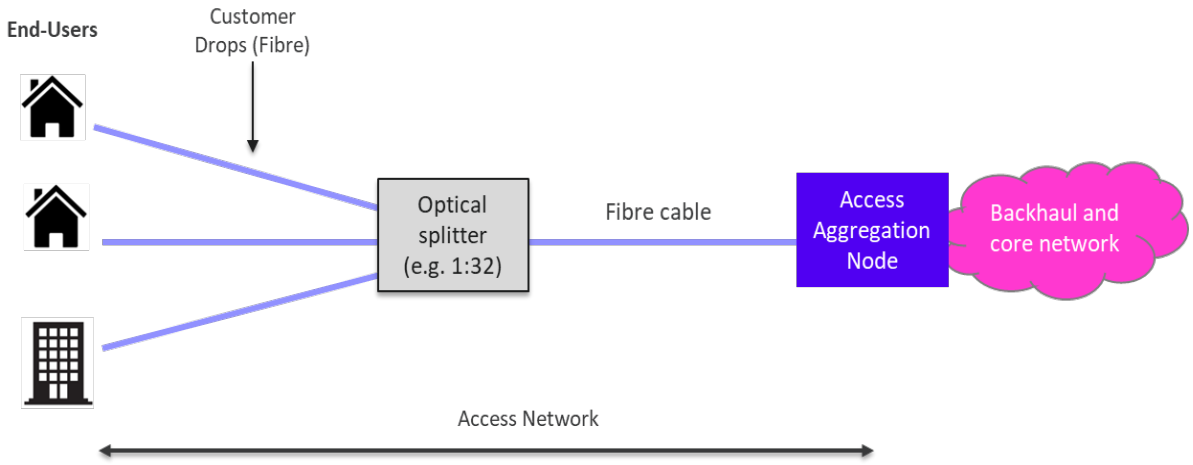
Fibre to the premises (FTTP) access network

A6.35 Networks which use copper for the final connection to the end-user, including cable networks, are in the process of being superseded by fibre to the premises (FTTP) which is currently being rolled out across the UK by many network operators.[51]

A6.36 FTTP or full-fibre networks can be provided in two main ways[52]:

- Shared point-to-multipoint passive optical networks (PON), which we discuss below
- Dedicated point-to-point fibre, which we cover later in this annex under 'Leased lines connectivity for business customers'

Figure A6.6: Fibre to the premises access network using a PON



Source: Ofcom. 2025.

A6.37 A PON is a shared fibre network (as shown in Figure A6.6). Each end-user, with an optical network terminal (ONT), is assigned a dedicated fibre connecting to an optical splitter which then connects to an optical line terminal (OLT) equipment at the access aggregation node. As several end-users are connected to the same optical splitter (e.g., 8, 16 or 32-way split), the capacity for each PON connected to the OLT is shared between them.[53] The number of end-users connected to each shared PON is typically 32 or less, which is generally fewer than the shared infrastructure on an FTTC or a cable network.[54]

[50] Cablelabs, 2025. DOCSIS 4.0 technology. Accessed on 20 January 2025.
[51] ISPreview. 7 February 2024. Virgin Media O2 is also installing XGS-PON (10 Gbit/s symmetrical passive optical network) systems using FTTP, rather than using coaxial cable for the final customer drop. Virgin Media UK Launch 2Gbps Broadband and Symmetric Speeds UPDATE2 - ISPreview UK. Accessed on 21 October 2024.
[52] Ofcom. 26 September 2023. Evolution of Fixed Access - Ofcom. Accessed on 21 October 2024.
[53] PON architectures are 'Point-to-multi-point' which employ a single higher capacity central terminal (such as an OLT) shared among many connections. An OLT can serve several PONs, and each PON can have multiple end-users (depending on the spit ratio of the optical splitter). Optical splitters in a PON are 'passive', which means they do not require an external power source to operate. On the other hand, both OLT and ONT are 'active', which means they require an external power source to operate.
[54] In both the FTTC and cable networks, the fibre to the cabinet is shared by all the end-users on the cabinet.

A6.38 Initial PON deployments generally use gigabit PON technology (GPON), with capacity of 2.5 Gbit/s downstream and 1.25 Gbit/s upstream. While the majority of FTTP deployments within the UK have been historically based on GPON, higher speed symmetric PON technologies are now available and being deployed. The expectation is that older PON systems can be upgraded easily to higher speed PON systems.[55] [56] These can be, for example, symmetric 10 Gbit/s systems (e.g., XGS-PON) or symmetric 50 Gbit/s systems (e.g., 50G-PON).[57] [58] This can be done as demand for faster speeds grows and as equipment costs fall, and this upgrade can take place without the need to replace the optical fibres and optical splitters.

A6.39 GPON capacity is shared, so although peak speeds (typically 1 Gbit/s as seen by the end-user) may be achieved in short bursts, the average capacity available to an end-user may be less. Therefore, the average speed depends on the number of active users on the network at any one time.[59] Other FTTP networks may be configured to have fewer users connected, and so can offer higher average speeds.

A6.40 Some telecoms providers may use XGS-PON and other high-speed symmetric PON (e.g., 50G-PON) to deliver residential broadband services, where capacity is shared, as well as high-speed 'leased line equivalent services', where some of the shared capacity can be 'ringfenced' for a particular end-user to whom the capacity appears uncontended, i.e. Ethernet over symmetric PONs.

A6.41 As an example, an XGS-PON based FTTP network which has a capacity of 10 Gbit/s can be shared among multiple end-users. It can also be used to offer a symmetric uncontended capacity over the same PON. To do this, the PON would be configured to 'ringfence' or reserve 1 Gbit/s of the shared capacity to offer a 1 Gbit/s 'leased line equivalent' Ethernet service.[60] In practice, this means that up to seven 1 Gbit/s 'leased line equivalent' Ethernet connections can be provided over one XGS-PON based FTTP network, however, this may constrain the capacity available for existing as well as prospective residential broadband connections on that XGS-PON based FTTP network.[61]

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[55] ISPreview. 14 October 2024. Progress Update on CityFibre's UK Rollout of 10Gbps XGS-PON Broadband - ISPreview UK. Accessed on 24 October 2024.

[56] UK Fibre Connectivity Forum, 2024. Netomnia Update on Plan for 50Gbps UK FTTP Network by End of 2024 - UK Fibre Connectivity Forum. Accessed on 24 October 2024.

[57] XGS-PON offers 10 Gbit/s symmetric services (X stands for 10, S stands for symmetric) where the downstream as well as the upstream capacity is 10 Gbit/s.

[58] 50G-PON offers 50 Gbit/s symmetric services where the downstream as well as the upstream capacity is 50 Gbit/s. It can also be available as an asymmetric service where the downstream capacity is 50 Gbit/s and the upstream capacity can be either 12.5 Gbit/s or 25 Gbit/s.

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

[60] The notion of 'leased line equivalent' refers to features such as uncontended capacity, symmetric download and upload speeds, and quality of service parameters similar to business point-to-point dedicated leased line services (e.g. high availability, fast repair times and installation times, and continuous monitoring and support). PON based 'leased line equivalent' services may not be able to match certain characteristics of a point-to-point leased line using a dedicated fibre link which offers, for example, higher physical security and uncontended access across a wide range of bandwidths and at speeds greater than those supported on a PON.

[61] Although an XGS-PON has a headline capacity of 10 Gbit/s, in practice the available capacity is reduced to around 7 - 8 Gbit/s due to, for example, standard specified protocol (aka signalling) overheads.

A6.42 To take advantage of these high-speed, high-capacity access networks, the backhaul and core networks must be configured to provide sufficient capacity at peak times. Similarly, any services being accessed, such as data storage at a data centre must be configured to provide the capacity and speeds needed to meet user demand and avoid capacity bottlenecks in delivering an end-to-end service.

A6.43 PON systems can also be used to carry, as an overlay, the same DOCSIS signals used in the cable access networks described earlier. This uses a technique referred to as Radio Frequency over Glass (RFoG).[62] This is the approach used by Virgin Media O2 as it rolls out its XGS-PON based FTTP network and has an advantage of using the same customer equipment (i.e., routers) for both HFC and FTTP networks.[63]

A6.44 FTTP networks, although often used to denote PONs, can also be deployed using a dedicated point-to-point fibre connection, rather than shared connections across multiple end-users, such as in a PON. These point-to-point connections are covered in more detail in the following description of leased lines, and although they can be used to connect to residential end-users with high-speed requirements, they are generally used to connect to businesses.

Leased lines connectivity for business customers

A6.45 Traditionally, businesses (including mobile operators) have used leased lines to connect their sites to a telecoms provider's network using high-capacity, point-to-point, symmetric and dedicated circuits for use by a single customer (i.e., providing uncontended capacity).[64] Leased lines can be significantly more expensive per end-user or customer than broadband services as they are provided over dedicated infrastructure rather than the infrastructure, and costs, being shared by multiple customers.

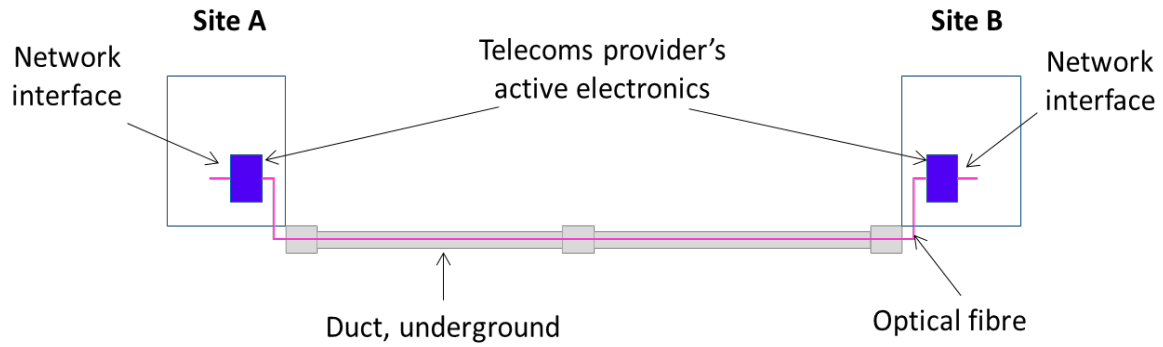
Leased lines overview

A6.46 Leased lines generally use optical fibre (or increasingly less common, copper) to make the physical connection between two points. These connections in the form of cables are typically run inside a duct (as illustrated in Figure A6.7). The route between two points in a network can be referred to interchangeably as circuits or connections.

A6.47 Leased lines can be provided by a supplier with or without active electronics. The electronics, whether provided by the supplier or customer, can use several different technologies such as Ethernet or wavelength division multiplexing (WDM).[65] These technologies are covered in more detail in Section 2 of Volume 2.

[62] With RFoG, the passive architecture is the same as PON. It emulates HFC (DOCSIS) over fibre, but fibre connectivity is converted back to coaxial cable connectivity at the customer premises.
[63] ISPReview. 20 April 2023. Virgin Media UK's XGS-PON Full Fibre Upgrade to Go Live Later in 2023 - ISPreview UK. Accessed on 21 October 2024.
[64] Symmetric implies that the upload speeds are the same as the download speeds in a leased line. Dedicated implies that each leased line circuit is for the exclusive use of a single business customer. Uncontended capacity implies that the capacity of a leased line is guaranteed and not subject to reduction at, for example, busy times.
[65] These types of technologies have also been referred to as contemporary interface (CI) in previous Ofcom market reviews.

Figure A6.7: Structure of a typical leased line

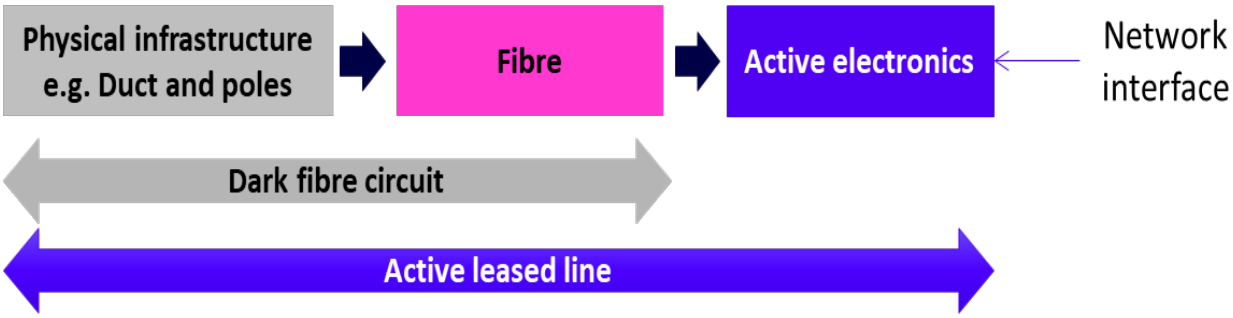


Source: Ofcom. 2025.

A6.48 A circuit without active electronics is often referred to as a dark fibre (DF) connection.[66] For DF, the customer creates an active leased line by connecting the DF into their own electronic equipment at both ends of the circuit, eliminating the need for intermediate electronics in the end-to-end circuit. This can give technical benefits such as improved reliability and reduced latency. Customers using DF will need expertise to specify, install, and manage the end-user equipment and fault management on the dark fibre connection.

A6.49 A leased line can also be created by using third-party supplied physical infrastructure (e.g. ducts or poles), with the telecoms provider then adding its own fibre cables and electronics to connect to an end-user or customer. The relationship between the building blocks used to provide a dark fibre circuit and an active leased line is shown in Figure A6.8.

Figure A6.8: Main building blocks of a leased line



Source: Ofcom. 2025.

Leased line networks

A6.50 A leased line network can be configured in several ways, using leased lines as the building block to create an end-to-end service which can be optimised to meet a particular service requirement. We cover the following example configurations:

- Dedicated leased line networks
- Business virtual private networks (business VPNs)

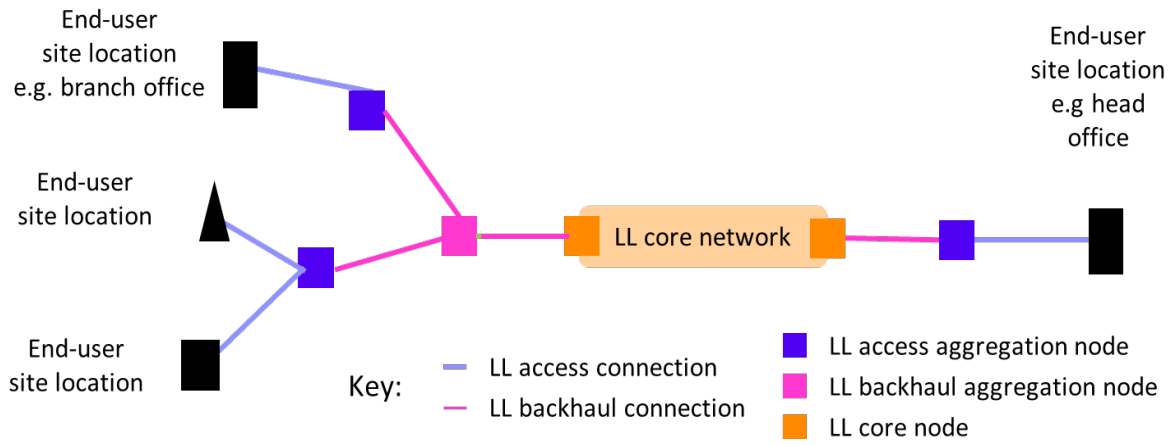
[66] Dark fibre is a term used to describe an optical fibre that has not been connected to any electronic equipment. It is called a 'dark fibre' product as the electronic equipment which 'lights' the fibre and enables the circuit to receive and transmit data is not included as part of the dark fibre connection.

- Mobile leased line networks
- Broadband leased line networks

Dedicated leased line networks

A6.51 A dedicated leased line network (as shown in Figure A6.9) provides a collection of point-to-point end-to-end connections to create a private network, i.e., circuits in the end-end network are not shared. This model is becoming less common but may still be used when security or network features, such as low end-to-end latency, are a key concern. These networks have mainly been superseded by business VPNs (see Figure A6.10).

Figure A6.9: Dedicated leased line end-to-end connectivity



Source: Ofcom. 2025. LL is short for leased line.

Business VPNs

A6.52 Business VPNs provide any-to-any connections between multiple business sites which can be spread over a wide geographic area (see Figure A6.10). These networks are likely to include internet connectivity and connections to outsourced cloud computing services. Figure A6.10 also shows the end-user sites connected with leased lines to provide high speed dedicated capacity.

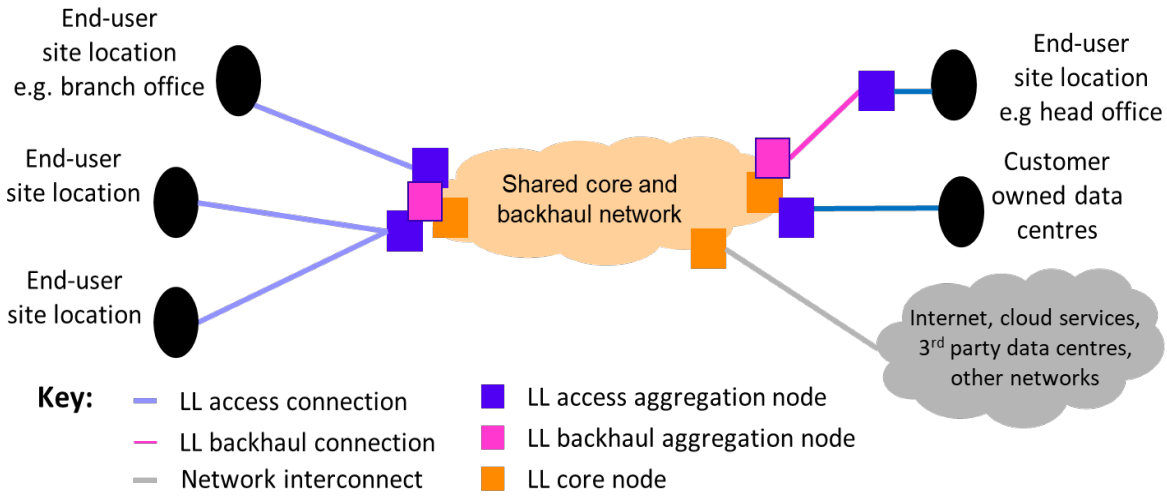
A6.53 Although not shown in Figure A6.10, end-user sites can also be connected using a business broadband connection (such as those delivered over an FTTC or FTTP PON) where higher speeds available over a 'dedicated' point-to-point leased line may be of less importance – such as to a small branch office. Some businesses may prefer newer PON technologies (e.g. XGS-PON) which can offer symmetric upload and download speeds, combined with similar quality of service parameters as point-to-point leased lines.

A6.54 Unlike a dedicated leased line network, a business VPN shares backhaul and core capacity across multiple business customers. The same core and backhaul network may also be used to carry traffic for other services such as broadband and mobile. The data for each customer is separated using virtual paths on a shared physical connection within the backhaul and the core network, and therefore it appears as a 'private' network from a customer's perspective.

A6.55 Access to cloud-based services such as data storage, application hosting, and data processing can also be provided as part of an overall service. Figure A6.10 shows a single connection to cloud-based services. However, these services can be placed nearer to the customers' access connections (such as at multiple core nodes or even multiple backhaul

aggregation nodes) to improve reliability, reduce core capacity requirements, and speed up response times. This can be referred to as edge or distributed computing.[67]

Figure A6.10: Business VPN with connectivity to internet and cloud computing services



Source: Ofcom. 2025. LL is short for leased line.

Mobile leased line networks

A6.56 Leased lines can be used by mobile network operators (MNOs) to connect their base stations to their core network nodes using access and backhaul leased line connections (see Figure A6.11).[68]

A6.57 The term 'mobile backhaul' is often used to refer to the combination of access and backhaul leased line connections between the mobile base station and the mobile core node (i.e., the arrow labelled 'mobile backhaul' in Figure A6.11).[69]

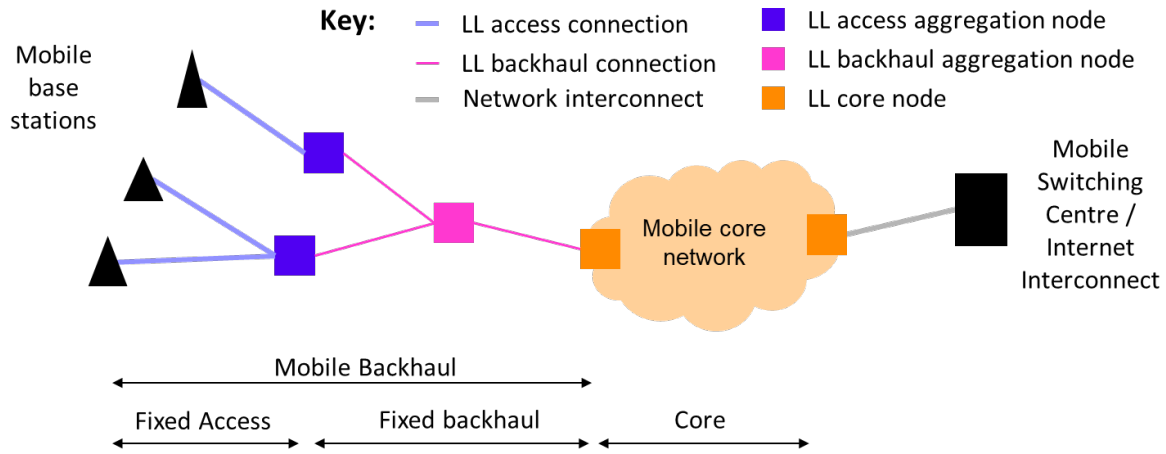
A6.58 MNOs may also use leased lines to provide connectivity between their core sites, and connections to the internet and other networks, to support mobile services.

[67] Content distribution networks (CDNs) for video streaming as part of a broadband network is another example where cloud hosted services are placed nearer to the customer rather than being centralised.

[68] A base station is a fixed transceiver used in mobile networks that serves as one of many connectivity points within a mobile network, where each base station may serve one or more mobile devices. It connects to the mobile core network via the mobile backhaul. These base stations provide the network of radio coverage that allows mobile phones to make calls and access internet while on the move.

[69] In Figure A6.11, a traditional monolithic architecture (typical of 4G deployments) is used, where the network components are tightly integrated in a dedicated special purpose hardware (i.e., there is tight integration between hardware and software). On the other hand, a disaggregated architecture (typical of 5G deployments) breaks down the monolithic architecture into smaller, modular network components hosted on a general-purpose hardware (i.e., software decouples from the hardware) which allows for a more flexible and scalable network architecture, allowing disaggregated network components to be located in different physical locations. This disaggregated architecture gives rise to a 'fronthaul' which could be a fibre-based link connecting the two disaggregated components in two different physical locations (e.g., a central unit could be located in an access aggregation node, while a remote unit stays at the mobile base station, with both units connected via a fibre-based link which is shown as an arrow labelled 'fixed access' in this figure).

Figure A6.11: Mobile network backhaul connectivity using leased lines



Source: Ofcom. 2025. LL is short for leased line.

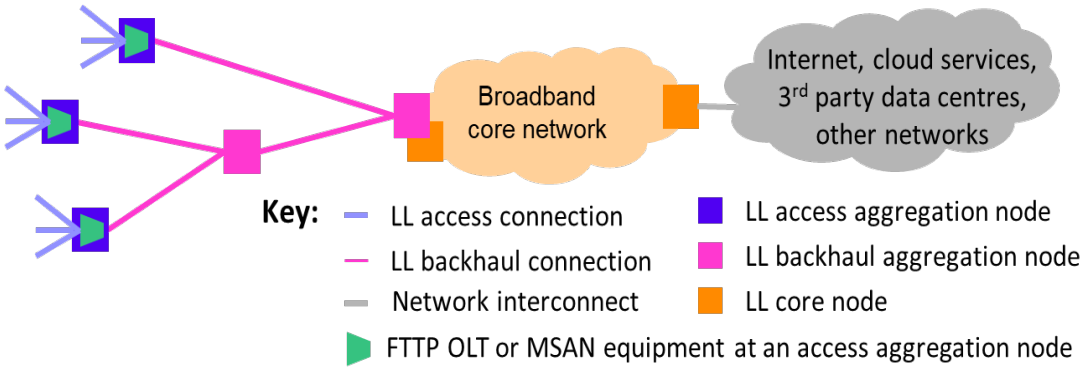
Broadband leased line networks

A6.59 Fixed broadband operators can build their own broadband network using leased lines to create backhaul leased line connections from the core network, which are then connected to broadband access connections at the access aggregation node.

A6.60 For example, a fixed broadband operator may place their network equipment (e.g. their MSAN at an access aggregation node) to connect to BT's copper access network at a BT local exchange.[70] In another example, a fixed broadband operator may place their FTTP OLT at an access aggregation node (in their own operational building) to connect to their own fibre access network. This equipment (at the access aggregation node) can then be connected to a backhaul and a core network which can be connected to the internet at suitable locations to provide an end-to-end broadband service. These two examples are represented in Figure A6.12.

A6.61 As with business VPNs earlier, the core and backhaul network may carry traffic for multiple access services such as broadband and leased lines.

Figure A6.12: Broadband network backhaul connectivity using leased lines



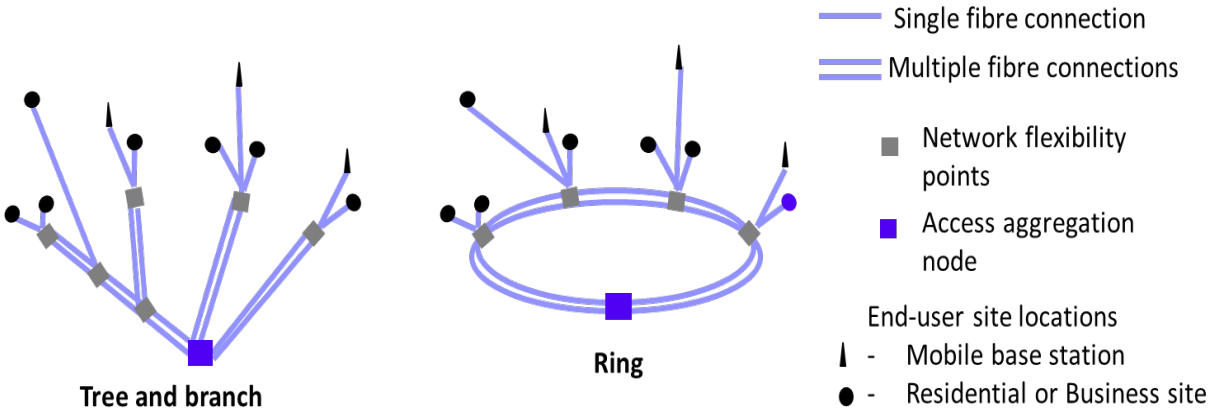
Source: Ofcom. 2025. LL is short for leased line.

[70] MSAN is short for multi-service access node used by 'local loop unbundlers' (LLU) to connect multiple BT copper access connections to electronics before backhauling the aggregated traffic back to a core/backhaul aggregation node in the network.

Network design choices

A6.62 There are many ways a network operator can choose to connect the nodes that make up its network in addition to a 'tree and branch' layout illustrated in the previous network diagrams. For example, nodes may be connected in a 'ring' architecture as illustrated in Figure A6.13. The 'tree and branch' layout is generally used by BT in its access network, partially due to historical reasons where originally, copper lines went from a central exchange, down streets to a distributed network of street cabinets, and then on to individual homes and business premises. A ring architecture is often used in backhaul and core networks to provide additional resilience. This is the preferred design for the core network for operators such as CityFibre.[71] A combination of both layouts can also be used.

Figure A6.13: Different types of network topology



Source: Ofcom. 2025.

A6.63 As shown in Figure A6.13, in a tree and branch architecture, individual fibres are taken from an end-user site and connected to a multi-fibre cable (or access 'distribution' cable) at fibre connection points (also referred to as network flexibility points).[72] These multi-fibre cables are then connected to equipment at an operator's site (i.e. an access aggregation node) to aggregate the traffic from the fibres connected to the end-user sites.

A6.64 For a ring architecture, the network can be set up to let traffic travel either clockwise or anti-clockwise around the ring. This means that if there is a problem in one direction of the network, traffic can be rerouted in the opposite direction (automatically, if suitable electronics are in place) i.e., the ring architecture provides additional resilience. This is not readily possible in a 'tree and branch' architecture where there is only one route from an end-user site to the access aggregation node. To get around this, 'tree and branch' networks may provide additional resilience by adding a second circuit with a different ('diverse') routing to the end-user site using the same or an alternative supplier.

Wireless technologies

[71] CityFibre. 25 March 2022. Modern Full Fibre Exchanges offer Service Providers the… | CityFibre. Accessed on 27 February 2024.

[72] Customer site or an end-user site is connected with a fibre cable with a limited number of fibres but only one fibre is necessary for the connection. At the network flexibility point, this fibre is connected to a fibre in a multi-fibre cable (with more fibres).

A6.65 The previous sections within this annex describe networks that provide services at a fixed end-user location using a wired (either copper, coaxial cable or fibre) connection all the way. This section looks at services that can be connected to end-users using wireless links and include:[73]

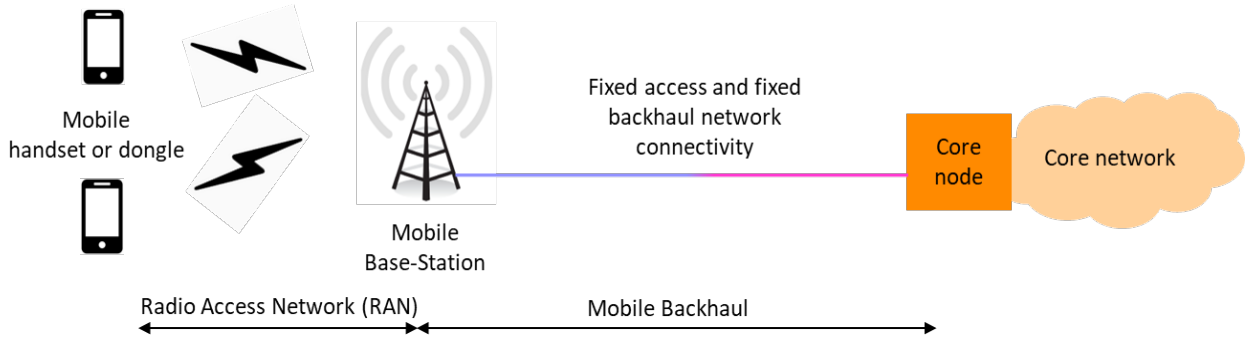
- Mobile broadband services delivered to nomadic end-users via a mobile network (such as 4G or 5G)
- Broadband services delivered to fixed end-users via a fixed wireless access (FWA) network
- Satellite broadband services delivered to fixed end-users via satellite or non-terrestrial networks (NTN)
- Wireless backhaul links for other networks (such as mobile networks).

A6.66 This section does not cover in-building WiFi connections which can be used, for example, to connect wirelessly to a fixed or a wireless broadband connection.

Mobile broadband services delivered to nomadic end-users via a mobile network

A6.67 Use of mobile broadband services can be a convenient way for customers to access the internet and can be used both as an alternative, as well as in addition, to a fixed broadband connection. Customers in this category can connect to a 4G or 5G mobile network when they are at home or on the move using their mobile phone, a dongle or similar equipment (see Figure A6.14). As shown in Figure A6.14, a typical mobile network consists of a radio access network (RAN) with a base station, a mobile backhaul (which is typically provided via a fixed connection), and a mobile core network.[74]

Figure A6.14: Typical mobile network topology



Source: Ofcom. 2025.

[73] Wireless links can have different connection topologies: Point-to-Point, where wireless connectivity is provided between two specified fixed points (microwave links for mobile backhaul are an example of this topology); Point-to-Multipoint, where wireless connectivity is provided between a single specified fixed point and more than one other fixed points (provision of residential broadband using fixed wireless access is an example of this topology); and Multipoint Mesh, where wireless connectivity is provided through full or partial connection between multiple fixed points (we have not covered Multipoint Mesh topology in this annex due to it not being used significantly in the UK market).

[74] Although mobile backhaul is typically provided via fixed connections such as leased lines using fibre, it can also be provided via point-to-point wireless links, such as a microwave links.

A6.68 While high speeds are possible, due to the shared nature of the network and the fact that speed will depend on the quality of signal being received, speeds are likely to be much lower in many cases. 5G networks offer faster downstream connectivity than 4G as seen in Ofcom's 2024 Mobile Matters report.[75] The report indicates that 47% of 5G connections had an average download speed of 100 Mbit/s or higher versus 11% on 4G.

A6.69 Mobile coverage is another factor that needs to be considered, with coverage poorest in more rural areas. Although 95% of the UK landmass has good 4G coverage from at least one operator, 5G is not as widespread as 4G, especially in rural areas, even though the 5G footprint is gradually increasing[76]

Broadband services delivered to fixed end-users via a FWA network

A6.70 In a fixed wireless access (FWA) network, wireless links are used to provide broadband connectivity to a fixed location, such as a residential or a business premises. The wireless links are the final wireless access connection between a fixed point at the end-user's site and a fixed radio transmitter (such as a mobile network base station or a wireless access point). This avoids the need to install a fixed access connection (such as a cable) between the end-user and a broadband or leased line network.[77] It is therefore suited to, for example, situations where a fixed access connection is not available or is relatively expensive to provide.

A6.71 FWA can be delivered by:

- Mobile network operators (MNOs)
- Wireless Internet service providers (WISPs)

FWA from MNOs

A6.72 FWA on mobile networks from MNOs is offered on licensed 4G and 5G networks, usually to an indoor customer premises equipment or router. The performance of the broadband connection is dependent on the quality of the mobile signal that is received indoors. Some operators have offered or are offering solutions to improve the quality of the signal received indoors for example through a pre-configured external antenna combined with an internal router designed for self-installation by customers. This then makes use of the stronger outdoor mobile signal to provide for an improved broadband experience.[78]

A6.73 These services share the network capacity with mobile users, meaning that the capacity of the network must be carefully managed between the demands of existing mobile users and FWA customers. There may be areas of high mobile demand where a reliable FWA service cannot be offered.

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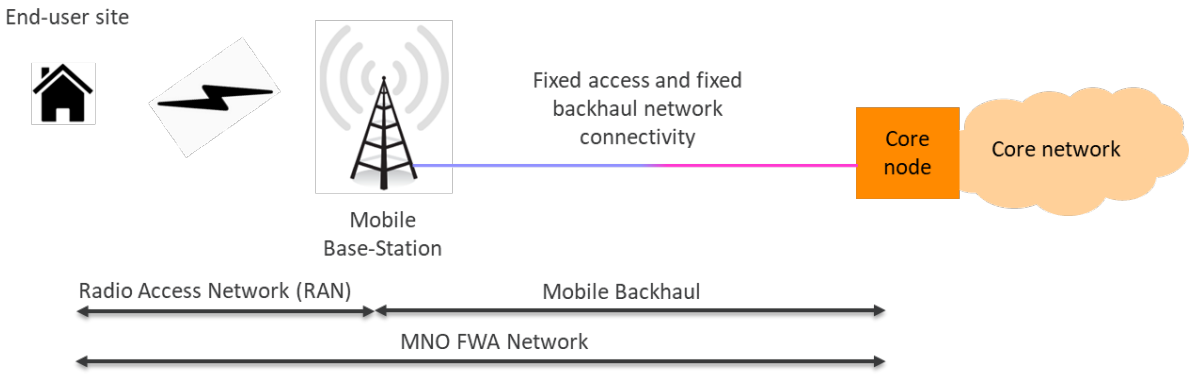
[75] Ofcom. 6 September 2024. Mobile Matters 2024, page 4. Accessed on 5 December 2024.
[76] Ofcom. 5 December 2024. Connected Nations UK report 2024, Chapter 3 Mobile, data and voice. Accessed on 5 December 2024.
[77] Installing a new fixed access connection (such as a fibre cable) may require civil works which may prove too costly, especially in rural areas where the number of premises could be limited but distances between the access aggregation node and premises may be very long (i.e., several kilometres).
[78] For example, Three have recently launched what is called a '5G Outdoor hub'. Ofcom. 5 December 2024. Connected Nations UK report 2024, Chapter 2 Fixed broadband and voice. Accessed on 5 December 2024.

A6.74 FWA over MNO's 4G/5G networks provides a connection between a mobile base station and a customer premises equipment (which acts as both a receiver of the mobile signal and also a transmitter of WiFi signals within a premises) - see Figure A6.15. This type of service shares many of the characteristics with mobile broadband but optimised for home usage. For example, the customer premises equipment can be placed at a suitable fixed location within a customer's site to allow connections to other customer equipment (e.g., smart TVs, computers) and to enable WiFi connectivity.

Figure A6.15: Typical 4G/5G FWA network topology



Source: Ofcom. 2025.

A6.75 As the customer premises equipment is mains powered and is a dedicated unit for internal use, it provides better performance than mobile broadband services delivered to nomadic end-users via a mobile network.

A6.76 Many MNO-based FWA systems have typically deployed point-to-multipoint links which are used to provide residential broadband connections.[79] MNOs also deploy point-to-point FWA links which are typically used to provide connections to business customers.

A6.77 Similar to mobile broadband services delivered via a mobile network, depending on traffic and capacity in the mobile network, speeds in an MNO based FWA network can vary. For example, based on Connected Nations data analysis in 2023, average download speed for some MNO based FWA connections was between 69 to 238 Mbit/s.[80]

FWA from WISPs

A6.78 FWA services from WISPs are based on proprietary solutions which require Line of Sight (LoS) or near-LoS wireless connectivity between the provider's access point (also referred to as a base station or a mast site) and the outdoor antenna on the customer's premise. The outdoor antenna on the customer's premise is connected to an indoor customer premises equipment using a wired connection. Connections from WISPs are particularly useful in more remote, hard to reach areas where network coverage may be poor.

A6.79 Services from WISPs traditionally used 'licence exempt' and 'light licensed' spectrum. However, we are beginning to see some use of shared access spectrum with 5G technology specifically for residential broadband services, which is enabling WISPs to provide superfast

[79] In an MNO based point-to multipoint FWA system, a base station serves multiple end-users at different end-user sites.

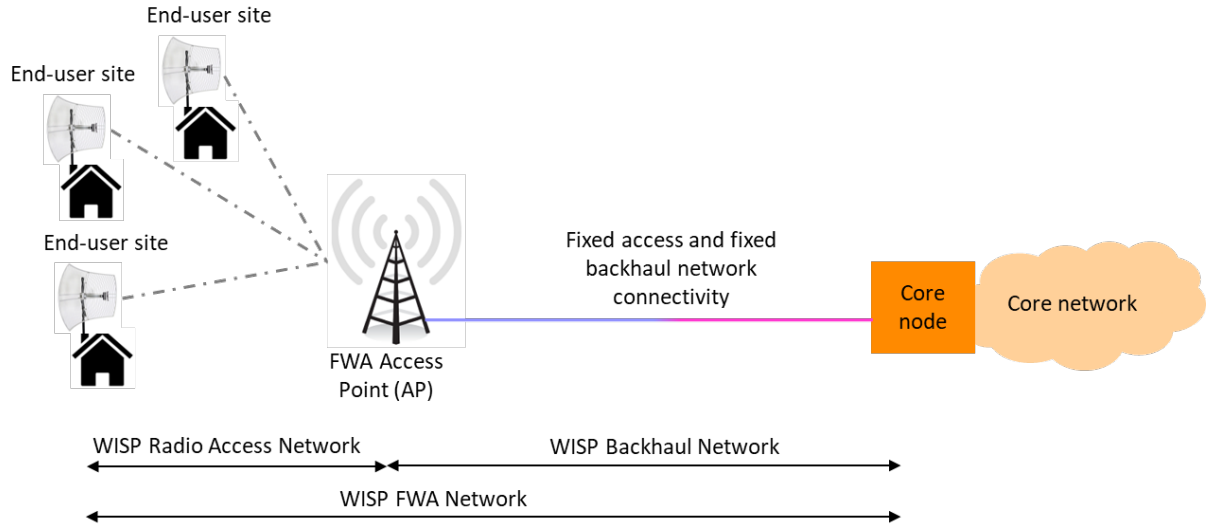
[80] Ofcom. 13 February 2024. Interactive report 2023 - Ofcom, page 18, Fixed, FWA mobile & LEO satellite performance. Accessed on 24 October 2024.

and above speeds much more widely.[81] The performance of services may be impacted by LoS issues, which can become more significant at higher frequencies (WISPs have a range of frequency options, with choice informed by capacity and performance requirements, as well as technology and kit available in a given band).

A6.80 Similar to MNO-based FWA systems, many WISP-based FWA systems have typically deployed point-to-multipoint links which are used to provide residential broadband connections.[82] WISPs also deploy point-to-point FWA links which are typically used to provide connections to business customers.

A6.81 Figure A6.16 shows a point-to-multipoint FWA system being used for connecting multiple customer premises for residential broadband services. Since these services are LoS between the network (or the FWA Access Point as shown in Figure A6.16) and the end-user site, they can be difficult to deploy in built up areas such as city centres.

Figure A6.16: Typical WISP based Point-to-Multipoint FWA network topology



Source: Ofcom. 2025.

Satellite broadband

A6.82 Satellite broadband service can be delivered via either a geostationary orbit (GSO) satellite or a non-geostationary orbit (NGSO) satellite constellation.[83] [84] These satellite technologies continue to evolve rapidly, offering an alternative for customers that cannot receive decent broadband, such as those located in remote rural areas.

[81] Ofcom introduced its Shared Access framework in 2019 to support local spectrum access for local networks. The framework includes the 3.8-4.2 GHz band and part of the 26 GHz band that are suitable for the provision of high-speed networks based on 5G technology.

[82] In a WISP based point-to multipoint FWA, an FWA access point (a type of base station which can serve multiple customers) is used to connect to multiple fixed external antennas at different end-user sites.

[83] GSO satellites orbit the earth at about 36,000 km and have traditionally been the primary way of delivering satellite communications services.

[84] According to ITU-T Recommendation Y.3200, NGSO systems include low Earth orbit (LEO) constellations which tend to orbit up to 2,000 kilometres above the Earth's surface, medium Earth Orbit (MEO) constellations which tend to orbit mainly between 8,000 and 20,000 kilometres above the Earth's surface and finally constellations operating in highly elliptical orbit (HEO) which operate with a range of operational altitudes between 7,000 km and more than 45,000 km.

A6.83 GSO satellites are fixed at a position on the geostationary belt moving with the Earth as it rotates. They are positioned at a very large distance from the Earth, being able to cover large areas. This results in delays in response times and slow speeds.

A6.84 NGSO satellites, on the other hand, are positioned much closer to the Earth, covering smaller areas than the GSO satellites and allowing for faster response times and higher speeds. As they are not at a fixed location, a network of hundreds of constantly moving satellites is necessary to provide consistent and constant coverage. In order to maintain a continuous connection, end-user terminals must be capable of tracking satellites as they pass overhead.

A6.85 GSO satellite services currently offer lower speeds than fixed broadband services, typically 25-50 Mbit/s download speed or less for GSO.[85] In addition, traditional GSO satellite services have higher latency than fixed broadband services.[86] This could affect some users who have requirements for low latency, e.g., end-users wishing to make video calls or gamers.

A6.86 At the time of writing, there are two NGSO satellite systems providing a satellite broadband service in the UK. Space X, which has more than 7,000 satellites in LEO orbit by February 2025 with its satellite broadband service, Starlink, available for use in several countries, including the UK.[87] Additionally, Eutelsat OneWeb, which has launched the first phase of its LEO constellation, offers satellite broadband services for businesses.[88] Following OneWeb's merger with Eutelsat, the operator is now looking to provide multi-orbit connectivity using both GSO and NGSO constellations.[89]

A6.87 Although satellite services do not typically guarantee any minimum speeds on their packages, in the data submitted to Ofcom for 2024 Connected Nations report, Starlink indicate average download speeds of over 160 Mbit/s and average upload speeds to be around 18 Mbit/s.[90]

A6.88 In the UK, premises using a Starlink satellite broadband connection are more likely to be in a rural area, and less likely to have access to a decent fixed line or FWA broadband service.[91] Starlink also offers portable terminals to support mobility for consumers.[92]

A6.89 Both FWA (provided by MNOs as well as WISPs) and satellite broadband connections can also provide superfast speeds and, under certain conditions, may be gigabit capable

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[85] ISPreview. Satellite Broadband ISP List - Page 1 - ISPreview UK Only Starlink in the list uses LEO. All other providers in the list use GSO. Accessed on 24 October 2024.

[86] GSO satellites tend to have high latency due to the signal having to travel the long distance to and from the satellite.

[87] Space.com. 27 February 2025. Starlink satellites: Facts, tracking and impact on astronomy | Space. Accessed on 28 February 2025.

[88] BBC. 26 March 2023. OneWeb launch completes space internet project - BBC News. Accessed on 24 October 2024.

[89] Eutalsat, 2025. Eutalsat. Satellite Connectivity Solutions | Eutelsat Group. Accessed on 3 February 2025.

[90] Ofcom. 5 December 2024. Connected Nations UK report 2024, Chapter 2 Fixed broadband and voice. Accessed on 5 December 2024.

[91] Ofcom. 5 December 2024. Connected Nations UK report 2024, Chapter 2 Fixed broadband and voice. Accessed on 5 December 2024.

[92] ISPreview. 1 August 2024. Starlink Broadband Launch Mini Dish and Mini Roam Service in UK - ISPreview UK. Accessed on 4 December 2024.

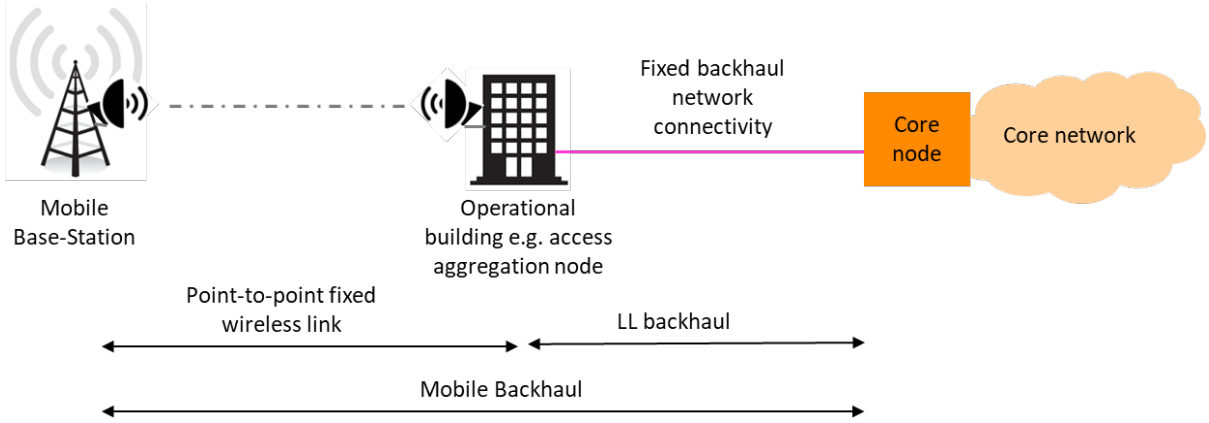
speeds,[93] but this will be dependent on the specific deployment, available capacity at the site, and the number and location of users.[94]

Wireless backhaul links

A6.90 Wireless links are also used for provisioning backhaul for other networks, such as backhaul for mobile network base stations (also referred to as mobile backhaul).

A6.91 Figure A6.17 shows a point-to-point fixed wireless link (e.g., a microwave link) being used for connecting a mobile base station to an access aggregation node as part of a mobile backhaul network.[95]

Figure A6.17: Example of a point-to-point fixed wireless link used for mobile backhaul



Source: Ofcom. 2025. LL is short for leased line.

A6.92 Using a point-to-point fixed wireless link (e.g., a microwave link) for connecting base stations to a mobile network can be a useful alternative to fixed connections (such as leased lines), particularly where operators require a wireless connection between a base station and fibre point of presence and/or in more remote, difficult to reach areas where fixed line coverage may be poor. However, compared to a leased line, these wireless links have some limitations such as lower capacity compared to fibre based backhaul and requirement for LoS connectivity.

A6.93 Satellite networks can potentially be used as an alternative backhaul solution for MNOs to expand their services into remote and hard-to-reach areas where traditional terrestrial backhaul methods like leased lines or point-to-point fixed wireless links are impractical.[96] However, satellite based backhaul solutions will also have limitations such as lower

[93] For FWA, equipment supporting gigabit capable speeds is available from various suppliers. For satellite services, this may be possible too, but it may come with an extreme cost, therefore making it viable only for some niche business connectivity use cases, instead of residential broadband.
[94] Ofcom. 5 December 2024. Connected Nations UK report 2024, Chapter 2 Fixed broadband and voice. Accessed on 5 December 2024.
[95] Connections from a mobile base station to one or more remote base stations can also be configured as a 'daisy-chain', as part of a resilient ring.
[96] Analysys Mason. 26 April 2024. Satellite is an increasingly cost-effective means for MNOs to reach remote mobile customers. Accessed on 24 October 2024.

capacity and higher latency compared to fibre based backhaul or point-to-point fixed wireless links.[97] [98]

[97] Ofcom. 5 September 2024. Update: Review of the use of fixed wireless links and spectrum implications. Accessed on 6 December 2024.

[98] As satellite constellations evolve and innovate, the latency and capacity available from a satellite based backhaul link is expected to improve.

A7. Methodology for geographic assessment of WLA network coverage and market shares

A7.1 In this annex we describe the input data and methodology that we use:

i) to define Area 2 and Area 3 for the WLA markets; and
j) to calculate WLA market shares in Area 2 and Area 3.

Geographic market analysis

A7.2 In Volume 2, Section 4, we identified which competitors to BT we consider relevant for the purposes of geographic market definition. Specifically, we provisionally concluded that VMO2 is a current material and sustainable competitor and any altnets planning to cover at least 50,000 premises by March 2031 are potential material and sustainable competitors.

A7.3 In this subsection we explain what data we collected from VMO2 and altnets, and describe how we mapped the current and expected geographic coverage of those relevant competitors in each postcode sector.

Input data

A7.4 The geographic market analysis uses data on altnets' and VMO2's existing and planned network coverage. This data was collected for Connected Nations and supplemented through TAR26 s135 notices.[99]

A7.5 The following paragraphs provide more detail about the input data used. We also include a table at the end of this annex setting out the altnets from which we used data.

Existing build and active customer connections data

A7.6 We use Connected Nations data on existing network coverage as of 1 July 2024 from VMO2 and each of the altnets in Table A7.5.

A7.7 The Connected Nations dataset provides information on UK premises passed and active customer connection by each operator as of July 2024.[100]

Planned build data

A7.8 Overall, our dataset includes data on planned build between July 2024 and January 2030.

A7.9 We used Connected Nations data on planned network coverage up to January 2030 from the altnets indicated in Table A7.5. Connected Nations formally requested data up to May

[99] In addition to the geographic market analysis, we have also used data on existing and planned coverage from altnets, VMO2 and Openreach to produce the figures on network coverage mentioned across the consultation document.
[100] The statutory information requests for Connected Nations ask operators to provide data on which individual premises in the UK they are actively connected to, including individual apartments in blocks of flats.

2027, but some providers voluntarily submitted data up to January 2030, which we have also used.

A7.10 In addition, we used our statutory powers to obtain supplementary data from some altnets on their planned network coverage between May 2027 and March 2031 (see Table A7.5 below for more details).[101] [102]

A7.11 As indicated in Table A7.5 below, of the altnets from which we requested supplementary data, only two [✂] submitted new data. For these two providers, we used the data submitted in response to the TAR26 s135 notices.

A7.12 Given the above, we consider that our modelling likely captures the vast majority of planned coverage. In any event, as noted in Volume 2, Section 4, we intend to update this analysis after the consultation. As part of this update, we will consider the appropriate and proportionate scope of our evidence gathering process to accurately capture evidence on planned build.

Data processing

A7.13 The data gathered by Connected Nations, as well as the supplementary data gathered through TAR26 s135 notices, was processed as described in the Methodology Annex of the Connected Nations report.[103]

A7.14 All existing and planned figures as well as the total number of premises per postcode sector are against the Connected Nations July 2024 premises base. This is the set of properties that formed the basis of the Connected Nations 2024 report and is described in detail in the Connected Nations Methodology Annex.[104] Hence we do not make any assumptions about the growth in the number of premises in a postcode sector.

A7.15 Coverage information for individual premises was then aggregated at postcode sector level to assess presence of relevant competitors as described in the paragraphs below.

Methodology

A7.16 This section provides more details on our methodology to identify relevant competitors to BT and our approach to assess coverage of relevant competitors at postcode sector level.

We use a 50,000 premises threshold to identify relevant competitors to BT

A7.17 As outlined above and discussed in detail in Volume 2, Section 4, the first step of our geographic analysis involves the identification of those competitors to BT we consider relevant for the purposes of defining the boundary between Area 2 and Area 3 – i.e., those altnets that are or have the potential to become material and sustainable competitors to BT.

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[101] In addition to premise level data, as part of these TAR26 s135 notices we also asked for aggregated figures on current and total planned coverage. For some providers we noted small discrepancies between the aggregated data submitted in response to TAR26 s135 notices and the data submitted to Connected Nations. However, these are generally small discrepancies and so this is unlikely to materially affect any of our findings. Moreover, as set out below we intend to update the modelling following the consultation

[102] We note that based on the planned build data collected by Connected Nations, the providers we requested supplementary planned build data from account for the vast majority [✂] of all altnets' planned build

[103] Ofcom. 5 December 2024. Connected Nations 2024 Methodology Annex. Pages 6-8.

[104] Ofcom. 5 December 2024. Connected Nations 2024 Methodology Annex. Pages 3-6.

A7.18 In particular, as detailed in Volume 2 Section 4, we provisionally concluded that VMO2 is a current material and sustainable competitor and any altnets planning to cover at least 50,000 premises by March 2031 are potential material and sustainable competitors.

A7.19 To identify altnets who are relevant competitors to BT we use data on total coverage (i.e., existing and planned coverage over the 2026-31 review period[105]) across the UK and including the Hull area.[106] Any altnet with a total coverage of at least 50,000 premises is considered a relevant competitor to BT.

A7.20 Specifically, the list of relevant competitors to BT includes: VMO2 (including its use of nexfibre's FTTP network) [107], CityFibre, Gigaclear, Hyperoptic, Community Fibre[108], Netomnia,[109] [✂][110] [111].

A7.21 Having identified the list of relevant competitors we then map their presence across postcodes in the UK (excluding the Hull area).[112] This is detailed below.

We use a 50% threshold to identify presence at postcode sector level

A7.22 As explained in Volume 2, Section 4, we consider a relevant competitor as 'present' within a postcode sector if its network covers at least 50% of premises within the postcode sector.

A7.23 To determine if one of the relevant competitors to BT is present, we assess each postcode sector separately, for each operator. For each postcode sector, we determine how many premises are within it. For each operator, we then determine how many premises within that postcode sector they are expected to cover by 2031 (summing existing and planned build). If an operator is expected to cover 50% or more of the premises in a postcode sector, we conclude that they are present in that postcode sector.

A7.24 Figure A7.1 provides an illustration of our approach to assess presence using VMO2 as an example.

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[105] As explained above, in practice the latest date available for planned coverage is January 2030.

[106] As explained in Volume 2, Section 4, this is because we think the potential for an altnet to be considered as an acquisition target would likely depend on their total coverage across the UK, including the Hull area. However, as further detailed below, we do not consider any build in the Hull area for the purpose of determining relevant competitors' presence and delineating the boundaries between Area 2 and Area 3.

[107] As set out in Volume 2, Section 4, VMO2 and nexfibre are separate companies, but we use the combined VMO2 and nexfibre data on coverage and active lines for the purpose of defining geographic markets and assessing SMP. Due to the arrangement between them, we consider that this approach accurately reflects the competitive constraint from VMO2 – including in areas where it uses nexfibre. This also includes Upp which was acquired by nexfibre in 2023. See: nexfibre. 6 September 2023. nexfibre acquires altnet Upp to accelerate fibre rollout by 175,000 homes in partnership with Virgin Media O2. Accessed on 12 March 2025.

[108] Community Fibre announced its acquisition of Box Broadband in 2021. In light of this, we have aggregated figures on coverage and take-up for Community Fibre and Box Broadband. See: Community Fibre. 11 August 2021. Community Fibre announces acquisition of Box Broadband. Accessed on 7 March 2025.

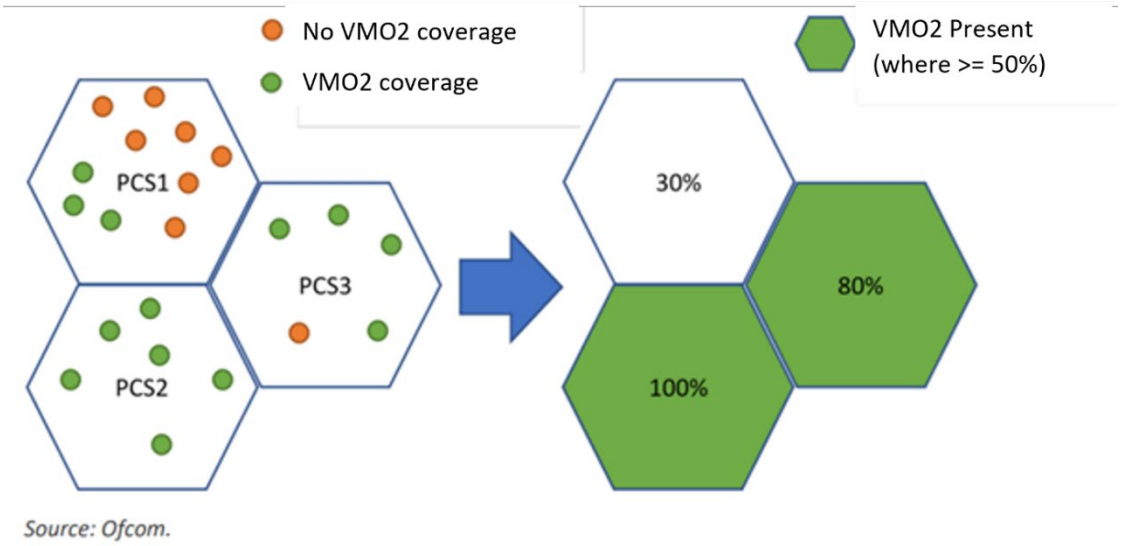
[109] In light of their recent merger, we have aggregated figures for coverage and take-up for Netomina and Brsk. See: Netomnia. 15 June 2024. Netomnia and Brsk to merge creating the second largest altnet in the United Kingdom. Accessed on 7 March.

[110] [✂] Information provided by [✂] by email on [✂].

[111] [✂].

[112] As explained in fn 8, this means that, for the purpose of delineating the boundaries between Area 2 and Area 3, we exclude any relevant competitors' coverage in the Hull area.

Figure A7.18: Example illustration of approach to assess coverage[113]



Source: Ofcom.

A7.25 As discussed in Volume 2, Section 4, all postcode sectors where at least one of the relevant competitors to BT is present are part of Area 2. All other postcode sectors are allocated to Area 3.

A7.26 The next section provides more details about relevant competitors presence and summarises how we propose to allocate UK postcode sectors into Area 2 and Area 3.[114]

Results of our geographic market analysis

A7.27 Tables A7.1 and A7.2 show the results of the geographic market analysis based on current or potential material and sustainable competitors' presence as of July 2024 and by 2031 respectively. Figures in all tables in this Annex exclude the 59 Hull Area postcode sectors and their premises.

A7.28 Table A7.1 shows that at least one or more of the relevant competitors to BT were present in 67% of UK postcode sectors that account for 76% of UK premises as of July 2024.

A7.29 Table A7.2 shows that we expect this figure to grow to 82% of UK postcode sectors that account for 90% of UK premises by 2031.

Table A7.1: Summary of results of WLA geographic market analysis based on existing presence of relevant competitors to BT as of July 2024

Relevant competitors existing presence	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Two or more	1,812	7.4m	19%	23%
One	4,722	16.9m	48%	53%
None	3,253	7.6m	33%	24%

[113] PCS means Postcode Sector.

[114] As discussed in this annex and in Volume 2, Section 4, when delineating the boundaries between Area 2 and Area 3, we exclude Hull Area postcode sectors.

Relevant competitors existing presence	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Total	**9,787**	**31.9m**	**100%**	**100%**

Source: Ofcom. Figures may not sum to 100% due to rounding.
Notes: Figures may not sum to 100% due to rounding. The premises are the total number of premises in the postcode sectors where relevant competitors are deemed to be present, not the number of premises passed by the network/s. All figures exclude 59 Hull Area postcode sectors.

Table A7.2: Summary of results of WLA geographic market analysis based on existing and planned presence of relevant competitors to BT over the review period

Relevant competitors network presence including plans	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Two or more	4,413	16.9m	45%	53%
One	3,656	11.8m	37%	37%
None	1,718	3.2m	18%	10%
Total	**9,787**	**31.9m**	**100%**	**100%**

Source: Ofcom analysis of providers data.
Notes: Figures may not sum to 100% due to rounding. The premises are the total number of premises in the postcode sectors where relevant competitors are deemed to be present, not the number of premises passed by the network/s. All figures exclude 59 Hull Area postcode sectors. The latest date available for planned coverage is January 2030.

A7.30 The map below (Figure A7.2) shows Area 2 (in blue), where at least one of the current or potential material and sustainable competitors are expected to have presence by 2031 based on existing and planned build.

Figure A7.2: Map of Area 2 and Area 3 postcode sectors

Source: Ofcom analysis of providers data. Contains Ordnance Survey data © Crown copyright and database right 2024. Contains Royal Mail data © Royal Mail copyright and database right 2024. Contains National Statistics data © Crown copyright and database right 2024.

A7.31 Table A7.3 shows the results for our proposed Areas 2 and 3. The postcode sectors making up those geographic markets that we have provisionally identified can be found in Schedule 2.

A7.32 Based on our analysis of existing and planned build, Area 2 comprises 82% of postcode sectors and 90% of UK premises.

Table A7.3: Summary of results of WLA geographic market analysis

WLA geographic market	Count of postcode sectors	Count of UK premises	% of UK postcode sectors	% of UK premises
Area 2	8,069	28.7m	82%	90%
Area 3	1,718	3.2m	18%	10%

Source: Ofcom analysis of providers data. All figures exclude 59 Hull Area postcode sectors.

WLA market shares

A7.33 In this section of the Annex, we set out our methodology for calculating WLA market shares.

Input data

A7.34 We use Connected Nations data (as per July 2024) on active broadband connections, i.e. connections that provide an active broadband service to residential or business customers, to determine the number of connections by network in each postcode sector.[115]

A7.35 Connected Nations collects information on individual customer connections, including location and technology, from the same network operators that provide coverage information and the largest retail service providers (see Table A7.5).

Data processing

A7.36 In line with data on existing and planned build, data on active broadband connections was first matched against the Connected Nations July 2024 premises base. In particular, just over 26.4m active connections in the Connected Nations data had a postcode sector in the WLA market areas.

A7.37 The number of active connections for each network operator was then aggregated at postcode sector level and used in conjunction with the results of the geographic market analysis.

[115] Ofcom. 5 December 2024. Connected Nations 2024 Methodology Annex. Page 9. Market share calculations are based on the number of active WLA connections, including broadband services used for standalone landline services, but do not include customers that take a standalone landline service delivered over the traditional Public Switched Telephone Network. Standalone landline refers to a landline service bought as a standalone contract and not as part of a bundle with other services such as broadband or Pay TV.

Methodology

A7.38 To calculate market shares we divide the number of active broadband connections from a specific provider by the total number of active broadband connections in a given geographic area.

A7.39 To reflect the overall level of competitive constraint exerted on BT, when calculating market shares, we take into account active lines provided by all altnets irrespective of whether they were identified as relevant competitors for the purpose of delineating the boundaries between geographic market areas.

A7.40 Market shares for WLA Area 2 and WLA Area 3 for BT, VMO2 and CityFibre are outlined in Table A7.4.

A7.41 As detailed in Table A7.5, Connected Nations collects data from the main broadband suppliers together with many smaller operators. Some of the smaller operators, which are not a part of the Connected Nations list, may not be captured in our calculations, but we do not expect this to impact our overall market shares.

Table A7.4: Summary of market shares for proposed WLA markets, July 2024

	Area 2	Area 3
BT, share of WLA connections	61-80% ([✂]%)	91%-100% ([✂]%)
Largest rival (VMO2), share of connections	11-30% ([✂]%)	0%-10% ([✂]%)
Second largest rival (CityFibre) share of connections	0%-20% ([✂]%)	0%-10% ([✂]%)

Source: Ofcom analysis of provider data.

Data collection from providers

A7.42 The data on coverage, take-up and planned network deployment for fixed networks was obtained from the providers listed in Table A7.5. Not all providers listed may have provided data on all of coverage, take-up and planned network deployment.

A7.43 We used data collected for the purposes of Connected Nations reporting, including coverage and take-up data that was collected in August 2024, and planned network deployment data collected in May 2024. Additionally, we used s135s to formally request some additional planned network deployment data for TAR in August-September 2024. This is explained in Paragraph A7.10 in more detail.

Table A7.5: list of providers we collected fixed network data from.

- 1310
- 4thUtility
- Airband
- AllPoints Fibre*
- Ask4
- Atlas Communications
- B4RN
- Bogons
- Box Broadband
- brsk*
- BT
- CityFibre*
- Community Fibre*
- Connect Fibre
- Connexin
- Country Connect
- County Broadband
- F&W Networks
- FibreNest
- FibreSpeed
- Fibrus*
- Freedom Fibre
- Full Fibre
- Fusion Fibre Group
- G.Network
- Gigaclear*
- Glide Business
- GoFibre
- Grayshott Gigabit
- Hampshire Broadband
- Hyperoptic*
- ITS Technology Group
- KCOM
- Lightspeed
- Lothian Broadband Networks
- MS3
- Michaelston y Fedw Internet
- Netomnia*
- nexfibre*
- OFNL
- Ogi
- Openreach*
- Orbital Net
- Quickline Communications
- Sky
- TalkTalk Communications, t/a PlatformX
- TalkTalk Telecom
- Technological Services
- Telcom Infrastructure
- Toob*
- Trooli*
- Truespeed*
- VMO2*
- Vodafone
- Voneus
- Wessex Internet
- WightFibre*
- Wildanet
- York Data Services
- Zzoomm*

*Note: providers marked with * are those who were sent the supplementary TAR26 s135 notices referred to at Paragraph A7.10 to collect additional information on planned network coverage. Two providers ([✂]) held the data requested and were therefore able to provide it to us in response to the supplementary TAR26 s135 notice.*

A8. Choice of anchor products

A8.1 In Volume 4 we assess options relating to the charge control on WLA services. One of these options is pricing continuity, which involves charge controlling an 'anchor' WLA product.

A8.2 In this Annex, we consider what specific product represents continuity with our approach to the anchor used in previous market reviews. We have considered whether to update the anchor product to reflect developments in the WLA market, end-user preferences and demand.

Approach to the choice of anchor product in previous market reviews

A8.3 We introduced anchor product regulation in the 2018 WLA Statement, and continued this approach in the WFTMR21.

A8.4 In the 2018 WLA Statement, we introduced a charge control on the FTTC 40/10 rental charge (and FTTP at the same price for homes served only by FTTP), which were the products Openreach used to meet its Virtual Unbundled Local Access (VULA) obligations.

a) We performed analysis to ensure that this anchor would protect consumers.[116]

b) We had regard to key objectives relating to investment. In particular, preserving the investment incentives faced by competitors to Openreach to build their own networks where viable, and preserving the investment incentives faced by BT/Openreach by applying the 'fair bet'.[117]

A8.5 We noted the tension between these objectives and the need to find an appropriate balance. Ultimately, we concluded that the balance would be achieved by a charge control on the FTTC 40/10 product, allowing pricing flexibility on higher speed products.[118]

A8.6 The WFTMR21 continued the approach of using an anchor charge control on FTTC 40/10, and FTTP 40/10 where FTTC was not available. As part of our assessment of pricing continuity, we considered:

a) The impact on investment, both by altnets and Openreach.[119]

b) Whether consumers would be sufficiently protected.[120]

A8.7 Given our objectives are unchanged from 2021, we consider that our underlying approach to the anchor product remains relevant for this review period.

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[116] Ofcom, 2018. Wholesale Local Access Statement, Volume 1, Paragraphs 9.90-9.93.
[117] Ofcom, 2018. Wholesale Local Access Statement, Volume 1, Paragraph 9.10.
[118] Ofcom, 2018. Wholesale Local Access Statement, Volume 1, Paragraph 9.25. We also noted that BT's 'fair bet' on FTTC had already been recouped.
[119] Ofcom, March 2021, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26. Volume 4, Paragraphs 1.19-1.42.
[120] Ofcom, March 2021, Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26., Volume 4, Paragraphs 1.43-1.59. We also considered whether there was a risk that Openreach might engage in a margin squeeze strategy, taking into account the substitutability of our anchor for higher speed broadband products (Paragraphs 1.60-1.61).

A8.8 Continuity of this approach involves adopting a basic superfast broadband product as the anchor that promotes investment by Openreach and competing networks while sufficiently protecting consumers.[121]

A8.9 In this annex we consider which of the following options best reflects these principles:

i) Retaining 40/10 for both FTTC and FTTP as the anchor, as implemented in the March 2021 Statement (**Option 1**).
ii) Shifting the anchor to 80/20 for both FTTC and FTTP (**Option 2**)

A8.10 Below we consider the implications of these options for investment and the protection of consumers, taking into account the evidence we have collected on the market dynamics and consumer preferences, before setting out our provisional conclusions. This allows us to identify the option that maintains continuity with the approach used in previous market reviews while taking into account the subsequent changes in the market.

Implications for investment

A8.11 We expect that applying the anchor charge control to either 40/10 or 80/20 products, as part of a pricing continuity approach, would have fairly similar impacts on investment.

A8.12 However, multiple stakeholders have expressed concerns that Openreach may raise FTTC 80/20 prices, and [✂] in particular is concerned about Openreach raising prices in response to ISPs signing commercial agreements with altnets. The threat of such behaviour may deter ISPs from using altnet FTTP (including limiting the number of altnet orders where a wholesale agreement is in place) which would likely harm altnet investment incentives.

A8.13 While the mix of FTTC products that different ISPs buy from Openreach varies, overall FTTC 80/20 is currently a more important product than FTTC 40/10. We forecast that this will remain the case over the review period.

A8.14 An FTTC 80/20 anchor price that provides continuity with Openreach's current, discounted FTTC price may provide ISPs that use altnets with more protection from retaliation by Openreach. This in turn would help preserve altnet investment incentives.

Implications for consumer protection

A8.15 When considering whether the anchor sufficiently protects consumers, it is important to look forward towards the likely position during the 2026-31 review period. An anchor charge control protects consumers in the following ways:

a) The charge control protects consumers by providing direct price protection, capping the price of the anchor product.

b) The charge control also has an indirect effect, as the potential for substitution to the charge-controlled anchor product constrains the price of the other non-anchor products in Openreach's portfolio.

[121] FTTC 40/10 was considered a 'basic SFBB' product during WLA 2018 and again in WFTMR21, with products offering 80 Mbit/s and above considered 'higher speeds'.

A8.16 We recognise that Option 1 and Option 2 will apply a stronger constraint on products with roughly similar speeds than those with much higher speeds (such as 500 Mbit/s or 1Gbit/s services). In particular, 80/20 is likely to impose a stronger constraint on higher bandwidth products than 40/10, simply because it is closer in speed to those products.

A8.17 In WLA Area 2, competition from altnets may provide an extra degree of protection for end-users. However, in WLA Area 3 where material and sustainable competition is not expected to emerge, there is a greater reliance on the charge-controlled anchor product to protect consumers.

A8.18 Below we discuss the evidence underlying our proposal before setting out our provisional conclusions.

Survey evidence on customer demand and preferences

A8.19 As part of our analysis on broadband end-user demand, willingness to pay and preferences, we gathered customer survey data conducted by communications providers as well as data relating to customer's upgrade and downgrade activity.

A8.20 The following consistent messages emerged.

a) Price and reliability of service, which include adequate and consistent speeds, are by far the most important considerations to consumers when they are selecting their broadband products.[122]

b) Despite price being a vital concern for customers, they are very unlikely to downgrade their broadband speed in the face of cost-of-living pressures or to save money.[123] To convince a customer to downgrade their service, the price differentials have to be very large.[124]

c) Broadband customers are using the internet more intensely since the COVID-19 pandemic. Family households and particularly affluent families, are the most likely to be engaging in high bandwidth or data intense activities such as streaming or gaming, which indicates they may require more expensive faster speed services.[125]

d) Many workers still work from home, and a significant proportion of those are working up to 4 days a week from home, placing an additional importance on the quality and reliability of their home broadband connection.[126]

A8.21 Under Option 2, consumers on higher speeds will be more adequately protected through a greater substitution effect with the 80 Mbit/s product, than if the anchor were retained at 40 Mbit/s under Option 1.

A8.22 Actual downgrade and upgrade data collected from providers also supports the view that customers tend to upgrade their speed in a stepwise manner. Once customers purchase a

[122] [✂] response dated [✂] to s135 notice dated [✂], question [✂]
[123] [✂] response dated [✂] to s135 notice dated [✂], question [✂]
[124] [✂] response dated [✂] to s135 notice dated [✂], question [✂]
[125] [✂] response dated [✂] to s135 notice dated [✂], question [✂]
[✂] response dated [✂] to s135 notice dated [✂], question [✂]
[126] [✂] response dated [✂] to s135 notice dated [✂], question [✂]

service at a given speed level, the majority do not downgrade to a lower speed with their existing provider.[127]

A8.23 In summary:

a) Price is important to consumers. As a result, a suitable anchor can indirectly constrain the price of other Openreach WLA products.

b) For an anchor product to offer sufficient protection to consumers it should be a product that customers willingly would choose should prices on other products rise, as well as one that meets their minimum bandwidth requirements. The reluctance of consumers to downgrade to a slower product suggest that Option 2 (an 80/20 anchor) is likely to offer a greater constraint on higher speed services than Option 1 (a slower 40/10 anchor).

Current Openreach pricing and discounts

A8.24 Almost all Openreach FTTP is sold pursuant to its Equinox 2 offer. As a result the Equinox 2 prices represent the market prices for Openreach FTTP services, rather than Openreach's list prices.

A8.25 For FTTC services, Openreach introduced a discount program that initially was conditional on providers meeting volume thresholds, one of which was for orders of 80/20 Mbit/s and above. This became unconditional in 2021 and has since been extended on rolling 6 monthly intervals until its current end date, 31 March 2026, the end of the current regulatory period.

A8.26 The effect these discount programs had on flattening Openreach's FTTC and FTTP prices is shown in Table A8.1, which shows discounts of 20% and above on services 80 Mbit/s or faster across all technologies.

Table A8.1: Openreach wholesale price list and discounts (2024-25 prices, selected products)

	Annual Rental List Price	Annual Rental Discounted Price	Discount
40/10 FTTC*	£177.23	N/A	
55/10 FTTC*	£227.23	£191.11	16%
80/20 FTTC*	£255.36	£191.11	24%
160/30 FTTC*	£272.35	£218.95	20%
40/10 SOGEA	£177.23	N/A	
55/10 SOGEA	£227.04	£191.16	16%
80/20 SOGEA	£249.72	£191.16	23%
40/10 FTTP	£201.91	N/A	

[127] [✂] response dated [✂] to s135 notice dated [✂], question [✂]

	Annual Rental List Price	Annual Rental Discounted Price	Discount
80/20 FTTP	£253.44	£194.52	23%
160/30 FTTP	£310.20	£203.28	34%
550/75 FTTP	£400.08	£239.28	40%
1000/115 FTTP	£458.76	£264.12	42%

*Note: * FTTC price includes £104.11 annual rental charge for MPF SML1 (charge controlled).*

Source: Openreach FTTP, FTTC, SOGEA published price lists, Equinox 2 offer price list, Special Offer on FTTC and SOGEA price list.

A8.27 The result of both discounting programs was that large volumes of customers were directed away from 40/10 products and towards higher speed tiers. For example, Openreach's Equinox 2 discounting program incentivised communications providers away from selling the regulated FTTP 40/10 product, as higher speeds could be offered for cheaper or equivalent amounts, leaving the anchor FTTP product with very low take-up.

A8.28 Whether Option 1 or Option 2 sufficiently protects consumers depends on the extent to which 40/10 or 80/20 products indirectly constrain other products. The historical pricing evidence presented above does not offer definitive evidence of substitutability, particularly when looking forward to the period 2026-31. That said, we have drawn the following tentative inferences.

A8.29 The narrowing pricing differential between products of 160 Mbit/s and below may suggest that there is an element of substitutability between these products, and that if the price of one variant in this bracket of products were out of line with the others, then consumers would opt for something else.

A8.30 As consumers migrate to higher bandwidth services on FTTP (above 160 Mbit/s), the indirect constraint from a lower speed anchor could reduce. This is because users of these products are likely to be looking for higher speeds for particular use cases, and so maybe less willing to downgrade to a lower speed anchor.

Current and forecast volumes on Openreach's network

A8.31 The following section makes reference to the Ofcom WLA forecasts, which are discussed in further detail in Annex 14.

A8.32 Between the start and end of the review period, we forecast around 8.4 million subscribers will move off the Openreach legacy network either onto Openreach FTTP or alternative networks. Despite this the two major legacy speeds, 40 Mbit/s and 80 Mbit/s, will continue to be relevant over the review period. In particular, 80 Mbit/s is expected to continue to remain the major legacy speed tier.

A8.33 If the anchor product is shifted to FTTC or SOGEA 80/20 under Option 2, the updated charge control is likely to be directly protecting the majority of consumers on legacy technologies. Option 1 is likely to directly protect roughly 30% of legacy customers.

A8.34 Based on our WLA volume forecasts, we are expecting a continued, significant flow of customers to [✂] FTTP services of 100 Mbit/s and above over the review period as

customers upgrade from legacy technologies. It is therefore important to consider the level of constraint that an anchor charge control would place on FTTP services of 100 Mbit/s and above [✂], given [✂]

A8.35 The anchor product could potentially constrain prices of FTTP [✂] services of 100 Mbit/s and above even if these FTTP [✂] consumers are reluctant to downgrade. This is because, if the price of FTTP [✂] services of 100 Mbit/s and above were to rise significantly, the flow of customer upgrades to these products would be slowed. These effects provide an indirect constraint on the price [✂] of these services. We consider that Option 2 is likely to exert a stronger constraint on this flow of customers into FTTP [✂] services of 100 Mbit/s and above, than Option 1. Customers would have a more suitable alternative if the anchor were 80/20, rather than if 40/10 was the charge-controlled product. Customers may delay their decision to upgrade from 80/20 legacy services if FTTP [✂] services of 100 Mbit/s and above increased in price.

A8.36 Our WLA forecasts also show that higher speed products with download speeds of 500 Mbit/s or greater will become more popular during the review period, with these speeds forecast to be [✂] 25-50% of Openreach's FTTP volumes in FY29. We recognise that both our proposed anchors are likely to provide a more limited constraint on these much faster products.[128]

Trends in bandwidth demand

A8.37 As explained above, to identify an anchor product that would sufficiently protect consumers it is important to look forward to the likely position over the 2026-31 review period. There has been significant growth in data usage as well as the demand for speed over the last 5-7 years, and we expect further growth as consumers continue to use their fixed-line broadband more intensely and in more ways.[129]

A8.38 In order to continue to be a reasonable choice for consumers and therefore continue to protect consumers from price rises on other products in the Openreach portfolio, it is important that the product selected as the anchor keeps pace with how end-users are using their broadband service. In this case, shifting the anchor to 80/20 services would surpass the current median fixed broadband speeds, and provide better protection for consumers as the demand for bandwidth grows, rather than retaining the anchor on 40/10.[130]

[128] As explained above, the anchor will indirectly constrain the price of FTTP [✂] services of 100 Mbit/s and above to some degree. These FTTP [✂] services may then impose a limited constraint on higher bandwidth services.
[129] Ofcom. 5 December 2024. Connected Nations UK report 2024, Pages 13-15
[130] Ofcom. 14 September 2023. UK Home Broadband Performance, Page 3

Provisional conclusion on consumer protection

A8.39 Having considered the evidence above, an 80/20 anchor (Option 2) is more likely to sufficiently protect consumers than a 40/10 anchor during 2026-31.

A8.40 We recognise that the constraint 80/20 exerts on the fastest Openreach broadband variants, such as FTTP 550/75, may be limited (albeit stronger than a 40/10 anchor). Nonetheless, we consider that it will sufficiently protect broadband customers as a whole.

Provisional overall conclusion on the anchor product

A8.41 As explained above, Option 2 (shifting the anchor to 80/20) reflects the underlying approach taken in past market reviews better than Option 1 (retaining the anchor on 40/10), both in terms of the impact on investment and in terms of sufficiently protecting consumers.

A8.42 Accordingly, in Volume 4 the option of maintaining pricing continuity for WLA services involves an 80/20 anchor.

A9. Leased lines geographic analysis

A9.1 In this Annex we describe the data analysis that we have carried out in relation to the LLA and IEC markets.

A9.2 We first cover:

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

A9.3 We then set out the methodologies we adopted in carrying out the following elements of our analysis:

- **network reach analysis,** used to determine the location of competing networks and their proximity to users of LLA services;
- **LLA provisions analysis**, used to calculate market shares and other measures of competitive market conditions in the provision of LLA services; and
- **IEC proximity analysis,** used to identify the proximity of BT exchanges to PCOs' networks.

A9.4 At the end of each methodology subsection, we set out the results that we draw on in reaching our provisional conclusions in our market analysis, as set out in Volume 2, Section 5.[131]

Input data

A9.5 In this subsection we describe the data inputs we used. All data supplied by telecoms providers was obtained using our formal information gathering powers.

Postcode data

A9.6 We used the Ordnance Survey Code-Point with Polygons dataset from July 2024[132] and the Office for National Statistics Postcode Directory dataset from May 2024.[133] This postcode data is used to determine the locations of demand sites (see below) and LLA circuit ends.

[131] We refer to our IEC proximity analysis in Volume 2, Section 6.
[132] See: Ordnance Survey. 2025. Code-Point with Polygons. Accessed on 10 March 2025.
[133] See: Office for National Statistics. 2024. ONS Postcode Directory (May 2024) for the UK. Accessed on 10 March 2025.

Physical network infrastructure data

A9.7 We asked LLA providers[134] to supply details of their physical networks as set out in the following paragraphs.

Flexibility points

A9.8 We asked providers to provide the location of all their network flexibility points. These are the points where existing physical links can be accessed to connect an end-user premises using a customer-specific network extension, and from which the provider would consider, within its current network planning practice, extending its network reach to provide services to additional end-user premises. Examples of flexibility points include buildings where fibre terminates on an optical distribution frame or underground chambers where fibre can be accessed, such as where ducts meet at a junction.

Duct maps

A9.9 We asked providers other than Openreach to supply digital maps of their entire duct networks.

Network sites

A9.10 We asked providers for a list of all their network sites. Network sites are locations in a provider's network where it has installed transmission equipment used for leased lines (or other connectivity services) and which are capable of serving more than one business customer. A network site can be a data centre or a location in a provider's network that is not an end-user site, such as a local exchange or a network aggregation node. We asked for the location of each network site, a brief description of the nature of the site, and whether it coincides with a customer site.

Network expansion plans

A9.11 We also asked providers for details of their plans for network expansion. Most stated that they had no specific network expansion plans (beyond customer-specific requests). [✂] stated that it had no planned network expansion but provided a list of postcodes where it would potentially infill its network to connect customers. [✂] stated that customer expansion would be on a case-by-case basis. [✂] stated that any future expansion would be restricted to customer-driven opportunities or rerouting of their network. Some providers submitted network expansion plans that were not specific to leased lines services. [✂] said it intended for business connectivity products to be delivered over its shared full fibre network. [✂] said that its future supply of leased lines would be driven by its existing network. [✂] provided plans for its network expansion but highlighted the uncertainties and limitations of the data, stating that network elements reported as planned may in fact be due to be built, may never be built or may already have been built. [✂] identified cities where it planned to expand its network.

[134] CityFibre, Colt, eircom, euNetworks, EXA, FibreSpeed, ITS, KCOM, Lumen, MS3, National Grid Telecoms, Neos, Nexfibre, Openreach, Verizon, VMO2, Vodafone, Vorboss, and Zayo.

Combined physical network infrastructure data

A9.12 We have used duct maps together with flexibility points to represent the location of networks in our network reach analysis.

A9.13 We have used network sites to identify the site type of leased lines circuit ends (see below).

LLA demand sites data

A9.14 We have sought to identify the locations of demand for LLA connectivity in the review period. We consider that the demand is likely to be driven by the following types of sites:

- sites of large businesses;
- mobile cell sites; and
- data centre access sites.

A9.15 We describe below the data used for each type of sites.

Sites of large businesses

A9.16 To identify business premises that are likely to demand LLA connectivity in the review period, we have focused on the current location of the sites of large businesses. We note that individual business sites may or may not demand LLA services in the review period. However, we consider that their locations provide the most relevant representation of the areas where the demand is likely to come from.

A9.17 We used the CACI D&B Business Data dataset from July 2024[135] to identify the sites of businesses with 250 or more employees nationally. As this dataset contains the postal address of each site, we identified the postcode of each site and used the postcode centroid to approximate the site's location. We consider this to be a proportionate way of representing each site's location. We also used this approach in the WFTMR21, albeit on a different dataset.

Mobile cell sites

A9.18 MNOs use leased lines to connect mobile cell sites to their core network (mobile backhaul).

A9.19 We asked BT/EE, Three, VMO2, and Vodafone, as well as Mobile Broadband Network Limited (MBNL) for data relating to BT/EE and Three, to provide an inventory of all live leased lines (including microwave links) that they self-supply and all live leased lines, duct, and dark fibre that they purchase from other parties for mobile backhaul.

A9.20 We used this data to construct a list of mobile cell sites.

Data centre access sites

[135] CACI. July 2024. D&B Business Data for Ofcom. The dataset is used subject to the following attributions:

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- © CACI 2024.

A9.21 We asked providers[136] for a list of all data centres[137] for which they have leased lines connectivity, whether they own that data centre or not. For each data centre, we asked for the name, operator, location and whether it is being used by the provider for aggregation and/or onward routing purposes[138] or is more akin to an end-user site (i.e. there is no aggregation or onward routing).

A9.22 Using this information, we identified data centres that are akin to an end-user site (data centre access sites), which we used in creating a list of demand sites.

Combined demand sites data

A9.23 We combined data on the location of the sites of large businesses, mobile cell sites and data centre access sites to create a list of modelled LLA demand sites.

Table A9.1: Summary of modelled LLA demand sites by category

Type of demand site	Number	Percentage
Sites of large businesses	98,454	64.7%
Mobile cell sites	53,044	34.8%
Data centre access sites	759	0.5%
Total	**152,257**	**100%**

Source: Ofcom analysis of CACI D&B Business Data and provider data.

Leased lines provisions data

A9.24 We asked providers to provide a list of all leased lines and dark fibre circuits that they connected to customers in 2020 to 2023. The information provided in relation to these circuits includes:

- circuits supplied to business customers, MNOs or other telecoms providers;
- newly connected circuits, and upgrades or regrades to existing circuits;
- on-net and off-net circuits; and
- services supplied using any of the following interfaces:
- Ethernet (other than EFM);
- WDM (incl. DWDM);
- SDH/PDH;
- EFM;
- SDSL;
- analogue; and

[136] BT, CityFibre, Colt, eircom, euNetworks, EXA, FibreSpeed, ITS, KCOM, Lumen, MS3, National Grid Telecoms, Neos, nexfibre, Sky, TalkTalk, Verizon, VMO2, Vodafone, Vorboss, and Zayo.
[137] Premises whose main purpose is to house computing, data and application hosting, and communications equipment. They tend to have multiple tenants and may be owned and operated by carriers and/or run by third-party providers that are carrier neutral. A carrier neutral data centre is owned and operated entirely independently of network providers and allows interconnection to and between multiple telecoms providers.
[138] This can include, for example, core and backhaul aggregation and traffic routing functionality as well as being used for interconnection to or between other telecoms providers' networks present at the data centre.

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

A9.25 We used this data to create the leased lines provisions dataset, containing all leased lines and dark fibre circuit ends connected by providers in 2020 to 2023.[139]

Data cleaning

A9.26 In this sub-section, we describe the steps involved in using our input data to create the leased lines provisions dataset we need for our analysis. The key steps are:

- identifying and excluding all circuits that are not in the LLA product market;
- removing duplicate dark fibre circuits;
- ensuring all circuits are classified as either being supplied by the network operator or being purchased from a third party;
- identifying the location of each circuit end;
- excluding circuit ends that do not connect to access sites;
- identifying the bandwidth sold to the customer; and
- identifying how the circuit was connected (e.g. whether and what type of build activity was required).

A9.27 We discuss these in turn below before describing our output dataset.

Identifying and excluding circuits not in the proposed LLA product market

A9.28 We looked for key words of products, bandwidths, interfaces and physical links that we wanted to exclude from the leased lines provisions dataset. We assumed that any circuits not flagged in this way for exclusion were in the proposed LLA product market.

A9.29 We excluded:

- circuits classed as analogue, PDH/SDH,[140] time division multiplex (TDM), radio base station (RBS) and legacy analogue traditional interface (TI) products;
- circuits with bandwidths of 2 Mbit/s or less, as they are indicative of legacy products;
- Cablelink circuits, as these are only used for access to network equipment within a BT exchange or to connect to infrastructure close to a BT exchange, which means that they are not LLA circuits;
- network-to-network interface products, as these are not LLA circuits;
- leased lines products used only for connectivity between BT exchanges (EBD);
- leased lines used for specialist applications such as Broadcast and Street Access;

[139] We did not ask for a full inventory of leased lines circuits given previous concerns in relation to the quality of the data held by network operators. See: Ofcom. 2019. Promoting competition and investment in fibre networks: review of the physical infrastructure and business connectivity markets. Annex 12. Paragraphs A12.70 to A12.74.

[140] Plesiochronous / synchronous digital hierarchy.

- business-grade connectivity services provided over Ethernet in the first mile (EFM) and asymmetric broadband (DSL, FTTx, G-PON);[141]
- wavelength division multiplex (WDM) individual wavelengths, as their presence would lead to double counting of circuits; and
- circuits transmitted via copper, radio/microwave or satellite, as these are not included in our proposed product market.

A9.30 Many of these excluded circuit types had low volumes. Table A9.2 shows that this step resulted in 13% of circuit ends in the leased lines provisions dataset being excluded.

Table A9.2: Leased lines products identification

Circuit end observations*	Number	Percentage
LLA products	710,126	87%
Non-LLA products	103,621	13%
Total	**813,747**	**100%**

Source: Ofcom analysis of provider data.

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

Removing duplicate dark fibre circuits

A9.31 Dark fibre circuits sold to other leased lines providers appear in the raw data twice: once as a dark fibre circuit for the supplier, and again as a leased line circuit for the provider who purchased it. To avoid double-counting, we excluded all dark fibre circuits sold to other providers.

A9.32 Table A9.3 shows that this step resulted in 2,719 dark fibre circuit ends being removed.

Table A9.3: Dark fibre identification

Circuit end observations*	Number	Percentage
LLA products	710,126	100%
Dark fibre supplied to other providers	2,719	0.4%
LLA products excluding dark fibre supplied to other providers	707,407	99.6%

Source: Ofcom analysis of provider data.

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

[141] See Volume 2, Section 5.

telecoms provider who supplies it using their own network and as "off-net" for the purchasing telecoms provider.

Classifying all circuit ends as on-net or off-net

A9.33 The majority of circuit ends were identified as being on-net or off-net in the data set. Where circuit ends were not identified as being supplied either on-net or off-net, we included them as on-net in our wholesale service share analysis (to the extent we were able to identify their geographic location – see below). Table A9.4 shows that 10% of circuit ends of LLA products excluding dark fibre supplied to other providers were classified in this way.

Table A9.4: On-net and off-net circuit ends

Circuit end observations	Number	Percentage
LLA products excluding dark fibre supplied to other providers	707,407	100%
On-net	570,730	81%
Off-net	66,349	9%
Unclassified	70,328	10%
LLA products wholesale (on-net and unclassified)	641,058	91%

Source: Ofcom analysis of provider data.

Identifying the location of each circuit end

A9.34 The first step was to ensure the postcodes provided were in a valid UK postcode format and to convert the coordinates provided into the British National Grid coordinate reference system (CRS). We then proceeded in the following steps:

a) Where we were provided only coordinates for a circuit end, we mapped the coordinates to the Ordnance Survey postcode polygons to retrieve the corresponding postcode.[142]

b) Where we were provided coordinates and postcodes for a circuit end, we validated whether the postcode was active against the Office for National Statistics Postcode Directory (ONSPD). For active postcodes we took the postcodes as given. For inactive postcodes, we mapped the coordinates provided to the Ordnance Survey postcode polygons to retrieve the corresponding active postcode.

c) Where we were provided only postcodes, we retrieved the postcode centroid from the ONSPD.[143] For inactive postcodes we mapped the postcode centroid to the Ordnance Survey postcode polygons to retrieve the corresponding active postcode.

A9.35 The results of postcode validation exercise are presented in Table A9.5.

Table A9.5: Missing and available postcodes

	Number	Percentage
LLA products excluding dark fibre supplied to other providers, of which:	707,407	100%
Missing postcode	32,757	5%
Available postcode	674,650	95%

Source: Ofcom analysis of provider data.

A9.36 We have noted the circuit ends with missing postcode data as having an unknown location in our final dataset.

Excluding circuit ends that do not connect to leased line access sites

A9.37 This step involves excluding circuit ends that are not within the access layer, i.e. those ends of circuits that do not connect to end-users. Specifically, those are circuit ends that correspond to BT exchanges, KCOM exchanges, network site data centres and other network sites.

A9.38 We asked network operators to identify whether each circuit end terminates in an end-user site or a network site. Where network operators did not provide this information, we used information on the postcodes of network operators' network sites to identify circuit ends connected to those network sites

[142] The Ordnance Survey postcode polygons draw boundaries between postcode units. The Thiessen process creates a set of polygons around individual Royal Mail Postal addresses within a postcode, creating consistent boundaries between postcode groups.

[143] The postcode centroid is the mean location of addresses in a postcode snapped to the nearest property.

A9.39 Table A9.6 shows that this step resulted in the exclusion of around 49% of circuit ends in the leased lines provisions dataset.

Table A9.6: Network sites and leased line access sites

	Number	Percentage
LLA products excluding dark fibre supplied to other providers, of which:	707,407	100%
Network sites	344,074	49%
Leased line access sites	349,465	49%
Unknown*	13,868	2%

Source: Ofcom analysis of provider data.
**Circuit ends with missing postcodes where the data provider has not identified the circuit end type.*

Bandwidth sold to the customer

A9.40 This step involved standardising the format of the information provided on the sold bandwidth used to define the bandwidth categories in the service share analysis. The process involved using regular expressions to identify the number provided in the bandwidth field. We assumed the number provided to be Mbit/s unless otherwise stated (in which case we converted to Mbit/s).

A9.41 For 20% of circuit ends in the leased lines provisions dataset, the bandwidth information was missing.

How the circuit end was connected

A9.42 For each on-net and dark fibre circuit end, we asked providers whether they used new blown fibre, new fibre cable, new tubing or new duct. In addition, for the connections that involved the installation of any of these infrastructures, we asked for information on the actual distance dug, the length of fibre cable or tubing installed and the length of blown fibre.

A9.43 The extent of information supplied by providers varied greatly, with some able to provide details of distances for individual circuit ends or circuits,[144] others only providing partial or aggregated data,[145] and some unable to provide any data at all on how individual circuits or circuit ends were connected. [✂]

[144] For data provided by circuit rather than circuit end, we had to make some assumptions to map this data to circuit ends for the purpose of our analysis. Where we identified only one end of the circuit to be an access end, we attributed the build data to this access end. Where we identified both ends to be access ends, we assigned the build to each end with a 50% probability. Where both ends were identified as non-access, the build was not relevant to our analysis.
[145] Where data was provided on how a circuit end was connected but not on the distance, we have included it in our analysis of the proportions of circuit ends that required build activity but were unable to use it for the analysis of build distances.

Output dataset

A9.44 Following the above steps, we created an output dataset including only circuit ends in the LLA product market. This dataset has 363,333 circuit ends.

A9.45 Table A9.7 below shows that the LLA provisions dataset contains a small proportion of circuit ends for which we are missing information on key variables. For example, for 9% of circuit ends we do not know whether these were on-net or off-net.

Table A9.7: Proportion of LLA circuit ends with unknown values of key variables

	Number	Percentage
LLA circuit ends, of which:	363,333	100%
Unknown if on-net or off-net	34,121	9%
Unknown location	11,571	3%
Unknown bandwidth	67,157	18%

Source: Ofcom analysis of provider data.

Network reach analysis

A9.46 Using the LLA demand sites dataset and the physical network infrastructure dataset, we conducted our network reach analysis to determine the scale and location of competing network deployment.

A9.47 In this analysis, we determined the number of competing networks located within 50m of each modelled demand site. We then classified each postcode sector based on whether at least 65% of its demand sites were located within 50m of zero, one or two or more competing networks. For example, a postcode sector with 50% of its demand sites located within 50m of two or more competing networks, 75% within 50m of one or more competing networks, and 100% within 50m of zero or more competing telecoms infrastructure providers, would be classified as BT+1.

A9.48 Some postcode sectors did not have any demand sites located within their boundaries. For these postcode sectors we notionally assigned each postcode a demand site located at the postcode centroid for the purposes of our geographic market classification. This ensures that competing network 'presence' is identified in these postcode sectors. The numbers of postcode sectors with no demand sites in each of our proposed geographic markets are summarised in Table A9.8 below.

Table A9.8: Postcode sectors with no demand sites

Geographic market	Total number of postcode sectors	Number of postcode sectors with no demand sites	Proportion of postcode sectors with no demand sites
HNR Area	935	111	12%
Area 2	4,208	296	7%
Area 3	4,591	282	6%

Source: Ofcom analysis of CACI D&B Business Data and provider data.

A9.49 The results of this analysis are set out in Volume 2, Section 5 and the postcode sectors making up the geographic markets that we have provisionally identified can be found in Schedule 3. Below we provide results on the following:

- the average number of competing networks by geographic market; and
- the proportion of demand sites within 50m of a given number of competing networks by geographic market.

Postcode sectors inside the CLA

A9.50 We have identified one postcode sector (E22 2) that was not included in the WFTMR21 and is located inside the area of another postcode sector (E14 9) classified as part of the CLA in the WFTMR21. As this new postcode sector is located in an area that we previously found to be effectively competitive in the WFTMR21, we consider it forms part of the CLA area that we previously deregulated. We have therefore not included it in our current market review and instead classified it as part of the CLA.

Average number of competing networks

A9.51 Tables A9.9 and A9.10 show the average number of competing networks within 50m of demand sites (i.e. for each demand site we identify the number of competing networks within 50m and then calculate an average for all demand sites in each geographic market), for each of our proposed geographic markets and for proposed HNR Area in major cities, respectively.[146]

Table A9.9: Average number of competing networks within 50m of demand sites for each geographic market

Geographic market	Average number of material and sustainable competitors within 50m	
	Current	Current and potential future
HNR Area	2.64	2.92
Area 2	1.15	1.43
Area 3	0.32	0.35

Source: Ofcom analysis of provider data.

[146] In Volume 2, Section 5 we sometimes refer to this as "network presence" for shorthand.

Table A9.10: Average number of competing networks within 50m of demand sites, for HNR Area postcode sectors in major cities

Area	Average number of current material and sustainable competitors within 50m
Liverpool	2.58
Manchester	3.58
North London	2.49
Birmingham	3.05
South West London	2.34
North West London	2.91
South East London	3.07
West London	3.32
Glasgow	2.57
East London	3.23
All other areas	2.39
Total for HNR Area	2.64

Source: Ofcom analysis of provider data.

A9.52 In Volume 2, Section 5, we assess competitive conditions in postcode sectors where the average number of rival networks present is materially higher than in other HNR postcode sectors, using the number of rival networks present in the 2021 CLA market as a reference point. We identified postcode sectors in which the average number of current material and sustainable competitors is greater or equal to the average of the 2021 CLA market (which was 5.1 networks).[147] There are 10 postcode sectors that meet this threshold. Of these, five are located in various parts of Greater London and five are located in Manchester. Table A9.11 provides an overview of these postcode sectors.

Table A9.11: Postcode sectors in the HNR Area with average network reach at or above the level of the 2021 CLA market

Postcode sector	Average number of current material and sustainable competitors within 50m
[✂]	5.33
[✂]	5.25
[✂]	5.60
[✂]	5.14
[✂]	5.57

[147] Ofcom. March 2021. Statement: Promoting investment and competition in fibre networks: Wholesale Fixed Telecoms Market Review 2021-26 – Volume 2: Market Analysis. Table 7.6.

Postcode sector	Average number of current material and sustainable competitors within 50m
[✂]	5.20
[✂]	5.38
[✂]	5.55
[✂]	5.14
[✂]	6.00

Source: Ofcom analysis of provider data.

Proportion of demand sites within 50m of N competing networks

A9.53 Tables A9.12 and A9.13 show the proportion of demand sites within 50m of a certain number of competing networks, for each of our proposed geographic markets and for proposed HNR Area postcode sectors in major cities, respectively. Areas of higher competition will see a higher proportion of demand sites within 50m of a higher number of competing networks.

Table A9.12: Proportion of demand sites within 50m of at least a certain number of competing networks, for each geographic market

Geographic market	Number of current (and potential future) material and sustainable competitors within 50m distance									
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+
HNR Area	100% (100%)	96% (96%)	82% (84%)	46% (54%)	23% (30%)	11% (15%)	5% (7%)	2% (3%)	1% (1%)	0% (0%)
Area 2	100% (100%)	82% (88%)	24% (38%)	6% (11%)	2% (3%)	1% (1%)	0% (0%)	0% (0%)	0% (0%)	0% (0%)
Area 3	100% (100%)	24% (26%)	6% (7%)	2% (2%)	0% (1%)	0% (0%)	0% (0%)	0% (0%)	0% (0%)	0% (0%)

Source: Ofcom analysis of provider data.

Table A9.13: Proportion of demand sites within 50m of at least a certain number of competing networks, for HNR Area postcode sectors in major cities

Area	Number of current material and sustainable competitors within 50m distance										
	0+	1+	2+	3+	4+	5+	6+	7+	8+	9+	10+
Liverpool	100%	98%	87%	48%	20%	5%	0%	0%	0%	0%	0%
Manchester	100%	94%	85%	72%	52%	34%	17%	4%	1%	0%	0%
North London	100%	98%	83%	38%	19%	6%	2%	1%	0%	0%	0%
Birmingham	100%	98%	86%	57%	39%	19%	5%	1%	0%	0%	0%
South West London	100%	95%	79%	41%	14%	4%	1%	1%	0%	0%	0%
North West London	100%	97%	85%	54%	27%	15%	8%	3%	1%	0%	0%
South East London	100%	95%	79%	53%	36%	21%	10%	6%	4%	3%	0%
West London	100%	96%	81%	61%	45%	28%	14%	6%	1%	0%	0%
Glasgow	100%	97%	85%	46%	18%	10%	1%	0%	0%	0%	0%
East London	100%	95%	80%	60%	39%	26%	15%	5%	2%	0%	0%
All other areas	100%	95%	80%	39%	16%	6%	2%	1%	0%	0%	0%
Total for HNR Area	100%	96%	82%	46%	23%	11%	5%	2%	1%	0%	0%

Source: Ofcom analysis of provider data.

LLA provisions analysis

A9.54 In this section we describe the analysis of the LLA provisions data.

Wholesale service shares

A9.55 Using the LLA provisions dataset, we conducted the analysis of Openreach's wholesale service share. Table A9.14 shows the number of LLA circuit ends provisioned and wholesale service shares for individual years 2020 to 2023, and for all four years combined, in each of our proposed geographic markets.

Table A9.14: Number of on-net LLA circuit ends provisioned and wholesale service shares in 2020 to 2023

		Period				
Geographic market	Indicator	2020	2021	2022	2023	2020 to 2023
HNR Area	Number of LLA circuit ends provisioned	11,379	12,133	11,299	11,990	46,893
	Openreach's wholesale service share	61-70% ([✂]%)	61-70% ([✂]%)	61-70% ([✂]%)	61-70% ([✂]%)	61-70% ([✂]%)
	VMO2's wholesale service share	11-20% ([✂]%)	11-20% ([✂]%)	11-20% ([✂]%)	11-20% ([✂]%)	11-20% ([✂]%)
	LL-only providers' wholesale service share	1-10% ([✂]%)	1-10% ([✂]%)	11-20% ([✂]%)	11-20% ([✂]%)	11-20% ([✂]%)
Area 2	Number of LLA circuit ends provisioned	31,737	36,080	31,935	32,003	131,872
	Openreach's wholesale service share	71-80% ([✂]%)	61-70% ([✂]%)	61-70% ([✂]%)	61-70% ([✂]%)	61-70% ([✂]%)
	VMO2's wholesale service share	11-20% ([✂]%)	21-30% ([✂]%)	21-30% ([✂]%)	21-30% ([✂]%)	21-30% ([✂]%)
	LL-only providers' wholesale service share	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)
Area 3	Number of LLA circuit ends provisioned	19,933	22,199	21,978	21,898	86,149
	Openreach's wholesale service share	81-90% ([✂]%)	81-90% ([✂]%)	81-90% ([✂]%)	81-90% ([✂]%)	81-90% ([✂]%)
	VMO2's wholesale service share	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)
	LL-only providers' wholesale service share	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)	1-10% ([✂]%)

Source: Ofcom analysis of provider data.

Note: The number of LLA circuit ends in the period 2020-2023 may exceed the total of the individual years. Some observations were provided for the period with an unknown year. These observations are included in the total for the whole period, but not the individual years.

A9.56 Table A9.15 shows the number of LLA circuit ends provisioned and Openreach's wholesale service share.

Table A9.15: Number of on-net LLA circuit ends provisioned and Openreach's wholesale service share in 2020 to 2023 for postcode sectors in the HNR Area with average network reach at or above the level of the 2021 CLA market

		Period				
Area	Indicator	2020	2021	2022	2023	2020 to 2023
Greater London and Manchester postcode sectors combined	Number of LLA circuit ends	336	316	294	305	1,251
	Openreach's wholesale service share	81-90% ([✂]%)	81-90% ([✂]%)	81-90% ([✂]%)	71-80% ([✂]%)	81-90% ([✂]%)
Greater London postcode sectors	Number of LLA circuit ends	115	105	89	119	428
	Openreach's wholesale service share	71-80% ([✂]%)	61-70% ([✂]%)	71-80% ([✂]%)	71-80% ([✂]%)	71-80% ([✂]%)
Manchester postcode sectors	Number of LLA circuit ends	221	211	205	186	823
	Openreach's wholesale service share	91-100% ([✂]%)	81-90% ([✂]%)	81-90% ([✂]%)	71-80% ([✂]%)	81-90% ([✂]%)

Source: Ofcom analysis of provider data.

Installation of new infrastructure

A9.57 Table A9.16 shows the results of our analysis of the extent of digging by Openreach and competing networks for each of our proposed geographic markets. We calculate the following statistics:

- proportion of LLA circuit ends provisioned in 2020 to 2023 already duct connected ('on-net duct connected')[148], those where digging was required ('on-net dig') and those purchased from a third party (i.e. 'off-net');
- the "build vs. buy" metric which shows the proportion of connections where digging was required compared to those that were purchased from a third party; and
- the median distance dug.

[148] To connect these circuits, network operators may have had to install fibre tubing, blow fibre or use an existing fibre connection to the end-user.

Table A9.16: Analysis of digging behaviour by geographic market and competing networks

Infrastructure indicator		HNR Area	Area 2	Area 3
Openreach's LLA circuit ends provisioned in 2020 to 2023	Number of LLA circuit ends	[✂]	[✂]	[✂]
	Proportion on-net with duct connected	90-100% [✂]%	90-100% [✂]%	90-100% [✂]%
	Proportion on-net with digging required	0-10% [✂]%	0-10% [✂]%	0-10% [✂]%
	Median radial distance dug	0-10m [✂]m	0-10m [✂]m	11-20m [✂]m
Competitors' LLA circuit ends provisioned in 2020 to 2023[149]	Number of LLA circuit ends (off-net and on-net)	[✂]	[✂]	[✂]
	Proportion on-net with duct connected	61%	49%	28%
	Proportion on-net with digging required	7%	12%	5%
	Proportion off-net	31%	38%	65%
	Build vs. buy[150]	18%	24%	8%

Source: Ofcom analysis of provider data.

A9.58 Due to limited data being provided on the dig distances by providers other than Openreach in 2020 to 2023, we were unable to calculate a robust measure of median distance dug by those providers. We note that the data we have received is consistent with the findings in the WFTMR21 that the median dig distances tend to be short across all geographic markets (in all cases less than 20m).[151]

A9.59 We also looked at how digging by networks in the provision of services with bandwidths above 1 Gbit/s, compared with that for services offering bandwidths of 1 Gbit/s and below. We found that over the period 2020 to 2023:

- 7% of new connections for bandwidths above 1 Gbit/s involved some digging compared with 8% for lower bandwidths.

[149] 'On-net with duct connected' is where a telecoms provider has existing duct in place to the customer site, but fibre may need to be installed. 'On-net with digging required' is where a telecoms provider extends their network by building new duct. 'Off-net' is where an active wholesale leased line product is purchased from another provider to reach the customer.

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

[151] Ofcom. March 2021. Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26. Table 8.3.

- as set out above we have limited data available on median dig distance for new connections. For Openreach, we find that the median dig distance for new connections for bandwidths above 1 Gbit/s was 11-20m ([✂]m) compared with 0-10m ([✂]m) for lower bandwidths.[152]

A9.60 Table A9.17 shows an analysis of on-net duct connected LLA circuit ends that required new fibre cable or tubing, and new blown fibre.

Table A9.17: Analysis of on-net duct connected LLA circuit ends

Infrastructure indicator		HNR	Area 2	Area 3
Openreach's breakdown of LLA circuit ends provisioned in 2020 to 2023	On-net duct-connected LLA circuit ends	[✂]	[✂]	[✂]
	New fibre cable or tubing	41-50% [✂]%	41-50% [✂]%	41-50% [✂]%
	New fibre blowing only	0-10% [✂]%	0-10% [✂]%	0-10% [✂]%
Openreach's median radial distance	New fibre cable or tubing	51-60m [✂]m	71-80m [✂]m	71-80m [✂]m
	New fibre blowing only	201-225m [✂]m	201-225m [✂]m	201-225m [✂]m
Competitors' breakdown of LLA circuit ends provisioned in 2020 to 2023	On-net duct connected LLA circuit ends	[✂]	[✂]	[✂]
	New fibre cable or tubing	10%	14%	9%
	New fibre blowing only	0%	0%	0%

Source: Ofcom analysis of provider data.

[152] See Openreach Limited response dated 19 June 2024 to s135 noticed dated 9 May 2024, questions A1 and A2.

IEC proximity analysis

A9.61 In this section we provide summary statistics of the distances between BT exchanges and PCOs' networks.

A9.62 For each BT exchange, we calculate the distance to PCOs' networks and identify the minimum distance to a PCO network that is not connected to the BT exchange using an external Cablelink product, that is, the distance to the closest unconnected PCO network.[153] We then calculate the averages and medians of these minimum distances across BT exchanges. For BT Only exchanges, we also show the figures in relation to the second closest unconnected PCO network.[154] These are shown in Table A9.18 below for BT Only exchanges, and Table A9.19 for BT+1 exchanges.

Table A9.18: The average and median distance from BT Only exchanges to PCOs[155]

Presence at BT exchange	Average distance (m) to:		Median distance (m) to:	
	1st closest	2nd closest	1st closest	2nd closest
BT Only	5,244	11,073	2,381	5,357

Source: Ofcom analysis of provider data.

Table A9.19: The average and median distance from BT+1 exchanges to nearest unconnected PCO[156]

Presence at BT exchange	Average distance (m)	Median distance (m)
BT+1	937	340

Source: Ofcom analysis of provider data.

[153] To determine the location of BT exchanges we use Eastings and Northings provided by Openreach, as part of its physical network infrastructure data submission described in paragraphs A9.7-A9.13.
[154] Given our findings in the SMP assessment of the IEC market in Volume 2, Section 6 that the presence of one non-BT PCO is not sufficient to exert a competitive constraint on BT, it is likely that two PCOs would need to roll out in order for a BT Only exchange to become competitive.
[155] In the WFTMR21, we found that average distance to the nearest PCO network at BT Only exchanges was 5.6km, with a median distance of 2.6km. We found that the average distance to the second nearest PCO network at BT Only exchanges was 11.6km, with a median distance of 5.7km. Ofcom. March 2021. Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, Annex 5, Table A5.26.
[156] In the WFTMR21, we found that the average distance to the second nearest (i.e. the nearest unconnected) PCO network at BT+1 exchanges was 875m, with a median distance of 250m. Ofcom. March 2021. Promoting investment and competition in fibre networks – Wholesale Fixed Telecoms Market Review 2021-26, Annex 5, Table A5.26.

A10. Inter-exchange connectivity analysis

A10.1 As explained in Volume 2, Section 6, in order to assess significant market power (SMP) in inter-exchange connectivity, we have looked at Principal Core Operator (PCO) presence at BT exchanges.

A10.2 In this annex, we describe the evidence gathering exercise we have undertaken to identify rival presence at a BT exchange, and the modelling approach we have used to complete our analysis. We have adopted a similar approach to the analysis of rival presence as we did in the WFTMR21. We also set out the results of our analysis, describing how they have changed since the WFTMR21.

Modelling approach

PCO presence

A10.3 The purpose of our IEC model is to determine which BT exchanges will have PCO presence during the 2026-31 review period.

A10.4 In order for a non-BT network to connect to a BT exchange for IEC purposes, it needs to purchase an external Cablelink product. Therefore, we gathered evidence from providers in relation to their purchases of external Cablelink products[157] and used the data to approximate PCO presence at BT exchanges.[158]

A10.5 We determine competitive presence at each BT exchange based on whether a PCO is connected at that exchange via a 'Cablelink External' (or legacy variants 'BT Cablelink-External' and 'LLU Egress-External)' for the purpose of providing backhaul and/or core services.

[157] On 29 July 2024 we sent a statutory information request to Openreach, requesting data on sales of external Cablelink products at each BT exchange. On 23 October 2024 we sent statutory information request to 20 providers, including the providers classified as PCOs in the WFTMR21 and the providers with the most purchases of external Cablelink products. This included [✂]. We asked these providers to verify their purchases of external Cablelink products from Openreach and confirm what they were using them for. This was to inform our assessment of presence at a BT exchange. We note some providers were not able to indicate with certainty whether the external Cablelink product was used for backhaul and/or core services. We also asked [✂] to provide information on external Cablelink products purchased from BT downstream divisions. In addition, we gathered evidence from providers to understand whether there had been any changes or new entry in the provision of IEC services, and their views on the key competitors in IEC services, since the WFTMR21.

[158] We do not expect to fully update the data between consultation and statement. This would be time and resource intensive (for both providers and us) and, given the relative stability of the market and the limited rollout plans that stakeholders have shared with us, we consider that the resource required for a full update is likely to be disproportionate to the likely change in modelling results. However, we may seek updates to some elements of the data between consultation and final statement, and refresh the affected modelling accordingly, if we consider these may result in meaningful changes to the modelling and the time and resource involved is proportionate.

A10.6 As in the WFTMR21, we count the PCO as present at an exchange if the PCO is directly or indirectly connected at an exchange:

a) Directly connected: a PCO is directly connected if the PCO has network equipment at a BT exchange and purchases an external Cablelink product to connect to its own network, for the purpose of self-supplying backhaul and/or core services, and/or supplying third-parties with backhaul and/or core services; or

b) Indirectly connected: a PCO is indirectly connected if a customer present at an exchange purchases an external Cablelink product to connect to a PCO's network, which may not have network equipment at the BT exchange, for backhaul and/or core services. A PCO could also be indirectly connected if the external Cablelink product is purchased by a PCO that does not have network equipment at the BT exchange but connects third-parties in the exchange to its own network to supply them with backhaul and/or core services.

Exchange exit

A10.7 As part of our information gathering process, we asked providers whether they had plans to exit any exchanges, and if so, the date of the planned exit. Where a provider has indicated that it plans to exit an exchange prior to the start of the review period, we have not counted the relevant PCO as present at that exchange. We also understand that some providers are planning to exit exchanges during the review period, however, we understand that this is largely related to the planned closure of these exchanges and is expected to happen at or around the same time as this planned closure. As such, we do not account for this potential exit in our model.

Results of our analysis

A10.8 In summary we have identified 4,216 BT Only exchanges, 731 BT+1 exchanges, and 77 new BT+2 exchanges.[159] [160]

A10.9 We have provided a list of exchanges that we would propose to regulate and not regulate in Schedule 4 to the legal conditions in Volume 7. We also list the 549 BT+2 exchanges which do not form part of this review as we previously found them to be effectively competitive, for completeness and ease of reference. The Exchange Exit pilot exchanges[161]

[159] Exchanges with two or more PCOs present are classified as BT+2 exchanges.

[160] Note there are four additional exchanges in the current list of exchanges since WFTMR21. Openreach and BT indicated that Baynard House (CLFAR, CLWOO) and Faraday Building (CLMOO, CLFLE) should be included as two separate exchanges. Openreach also indicated LNILC (ILFORD CENTRAL ATE), NSDIN (DINNET UAX), and STWHTLY (LOCKS HEATH WHITELEY TE) should be included in the list of exchanges; see Openreach Limited response dated 19 June 2024 to s135 notice dated 9 May 2024, question B3, and see British Telecommunications Plc response dated 27 November 2024 to s135 notice dated 23 October 2024, question C1. As such, we have listed Baynard House (CLFAR, CLWOO) and Faraday Building (CLMOO, CLFLE) as separate exchanges, and we have included three exchanges that were not included in our WFTMR21 list of exchanges. The figures cited in Paragraph A10.8 and set out in Table A10.1 include these four additional exchanges. NSDIN (DINNET UAX) and STWHTLY (LOCKS HEATH WHITELEY TE) have been identified as BT Only. LNILC (ILFORD CENTRAL ATE) and Faraday Building (CLMOO, CLFLE) are among the 77 new BT+2 exchanges. Note that in Schedule 4, these two have been classified as 'BT plus two or more', rather than 'BT plus two or more new' or 'BT plus two or more new (transitional)'.

[161] Openreach. Exchange Exit Programme.

have also been included. Schedule 4 also sets out the MDF IDs that are co-located within one exchange building and their respective classifications.

Changes in classifications since the WFTMR21

A10.10 Overall, the results of our assessment are similar to those in the WFTMR21.

A10.11 Nevertheless, there have been some changes in our results. There has been a decrease in the number of exchanges that are BT Only (-59 exchanges) and BT+1 (-14 exchanges), and we have found 77 new BT+2 exchanges (see Table A10.1 below). Overall, we find 201 exchanges with a different classification to WFTMR21 (see Table A10.2 below).

A10.12 The two tables below summarise the changes to our findings.

Table A10.1: Number of exchanges by classification

Classification	Number of exchanges in WFTMR21	Number of exchanges in TAR26	Change in number of exchanges
BT Only	4,275	4,216	-59
BT+1	745	731	-14
BT+2 (new)	N/A	77	N/A
BT+2 (existing)	549	549	N/A
Total	**5569**	**5573**	

Note: the 549 BT+2 (existing) exchanges refer to the exchanges we previously found to be effectively competitive in the WFTMR21. These exchanges do not form part of this review.

Table A10.2: Changes in classifications at the exchange level

Change in classification from WFTMR21 to TAR26	Number of exchanges
BT Only to BT+1	91
BT Only to BT+2	5
BT+1 to BT Only	35
BT+1 to BT+2	70

Note: the four additional exchanges described in footnote 160 are not included in the figures in Table A10.2, as these exchanges did not have a classification in the WFTMR21.

A11. Guidance on PIA network adjustments and no undue discrimination compliance

A11.1 In Volume 3, Section 5, we outlined our proposed specific access remedies for access to BT's physical infrastructure. These include a proposed requirement on BT to adjust its physical infrastructure network in certain circumstances. In Volume 3, Section 4, we also propose to impose a no undue discrimination requirement on BT in the physical infrastructure market.

A11.2 In this annex, we outline our proposed guidance on what we consider a network adjustment constitutes, and how we propose to monitor Openreach's compliance with our no undue discrimination remedy in the physical infrastructure market.

Network adjustments

The requirement to make network adjustments is limited

A11.3 While our approach allows Openreach some degree of flexibility, we seek to ensure that Openreach does not act unreasonably. Therefore, where Openreach refuses a request for network access, it should provide reasons for doing so. Furthermore, if it becomes apparent that this approach is not working, we will reconsider whether it is appropriate to adopt a more prescriptive approach.

A11.4 When designing our guidance on the extent of the network adjustments requirement we have taken into account the factors set out in section 87(4) of the Act, in particular:

i) the technical and economic viability (including the viability of other network access products, whether provided by the dominant provider or another person), having regard to the state of market development, of installing and using facilities that would make the proposed network access unnecessary;
ii) the feasibility of the provision of the proposed network access;
iii) technological developments that are likely to affect the design of the network;
iv) the need to ensure that the provision of network access does not have the effect of favouring one form of technology over another in relation to the design and management of the network;
v) the investment made by the person initially providing or making available the network or other facility in respect of which an entitlement to network access is proposed (taking account of any public investment made);
vi) the need to secure effective competition (including, where it appears to us to be appropriate, economically efficient infrastructure-based competition) in the long-term and to support innovative business models that support sustainable competition.

A11.5 In our proposed guidance, we have set out the criteria we expect to apply. In selecting these criteria, we have taken particular account of the first, second and sixth of the section 87(4) factors set out above. We consider these factors follow on from our reasons for imposing a PIA obligation. Without access to BT's physical infrastructure network, large-

scale network deployment in significant parts of the country is likely to be unviable. Without an obligation to make network adjustments, the scope for competitive network investment will be reduced. Moreover, our objective in imposing PIA is to unlock the efficiencies arising from sharing existing infrastructure to the greatest extent possible to help facilitate competitive network investment at scale, and therefore promote effective competition in the long-term. However, in imposing PIA we seek to ensure that the obligation is appropriately limited and that we do not create incentives to use PIA where this is not necessary.

A11.6 Specifically, we propose to maintain that the following three criteria should be applied to determine whether a particular network adjustment falls within the scope of the PIA obligation:

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

A11.7 With respect to the third and fourth factors set out in section 87(4) of the Act, our criteria are technologically and network design neutral and therefore take account of these factors.

A11.8 With respect to the fifth factor set out in section 87(4) of the Act, we take account of this through our approach to cost recovery, set out in Volume 4, Section 4. Specifically, we propose that Openreach has a fair opportunity to recover the costs of any network adjustments.

Defining a network adjustment

A11.9 Before discussing the three criteria we propose to apply to determine the extent of the PIA obligation on Openreach, we clarify what we mean by a network adjustment.

Facilitating access to existing infrastructure

A11.10 Network adjustments forming part of PIA involve facilitating access to existing infrastructure, rather than the construction of new infrastructure. Since the specific network access obligation proposed in this review requires Openreach to provide access to existing physical infrastructure, it does not ordinarily require Openreach to construct physical infrastructure on behalf of other telecoms providers. This does not mean that Openreach is never required to construct new physical infrastructure assets (e.g. new ducts, chambers or poles), but where it is required to do so, this will be for the purposes of facilitating access to existing physical infrastructure.

A11.11 Therefore, Openreach should not be required to construct new physical infrastructure for rival telecoms providers in geographic locations where it does not already have infrastructure (i.e. outside its network footprint). This amounts to an extension of the

infrastructure network rather than making use of existing infrastructure assets and will therefore always fall outside the scope of our network access obligation.

A11.12 Similarly, where additional capacity is required within the existing network footprint, as the amount of additional capacity sought increases relative to the total capacity in that section of the existing infrastructure, the work required to provide that capacity is increasingly likely to resemble the construction of new parallel infrastructure, rather than facilitating access to the existing infrastructure.

Permanent changes

A11.13 Network adjustments involve making changes which are permanent. It is sometimes necessary to remove obstructions preventing use of existing infrastructure that is otherwise in good working order.[162] Our view is that it is more appropriate to regard the removal of obstructions as ancillary activities associated with the deployment and maintenance of access networks, rather than network adjustments. This is because activities associated with removing obstructions often need to be undertaken every time cables are to be installed or where a telecoms provider needs to access its fibre network as part of on-going maintenance or repair of that fibre. The ability of telecoms providers to remove such obstructions is provided for by virtue of the requirement on BT to provide certain ancillary services, but we do not regard them as network adjustments.[163]

A11.14 In contrast, we regard network adjustments as involving permanent changes which are required to facilitate access to the physical infrastructure. Generally, this will involve making a permanent change to the physical infrastructure itself, although as we explain below, it may involve the permanent removal of redundant cables or equipment left in the physical infrastructure.[164]

Three criteria test for the network adjustment requirement

A11.15 Below, we explain how we propose to apply the three criteria identified above, to determine whether a particular network adjustment falls within the scope of the PIA obligation. We consider that these criteria are cumulative, i.e. Openreach should only be required to make network adjustments where all three criteria are met.

Is the requested adjustment necessary?

A11.16 In some of the cases where a telecoms provider encounters an unusable section of physical infrastructure, an alternative option of still using BT's physical infrastructure may exist, which would enable the telecoms provider to deploy its access network without an adjustment to the physical infrastructure being made. Provided these alternatives allow for a reasonably equivalent outcome for the telecoms provider compared to making an adjustment, Openreach is unlikely to be under an obligation to remedy the unusable section of the physical infrastructure.

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[162] For example, removing silt from ducts, or pumping water out of chambers before being able to deploy and maintain access networks through Openreach's underground physical infrastructure. Similarly, it is sometimes necessary to cut back trees to access the top of poles and install or maintain dropwires or pole-top equipment.
[163] The practical effect of this is that these ancillary activities are not subject to our proposals regarding the recovery of network adjustment costs below the financial limit.
[164] The removal of redundant cables or equipment left in the physical infrastructure by telecoms providers using the infrastructure (including BT), is distinct from changes to BT's active network. The latter is not part of the PIA remedy (although under our regulation BT can choose to meet its obligations to make network adjustments by making changes to its active network in lieu of making a network adjustment).

A11.17 For example, in the case of an unusable section of duct, an alternative duct route might exist; or in the case of an unusable chamber, an alternative chamber might be available with space to accommodate the equipment. Provided these alternatives allow the telecoms provider to deploy its network to the same end customer premises, and any additional cost incurred by the telecoms provider is not disproportionate[165], Openreach is unlikely to be under an obligation to remedy the unusable section of the physical infrastructure.

Is the requested adjustment feasible?

A11.18 Adjustments which are infeasible are not required under the network access obligation. In some cases, there may be technical, operational or legal barriers that prevent Openreach from being able to make the required adjustment, for example, wayleave access for the work is not granted, or planning restrictions are in place.

A11.19 In some cases, such barriers may not be insurmountable, but the cost involved in overcoming any barriers would be significant. We consider that this is addressed by the third factor discussed below (i.e. whether the adjustment is efficient).

Does the requested adjustment improve efficiency?

A11.20 We consider that Openreach should only be required to make network adjustments where this improves efficiency (i.e. it is quicker, easier and/or cheaper for Openreach to adjust the existing physical infrastructure than for a telecoms provider to install its own infrastructure alongside BT's). This is consistent with our rationale for requiring BT to provide network access in the form of PIA. We want to encourage infrastructure sharing when it is more efficient than the other options available to a telecoms provider, such as building its own physical infrastructure, as these efficiencies will facilitate investment which would not otherwise be viable.

A11.21 If telecoms providers paid the full upfront cost of any network adjustments they requested, we would expect them to have incentives to request network adjustments only where this was the most efficient way to overcome unusable sections of physical infrastructure. However, for the reasons set out in Volume 4, Section 4 we have decided that Openreach should recover the costs of network adjustments, up to a financial limit, over all users of the physical infrastructure. We recognise that as a result, telecoms providers may not have the incentive to choose the most efficient solution to overcome unusable sections of physical infrastructure (for example, when choosing between requesting a network adjustment or building their own parallel infrastructure).

A11.22 Given the risk that telecoms providers request network adjustments which would be inefficient, we consider that Openreach should only be required to adjust its physical infrastructure where this improves efficiency. This reflects our aim in requiring Openreach to make network adjustments, namely, to avoid unnecessary duplication of the physical infrastructure in situations where it is quicker, easier and/or cheaper for Openreach to adjust the infrastructure than for a telecoms provider to install their own infrastructure.[166]

[165] For example, a telecoms provider may incur additional costs associated with longer lengths of fibre, or higher rental charges associated with longer lengths of duct. In assessing whether the additional cost is disproportionate, we would consider how any cost difference compares to the cost of undertaking the requested adjustment.

[166] We recognise that it might be argued that Openreach should also be required to make network adjustments in situations where the adjustment is as efficient as the telecoms provider installing its own

A11.23 We would consider whether this is the case by comparing two scenarios:

a) Openreach adjusts its physical infrastructure to remedy the unusable section of Openreach's infrastructure (the 'factual' scenario); and
b) the telecoms provider builds its own network asset to circumvent the unusable section of Openreach's infrastructure (the 'counterfactual' scenario).

A11.24 Openreach should only be required to make network adjustments where the factual scenario is more efficient than the counterfactual scenario, for example, it is quicker, easier and/or cheaper.[167]

A11.25 In this comparison, the cost in the factual scenario should be the incremental cost to Openreach of making the adjustment at the telecoms provider's request. For example, if Openreach would have carried out the work anyway, even if the telecoms provider had not requested the adjustment, the incremental cost will be lower than the cost of the civil works (and in some cases could be zero).

A11.26 Moreover, the factual and counterfactual scenarios should be based on Openreach's own engineering practices applicable at the time. This ensures that Openreach cannot refuse requests for network adjustments by requiring competing telecoms providers to choose a lower cost engineering solution that it would not choose for itself. This approach will also provide greater certainty to Openreach and competing telecoms providers in cases where a range of engineering solutions might exist.

A11.27 We recognise that it might be argued that even in cases where it is more efficient for Openreach to make an adjustment than for the telecoms provider to build its own network asset, the costs involved in making the adjustment outweigh the benefits of making of the adjustment (i.e. so the adjustment could still be considered inefficient). At the level of individual network adjustments, we think a comparison of the costs and benefits is unlikely to be a meaningful exercise. This is because the benefits of making network adjustments – i.e. more fully realising the efficiency benefits of sharing the existing infrastructure, thereby increasing the scope for competitive network investment – arise from the cumulative impact of multiple adjustments, rather than an individual network adjustment. We consider that the risks of the costs outweighing the benefits should be assessed at the overall level of whether the entry of a competing network provider is efficient, and address this in Volume 4, Section 4.

Openreach should choose how to undertake network adjustments

A11.28 We believe that, where an adjustment is necessary for Openreach's physical infrastructure network to be available to telecoms providers for the purpose of deploying their own networks, Openreach should be able to choose the form of adjustment it makes to meet its obligation. This provides Openreach with the flexibility to choose the most efficient solution possible and allows it to take account of its own future requirements.

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infrastructure, on the basis that this would promote greater network competition and would still ensure efficient network adjustments. However, at this stage, we are not persuaded that such an obligation is necessary to ensure effective competition in the long term or proportionate given our current understanding of the benefits and risks. For the avoidance of doubt, our approach does not prevent Openreach from choosing to undertake a broader set of network adjustments than required under the network access obligation, provided it treats all telecoms providers including BT in the same way (unless differences can be justified).

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

A11.29 We note that a possible concern of other telecoms providers might be in relation to Openreach's ability to choose how to undertake network adjustments. Notwithstanding the benefits of giving Openreach flexibility, it is important that Openreach is not able to exploit this flexibility to undermine the effectiveness of the remedy. We consider that our broader proposals prevent Openreach from doing this in the following ways[168]:

a) The proposed non-discrimination requirements prevent Openreach from applying a different approach for external PIA users to the approach taken for its own network deployments unless such a difference can be justified;
b) The proposed requirement to produce a Reference Offer includes a requirement to set out the terms and conditions on which other providers may purchase PIA and access BT's infrastructure (also see below); and
c) Our proposal regarding how BT should recover the costs of making any adjustments provide Openreach with the incentive to select the most efficient approach and limit the incentive to select high cost solutions to increase a competing telecoms provider's costs of deployment.

A11.30 Some network adjustments may be just as easily carried out by the telecoms provider. For the avoidance of doubt, our guidance sets out where a network adjustment is likely to be required. If an adjustment falls within the scope of the access obligation, although the responsibility for the adjustment rests with Openreach, it may meet this requirement by agreeing with industry arrangements for the telecoms provider to undertake the works itself (effectively on behalf of Openreach).[169]

Breaking in and out of BT's network infrastructure

A11.31 Telecoms providers are likely to deploy hybrid networks, using a mixture of Openreach's infrastructure and their own infrastructure.[170] Therefore, to make effective use of Openreach's physical infrastructure, telecoms providers need to be able to break in and out of the infrastructure to interconnect with their own infrastructure. In addition, the ability of telecoms providers to overcome unusable sections of Openreach's physical infrastructure as efficiently as Openreach depends on the ability to break in and out of Openreach's physical infrastructure at particular points.[171]

A11.32 For the avoidance of doubt, the ability of telecoms providers to break in and out of the infrastructure is provided for by virtue of the requirement on BT to provide certain ancillary services, but we do not regard breaking in and out of the network as network adjustments on the basis that these are for the purpose of enabling hybrid networks rather than making BT's network ready for use.

[168] For further details about the proposed NUD requirement and Reference Offer, see Volume 3, Sections 4 and 5 respectively. For further details about proposed cost recovery of network adjustments, see Volume 4, Section 4.
[169] As network adjustments are made to Openreach's physical infrastructure, Openreach will retain ownership of the relevant assets.
[170] Most deployments are hybrid designs but with varying use of Openreach's infrastructure.
[171] For example, the ability to install duct directly between Openreach's chambers requires that they can break out of the end walls of Openreach's chambers (i.e. in the direction of the duct run).

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

A11.33 In Volume 3, Section 4 we propose to maintain a no undue discrimination on BT in the physical infrastructure market. We said we would interpret that obligation as requiring strict equivalence in respect of all processes and sub-products that contribute to the supply and consumption of network access, with discrimination permitted only in cases where Openreach demonstrates that a difference in respect of a specific process step or sub-product is justified. Where Openreach can justify any processes or systems used by network users as being different from those used by Openreach, the condition requires these to be broadly equivalent. This means that any difference must not put network users at a disadvantage, particularly in terms of extra cost, time or uncertainty, compared to the processes Openreach follows internally.

A11.34 We are not proposing an upfront obligation on Openreach to justify all instances of non-equivalence, however, we are proposing to retain the requirement on Openreach to produce an Internal Reference Offer that requires it to set out its internal processes to some degree. This will allow Ofcom and stakeholders to identify any differences in the processes for internal use of network access compared to such use by third parties and to assist transparency for the monitoring of potential anti-competitive behaviour. This helps to ensure that PIA users can have confidence that they are not at a disadvantage, particularly in terms of extra cost, time or uncertainty, compared to the processes Openreach follows internally.

A11.35 The Internal Reference Offer should set out the services used by Openreach in a different manner, giving visibility to any justification for non-equivalence, as well as highlighting where processes, rules or systems (or similar) are the same. For example, where engineering rules are equivalent this should be made transparent and steps taken by Openreach to ensure consistency across all activities for physical infrastructure access whether undertaken under PIA, or otherwise.

A11.36 Our ongoing monitoring programme's scope includes ensuring that Openreach complies with the current non-discrimination obligation and we propose to maintain this going forward. This programme involves working with the OTA2 and PIA users in order to evaluate their experience of the network access products. We will also continue to make use of our information gathering powers where appropriate to evaluate any network access processes that we identify are at risk of failing to be equivalent. Furthermore, we will carefully consider, and where appropriate investigate, any evidence of non-compliance. This evidence could come from a range of sources, such as information submitted by our stakeholders, our regular review of BT's Regulatory Financial Statements, information gathered as part of our market reviews, the set of no undue discrimination (NUD) KPIs and through use of our investigatory powers.

PIA pricing under the NUD obligation

A11.37 We consider our proposed NUD condition would require Openreach to supply PIA to BT downstream divisions (e.g. BT Enterprise) on an equivalent basis to how third parties use PIA,[172] including the same PIA charges.

[172] That is, we do not expect differences between BT downstream and third party PIA users to be justified.

A11.38 Openreach is not required to, nor does it, consume exactly the same services and so does not pay the PIA charges that other telecoms providers pay. It is important that this does not result in competing telecoms providers being at a disadvantage to Openreach.

A11.39 As explained below, we consider that our proposals on PIA pricing (i.e. the price caps we are proposing and our proposal that Openreach should recover the costs of making the existing infrastructure ready for use across all users of the infrastructure) sufficiently addresses most of our concerns over discrimination with respect to PIA pricing. Where this is not the case, the proposed NUD obligation for the physical infrastructure market should ensure equivalence except where differences can be justified.

Rental charges

A11.40 Any concerns about discrimination between the level of rental charges paid by external customers and what Openreach pays for its use of the physical infrastructure assets are sufficiently addressed by our proposed regulation of rental charges. As explained in Volume 4, Section 4, we propose to set PIA rental charges that telecoms providers other than Openreach will pay based on 'fair shares'. In setting these charges, one of our objectives is to ensure a level playing field exists between Openreach and other telecoms providers that make use of PIA to provide downstream products. The way these charges are set means they are not intended to be paid by Openreach. Rather, Openreach must recover the balance of costs not recovered from other users of the physical infrastructure from its own downstream services.[173]

Ancillary charges – network adjustments

A11.41 With respect to ancillary charges, the most significant of these relate to network adjustments i.e. charges for making the existing physical infrastructure ready for use.

A11.42 As explained in Volume 4, Section 4 we propose that Openreach should recover the costs of network adjustments, below the financial limit, over all users of the physical infrastructure, in the same way as it does for BT. Where telecoms providers are not charged for network adjustments, no concerns over discrimination with respect to pricing of network adjustments arise.

A11.43 However, we have also proposed that a financial limit should apply to the costs of network adjustments, with any costs incurred above the financial limit recovered directly from the telecoms provider requesting the network adjustment, through ancillary charges.

A11.44 To ensure that other telecoms providers are not at a disadvantage to Openreach with respect to network adjustment charges above the financial limit, we propose to continue to interpret the no undue discrimination obligation to mean that Openreach should charge itself internal transfer charges for network adjustments which are consistent with the charges faced by competing telecoms providers using PIA (to the extent that a different approach cannot be justified). This means that where Openreach undertakes network

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

adjustments to support its own network deployments, the costs of network adjustments above the financial limit should be attributed entirely to the relevant Openreach downstream products in the regulatory accounts, and not spread across all users of the physical infrastructure. The regulatory accounts will support any assessment of compliance with the no undue discrimination obligation.

A11.45 For the avoidance of doubt, Openreach is not required to charge the internal transfer charges at the point of undertaking the ancillary activity. It can calculate these charges (which should be the same as those incurred by other telecoms providers) retrospectively as part of its regulatory financial reporting. Openreach is also not required to maintain a separate inventory for any assets created or improved by network adjustments which exceed the limit. These assets remain part of the Openreach asset base and are accessible by all users of the infrastructure.

Ancillary charges – other ancillary services

A11.46 With respect to ancillary services other than network adjustments, these are not expected to be as material as network adjustment charges. However, in principle, we would interpret the no undue discrimination obligation in the same way. That is, Openreach should charge itself internal transfer charges which are consistent with the charges faced by competing telecoms providers using PIA (to the extent that a different approach cannot be justified). This means that where Openreach provides other ancillary services to support its own network deployments which are the same or similar to those provided to other telecoms providers, the costs of those services should be the same as those incurred by other telecoms providers and be attributed entirely to the relevant Openreach downstream products, and not spread across all users of the physical infrastructure.

A12. Regulatory support for copper retirement: Further details on the Defined Exclusions Approach

A12.1 In Volume 3, Section 2 we discuss regulatory support for copper retirement. One option for setting the second threshold is a Defined Exclusions Approach. This approach involves Ofcom specifying in a direction the specific circumstances under which premises would be excluded when assessing whether the second threshold is met.

A12.2 In this Annex we discuss the Defined Exclusion Approach, and how it might work in practice, in more detail. As explained in Volume 3, Section 2 if we were to adopt this approach we are minded to exclude the following categories of premises:

a) Premises that Openreach is unable to access;

b) Premises where the cost to Openreach of making ultrafast services available is high and that are served, or contracted to be served, with gigabit-capable broadband by non-Openreach providers using public funding; and

c) Other premises where the cost to Openreach of making ultrafast services available is very high and that are not expected to be supported by existing public funding.

A12.3 We discuss each of these categories in turn below.

A12.4 Openreach proposed similar categories to the three listed above. In addition, Openreach also proposed excluding premises served by other fixed networks. It said that, given the presence of an alternative option for end-users, whether or not Openreach ultrafast broadband is available to these premises should not affect whether the second threshold can be triggered.[174]

A12.5 We consider that it would not be appropriate to include this category. As explained in Volume 3, Section 2 we propose maintaining the approach envisaged in the WFTMR21 when specifying the second threshold i.e. only excluding premises if they are unable to receive ultrafast services from Openreach because of exceptional circumstances beyond Openreach's control. Based on data collected by Connected Nations, around 22m premises covered by Openreach in the UK (approximately 70% of the total) had access to gigabit-capable broadband from at least one network other than Openreach in July 2024.[175] This figure is expected to grow. By January 2030, it is forecast to increase to around 27m premises (approximately 85% of the total).[176] Excluding such a wide category of premises when assessing whether the second threshold is met would represent a significant departure from the approach envisaged in the WFTMR21.

[174] Openreach. Telecoms Access Review (TAR) 2026 Openreach Submission. Pages 65-66.
[175] For Openreach coverage of all technologies are taken into account, whereas for other networks only gigabit-capable coverage is included.
[176] Ofcom analysis of Connected Nations coverage data (collected August 2024), Connected Nations planned network deployment (collected May 2024), and additional planned network deployment data provided for TAR26 (collected August-September 2024, for additional detail see Annex 7)

Premises that Openreach is unable to access

A12.6 There are instances where Openreach will be denied permission to access land or premises to provide ultrafast services.

A12.7 Access to flats and apartments (known as multi-dwelling units or MDUs) can be particularly challenging. Openreach must request and be granted access from landlords or property management firms. Accessing a property typically requires a Code Agreement[177], usually in the form of a wayleave. A wayleave is a contractual right granted by a landowner or property occupier allowing a network provider to access land or property to install or maintain its network.[178] In the last five years, Openreach has requested [✂] wayleaves and only [✂] have been granted.[179]

A12.8 Network providers face access challenges when they are denied access and/or landlords fail to respond to requests for access. There are a variety of situations where network operators will face difficulties in gaining access, it is not limited to MDUs. For example, needing to cross privately owned land with a cable in order to serve a group of premises. The UK Government has already made an attempt to improve access to MDUs by introducing regulations in 2022 to implement elements of the Telecommunications Infrastructure (Leasehold Property) Act 2021. This created a new route through the courts that operators can use to access premises if a landowner is repeatedly unresponsive to requests for access.[180] Outside of this new route, network providers can use Code powers to gain access to private land via the pre-existing process provided for in the Electronic Communications Code, which also ultimately ends with an application for a court order to gain access to the property.

A12.9 We understand that Openreach follows a systematic process to gain access to premises, issuing a wayleave form to the landowner for approval. If negotiations reach a deadlock, its legal team steps in to provide support. Deadlocks may be resolved by an alternative dispute resolution ('ADR') mediator, but if unresolved and suitable for court, Openreach's legal team may commence litigation and follow the Lands Tribunal process.[181]

A12.10 The last step in the process of gaining access (described above) is an application for a court order. One way of applying the Defined Exclusions Approach would be to exclude premises based on a refusal of that application by the court. Such an approach would clearly demonstrate that Openreach had pursued all options for gaining access to premises. However, our understanding is that, to date, Openreach has only taken one case forward to the Lands Tribunal.[182] Furthermore, it told us that this was not a "scalable solution".[183] Therefore, defining exclusions based on a court decision could risk setting the bar too high and therefore making it too slow, difficult and/or costly for Openreach to meet the second threshold.

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[177] An agreement pursuant to the Electronic Communications Code (Schedule 3A to the Act).
[178] Gov UK. Guidance on access agreements - GOV.UK. Accessed 24 February 2025.
[179] Openreach response dated 6 January 2025 to s135 notice dated 2 December 2024, question B1.
[180] Gov UK. Regulations to implement the Telecommunications Infrastructure (Leasehold Property) Act - government response. Accessed 14 February 2025.
[181] Openreach. June 2023. Wayleaves: WL Deadlock High Level Process external 06 June 2023. [Accessed 03 March 2025].
[182] Openreach response dated 6 January 2025 to s135 notice dated 2 December 2025, question B1; Information provided by Openreach in writing on 10 March 2025.
[183] Openreach response dated 6 January 2025 to s135 notice dated 2 December 2025, question B1.

A12.11 Another option would be to use an earlier step in the statutory defined process as a basis for defining exclusions. Both the new process introduced for MDUs and the pre-existing process require a notice (or multiple notices) to be served by the network provider on the landowner before an application for a court order can be made. It may be possible to define an exclusion based on the service of a notice by Openreach on a landowner followed by either a refusal of agreement by the landowner or a failure to respond.

High cost premises that are served by non-Openreach providers using public funding

A12.12 The UK Government, and the devolved administrations in the UK's nations, have committed significant sums of public funding to subsidise the delivery of ultrafast services to premises that are deemed to be commercially unattractive.

A12.13 The UK Government, through Project Gigabit, is supporting gigabit roll out alongside other broadband investment programmes from devolved governments in the UK's nations, including the Superfast Cymru programme in Wales, the Reaching 100% (R100) programme in Scotland, and Project Stratum in Northern Ireland. Whilst this funding will extend coverage of full fibre beyond the commercial rollouts, other technologies such as Fixed Wireless Access (FWA) or satellite are likely to play a role in addressing the needs of the hardest-to-reach areas. As an illustration of the sort of interventions carried out by these programmes, Project Gigabit is using a combination of:

a) Contracts with suppliers to build to premises that would not be reached commercially;

b) Vouchers for residential and commercial premises worth up to £4,500 intended to cover the costs of a supplier extending its network to these premises; and

c) Grants to connect local public services such as schools, libraries and GP surgeries.[184]

A12.14 Contracts are awarded to suppliers to extend their build plans following an open procurement process.[185]

A12.15 As of February 2024, public intervention had subsidised the delivery of gigabit-capable connectivity to more than one million premises. Around three quarters were given access through the contracts programme with voucher projects contributing most of the remainder.[186]

A12.16 To exclude premises that are served, or contracted to be served, with gigabit-capable broadband by non-Openreach providers using public funding, both Openreach and Ofcom would need access to a comprehensive data set which accurately identifies these premises.

A12.17 We are aware that BDUK have recently begun to publish premise level data for the premises that are contracted to be built to under Project Gigabit.[187] However, currently this data may not be suitable for identifying all premises which should be excluded when assessing whether the second threshold is met. This is for the following reasons:

[184] Gov UK. BDUK Corporate Plan 2024 to 2025. Accessed 18 February 2025.
[185] Gov UK. One million premises upgraded to gigabit broadband by government. Accessed 18 February 2025.
[186] Gov UK. BDUK Corporate Plan 2024 to 2025. Accessed 18 February 2025.
[187] Gov UK. Premises in BDUK plans (England and Wales). Accessed 13 March 2025.

a) It only includes contracted/planned build, and therefore does not identify the substantial amounts of build already completed under Project Gigabit.

b) The data does not yet cover Scotland and Northern Ireland.

c) Premises that have been previously served as a result of the voucher schemes are not yet included.

Other very high cost premises

A12.18 For some premises the cost to Openreach of making ultrafast services available is very high, so build is not commercially viable. While some of these may ultimately be served as a result of public funding, others may not.[188]

A12.19 This often reflects circumstances such as extreme rurality, where these premises may be better served by alternative technologies such as FWA services or satellite broadband. This could also reflect more complex builds, such as where a train track or river blocks the route from the aggregation point to the premises.

A12.20 For these premises to be excluded when assessing whether the second threshold is met there would need to be:

a) A practical, reasonably accurate, and verifiable way to estimate the costs for Openreach of deploying ultrafast broadband to the remaining premises in an exchange area that takes into account the particular features of very high cost premises; and

b) Clarity of the point at which those costs are too high, for example because they exceed some pre-specified level.

Challenges with estimating the cost of deploying ultrafast broadband to very high cost premises

A12.21 It may be theoretically possible for Openreach to model its costs of deploying ultrafast broadband to the remaining premises in an exchange area in a way that takes into account the particular features of very high cost premises. However, currently no suitable model exists, so either it would need to be built for this purpose or adapted from an existing model produced for some other purpose.[189]

A12.22 That model would need to estimate costs with sufficient accuracy for the purposes of the Defined Exclusions Approach. This calculation may also need to omit premises that should be excluded when assessing whether the second threshold is met for other reasons (e.g. because Openreach cannot gain access). The model would also need to include appropriate assumptions on the level of common cost allocation between existing build and additional build.

[188] Digital Connectivity: Consultation on Improving Broadband for Very Hard to Reach, DSIT, October 2023, Page 8. Digital Connectivity: Consultation on Improving Broadband for Very Hard to Reach

[189] Openreach has an existing FTTP 'Cost at the DP' (CAD) modelling tool which is used to estimate potential costs of FTTP coverage across different parts of the UK. Ofcom's Fibre Cost Model (FCM) estimates the average cost to build and connect premises for each postcode sector but does not produce a cost estimate for every premises. Furthermore, there has been limited build to very costly premises, so both models are unlikely to be sufficiently calibrated to accurately estimate the costs for relatively niche cases as might be the case with very costly to serve premises.

A12.23 We think there are challenges when modelling costs for very high cost or difficult to serve premises. In particular:

a) Openreach's FTTP build to date has generally focussed on cheaper premises. Therefore, it currently has limited experience and data to accurately model its costs of deploying to very high cost or difficult to serve premises. However, as Openreach's experience in relation to these premises improves, better data may become available over time.[190]

b) Even as better data becomes available over time, site specific factors and the potential for bespoke solutions (e.g. radio backhaul) could mean that it remains challenging to robustly model costs for these premises.

A12.24 The development of such a model and the potential need to update it is likely to require Openreach to commit resources on an ongoing basis. We would also need to satisfy ourselves that the model is fit for purpose. This also applies to whatever updates are made.

Identifying when costs are sufficiently high

A12.25 There would also need to be clarity about when Openreach's estimated costs of deploying ultrafast broadband to the remaining premises are sufficiently high for those premises to be excluded. One way this could be done is to identify some pre-specified level.

A12.26 Given the cost modelling challenges we have highlighted we consider it is premature to propose such a level in this consultation. However, that level would need to be consistent with the estimates that emerge from the modelling in future. We could also combine these modelling estimates with other data points. For example, we could consider the maximum per premises funding available under publicly funded schemes as a potential reference point. This information is not publicly available so, if we were to make use of it, we would need to do so in a way that avoids the risk of compromising the integrity of the procurement process for publicly funded build.

A12.27 We may also need to consider how to take the presence of rival networks into account. The point at which Openreach's costs of deploying ultrafast broadband become sufficiently high to exclude a group of premises is likely to be lower when another network is present at those premises. This is because the presence of that other network will reduce the take-up that Openreach is likely to achieve, making it harder for Openreach to recoup its costs.

[190] [✂] response dated [✂] to s135 notice dated [✂], question [✂].

A13. Quality of service performance and locational analysis

A13.1 In this annex we cover the following:

p) a review of Openreach's performance since the WFTMR21 using KPI information. As set out in Volume 5, this informs our assessment of existing performance, including how well the current regulations are working; and

q) locational analysis of Openreach WLA repair and provisioning data. As set out in Volume 5, this informs our assessment of whether changes in the proportion of rural customers should lead to changes in our proposed minimum QoS standards as well as our proposed minimum QoS standards for FTTP in WLA Area 3.

Overview of Openreach's KPI performance

Overview

A13.2 This subsection of the annex gives an overview of Openreach's performance in the current market review period. We have reviewed performance across the FTTC, FTTP and leased lines services.[191]

A13.3 The data used here is from the monthly KPI data we receive from Openreach. Openreach's QoS obligations are evaluated on a yearly basis, but we have shown data on a monthly level for transparency, so performance can be viewed on a more granular basis. We have assessed performance from April 2021 to December 2024 for FTTP and FTTC and August 2021 to December 2024 for leased lines.[192] In each graph where we plot KPI performance, we show Openreach average performance across all its customers, including both downstream BT and third parties. This is referred to in the graphs as the 'Openreach Average'. The regulatory QoS standard is indicated in each graph by a horizontal green line, which demonstrates how Openreach is performing in each month relative to the annual QoS standard.[193]

A13.4 Both FTTC and FTTP performance have tended to steadily improve in the period 2021-2024. Yearly average FTTC performance has consistently remained above the minimum QoS standard after a period of industrial action (discussed below). For leased lines the data indicates that performance has been improving against leased lines standards. Openreach has also been able to meet its yearly obligations for each leased lines minimum QoS standard apart from one occasion in 2022/23.

[191] Unless expressed otherwise, in this annex references to FTTC include G.fast, SOGEA and SOGfast and references to MPF include SOTAP i.e., as currently defined in Direction 3 of the QoS Directions.
[192] August 2021 is the first available data for leased lines (in the same format as WLA KPIs), as the reporting requirements for leased lines services were only introduced in the WFTMR21.
[193] Note that Openreach's performance experiences seasonality due to factors such as storms and adverse weather

Impact of industrial action on performance

A13.5 Between Q2 2022 and Q4 2022 Openreach faced industrial action which had a significant negative impact on its performance across FTTC, FTTP and leased lines.[194]

A13.6 Performance for FTTP declined more sharply than FTTC, and also recovered more slowly. FTTC KPIs fell below the minimum standard in 2022 but recovered within 5-6 months for repairs within SML 1 and SML 2, and within 2 months for installations. [✂]. This difference in recovery may be due to Openreach wanting to avoid performing below the minimum standard we set for the regulated FTTC product, and therefore diverting resources which would have otherwise been used for FTTP provisions/repairs.

A13.7 Performance on regulated leased lines products also dropped around the industrial action period. Leased lines KPIs show it took 5-8 months for Openreach to consistently perform back above the QoS standards, depending on the standard being measured against.

A13.8 On 18 March 2024 Ofcom concluded an own-initiative investigation into Openreach's compliance with its quality of service obligations in the LL access and WLA markets during 2022/23. We found that Openreach had contravened its SMP conditions by failing to meet three of its obligations. There were a number of factors we considered that meant we did not impose a penalty or other remedies on this occasion.[195]

WLA performance

A13.9 Table A13.1 sets out the minimum standards we imposed in the WLA market in the WFTMR21.[196] These are applied on copper-based products, but we focus our assessment in this Annex on FTTC.[197] Openreach must meet these minimum QoS standards on both a UK wide basis and for each UK management region.

[194] When referring to quarters in this annex we mean calendar years e.g.: Q2 2022 means April-June 2022
[195] Ofcom, March 2024. Confirmation Decision served on BT by Ofcom for contravention of SMP Condition 10.1
[196] In the WFTMR21 we applied a different standard in year 1 of the review period due to the impact of Covid-19. When graphing KPIs in the section below we have included a horizontal line showing the minimum QoS standard we set for years 2-5.
[197] We focus on FTTC due to the higher number of premises with FTTC products compared to MPF products. We have also reviewed MPF performance and have not observed materially different results from those seen for FTTP.

Table A13.1 Current minimum WLA QoS standards[198]

Standard	Level (Year 1)	Level (Years 2-5)
Repair within 2 working days (SML1) Repair within 1 working day (SML2)	83%	85%
Repair within 7 working days (SML1) Repair within 6 working days (SML2)	96%	97%
Installations to be completed by Committed Date	91%	94%
First Available Date (FAD) for installations requiring an engineer visit - working days within which first date offered for installation appointments	12 days	10 days
Quality standards in relation to the FAD - Frequency with which regulated installation appointment date must be offered	89%	89%

A13.10 All these measures are covered by the KPI transparency requirements. These KPIs are the main data source that we use to review Openreach's performance.

A13.11 Openreach has met the minimum QoS standards for FTTC for each year over the period except 2022/23 where three of its QoS obligations were not met. Other than this period of industrial action Openreach has generally exceeded the relevant minimum QoS standard. Below, we look at how Openreach performed in each month relative to the annual minimum QoS standards.

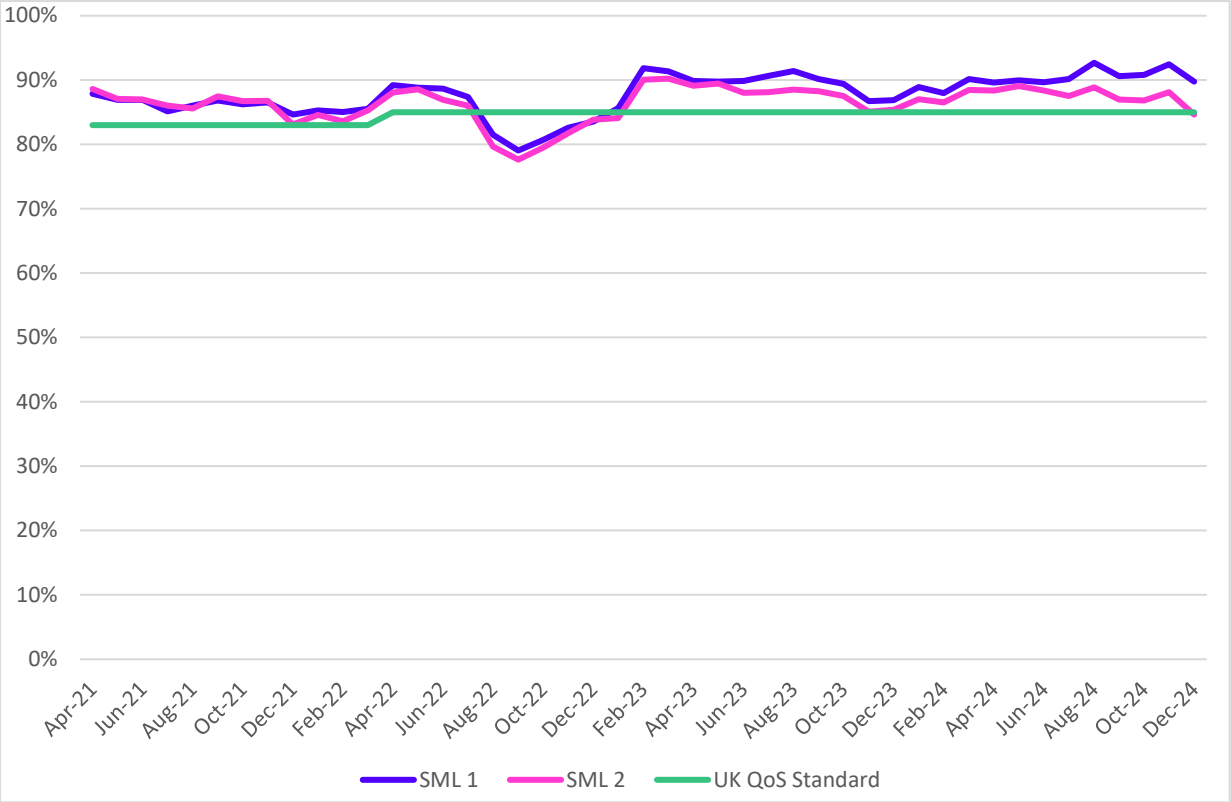
Openreach's performance against FTTC quality of service standards – repair

A13.12 Figure A13.1 shows the percentage of orders during the relevant month in which Openreach achieved a restored service by the Repair Service Level Commitment for repair service maintenance level 1 ('SML1') and service maintenance level 2 ('SML2').[199]

A13.13 In general, performance over the entire period followed a positive trend. Both service levels followed a very similar pattern of performance across the period shown. Both SMLs performed on average above the minimum QoS standard of 85% across the period, with SML 1 at 87.8% and SML 2 at 86.4%[200]. However, in 6 of the 45 months the SMLs went below the equivalent of the annual minimum QoS standard of 85%. This occurred for 5-6 consecutive months from August 2022 depending on the SML. This second prolonged period of underperformance in comparison to the QoS standard occurred during and following the period of industrial action mentioned above.[201] Openreach's monthly average performance met the equivalent of the annual QoS standard for every remaining month after that period besides December 2024 for SML 2.

[198] Standards must be met individually in all of Openreach's Management Regions, aside from the "Repair within 6/7 working days standard", which must be met nationally. Openreach can also exclude some repair or provisioning orders impacted by MBORC events from the calculation in up to 2 regions.
[199] SML 1 means a consumer can expect repair within 2 working days of the fault being recorded.
[200] Calculated on a monthly average basis.
[201] We comment upon this in Paragraph A13.6 of this annex.

Figure A13.1 FTTC percentage of repairs completed within SML1 or SML2[202]



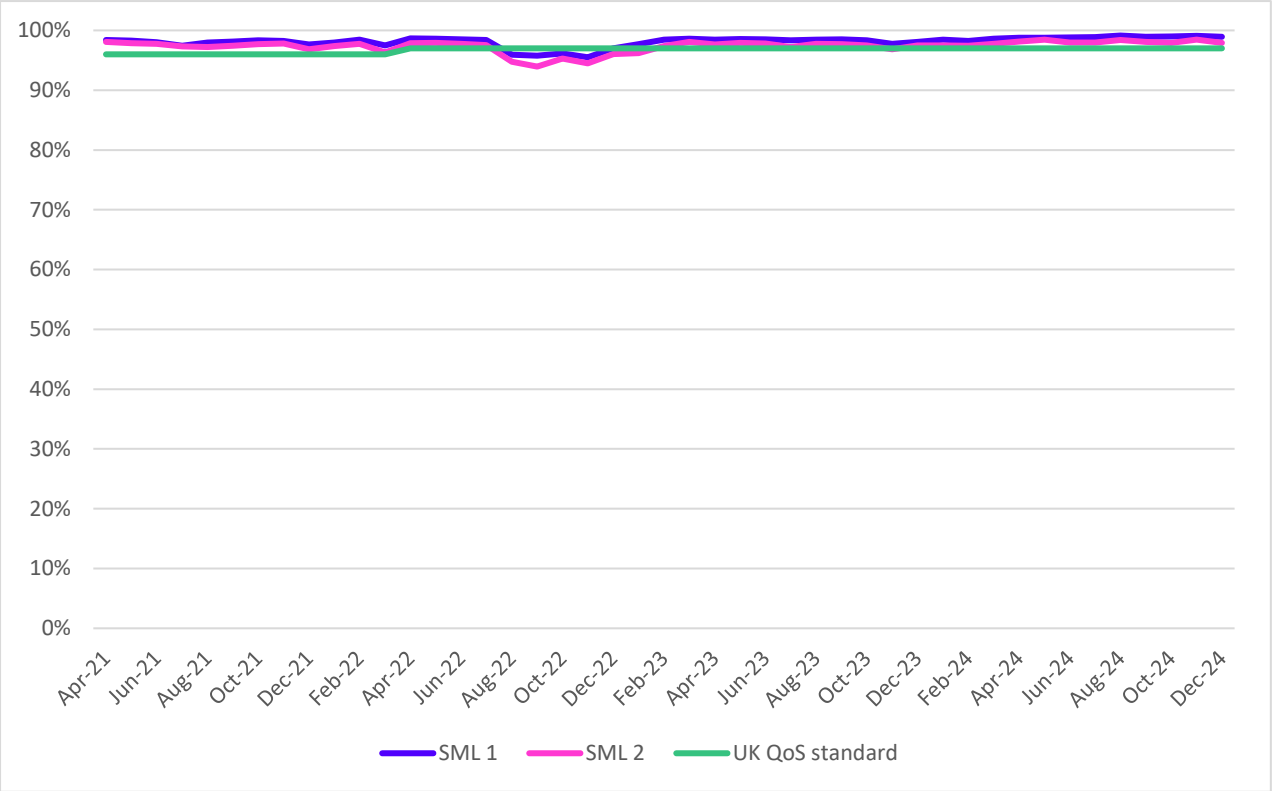
Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

A13.14 Figure A13.2 shows the percentage of orders during the relevant month in which Openreach achieved a restored service 5 days beyond the Repair Service Level Commitment for SML 1 and SML 2.[203] These KPIs followed a similar pattern to the KPIs in Figure A13.1 above.

[202] The two different KPIs shown are i) 'FTTC - KPI 3 (a) (i) Percentage Repair completion: Restored Service during the relevant month within: the Repair Service Level Commitment (SML1)'; and ii) 'FTTC - KPI 3 (b) (i) Percentage Repair completion: Restored Service during the relevant month within: the Repair Service Level Commitment (SML2)'

[203] These KPIs match with the second FTTC QoS repair standard set out above, namely repair within 7 working days (SML1) and repair within 6 working days (SML2).

Figure A13.2 FTTC Percentage of repairs completed 5 days beyond SML1 or SML2[204]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

A13.15 Both KPIs illustrate that on average Openreach has been able to perform above its repair service maintenance level agreements and its QoS obligations on a monthly basis outside of the period affected by industrial action.

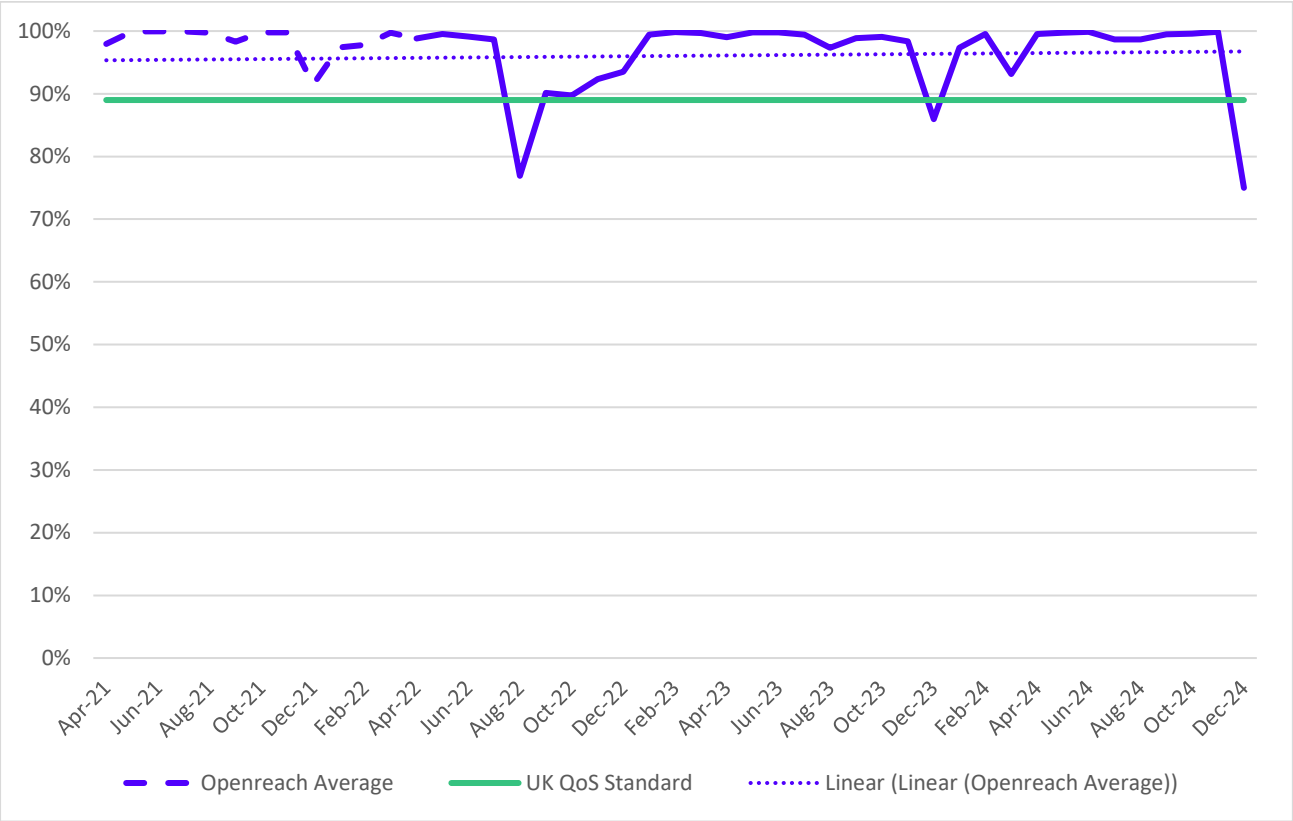
Openreach's performance against FTTC quality of service standards – provisioning

A13.16 Figure A13.3 shows the percentage of appointments which have been offered on or before the required first appointment date (FAD).[205] Monthly performance for this metric fell below the equivalent monthly minimum QoS standard on three occasions, August 2022, December 2023 and December 2024. There is also some indication of a seasonal dip in performance in Q4 since monthly performance in this quarter appears to be generally below the mean.

[204] The two different KPIs shown are i) 'FTTC - KPI 3 (a) (iv) Percentage Repair completion: Restored Service during the relevant month within: five working days beyond the Repair Service Level Commitment (SML1)'; and ii) 'FTTC - KPI 3 (b) (iv) Percentage Repair completion: Restored Service during the relevant month within: five working days beyond the Repair Service Level Commitment (SML2)'.

[205] 12 days was the FAD for the first year of WFTMR21 and 10 days was the FAD for years 2-5.

Figure A13.3 FTTC Percentage of times Openreach provides a first appointment within 10 working days (12 working days in 2021/2022) [206]



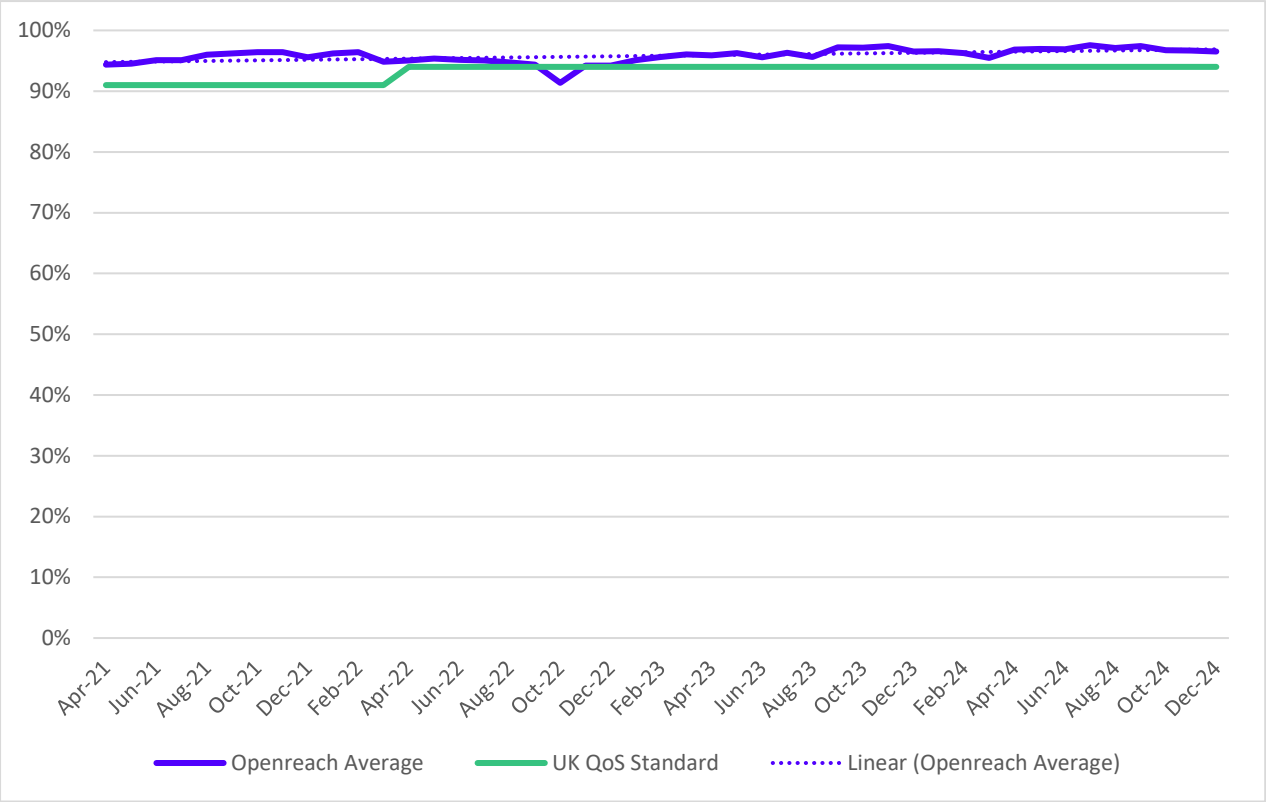
Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

A13.17 Figure A13.4 shows the percentage of all completed installation orders which are completed by the date Openreach commits to.[207] This KPI was largely stable over the period, and the monthly equivalent of the minimum standard of 94% was consistently met on a monthly basis, besides one month (October 2022).

[206] FTTC - KPI 1a Percentage first available date appointment availability: on or before the Required First Appointment Date.

[207] Orders completed by the committed date include those (more complex) orders where a committed date was provided after a survey (the KCI2 Assure process) to allow further works to be completed.

Figure A13.4 FTTC Percentage of installation completion: by the committed date:[208]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

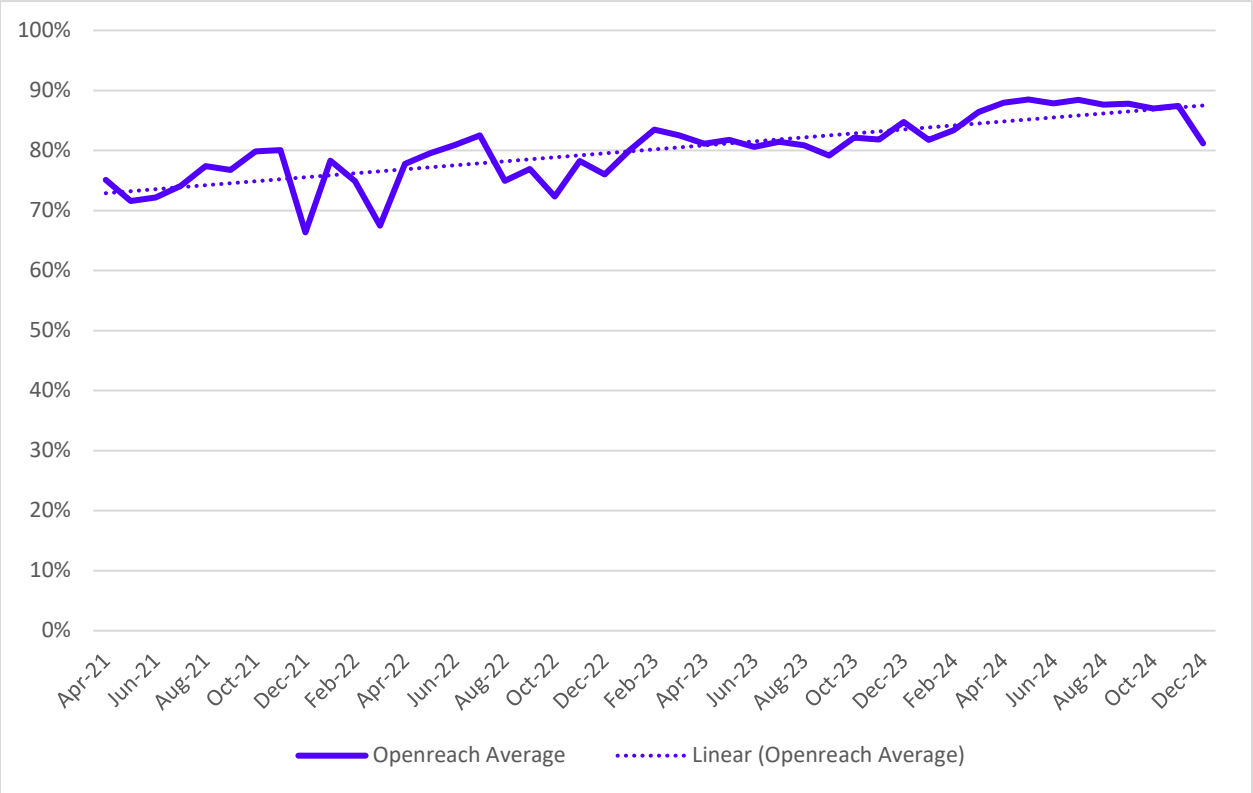
FTTP performance

A13.18 For the major provision and repairs KPIs for FTTP, average performance has either improved or been maintained across the period measured. We do not currently have minimum QoS standards for FTTP, therefore we do not include a QoS standard line in the graph like we do above.

A13.19 Figure A13.5 shows that repair performance has been on a steadily increasing trend across the time period.

[208] FTTC - KPI 2a Percentage installation completion: by the committed date.

Figure A13.5 FTTP Percentage of repairs completed within 1 working day (SML2)[209]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

A13.20 [✂]. Installing FTTP for the first time usually takes longer and can be more uncertain than FTTC.[210] To recognise this Openreach has a longer 18 day First Available Date (FAD) agreement in its service level agreement for FTTP. [✂].[211]

Figure A13.6 [✂][212]

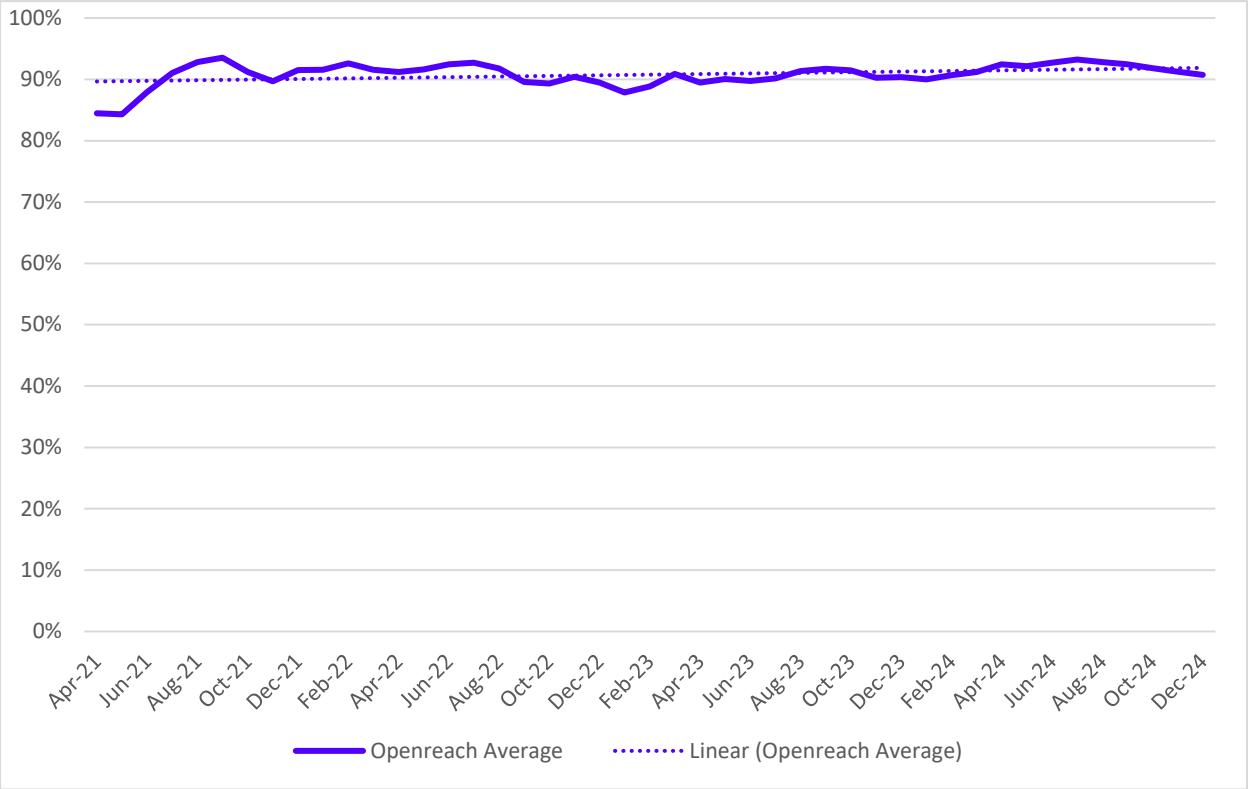
[✂]

Source: [✂]

A13.21 Figure A13.7 shows FTTP's performance in installing FTTP by its committed date. This has consistently been at around 90%. Orders completed by the committed date include those (more complex) orders where a committed date was provided after a survey (the KCI2 Assure process) to allow further works to be completed.

[209] FTTP - KPI 3 (b) (i) Percentage Repair completion: the Repair Service Level Commitment for Service Maintenance Level 2.
[210] Our evidence on this is set out is Volume 5 Paragraph 3.15.
[211] [✂].
[212] FTTP - KPI 1a Percentage first available date appointment availability: on or before the Required First Appointment Date.

Figure A13.7: FTTP Percentage installation completion by the committed date[213]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

Non discriminatory requirement review

A13.22 As part of the reporting requirement, we receive information on how Openreach's performance on the service they provide to downstream BT customers compares with the average service they provide to other CPs.

A13.23 We have reviewed how Openreach's service compares across the WLA market for BT and non-BT consumers using the data we have available to us. Table A13.2 details the average performance across key KPIs. In these KPIs, average performance levels and trends across the period for FTTP and FTTC have been very similar between BT and non-BT consumers for provisions and repairs. On the basis of this data, it does not appear that Openreach is systematically providing its downstream divisions with materially better services than other telecoms providers.

Table A13.2: Openreach WLA KPI performance for BT and Non-BT customers[214]

WLA Standard	FTTC Monthly Average Performance (BT)	FTTC Monthly Average Performance (Non – BT)	FTTP Monthly Average Performance (BT)	FTTP Monthly Average Performance (Non – BT)
Repair within 2 working days (SML1)	88.36%	87.42%	N/A	N/A

[213] [✂].
[214] The is the average from April 2021 to December 2024.

WLA Standard	FTTC Monthly Average Performance (BT)	FTTC Monthly Average Performance (Non – BT)	FTTP Monthly Average Performance (BT)	FTTP Monthly Average Performance (Non – BT)
Repair within 1 working day (SML2)	87.42%	85.75%	78.84%	82.70%
Installations to be completed by Committed Date	96.47%	95.13%	90.01%	91.52%
Quality standards in relation to the FAD - Frequency with which regulated installation appointment date must be offered	96.70%	96.98%	[✂]%	[✂]%

Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

Comparing FTTC performance to FTTP

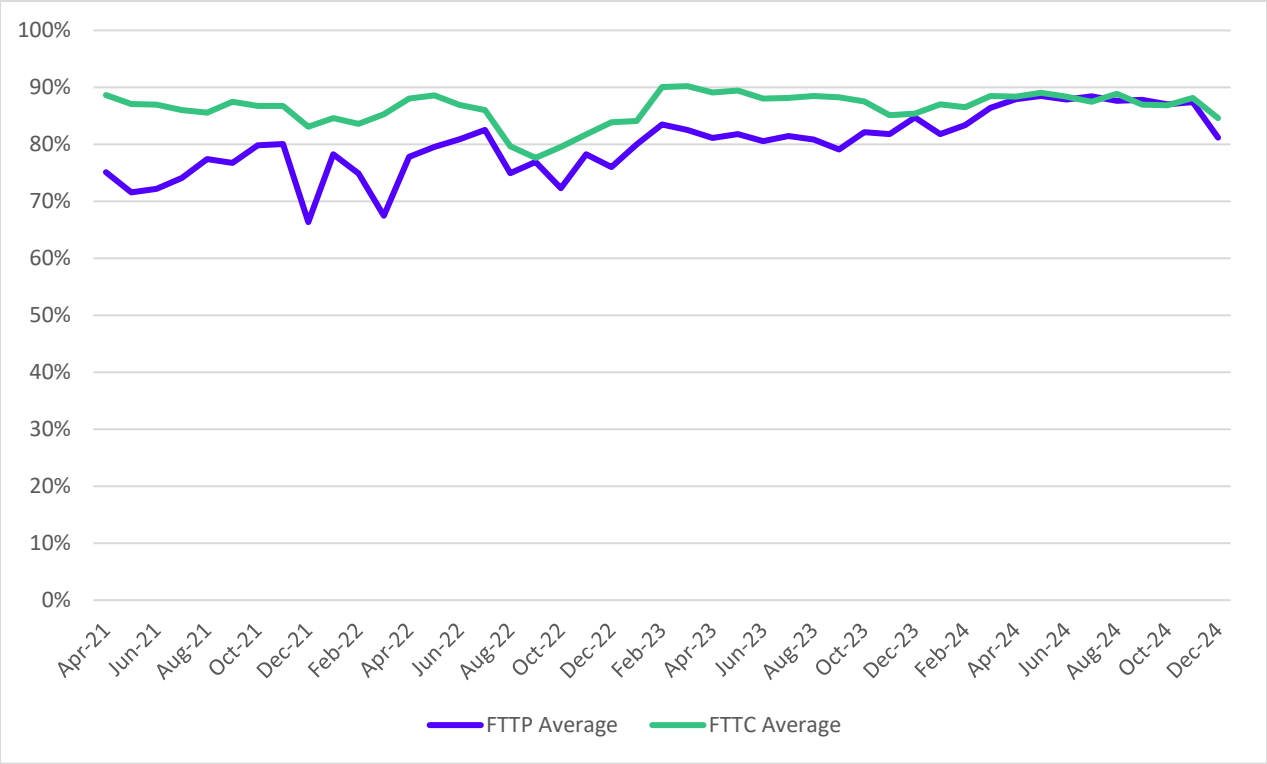
A13.24 We assessed how Openreach's performance on FTTC products compares to performance on FTTP on equivalent KPI parameters. [✂].[215]

A13.25 FTTP also tended to be subject to higher volatility across all KPIs. We understand that this is due to FTTP undergoing major rollout across the UK during this period leading to volumes being lower for the early part of this period.

A13.26 Monthly FTTP repair completion performance, measured by KPI 3(b)(i) sits below the equivalent of the annual FTTC standard of 85% for most of the period measured. It is only in the final 10 months of the period covered by our data where FTTP performance reaches a similar level to the equivalent FTTC KPI.

[215] These KPIs do not give a full picture of performance, because they do not recognise that a) Installing FTTP for the first time usually takes longer and can be more uncertain than FTTC because it is a more complex provisioning process; and b) FTTP have materially lower fault rates.

Figure A13.8 FTTP & FTTC Percentage Repair completion by SML 2[216]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

A13.27 [✂].

A13.28 Installing FTTP for the first time usually takes longer and can be more uncertain than FTTC because it is a more complex provisioning process. A fibre connection needs to be made into the premises and a new optical network terminal (ONT) installed. [217] [218] FTTC provisioning is unlikely to be as complex. In many cases an existing copper line from the premises to be served can be connected by an engineer at the FTTC cabinet often without requiring a visit to the premises.[219]

A13.29 [✂] and A13.11 illustrates how performance of completed installations by the committed date has also been lower.

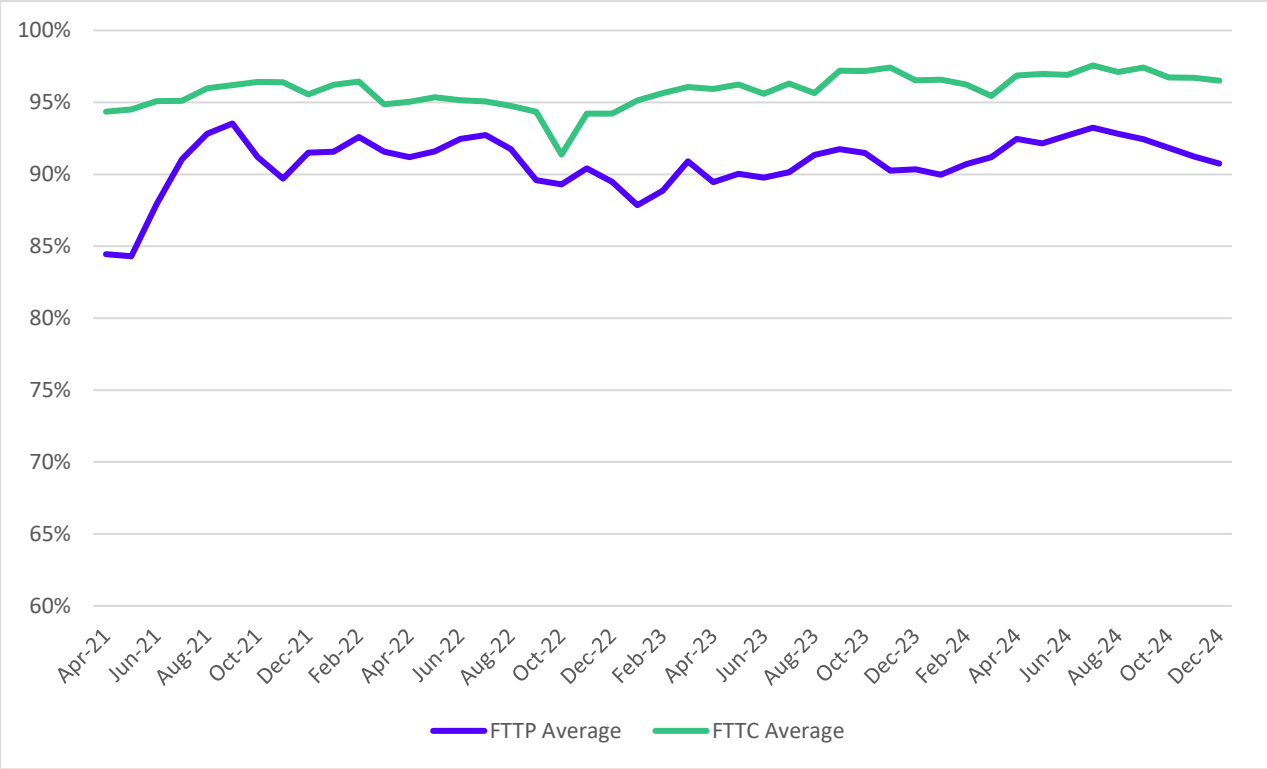
Figure A13.9 [✂][220]

[✂]

Source: [✂]

[216] KPI 3 (b) (i) Percentage Repair completion. In respect of services subject to Service Maintenance Level 2, the percentage of Faults whereby the Dominant Provider achieved a Restored Service during the relevant month within: the Repair Service Level.
[217] Either overhead from a nearby pole or buried from a nearby flex point e.g., in the pavement and then into the premises through a drilled hole. In a minority of cases, additional civil works are needed to extend the fibre network to reach the premises to be served.
[218] Unlike the network termination equipment (NTE) for copper connections, the ONT for FTTP requires power.
[219] So, in many cases, no appointment needs to be organised with the end customer.
[220] KPI 1a Percentage first available date appointment availability: on or before the Required First Appointment Date.

Figure A13.10 FTTP & FTTC Percentage installation completion: by the committed date[221]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR WLA KPI Report – December 2024.

Leased lines performance

A13.30 Table A13.3 sets out the standards we applied to the regulated leased lines markets over the period 2021 to 2026.[222]

Table A13.3 Current Leased Line standards

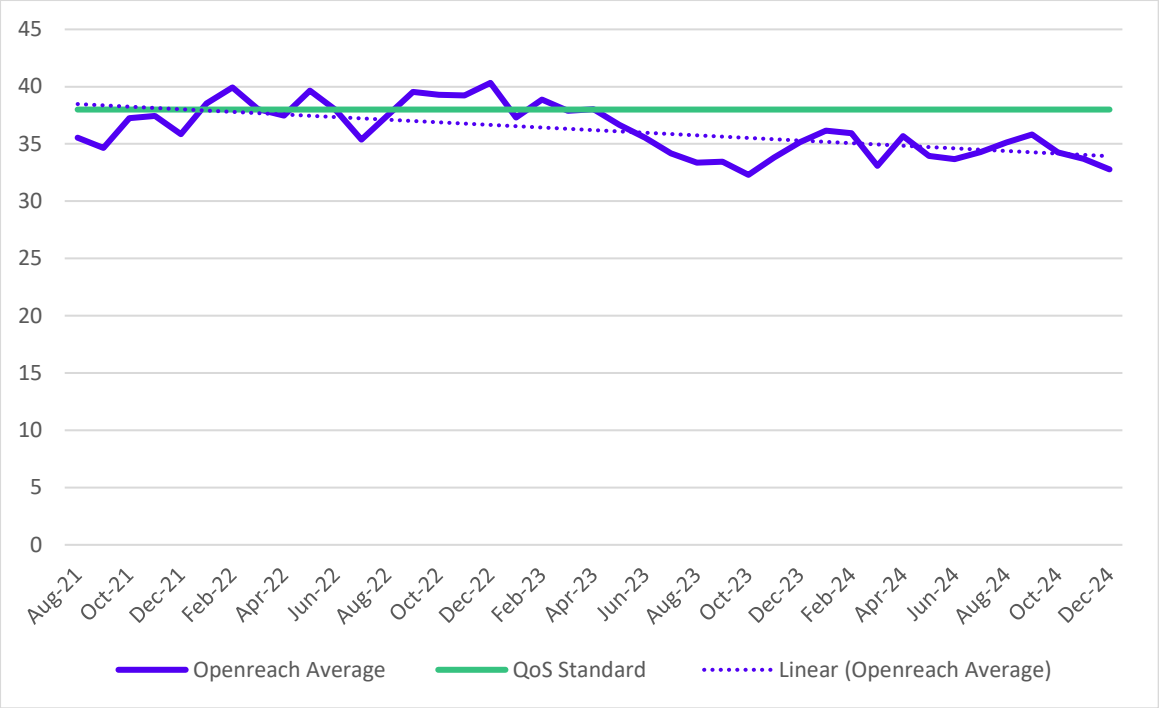
Standard	Level (Years 2021 to 2026)
MTTP (mean time to provide) across orders	No more than 38 working days
Upper percentile limit for provisions	No more than 4.5% of orders older than 133 working days
Certainty: Percentage of orders completed on or before the initial contractual delivery date (iCDD)	86%
Certainty cross-link: Maximum mean period for the iCDD	No more than 53 working days
Faults repaired within the service level agreement (SLA)	94%

[221] [✂].

[222] Note these minimum QoS standards apply to both geographic leased lines Area 2 and Area 3 but not the HNR Area or the CLA.

A13.31 In the financial year 2022/23 Openreach marginally missed the MTTP standard of 38 working days.[223] This can be seen in figure A13.11 where before Q2 2023 the KPI monthly value commonly lies above the green QoS standard line. Since Q2 2023 we have observed an improving trend in performance (i.e. a decreasing mean time to provide) and Openreach has generally been able to meet the equivalent of the annual standard on a monthly basis with the monthly average sitting around 35 working days.[224]

Figure A13.11 LLA Mean Time to Provide across orders[225]



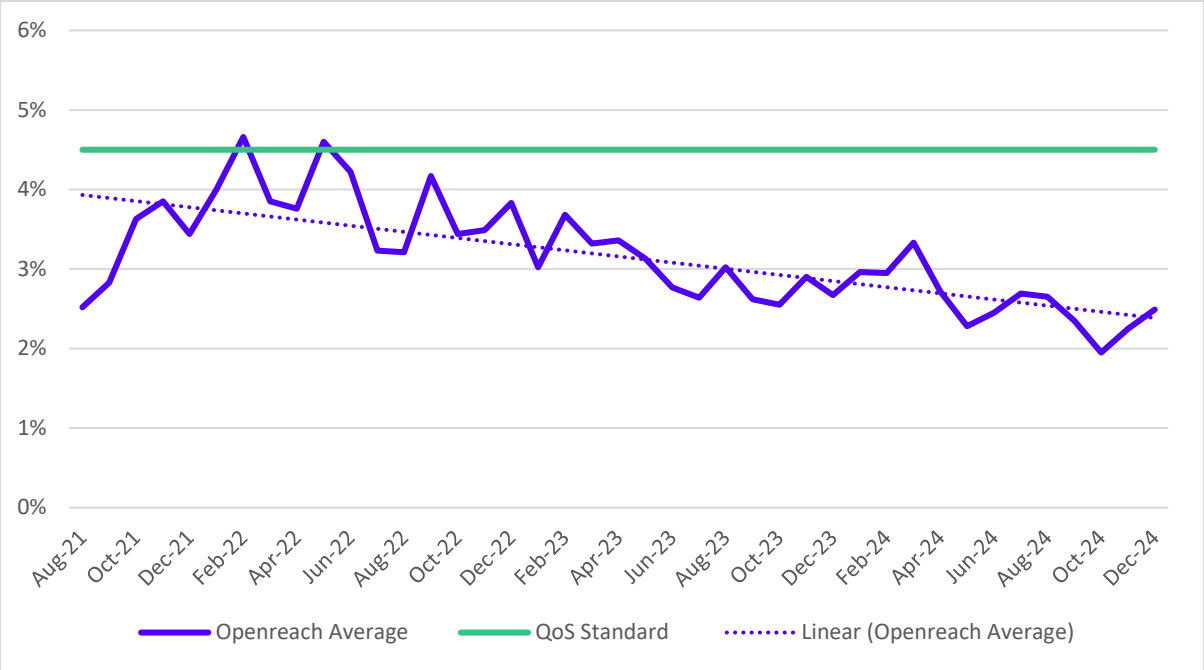
Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR Leased Line KPI Report – December 2024.

A13.32 Openreach has met the minimum QoS standard for each year over the period measured across all other leased lines KPIs. There are some individual months shown on the graphs in which performance temporarily dips below the green line showing the minimum QoS standard but this is not frequent enough to prevent them from meeting their yearly obligations. In general we have observed an improvement in performance over the period measured.

A13.33 Figure A13.12 below shows the percentage of orders that are older than 133 working days and how that complies with the QoS standard of this being no more than 4.5%. Openreach's performance for this metric has been on an improving (i.e. downwards) trend over the period measured. There were 2 months in 2022 where Openreach's monthly average performance fell the equivalent monthly minimum QoS standard, but the monthly average since then has been comfortably below the green QoS line.

[223] Ofcom, March 2024. Confirmation Decision served on BT by Ofcom for contravention of SMP Condition 10.1
[224] We comment upon Openreach missing its obligations in the 'Industrial Action' section of this annex
[225] LLA - KPI A Mean Time to Provide across orders.

Figure A13.12 LLA Time to provide upper percentile limit[226]

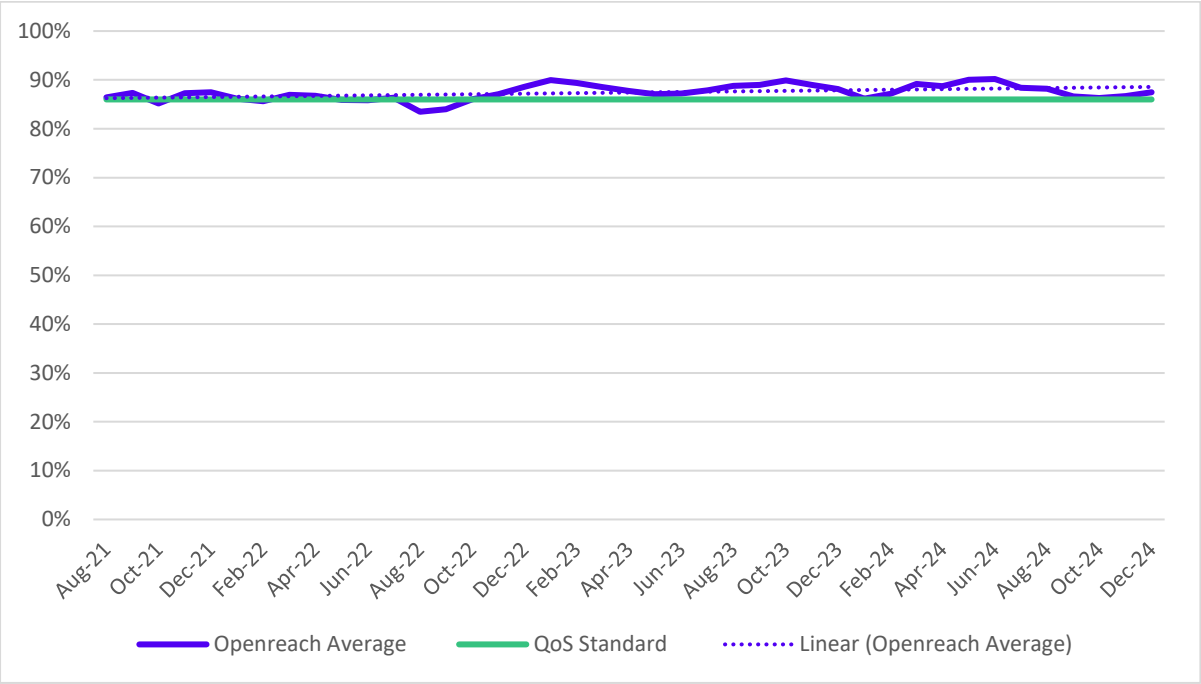


Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR Leased Line KPI Report – December 2024.

A13.34 Figure A13.13 shows the percentage of orders which are completed on or before the iCCD. There were 5 months where the average monthly percentage dipped slightly below the monthly equivalent of the minimum QoS standard of 86%. Since Q4 2022 the minimum standard has been met every month.

[226]LLA – KPI E Time to provide upper percentile limit.

Figure A13.13 LLA Percentage of orders completed on or before the initial contractual delivery date (iCDD) [227]

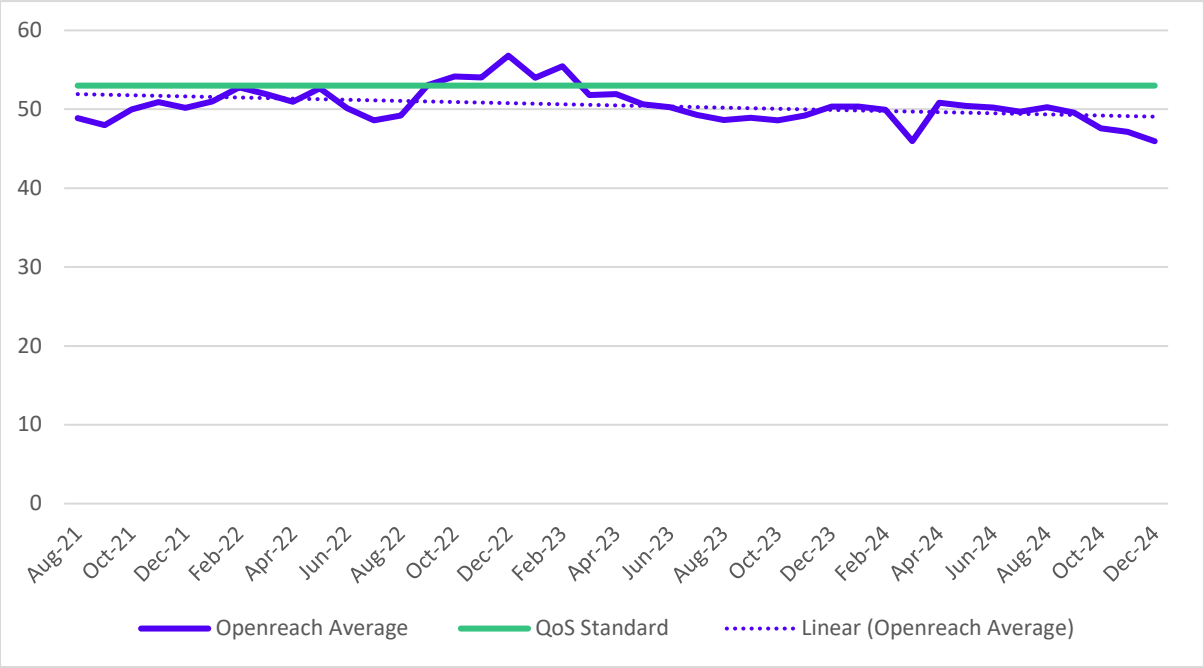


Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR Leased Line KPI Report – December 2024.

A13.35 Figure A13.14 below shows the mean numbers of working days for the initial contractual delivery period (iCDD). Openreach's monthly average was lower than the monthly equivalent of the minimum standard for 4 months of 2022/23 (i.e. took longer), but has performed above the minimum standard for the rest of the period. This KPI has been moderately improving throughout the period.

[227] LLA - KPI C Certainty: Percentage of orders completed on or before the initial contractual delivery date (iCDD).

Figure A13.14 LLA Mean initial contractual delivery period[228]

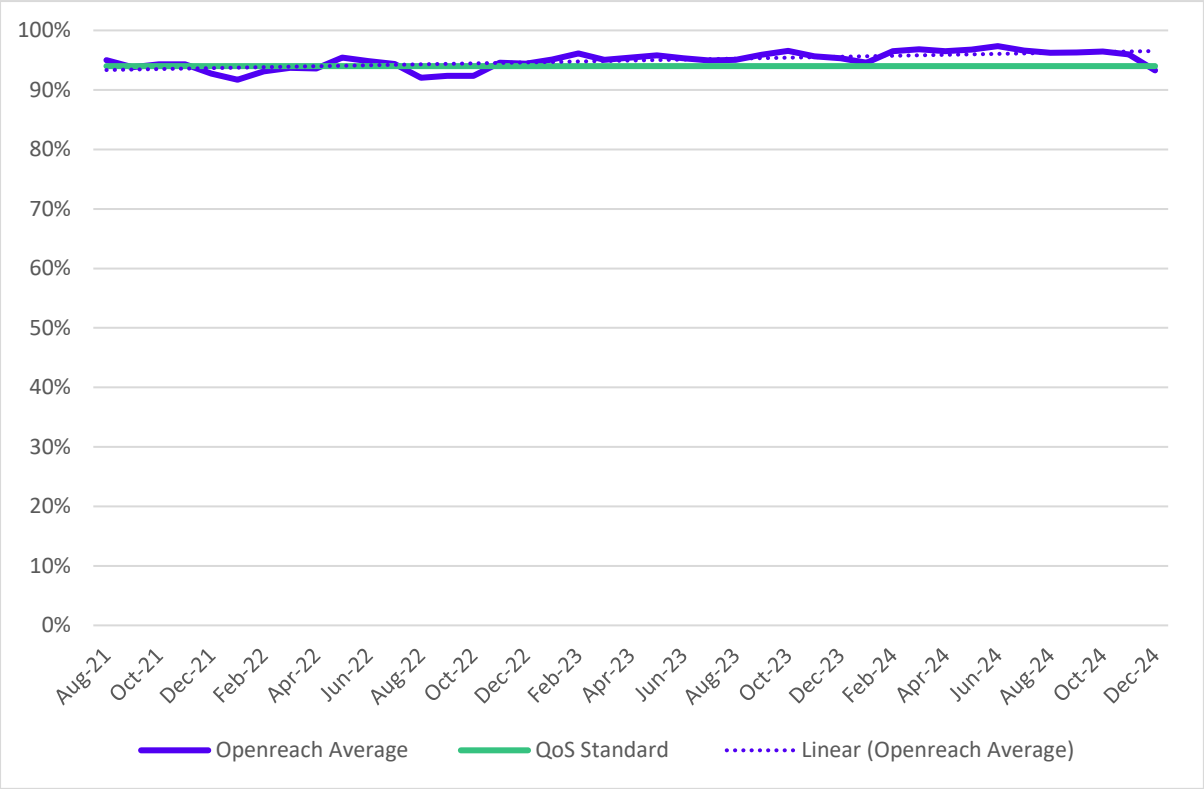


Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR Leased Line KPI Report – December 2024.

A13.36 Figure A13.15 shows the percentage of faults which are repaired by the times stated in the relevant service level agreement. Openreach's monthly average dropped below the equivalent monthly minimum QoS standard in 10 months of the 38 in the period shown, largely in the period before December 2022. Since then, performance has generally improved, with the minimum standard being met in every month except one.

[228] LLA – KPI F Mean initial contractual delivery period.

Figure A13.15 LLA Faults repaired within the service level agreement (SLA) [229]



Source: Ofcom analysis of Openreach reports to Ofcom. WFTMR Leased Line KPI Report – December 2024.

Locational analysis of Openreach WLA repair and provisioning data

A13.37 The WLA KPI data above is monthly aggregated information covering the whole of the UK.[230] However we also wanted to understand:

a) Differences in performance between both rural and urban areas of the UK, in order to consider whether a change in the proportion of rural customers should lead to changes to QoS minimum standards; and

b) FTTP performance in WLA Area 3, to help inform the setting of FTTP minimum QoS standards specific to that area.

A13.38 This subsection is structured as follows:

a) Data sources used in this analysis;

b) Classifying urban and rural locations;

c) Analysing the impact of a changing rurality mix for FTTC QoS standards; and

d) Analysing FTTP performance in WLA Area 2 and WLA Area 3.

Data sources

[229] LLA - KPI B Faults repaired within the service level agreement (SLA).
[230] Or in some cases by Openreach UK management region.

A13.39 We obtained WLA data from Openreach on individual provisions and repair orders over the period from April 2021 to March 2024.

A13.40 Each data point included:

a) WLA Product;

b) Postcode (which allows us to segment orders into geographical regions);

c) Relevant dates for the order to allow calculation of performance (date order accepted, order received, estimated delivery date provided to wholesale provider);

d) A unique customer reference number; and

e) Factors which may have affected the order (site survey, engineering visit, MBORC).

Classifying urban and rural locations

A13.41 We evaluated urban and rural locations using the Bluewave rurality system. This is a locale classification in which postcodes are segmented into a number of geographical groupings based on different population and spatial conditions. The Bluewave locale groups are described in Table A13.4.

Table A13.4 Bluewave locale classifications[231]

Locale Group	Type	Condition
A	Large City	Population: <500,000
B	Medium City/Large Town	Population: 100,000-500,000
C	Small City/Medium Town	Population: 15,000-100,000
D	Accessible Small Town	Small Towns that have populations between 2,000 and 15,000 and within 10 miles or so of one of the large urban areas defined in Locale Groups A, B and C.
E	Remote Small Town	Small Towns that have populations between 2,000 and 15,000 and are more than 10 miles or so from the large urban areas defined in Locale Groups A, B and C.
F	Accessible Rural Area	Villages with populations between 500 and 2,000 and areas that have populations of less than 500 (hamlets, open countryside and town fringes) and are within 10 miles or so of a larger urban area defined in Locale Groups A, B and C.

[231] Bluewave Geographics. Locale classification. Accessed on 4th March 2025. Accessed on 4 March 2025.

G	Remote Rural Area	Villages that have population between 500 and 2,000 and areas that have population less than 500 (hamlets and open countryside) and are more than 10 miles or so from a large urban area defined in Locale Groups A, B and C

A13.42 For our analysis we created an urban/rural split in which we classified any postcode in locale groups A-E as urban and any postcode in groups F and G as rural.[232] This is the same approach as we adopted when analysing urban and rural areas in our Connected Nations report.[233]

Analysing the impact of changing rurality for copper

A13.43 The transition from copper-based broadband to FTTP is likely to proceed at a different pace in different places, for a variety of reasons.[234] Openreach told us that copper provision and repair volumes [✂].[235] While the exact pattern is uncertain, we recognise that this transition may change the proportion of provision orders and/or repairs in rural areas. Due to the remoteness of some rural premises making them harder and more costly to service, this may make the existing FTTC QoS standards harder to achieve.

A13.44 To estimate how rurality could affect Openreach's performance we assigned each repair or provision order as either in an urban or rural location using the postcode associated with each order.[236]

A13.45 Our analysis of FTTC provisions showed that there is only a small difference in performance between urban and rural areas. We thus consider that an increasing rural proportion of FTTC customers should have little impact on FTTC provisions.

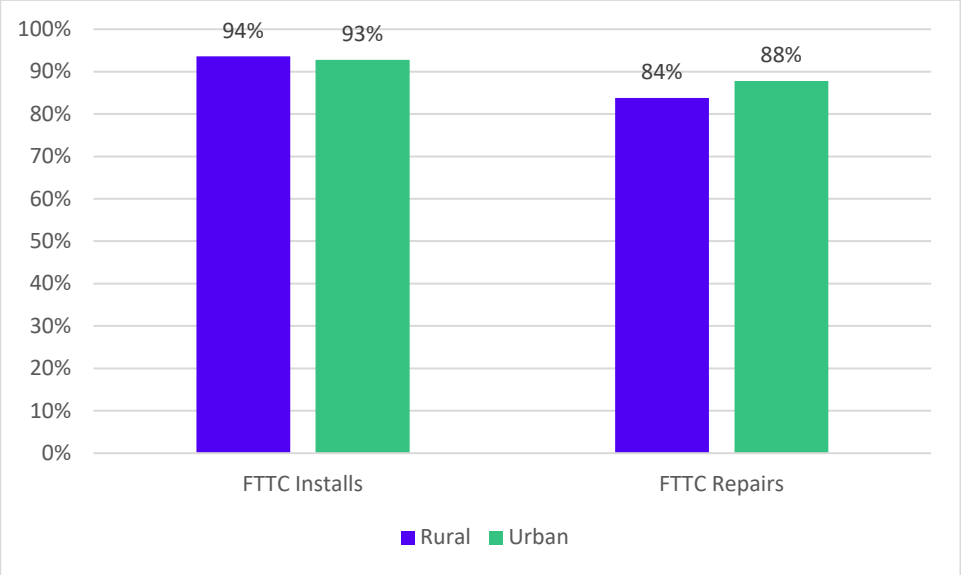
A13.46 FTTC repairs however, showed worse performance in more rural areas. We have thus considered repairs in further detail.

A13.47 Figure A13.16 shows that there was a 4 percentage point difference in FTTC repair completion within service level agreement timelines between urban and rural areas in the period April 2021 to March 2024.[237] This 4 percentage point difference in performance suggests that on average, we might expect the on time repair performance to decrease by approximately 1 percentage point (e.g. from 87% to 86%) every time the proportion of rural customers increases by about 25 percentage points (e.g, from 25% to 50%).

[232] Note when using our hybrid approach described in paragraph A13.66 to weight orders in each we apply
[233] Ofcom. December 2024. Connected Nations UK Report 2024
[234] Relevant factors include (i) the pace of Openreach's FTTP deployment in urban and rural areas; (ii) the extent to which rival networks (including VMO2) are present in urban and rural areas; and (iii) any differences between urban and rural consumers' propensity to purchase FTTP where it is available. The interplay between these factors may also change over the course of the 2026-31 review period.
[235] [✂].
[236] See Paragraph A13.42 on how we classified each data point as urban or rural.
[237] For Installs, the completion rate represents the percentage of orders completed by the Committed Date. For Repairs, the completion rate represents the percentage of repairs completed within the Repair Service Commitment for Service Maintenance Level 2.

Figure A13.16 FTTC repair and installation completion by Urban/Rural areas April 2021 – March 2024

1.2



Source: Ofcom analysis of Openreach s135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

A13.48 We conducted analysis to see how a changing rurality mix over the 2026-21 review period with a higher proportion of rural areas may impact Openreach's ability to meet the QoS standard based on its historic performance.

A13.49 In order to consider how a changing rurality mix may impact performance in FTTC repair standards, we used a weighted average order completion rate. This was created through the equation below where the percentage of orders in the urban locale is multiplied by the urban KPI performance level (i.e. 88%), and the percentage of orders in the rural locale is multiplied by the rural KPI performance level (i.e. 84%). The equation is shown below:

$$Weighted\ KPI = (Urban\ \% * 0.88) + (Rural\ \% * 0.84)$$

A13.50 In our example below, we use all FTTC repair orders from April 2021 to March 2024. 82% of orders are from urban areas and 18% from rural areas.

$$Weighted\ KPI = (0.82*0.88) + (0.18*0.84) = 0.87$$

A13.51 We then adjusted the weighting of rural/urban orders to reflect potential future scenarios where a greater proportion of rural orders would exist to understand how overall performance might be affected.

A13.52 Table A13.5 below shows how historic performance could have changed with different urban/rural weightings. The weightings shown in the first column show the volume of FTTC repair orders which are classified as urban or rural. For example, the weighting 82/18 is a scenario in which 82% of repair orders are urban and 18% are rural. We find that under all rurality split scenarios in which the percentage of rural orders does not rise above 80%, the weighted KPI did not fall below the existing minimum standards. Only in the '15/85' and '5/95' split scenario does the weighted KPI figure fall slightly below the WFTMR21 minimum standard of 85%.

A13.53 We consider that although there is some difference in FTTC repair performance between urban and rural areas, the gap is not big enough to suggest major concerns with

Openreach's ability to meet the UK-wide minimum QoS standards during this review period as a result of an increasing rural proportion of FTTC customers.

A13.54 The same result holds within each management region, as shown in Table A13.6. There would need to be extreme swings in the rurality split of customers for performance to fall below existing minimum standards based on current performance.

Table A13.5 Rurality split scenarios for FTTC repairs and the relevant KPI outcome

Urban/Rural Scenario	Weighted KPI
82/18	87%
50/50	86%
20/80	85%
15/85	84%
5/95	84%

Source: Ofcom analysis of Openreach S135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

Table A13.6 Management region rurality split scenarios for FTTC repairs and the relevant KPI outcome

1.3 Management Region	Rurality split 2021-2024	Rurality split at which weighted KPI drops below 85% (based on existing performance)
London and South East	92/8	55/45
Northern England	87/13	25/75
Wales and Midlands	80/20	15/85
Wessex	75/25	25/75
East Anglia	74/26	Never
Scotland	78/22	Never
Northern Ireland	52/48	Never

Source: Ofcom analysis of Openreach s135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

Setting minimum QoS standards for FTTP in WLA Area 3

A13.55 We are proposing to set minimum QoS standards on FTTP in WLA Area 3 only and are proposing to use similar metrics to set standards as we do for copper-based standards.[238] We are proposing to set Area 3 standards by estimating how Openreach has performed in the parts of Area 2 with comparable rurality to Area 3.

[238] See Volume 5 Section 3 for our proposal on this.

A13.56 Our proposed standards for FTTP QoS in WLA Area 3 are set out in Table A13.7 and we set out our proposed approach for determining these standards below.

Table A13.7 Proposed minimum QoS standards for FTTP products in WLA Area 3

Standard	Level
Repair within 1 working day (SML2)	79%
Repair within 11 working days (SML2)	96%
Installations to be completed by Committed Date	91%
First Available Date (FAD) for installations requiring an engineer visit - working days within which first date offered for installation appointments	18 days
Quality standards in relation to the FAD - Frequency with which regulated installation appointment date must be offered	90%

FTTP on time repair standards

A13.57 Below we discuss our approach to setting the proposed minimum repair standards for FTTP in WLA Area 3 (i.e. the first two rows of Table A13.7 above). First, we explain the calculations underpinning our proposed 79% figure for repair within 1 working day. We then explain why the next minimum standard relates to repairs within the 11 working days (i.e. 10 working days after the original SLA) and why we propose setting it at 96%.

Setting the standard for repair within 1 working day

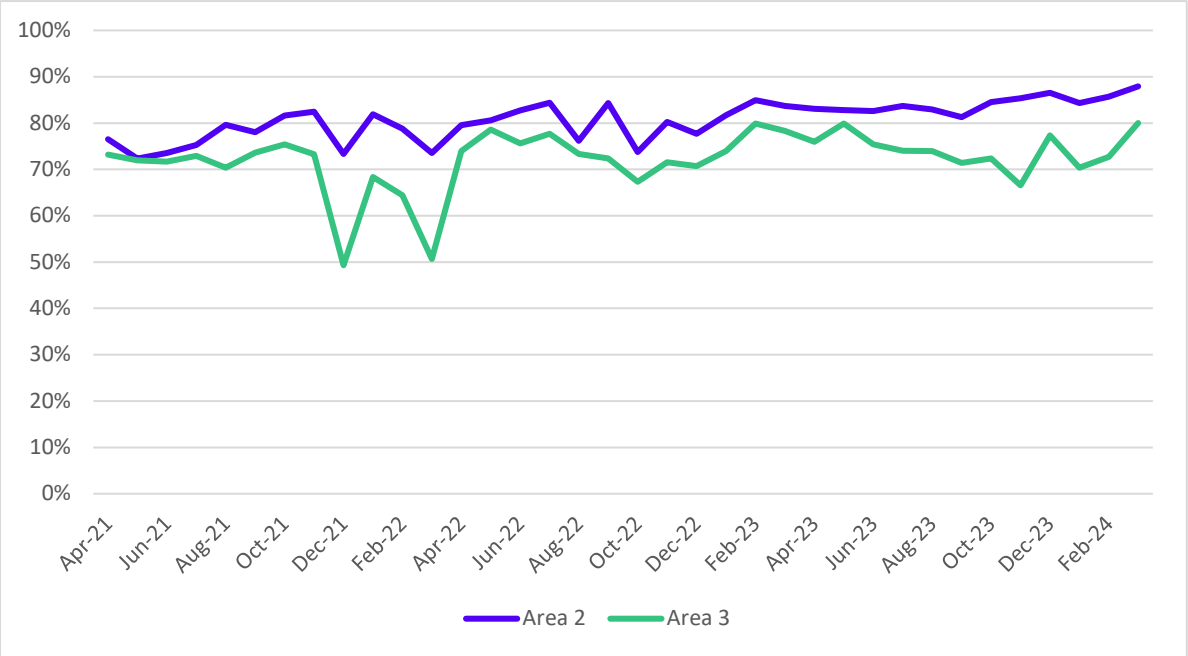
A13.58 We outline in Volume 5 that we propose to set QoS minimum standards for FTTP in WLA Area 3 at a level broadly consistent with existing Openreach performance in areas with comparable rurality.

A13.59 We used the postcode information that we have for every fault observation to divide our dataset into faults which occurred in our new proposed geographic markets (WLA Area 2 and WLA Area 3). This allows us to measure the average performance separately for each area.

A13.60 We calculated the repair performance metric by taking the difference between the day the fault was reported and the day it was closed and comparing this against the service maintenance level standard.

A13.61 Openreach's average monthly performance in WLA Area 2 and 3 for this metric is shown in Figure A13.17. This shows that WLA Area 2 performance is above WLA Area 3 for the whole period (we also note WLA Area 3 performance decreased more significantly around the time of industrial action in 2022 than in WLA Area 2). There could be various reasons for this. One potential reason for this difference in performance could be due to the nature of WLA Area 3 properties being more rural, and therefore being more challenging to repair as a result. Another possible factor is the potential development of competition in WLA Area 2 incentivising Openreach to offer a higher level of performance to consumers.

Figure A13.17 Mean repairs completed within the SLA for FTTP in WLA Area 2 and Area 3



Source: Ofcom analysis of Openreach s135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

A13.62 Table A13.8 also shows how the annual average for repairs completed within the SLA increased for both areas over the period shown.

Table A13.8 Mean repairs completed within the SLA for FTTP – Annual Average

	2021/22	2022/23	2023/24
WLA Area 2	77%	81%	84%
WLA Area 3	66%	74%	74%

Source: Ofcom analysis of Openreach s135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

A13.63 As we want to set a standard broadly consistent with existing performance, we think it is appropriate to use the most recent year of data (the 2023/24 financial year) when setting repair standards. This also means that we avoid using data that may be affected by the industrial action period. One downside of only using one year of data is the risk that it is atypical. However, the 2023/24 average is not an obvious outlier and appears to be broadly consistent with the three year trend. We also consider the volatility of the monthly outputs are not sufficiently large to make this a material risk.

A13.64 In 2023/34 there was a 10 percentage point difference in performance between WLA Area 2 and WLA Area 3. However, we recognise that these areas do not cover uniform geographic conditions, and in particular have different rural/urban splits, with WLA Area 3 having a higher percentage of rural properties which are likely to be more challenging to service. We have therefore calculated the performance in rural and urban locations for

those areas.[239] Table A13.9 shows how performance varies by rurality in each of the WLA areas.

Table A13.9 Mean repairs completed within the SLA for FTTP – Average 2023/24

Option	Rural	Urban
WLA Area 2	76%	86%
WLA Area 3	70%	84%

Source: Ofcom analysis of Openreach s135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

A13.65 There was a 6 percentage point difference in performance between rural premises in WLA Area 2 and WLA Area 3. This suggests that, although some of the 10 percentage point overall difference in performance is likely to be due to a higher percentage of rural premises in WLA Area 3 compared to WLA Area 2, there are likely to be other factors affecting performance.

A13.66 We have thus developed a hybrid approach which seeks to estimate the performance we would expect to have observed in Area 2 if it had a similar rurality profile to Area 3. To do this, we have taken the average performance seen in WLA Area 2 for repairs in each of the seven locale types outlined above, weighted by the proportion of orders in the category in WLA Area 3. This hybrid approach resulted in an average performance of 79%. This is a 5 percentage point increase compared to the actual performance seen in WLA Area 3 in 2023/24 (74%).

A13.67 Reflecting the above analysis, Table A13.10 outlines three potential options for setting a QoS minimum standard for 'FTTP mean repairs completed within the SLA' in Area 3.

Table A13.10 WLA Area 3 FTTP repair options

Option	Value
Option 1 (low): Openreach's average performance over 2023/24 in WLA Area 3	74%
Option 2 (medium): Openreach's performance in WLA Area 2 which matches the rurality of WLA Area 3 in 2023/2024	79%
Option 3 (high): Openreach's average performance over 2023/24 nationally	83%

Source: Ofcom analysis of Openreach S135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

A13.68 We discuss our proposed approach in Section 3 of Volume 5 and why we propose to set the standard at 79%.

Setting the standard for repair within 11 working days

A13.69 The second repair standard we set is for repairs which have failed to meet the service maintenance level by a specified number of working days beyond the SLA.[240]

[239] We identified whether a repair was urban or rural based on the Bluewave classification system described above.
[240] This is 11 days for SML2.

A13.70 We have explored several different options to determine what would be the most appropriate number of days to set, and the percentage of repairs which must be completed within this timeframe for FTTP.

A13.71 Our intention is to set a standard which covers the majority of repairs that go on longer that the SLA timeframe. This is to ensure that there continues to be an incentive for Openreach to complete the repair as quickly as possible.

A13.72 The first step of our analysis was to run different scenarios using our dataset to see what percentage of faults are repaired for different numbers of days past the SLA in WLA Area 3. In order to control for the rurality effects between the WLA Area 2 and 3 we used the same hybrid approach as described above for the SML2 repair standard.

A13.73 We started with SLA + 5 working days, which is the same number we use for the equivalent FTTC metric. 92% of repairs meet this level of performance. As this standard is there to ensure Openreach is incentivised to clear the faults which it failed to repair in the SLA timelines, we consider that we should cover a larger proportion of consumers than this. We set out in Volume 5, Section 3 why we have extended the number of days to SLA +10 days which was met for 96% of repairs in the year 2023/24.

A13.74 Due to the volume of repairs being covered under the FTTP repair measure being smaller than FTTC, we also investigated whether volatility was a potential issue. Underperformance of relatively few premises could cause the QoS standard to be missed if this was the case. We investigated this through observing what the fluctuation was in performance over the 2023/24 financial year in WLA Area 3 which is shown in Table A13.11. While there has been some variation in performance across the year, even when looking at performance on a monthly basis, the results stay within a 6% percentage point range (91%-97%).[241] From these monthly results we have inferred that impact of volatility on a year-to-year basis is likely to be small. We also expect volatility to further decrease as FTTP volumes increase.

Table A13.11 Percentage of faults which are repaired by SLA + 10 in Area 3 in 2023/24

Month	Percentage
04/2023	93.2%
05/2023	95.7%
06/2023	95.7%
07/2023	96.4%
08/2023	95.0%
09/2023	93.4%
10/2023	94.7%
11/2023	91.2%
12/2023	94.9%

[241] The monthly results shown here are the actual WLA Area 3 performance, so the overall average is lower than 96%, which was calculated using the hybrid approach.

Month	Percentage
01/2024	93.5%
02/2024	92.5%
03/2024	96.9%

Source: Ofcom analysis of Openreach S135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

Proposed standards for FTTP provisioning

A13.75 For percentage of installations completed by the committed date, we reviewed the difference between WLA Area 2 and 3 performance for both urban and rural provisions. We applied the same methodology as described above to divide our observations between WLA Area 2 and 3 using postcodes. We also used Bluewave to divide observations further into urban and rural areas. The figures for the 2023/24 financial year are shown in Table A13.12 below.

A13.76 These figures are similar to each other, both across the geographic market areas, and across rurality. We therefore believe that it is suitable in this case to use Openreach's current UK average performance (91%) to set the minimum QoS standard, rather than the hybrid approach we propose for FTTP repairs.

Table A13.12 Mean provisions completed by the committed date – Average 2023/24

Option	Rural	Urban
WLA Area 2	90%	91%
WLA Area 3	88%	90%

Source: Ofcom analysis of Openreach S135 to Ofcom. Openreach response dated 14 November 2024 to s135 notice dated 10 July 2024, questions A&B.

A14. Revenue and cost modelling for active legacy services

A14.1 We have undertaken both revenue and cost modelling to understand the likely evolution of future revenues and efficient costs of the relevant services[242] over this review period. The purpose of the modelling is to:

a) Provide the cost inputs for copper services for our Area 3 RAB modelling (see Annex 16).
b) Provide the 2025/26 and 2030/31 cost inputs for the EAD and EAD LA services that are used as the starting points within our dark fibre cost modelling (see Annex 17).
c) Calculate our proposed cost-based (CPI-X) charge control to be applied to Ethernet services of bandwidths 1 Gbit/s and below in LLA Area 3 (see Volume 4 Section 2).

A14.2 We have calculated the cost of services in Area 2 and Area 3 by forecasting the unit cost by service on a national basis and then applying our forecast volumes for Area 2 and Area 3 respectively to these national costs.

A14.3 We have used the WFTMR21 top-down cost model as a starting point and largely follow forecasting methodologies used within the WFTMR21. We have updated it to take into account market developments as outlined in the rest of this annex. We refer to this model as the 'cost forecast model'.

A14.4 In this annex we set out:

- a summary of the proposed price controls for regulated services included in the cost forecast model, including proposed ranges for cost-based price controls;
- net cost recovery estimates for services included in the cost forecast model from the WLA and Wholesale Fixed Analogue Exchange Line (WFAEL)[243] market, LLA market and IEC market respectively, when combined with net cost recovery estimates for ancillary services from each of these markets;
- the overall approach to cost modelling;
- the key modelling assumptions; and

[242] Within this annex we refer to relevant services. This comprises: MPF rentals and connections (WLA market); FTTC rentals and connections (WLA market); G.fast/SOGfast rentals and connections (WLA market); SOGEA rentals and connections (WLA market); SMPF rentals and connections (WLA market); Wholesale Line Rental (WLR) rentals and connections (WFAEL market); Ethernet basket services including rentals, connections and main link (LLA market; IEC market); WDM (Optical) services including rentals, connections and main link (LLA market; IEC market).

[243] The WFAEL market (which was deregulated in 2021) concerns the provision of wholesale analogue voice services; the product offered by BT in this market is called WLR. We forecast volumes and costs for WLR rental and connection services because (1) they share a significant proportion of fixed and common costs with WLA services and (2) non single order FTTC services are sometimes purchased with WLR so WLR is still relevant for downstream FTTC provision.

- a summary of the modelling assumptions used in our low cost and high cost scenarios, which are used to generate our proposed ranges for cost-based price controls.

Summary of proposed price controls

A14.5 Tables A14.1, A14.2, A14.3, A14.4 and A14.5 below summarise our proposed charge controls specifically for services included in the cost forecast model across the WLA, LLA and IEC markets. We set out our proposed charge controls for the following geographic markets:

- WLA Area 2
- WLA Area 3
- LLA Area 2
- LLA Area 3
- IEC BT Only exchanges and IEC BT+1 exchanges

Table A14.1: Proposed charge controls for WLA Area 2

	Proposed level
MPF SML1 rentals	CPI-0% [see Section 1 of Volume 4]
80/20 FTTC rentals and 80/20 SOGEA rentals	CPI-0% [see Section 1 of Volume 4]

A14.6 We are also proposing to set charge controls for various types of WLA connection service. Further detail is provided in Volume 4 Section 5.

A14.7 For context, we are also proposing to set a CPI-0% charge control on 80/20 FTTP rentals in areas where a copper-based 80/20 service is not available. Further detail is provided in Volume 4 Section 1.

Table A14.2: Proposed charge controls for WLA Area 3

	Proposed level
MPF SML1 rentals	CPI-0% [see Section 1 of Volume 4]
80/20 FTTC rentals and 80/20 SOGEA rentals	CPI-0% [see Section 1 of Volume 4]

A14.8 We are also proposing to set charge controls for various types of WLA connection service. Further detail is provided in Volume 4 Section 5.

A14.9 For context, we are also proposing to set a CPI-0% charge control on 80/20 FTTP rentals in areas where a copper-based 80/20 service is not available. Further detail is provided in Volume 4 Section 1.

Table A14.3: Proposed charge controls for LLA Area 2

	Proposed level
Ethernet services at all bandwidths (basket charge control)	CPI-0% [see Section 2 of Volume 4]
WDM services	CPI-0% [see Section 2 of Volume 4]

Table A14.4: Proposed charge controls for LLA Area 3

	Proposed level
Ethernet services of bandwidths 1 Gbit/s and below (basket charge control)	CPI-4.75% to CPI-8.50% [see Section 2 of Volume 4]
Ethernet services of bandwidths above 1 Gbit/s (basket charge control)	CPI-0% [see Section 2 of Volume 4]
WDM services	CPI-0% [see Section 2 of Volume 4]

A14.10 For context, we are also proposing to set cost-based charge controls on dark fibre access (DFA) services in LLA Area 3. DFA services are not directly included in the cost forecast model: we have estimated their costs in a separate dark fibre cost model (consistent with the approach used in the WFTMR21). Further detail is provided in Annex 17.

Table A14.5: Proposed charge controls for IEC BT Only exchanges and IEC BT+1 exchanges

	Proposed level
Ethernet services at all bandwidths (basket charge control)	CPI-0% [see Section 3 of Volume 4]
WDM services	CPI-0% [see Section 3 of Volume 4]

A14.11 For context, we are also proposing to set cost-based charge controls on dark fibre inter-exchange (DFX) services at BT Only exchanges and BT+1 exchanges. DFX services are not directly included in the cost forecast model: we have estimated their costs in a separate dark fibre cost model (consistent with the approach used in the WFTMR21). Further detail is provided in Annex 17.

Aggregate recovery estimates

A14.12 We have used the cost forecast model to assess cost recovery across all services in aggregate in (i) the WLA and WFAEL[244] markets and (ii) the LLA and IEC markets. The purpose of this exercise is to assess whether our proposed charge controls enable

[244] As noted above, the (deregulated) WFAEL market concerns the provision of wholesale analogue voice services; the product offered by BT in this market is called WLR. We include forecast volumes and costs for WLR rental and connection services because (1) they share a significant proportion of fixed and common costs with WLA services and (2) non single order FTTC services are sometimes purchased with WLR so WLR is still relevant for downstream FTTC provision.

Openreach to recover its efficiently incurred costs[245] in aggregate across almost all services[246] (circuit rentals, connections, main link rentals and ancillary services) in (i) the WLA and WFAEL markets and (ii) the LLA and IEC markets. We have focused our analysis on WLA Areas 2 and 3, LLA Areas 2 and 3, and IEC at BT Only exchanges and BT+1 exchanges.

A14.13 We have calculated 'net recovery', which refers to the net difference between forecast revenue and forecast fully allocated cost (FAC). Net recovery may be positive (indicating over-recovery of costs) or negative (indicating under-recovery of costs).

A14.14 For some of the services included in this assessment, we are not proposing to apply charge controls. For these services we have based our net recovery assessment on an assumption that prices increase annually by CPI-0%. For those services where we are proposing to apply charge controls, we have incorporated those charge controls in our net recovery assessment.

A14.15 Below we explain our net recovery estimates, first for WLA and WFAEL services and second for LLA and IEC services.

Recovery for WLA & WFAEL services

A14.16 We have used the cost forecast model to assess net cost recovery across all services in aggregate in the WLA and WFAEL markets.

A14.17 We have also accounted for forecast net recovery of costs across ancillary services[247] in the WLA and WFAEL markets.

A14.18 Table A14.6 below shows our range of expected over or under recovery compared to fully allocated cost (FAC). Our modelling suggests that our proposed charge controls could lead to BT recovering over the review period[248]:

i) an amount within an estimated range of c.£400m less than fully allocated cost (FAC) to c.£1,525m more than FAC in WLA Area 2;
ii) an amount within an estimated range of c.£100m less than FAC to c.£250m more than FAC in WLA Area 3.
iii) an amount within an estimated range of c.£50m more than FAC to c.£375m more than FAC in the WFAEL market.

[245] By efficiently incurred costs, we mean the efficiency incurred incremental cost plus an allocation of efficiently incurred common costs which would be sufficient for Openreach to recover the fully allocated cost (FAC) of providing the services in question.

[246] It is not possible to include dark fibre services in this assessment, so we have not included these services, but we note that including them would likely have only a small impact on aggregate cost recovery.

[247] Excluding connections which are listed as being included in the cost forecast model above.

[248] The £m estimates shown are in 2022/23 real terms and account for current price discounts where available. We have compared revenues from our proposed charge controls against FAC across all years of the 2026-31 review period.

Table A14.6: Recovery estimates for WLA and WFAEL compared to FAC.[249]

Services	Low Costs		High Costs		Base	
	Area 2	Area 3	Area 2	Area 3	Area 2	Area 3
FTTC, SOGEA, G.fast and SOGfast rentals and Connections	£1,466m	£244m	-£132m	-£41m	£578m	£85m
MPF and SMPF rentals & connections	£21m	£2m	-£132m	-£18m	-£32m	-£4m
WLA ancillaries[250] [251]	£15m	£2m	-£120m	-£20m	-£51m	-£8m
WLR rentals & connections	£316m	£71m	£88m	£20m	£269m	£63m
WFAEL ancillaries	-£19m		-£47m		-£27m	

Recovery for LLA and IEC services

A14.19 We have used the cost forecast model to assess net cost recovery across almost all services in aggregate in the LLA and IEC markets.

A14.20 We have also accounted for forecast net recovery of costs across ancillary services in the LLA market and IEC market.

A14.21 Tables A14.7 and A14.8 below show our range of expected over or under recovery compared to fully allocated cost (FAC). Our modelling suggests that our proposed charge controls (CPI-0% for some services; cost-based charge controls for other services) could lead to BT recovering over the review period[252]:

- an amount within an estimated range of c.£525m to c.£900m more than FAC across the LLA markets over the review period.
- an amount within an estimated range of c.£400m to c.£475m more than FAC across the IEC markets over the review period.

[249] Negative numbers in the table below represent under recovery compared to FAC.

[250] Commingling accommodation services have been included within this recovery estimate for WLA. GEA cablelink has not been included within this recovery estimate.

[251] WLA ancillaries recovery has been split between Area 2 and Area 3 using Ofcom estimated Area2:Area3 ratio for MPF, FTTC, SOGEA, G.fast and SOGfast rentals in combination.

[252] The £m estimates shown are in 2022/23 real terms. We have compared revenues from our proposed charge controls against FAC across all years of the 2026-31 review period.

Table A14.7: Recovery estimates for LLA compared to FAC.

Services	Low Costs		High Costs		Base	
	Area 2	Area 3	Area 2	Area 3	Area 2	Area 3
Up to and including 1 Gbit/s Ethernet rentals and connections	£434m[253]	£77m	£223m	£41m	£343m	£63m
Above 1 Gbit/s Ethernet rentals and connections		£63m		£39m		£51m
WDM (Optical) rentals and connections	£118m	£100m	£90m	£66m	£106m	£83m
LLA ancillaries[254]	£97m		£85m		£92m	

Table A14.8: Recovery estimates for IEC compared to FAC.

Services	Low Costs	High Costs	Base
	BT only and BT +1	BT only and BT +1	BT only and BT +1
Ethernet rentals and connections (all bandwidths)	£246m	£219m	£235m
OSA rentals and connections	£194m	£174m	£185m
IEC ancillaries[255]	£27m	£22m	£25m

Overall approach to cost modelling

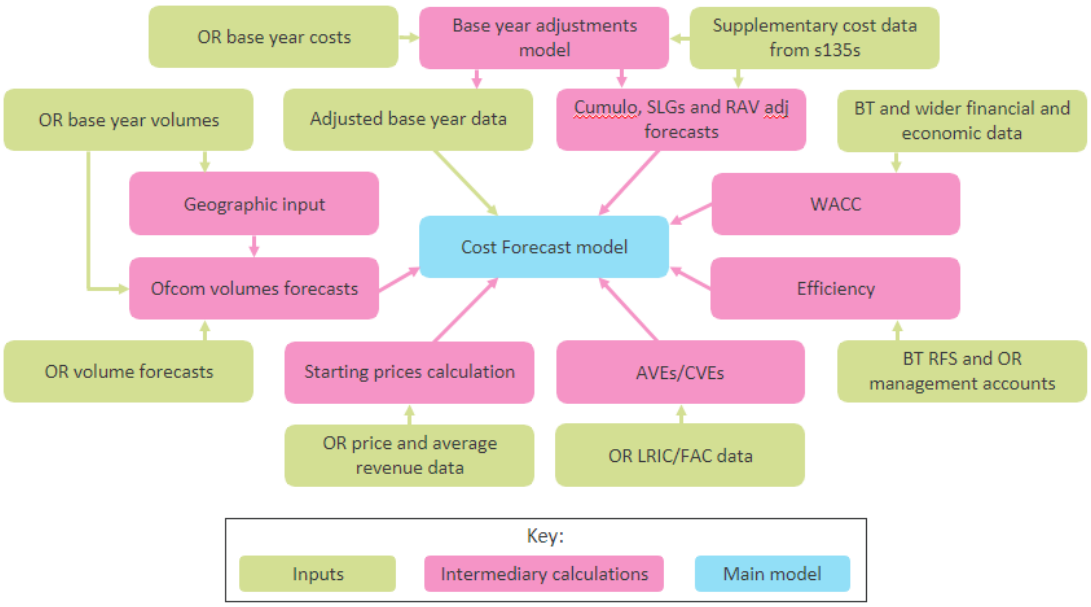
A14.22 The objective of our modelling exercise is to forecast BT's efficient costs of providing copper-based WLA services (e.g. MPF and FTTC/SOGEA services) and leased line services over the charge control period. We have structured our model as illustrated in Figure A14.1 below.

[253] For LLA Area 2 we present the overall net recovery across Ethernet services of all bandwidths, because we are proposing to set a CPI-0% charge control on a basket containing Ethernet services of all bandwidths. Further details are provided in Volume 4 Section 2.

[254] Accommodation services have been included within this recovery estimate for LLA. Ethernet excess construction charges have not been included within this recovery estimate.

[255] Accommodation services have been included within this recovery estimate for IEC.

Figure A14.1: The Cost forecast model structure



Note: in this Figure 'OR' refers to Openreach. Other acronyms are described later in this annex.

Approach to modelling

A14.23 Consistent with the WFTMR21 Statement and previous reviews, we have built our model using a top-down cost modelling approach based on cost data from BT's regulatory financial reporting systems. The top-down modelling approach is an accounting approach that forecasts how BT's efficiently incurred costs may change over time relative to the base year.

Cost standard

A14.24 Our typical approach to setting charge controls on BT has been to allow it to recover the incremental costs of provision plus an appropriate allowance for the recovery of common costs.[256] This is based on forward-looking costs plus some relevant sunk costs, such as the cost of duct.

A14.25 As in previous reviews of leased line and WLA charge controls[257], we consider Current Cost Accounting (CCA) Fully Allocated Cost (FAC) to be the most appropriate standard for estimating the cost of providing leased lines, WLA and WFAEL services.

A14.26 The use of a CCA FAC approach values BT's assets on the basis of an estimate of their current replacement costs. We consider that a CCA FAC approach has the advantages of being transparent and practicable to implement as BT's costs are known and are based on its Regulatory Financial Statements (RFS) which are publicly available to stakeholders each year. We consider that current costs give better signals for efficient investment and entry than historical costs. Using BT's costs also has the benefit of leading to consistent cost

[256] Common costs are those which arise from the provision of a group of services, but which are not incremental to the provision of any individual service.

[257] WFTMR21, 2019 BCMR and 2018 WLA Statements.

recovery decisions, both over time and between other regulated markets. We therefore use BT's CCA FAC as the cost standard in our model.

Key steps in our cost modelling

A14.27 Our modelling approach consists of six key steps:

d) First, we calculate the base year costs for each set of relevant services. These costs use BT's RFS as a starting point, with some adjustments.
e) Second, we forecast costs for each year until the end of the charge control period. We forecast operating and capital costs starting from the base year, taking into account our volume forecasts, efficiency assumptions, input price changes, asset volume and cost volume elasticities (AVEs and CVEs), as well as our view of the appropriate forward-looking weighted average cost of capital (WACC).
f) Third, to reduce the risk of asset stranding due to copper retirement, we add in our estimate of the accelerated depreciation cost for stranded copper assets capitalized within our control period.
g) Fourth, we remove any costs that were subject to accelerated depreciation in the previous control period to ensure these are not recovered twice.[258]
h) Fifth, we forecast revenues in each year (assuming that there was no charge control).
i) Finally, we compare revenues and costs for each set of relevant services.

A14.28 We describe each of the steps and key assumptions used in more detail below.

Base year costs

A14.29 The first step in our top-down modelling is establishing the relevant costs in the base year. These base year costs are based on regulatory accounting data provided by BT.

A14.30 For this consultation, we use BT's 2022/23 restated[259] RFS costs as the starting point for our base year. We then adjust the data to reflect our view of BT's efficiently-incurred costs. These adjustments are quantified in Table A14.9 and discussed separately below. For the statement, we intend to update the base year to 2023/24 restated.[260]

[258] This step was not required in the WFTMR21 as that was the first review period where we had accelerated depreciation.

[259] We have used restatement run RS29 for our base year. This is not the 2022/23 restated numbers from BTs 2024 published RFS, but a restatement run which comprises all restatements made within BT's 2024 Change Control Notification (CCN).

[260] The 2023/24 restatement run used within BT'S 2025 CCN.

Table A14.9: Summary of adjustments to our base year model on Relevant Services (£m)

	PI* Operating costs (opex)[261] (£m)	PI CCA Depreciation (£m)	PI Mean Capital Employed (MCE) (£m)	Active Operating costs (opex)[262] (£m)	Active CCA Depreciation (£m)	Active Mean Capital Employed (MCE) (£m)
2022/23 Restated RFS total unadjusted	27.5	127.9	2,203.2	679.2	726.0	4,581.9
Remove cumulo costs[263]	-	-	-	-90.7	-	-
Remove Ethernet SLG costs	-	-	-	-24.4	-	-
Restructuring charges and property provision costs smoothed for 3-year average	0.8	-	-	0.6	-	-
Reallocate ECC costs[264]	-	-	-	2.9	-	-
2022/23 restated revised total	28.3	127.9	2,203.2	567.8	726.0	4,581.9

** PI refers to physical infrastructure, such as Openreach's ducts and poles*
Source: Ofcom figures calculated from analysis on BT data

Adjustment to remove cumulo costs

A14.31 BT's cumulo rate costs are the non-domestic rating costs BT pays on its rateable network assets.

A14.32 BT's rates bill is expected to increase over the charge control period at a faster rate than other operating costs, explained in more detail in the cumulo section below. Due to this, we have removed the cumulo costs from the base year data and forecast them separately

[261] Excluding holding gains and losses and other CCA adjustments.

[262] Excluding holding gains and losses and other CCA adjustments.

[263] The removal of all cumulo costs is the first adjustment made to the 2022/23 restated base data. All other adjustments below have been made excluding cumulo.

[264] Although the reallocation is a net zero reallocation, costs are being moved from ECC services (non-relevant services) to EAD connections (relevant services).

in the cost forecast model. This is consistent with the approach taken in the WFTMR21 Statement.

Adjustment to remove Ethernet Provision SLG costs

A14.33 BT's Ethernet SLG Provision costs are the costs BT pays on delayed provisioning of connections.

A14.34 BT's Ethernet provision SLG costs are linked to the monthly rental prices of the underlying Ethernet service and would be expected to be correlated to volumes growth/decline of the service, explained in more detail in the Ethernet SLG section below. Due to this, we have removed the Ethernet Provision SLG costs from the base year data and forecast them separately in the cost forecast model. This is consistent with the approach taken in the WFTMR21 Statement.

Adjustment to smooth restructuring charges and property rationalisation provision costs

A14.35 Restructuring costs are associated with changes in BT's organisational structure that result in employee redundancies (with costs from redundancies known as leaver payments).

A14.36 Property rationalisation provision costs relate to BT's strategy of consolidating its office space to enable the mothballing and subletting of buildings.

A14.37 As in the WFTMR21 Statement, we consider that leaver payments, restructuring costs and property rationalisation provision costs are forward looking and efficiently incurred if they produce future efficiency benefits and reduce future property related costs (and we are not aware of any information suggesting these costs may be inefficient). These costs fluctuate year on year therefore these costs have been included in the base year for the Consultation by smoothing them over a three-year period.[265][266]

Adjustment to reallocate Excess Construction charges (ECCs)

A14.38 Within Volume 4 Section 5. we propose to fix the ECC threshold for the duration of this review period at £3,680. Within BTs current RFS, costs are allocated to EAD connection services using actual ECC capex spend, actual relevant EAD lines and a threshold of £2,800.

A14.39 Changing the threshold should not result in the total ECCs for a given year to change but will result in the allocation to EAD connections and ECC services in the RFS changing. Increasing the threshold will mean that more ECCs will be captured by the threshold and so more costs will flow to EAD connections and less to ECC services.[267] The base year adjustment we have made reflects this net zero reallocation.

A14.40 We have used Openreach's 2023/24 ECC balancing charge compliance submission and updated the threshold used in the calculations to use the proposed ECC threshold of £3,680. This results in £2.9m of costs that were previously not captured by the threshold now being captured. It is these costs that we have reallocated in our adjustment.

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[265] The calculation for this adjustment has been made in the same way as described in the BCMR 2019 Statement, Annex 19, paragraphs A19.18-20.

[266] BT response to questions A6 and A7 of the s135 notice dated 2 May 2024 and BT response to question C1 of the s135 notice dated 19 August 2024.

[267] ECC services record the costs and revenue for ECCs that are above the £2,800 threshold.

Adjustment to separate different SOGEA connections

A14.41 Currently within our base year data costs and revenues for SOGEA connections represent new connections requiring installation at premise or cabinet combined with start of stopped line connections.

A14.42 Given the unit cost and our volume forecasts of these different types of connections are materially different, we have made an adjustment to approximate the split of costs between the different connection types. We have assumed that the unit FAC for start of stopped line connections is equivalent to the price for this type of connection currently being charged by Openreach[268] and multiplied this by SOGEA start of stopped line connection volumes to estimate a base year FAC. The remaining FAC within the SOGEA connection, after subtracting this approximated amount for start of stopped line connections, is assumed to be the FAC for connections requiring installation.

Forecasting costs

Overall approach

A14.43 BT's costs consist of operating and capital costs (opex and capex). We forecast each of these cost types separately. We have taken a similar approach to forecasting costs as we took in the WFTMR21 Statement.[269]

A14.44 While we are ultimately interested in service-level costs, our cost forecasts are calculated at a network component level. We consider that this is more robust than forecasting at a service level as BT's services are made up of a common pool of network components such as lengths of fibre. By forecasting how the costs of these 'building blocks' are expected to change, we can build up the costs of each service. This allows our forecasts to account for economies of scale due to volume growth where multiple services use a single component (i.e. share the same underlying costs). These economies of scale might be missed were we to treat each service as separate.

A14.45 We forecast costs in each year until the end of the charge control period. We do this in two steps after we have established the base year costs:

a) First, we forecast costs assuming volumes remain constant in all years. This takes into account changes in input prices and expected efficiency gains.
b) Second, we add the effects of our volume forecasts. We use AVEs and CVEs to estimate the impact of changes in volumes on costs.

[268] £3.71 per connection until April 2025. https://www.openreach.co.uk/orpg/home/products/pricing/loadProductPriceDetails.do?data=V%2FtqAak%2FPzhnW%2FRTytLW31mPugcWvoirD3ZL95dzyuc9q%2FCUHfmZJHKkF036xG69e6YShZ82RgLOGLsH2e9%2Bmw%3D%3D

[269] WFTMR21 Statement, Annex 14.

Key modelling assumptions

Volume forecasts

A14.46 Service volume forecasts are required for our top-down cost model, driving both cost and revenue forecasts. For costs, service volumes are converted into component volumes by using service and component specific cost usage factors. Costs are then forecast at a component level. For a description of how service volumes are used in our revenue forecasts, please see paragraphs A14.157 to A14.158.

A14.47 For leased lines, there is a long list of services, so we base our volume forecasts initially on Openreach's own forecasts. We consider that Openreach's forecasts of service volumes provide the best starting point for our leased line forecasts.

A14.48 For our WLA and WFAEL volume forecasts, where the list of services is significantly shorter than leased lines, we consider it appropriate to determine our own input assumptions which then drive our service volume forecasts. For WLA and WFAEL services, we then cross-check our forecasts against those provided by Openreach and ([✂]) several communications providers.

WLA and WFAEL forecasts

A14.49 We forecast WLA and WFAEL service volumes, by geographic area and up to 2035/36, to be used as an input into the top-down cost forecast model and our RAB model. We forecast single order and G.fast services separately from FTTC, and estimate rental and connection volumes but do not forecast ancillary services.[270]

A14.50 An important driver of our forecasts is the rate of migration from copper to fibre services over the review period. Another important element is the impact that competing networks will likely have on the number of Openreach lines. Both are subject to a high degree of uncertainty. We have collected data from a wide range of sources to estimate the impact of these elements on WLA and WFAEL line volumes.

A14.51 We have used the following sources of information:

- Copper and GEA service volume data and forecasts from Openreach for the financial years 2021/22 through to 2028/29 using our statutory information gathering powers.[271]
- Forecasts provided by several communications providers ([✂]) which, alongside Openreach's forecasts, are used to cross-check against our modelled forecasts. This allows us to test the robustness of our model and whether our modelling assumptions are reasonable.

[270] We do not consider it necessary to add further complexity to the volumes model by forecasting ancillary services given that we have found revenues and costs for ancillary services to be broadly aligned see Volume 4 Section 6 for more detail on our proposed control for ancillaries.

[271] Openreach response to questions A4, A6, and A8 of the s.135 notice dated 14 May 2024 provided actuals for 2021/22 to 2023/24, including a recent snapshot of rental volumes by postcode sector. Its response to questions A5, A7, and A9, of the same s.135 notice, provided forecasts for 2024/25 (quarterly volumes) and 2025/26 to 2028/29 (annual volumes).

A14.52 We have projected volumes of WLR, MPF, SMPF, and GEA rentals[272] using the following steps in our volumes model:

- **Step 1– forecast the number of Openreach lines:** calculating the number of Openreach residential and business lines and applying annual growth rates for household and business growth to each, respectively.[273] We then make an adjustment to this forecast to account for the impact of future competitor network roll-out.
- **Step 2 – forecast individual rental volumes:** we forecast broadband penetration, decline in copper only broadband services (i.e. ADSL), migration to SOGEA, and take-up of FTTP services to estimate how our Openreach line forecasts are split between its WLA and WFAEL rental services.
- **Step 3 – forecast rentals by bandwidth:** we estimate how FTTC, SOGEA, and G.fast rentals are split by bandwidth primarily based on historic trends but cross-checked against Openreach and ISP forecasts. For FTTP, we largely base our bandwidth forecasts on Openreach's Medium Term Plan (MTP) forecasts.[274]
- **Step 4 – forecast connection volumes:** we forecast connection volumes based on our rental forecasts. For legacy copper connections, we apply the percentage change for the relevant legacy copper rental to the legacy copper connections.[275] For FTTP connections we apply a similar approach except we keep FTTP connections flat from 2028/29 onwards. For SOGEA connections we strip out Start of Stopped Lines, and forecast these separately.
- **Step 5 – forecast geographic split consistent with our new proposed boundary:** we have used service volumes by postcode sector (as of June 2024) provided by Openreach to adjust the Area 2 and Area 3 service volumes to reflect our proposed definition for those geographic areas.

A14.53 In summary, we estimate the following key trends at a national level from 2023/24 to 2030/31, and further trends for Area 3 up to 2035/36:

- broadband penetration on Openreach's network will reach 97% by 2030 and the proportion of Openreach broadband lines that use fibre (i.e. FTTC, G.fast and FTTP) will increase from 90% to 95% by 2030/31 and 100% by 2033/34;
- the proportion of Openreach broadband lines that are FTTP will increase from 18% to 74% in 2030/31 and 100% by 2033/34; and

[272] This includes FTTC, SOGEA, G.fast, SOGfast, and FTTP rentals broken down by their available bandwidths.

[273] BT's RFS based volume data does not differentiate between business and residential lines. We therefore split them into business and residential lines using the split at the overall industry level.

[274] However, given that our total FTTP forecasts do differ from Openreach's we have estimated our own forecasts for the 160 Mbit/s FTTP services which capture any differences between our total FTTP forecasts and Openreach's. We have chosen this service as [✂].

[275] Over the review period, we think this strikes the right balance of ensuring our connection forecasts are consistent with our rental forecasts without having to forecast the uncertain volatility of legacy connection volumes or needing to forecast ancillary services, e.g. ceases.

- the total number of Openreach lines will fall from 20.3 million to 16.9 million by 2030/31 in Area 2 (primarily driven by line loss to network competition net of any growth in the market) and increase in Area 3 from 3.0m to 3.2m by 2030/31 and to 3.3m by 2035/36 (due to growth in households and businesses but no line loss from network competition).

A14.54 We have also modelled high and low scenarios for our WLA and WFAEL volume forecasts which are used as one of the inputs that determine the ranges for our cost recovery estimates. As such, the purpose of these volume forecast scenarios is to create scenarios where legacy (i.e. non FTTP) volumes are higher and lower. For our high and low scenarios that are used to construct the ranges above, we forecast the following trends up to 2030/31:

- broadband penetration on Openreach's network reaches 99% in our high scenario and only 92% in our low whilst the proportion of Openreach broadband lines that use fibre reaches 97% in our high scenario and 93% in our low; and
- the proportion of Openreach broadband lines that are FTTP only increases to 62% in 2030/31 under our high scenario but goes as high as 87% under our low scenario;
- the total number of Openreach lines in Area 2 falls to 18.5 million in our high scenario and 15.4 million in our low scenario, reflecting the uncertainty around the number of lines lost to altnets over the review period;
- Area 3 volumes are largely unchanged as they are only impacted by small changes in our forecast in total line growth.

A14.55 Table A14.10 and A14.11 below sets out 2023/24 actuals and our estimated base case forecasts on the main rental volumes.[276] These volumes are for the average number of lines in each year, to be consistent with BT's RFS.

Table A14.10: Summary table of 2023/24 WLA and WFAEL national volumes broken down by service (base case, mid-year rentals)

2023/24 Actuals	Number of lines (millions)	Share of all Openreach lines
MPF lines[277]	0.9	4%
WLR lines[278]	2.2	9%
WLR + SMPF	1.3	6%
MPF + GEA FTTC	5.7	24%
WLR + GEA FTTC	5.2	22%

[276] For the purposes of calculating our proposed charge controls, we have constructed a range for the service volume forecasts based on different growth rates for Openreach FTTP and different impacts from alternative networks.

[277] Includes only MPF lines that are not purchased with GEA.

[278] Includes both residential and business lines that use WLR but without a SMPF or GEA service.

2023/24 Actuals	Number of lines (millions)	Share of all Openreach lines
SOGEA lines	4.0	17%
G.fast lines	0.3	1%
FTTP lines	3.9	17%
Total Openreach lines[279]	**23.3**	

Source: Ofcom 2025 WLA Volumes Module

Table A14.11: Summary table of 2030/31 national and 2035/36 Area 3 WLA and WFAEL volume forecasts broken down by service (base case, mid-year rentals)

	2030/31 national Openreach volumes (millions)	2030/31 national shares	2030/31 Area 3 volumes (millions)	2035/36 Area 3 volumes (millions)
MPF lines[280]	0.4	2%	0.1	0
WLR lines[281]	0.6	3%	0.3	0
WLR + SMPF	0.5	2%	0.1	0
MPF + GEA FTTC	0.1	<0.5%	0	0
WLR + GEA FTTC	0.3	1%	0	0
SOGEA lines	3.7	18%	0.6	0
G.fast lines[282]	0.3	1%	0.0	0
FTTP	14.3	71%	2.1	3.3
Total Openreach lines[283]	**20.0**		**3.2**	**3.3**

[279] Note that the individual lines do not add up to this total due to rounding.

[280] Includes only MPF lines that are not purchased with GEA.

[281] Includes both residential and business lines that use WLR but without a SMPF or GEA service, as well as SOTAP.

[282] This includes SOGfast.

[283] Note that the individual lines do not add up to this total due to rounding.

Leased line forecasts (LLA and IEC markets)

A14.56 Openreach provided us with the following volumes forecast data:

- For leased line access (LLA) services, a forecast of national connection and rental volumes from 2023/24 to 2028/29, split by internal and external volumes. The forecast splits LLA services into various product categories.[284]
- For interexchange only (IEC) services, a forecast of national connection and rental volumes from 2023/24 to 2028/29, split by internal and external volumes. The forecast splits IEC services into various product categories.[285]
- A suggested mapping of (i) the individual Regulatory Financial Statements (RFS) service codes for LLA and IEC services (which are used for outturn RFS volumes) and (ii) the product categories shown in Openreach's LLA and IEC volume forecasts. The output of this mapping is a concatenated product category for each of the relevant RFS service codes.[286] The use of concatenated product categories allows for the Openreach forecasts to be applied to individual RFS service codes, despite most of the forecast data being provided at a more aggregated level than this.

A14.57 We requested volumes forecasts to 2030/31 (as this is the final year of the next charge control period) from Openreach, but Openreach only had forecast data available up to 2028/29.[287]

A14.58 Our general forecasting approach has been to start with outturn volumes by RFS service code taken from BT's 2023/24 RFS data, and to apply Openreach's forecast annual growth in national volumes (for the relevant concatenated product category associated with each RFS service code) to generate forecast volumes for each RFS service code for 2024/25 to 2028/29.

A14.59 Our volumes model needs to output volumes data from 2022/23 to 2030/31 for each relevant RFS service code, as this is the timespan of the cost forecast model. The sources of our volumes outputs are as follows:

- For 2022/23 and 2023/24 the model captures outturn volumes by RFS service code. The 2022/23 volumes were provided by Openreach[288], and the 2023/24 volumes were taken from BT's 2023/24 RFS data as explained above.
- For 2024/25 to 2028/29 the model outputs volume forecasts which are informed by Openreach's forecasts to 2028/29 under our 'general forecasting approach', as explained above.
- For 2029/30 to 2030/31 we use a forecast extrapolation approach to extend the forecast time series through to 2030/31. We explain this further below.

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[284] Openreach response dated 24 June 2024 to s135 notice dated 14 May 2024, question A1.

[285] Openreach response dated 24 June 2024 to s135 notice dated 14 May 2024, question A1.

[286] Openreach response dated 1 July 2024 to s135 notice dated 14 May 2024, question A10. An example of a concatenated product category is 'EAD 1000ConnectionExt' for LLA services, which maps to all RFS service codes that relate to external EAD 1 Gbit/s connections in the LLA market.

[287] Openreach response dated 24 June 2024 to s135 notice dated 14 May 2024, question A11.

[288] Openreach response dated 24 June 2024 to s135 notice dated 14 May 2024, question A1.

A14.60 Next, we explain several adjustments that we have made to Openreach's leased line forecasts to generate our volumes outputs.

Adjustments to Openreach's leased line forecasts

A14.61 We have identified some areas where we consider adjustments are needed to Openreach's leased line forecasts to make them appropriate for use in our cost forecast model:

- extrapolation of forecast volumes to 2030/31;
- a bespoke forecast of main links;
- an adjustment to the forecast for dark fibre access (DFA) rentals and DFA connections in LLA Area 3, which also impacts the forecasts for active services at all bandwidths;
- an adjustment to the forecast for internal volumes of some services in the IEC market, based on information provided by BT;
- an adjustment to the forecast for DFX services and active services in the IEC market, to reflect the introduction of DFX at additional BT Only exchanges and BT+1 exchanges from the 2026-31 period onwards.

Extrapolation of forecast volumes to 2030/31

A14.62 The cost forecast model requires forecasts to 2030/31, which is the final year of the upcoming charge control period. As noted above, Openreach's forecasts end at 2028/29.

A14.63 We have extrapolated our forecasts to 2030/31 by starting with our forecast volumes for each RFS service code for 2024/25 to 2028/29, and then applying linear trend extrapolation (at the RFS service code level) to generate forecast volumes for 2029/30 and 2030/31.

Main link forecast

A14.64 Openreach's volume forecasts do not include forecasts for main link services. However, the concatenated product categories provided by Openreach's suggested mapping do include main link services: they assign a given main link RFS service code the same concatenated product category as the relevant circuit rental RFS service code which drives use of that main link service.

A14.65 To forecast main link volumes, we have therefore applied the national forecast growth rates for the corresponding circuit rental service to the outturn 2023/24 volume for each main link RFS service code. We consider this is a reasonable predictor for the growth of main link services because they are always purchased alongside other services and the average main link length per circuit appears to have remained relatively constant over the past five years.

Adjustments to the DFA forecast

A14.66 Openreach's volume forecast includes a projection that DFA circuit rental volumes will grow to [✂] external circuits and [✂] internal circuits. Openreach has informed us that its forecast assumes a proportion (around [✂]%) of annual new demand (connections) for EAD services of bandwidth [✂] across the UK will instead become DFA circuit orders in LLA Area 3 by 2028/29.[289]

[289] Openreach response dated 21 February 2025 to s135 notice dated 10 February 2025, question 14.

A14.67 We have engaged with communications providers (CPs) about their future plans for purchasing DFA in LLA Area 3. We have identified from this engagement that:

- BT's downstream business [✂].[290]
- For external telecoms providers, as we explain in Volume 3 Section 7 and Volume 4 Section 2, DFA appears to be particularly useful for telecoms providers who require higher bandwidth services (including mobile backhaul).

A14.68 As set out in Volume 4 Section 2, based on the evidence we have gathered, we consider that DFA is most attractive as a substitute for active LLA circuits of very high bandwidth (above 1 Gbit/s).

A14.69 We have therefore made some adjustments to the forecast for DFA rentals and DFA connections in LLA Area 3, which also impacts the forecasts for active services at all bandwidths. We describe these adjustments below.

- First, we have removed all forecast growth in internal and external DFA rentals, which implies that DFA rentals remain constant at their 2023/24 level through to 2028/29. We have reallocated the removed DFA rentals by making a corresponding proportionate uplift to EAD LA rentals and EAD rentals at bandwidths of 10 Mbit/s, 100 Mbit/s and 1 Gbit/s. The combined aggregate uplift to EAD LA rentals and EAD rentals exactly matches the reduction in DFA rentals.
- Second, we have added a revised forecast growth trajectory for external DFA rentals through to 2028/29. This trajectory is based on an assumed share of VHB external active LLA rentals in Area 3 which migrate to DFA. In our base case, we have assumed that DFA rentals reach around 32% of combined external DFA rentals and external >1 Gbit/s actives rentals in Area 3 by 2028/29.[291] As part of this step, we have made a proportionate downward adjustment to external VHB active LLA rentals in Area 3 such that the total volume of DFA rentals and >1 Gbit/s actives rentals is unchanged.
- Third, we have adjusted the external DFA connections forecast for consistency with the revised external DFA rentals forecast. We have assumed no ceases, implying that the annual volume of external DFA connections matches the annual increase in external DFA rentals.

Adjustment to internal IEC volumes

A14.70 Openreach's national volumes forecast for IEC services showed a [✂] in forecast internal volumes for EAD 1,000 circuit rentals, Ethernet Backhaul Direct (EBD) 10 Gbit/s circuit rentals and EBD 1 Gbit/s circuit rentals.[292][293] These services are important contributors to

[290] BT response dated 17 July 2024 to s135 notice dated 19 June 2024, questions B2 and B3; BT response dated 25 February 2025 to s135 notice dated 10 February 2025, question 2.

[291] We have applied judgement to produce this estimate. We note that the impact of any forecasting error in this external DFA growth assumption on the forecast volumes, revenue and cost of external VHB active LLA services in LLA Area 3 (in our top-down cost modelling) is relatively small.

[292] Openreach response dated 24 June 2024 to s135 notice dated 14 May 2024, question A1; Openreach response dated 3 October 2024 to s135 notice dated 26 September 2024, question B1.

[293] Ethernet Backhaul Direct (EBD) is an Ethernet backhaul product offered by Openreach providing high bandwidth, inter-exchange connectivity between designated BT exchanges.

[✂]. Openreach informed us that their [✂] in some IEC rental volumes reflected [✂].[294] Openreach told us it based its forecast on the available information it had from BT.

A14.71 As a cross-check, we requested BT's forecast of IEC volumes purchased from Openreach. These forecasts showed some significant differences from the Openreach forecast, including [✂] in EBD circuit rentals and [✂] in EAD circuit rentals of bandwidths 1 Gbit/s and below.[295]

A14.72 Although our general volumes forecasting approach for LLA and IEC services is to use Openreach's volume forecasts, we note the significant differences between the Openreach and BT forecasts of internal IEC volumes, and we consider that BT is likely to have greater information about its planned future purchases of IEC services than Openreach.

A14.73 We have therefore adjusted our internal IEC volumes forecasts to use BT's forecast annual volumes growth between 2023/24 and 2028/29 (instead of Openreach's forecast volumes growth) for some IEC services. This adjustment specifically applies to EAD connections and circuit rentals at all bandwidths, EBD connections and circuit rentals at all bandwidths, WDM (Optical) services connections and circuit rentals, DFX connections and circuit rentals.

A14.74 For the service codes affected by this adjustment, we have taken outturn volumes by RFS service code from BT's 2023/24 RFS data and applied BT's forecast annual growth in national volumes (for the relevant concatenated product category) to generate forecast volumes for each RFS service code for 2024/25 to 2028/29.

Adjustment to DFX forecast (reflecting extension of the DFX remedy to additional BT exchanges)

A14.75 As set out in Volume 3 Section 8, we propose to extend the DFX remedy to additional BT Only exchanges and BT+1 exchanges. We have assumed that Openreach's forecasts for DFX volumes do not account for potential extensions in DFX availability across BT exchanges, and we have therefore made an upward adjustment to forecast DFX connection volumes and DFX circuit rental volumes.[296]

A14.76 Specifically, we have assumed that from 2026/27 (when the proposed extension of DFX takes effect) to 2028/29, the per-exchange growth in DFX circuit rental volumes is 2.5 times higher at new DFX exchanges than at existing DFX exchanges. This assumption has been informed by the outturn growth of DFX circuit rental volumes at existing DFX exchanges, and it reflects significant anticipated demand for DFX at new DFX exchanges. We have also adjusted forecast DFX connection volumes to align with our adjusted profile for DFX circuit rental volumes.

A14.77 We have additionally made a downward adjustment to active IEC services which evidence suggests are substitutable for DFX. This reflects some assumed migration away from active IEC services towards DFX at new DFX exchanges. For simplicity we have made proportionate downward adjustments to the affected active IEC services such that the

[294] Openreach response dated 3 October 2024 to s135 notice dated 26 September 2024, question B1.

[295] BT response dated 10 December 2024 to s135 notice dated 25 November 2024, questions A1 and A2; Openreach response dated 24 June 2024 to s135 notice dated 14 May 2024, question A1;

[296] This adjustment sequentially follows on from the aforementioned adjustment we have made to internal IEC volumes, including internal DFX volumes, based on BT's forecasts.

combined reduction in rental volumes across all of these services matches the increase in DFX rental volumes.[297]

A14.78 The net increases in annual DFX volumes and the net decreases in IEC actives volumes are then applied to the relevant concatenated product categories and spread across the relevant service codes relating to BT Only exchanges and BT+1 exchanges. This results in revised forecast volumes for each affected RFS service code for 2026/27 to 2028/29.

Adjustments to our leased line forecasts for changes in geographic market classifications

A14.79 As noted above, our general forecasting approach has been to start with outturn volumes by RFS service code taken from BT's 2023/24 RFS data. The RFS is prepared based on the existing geographic market classifications from the WFTMR21.

A14.80 As set out in Volume 2 Section 5 and Volume 2 Section 6, we propose to update the LLA and IEC geographic market classifications for 2026-31. For the LLA product market this means we propose to update the allocation of UK postcode sectors (excluding the Hull Area) to the LLA geographic markets, which creates new geographic market boundaries. For the IEC product market this means we propose to update the categorisation of BT exchanges (each of which is a distinct geographic market) into BT Only, BT+1 and BT+2 exchanges.

A14.81 We have adjusted the outturn 2023/24 volumes for each LLA RFS service code to better account for the proposed boundaries, by using information about changes in the share of LLA postcode sectors within each geographic market to re-allocate the national 2023/24 volumes for a given service between the relevant service codes, each of which relates to an individual geographic market. Our approach ensures that the national 2023/24 volumes for a given service remain consistent with the 2023/24 RFS following our adjustment.

A14.82 For IEC services, we have made a similar adjustment. We have used information about changes in the share of BT exchanges within each exchange categorisation (BT Only; BT+1; BT+2) to re-allocate the national 2023/24 volumes for a given service between the relevant service codes, each of which relates to an individual exchange categorisation. As with LLA services, our approach ensures that the national 2023/24 volumes for a given service remain consistent with the 2023/24 RFS following our adjustment.

A14.83 By adjusting the 2023/24 volumes of LLA services and IEC services in this way, we automatically adjust the forecasts for each RFS service code in 2024/25 to 2028/29 (as well as the extrapolated forecasts to 2030/31), since the 2023/24 volumes are the starting point for these forecasts.

Sensitivity scenarios in our volume forecasts

A14.84 The sub-sections above describe our approach to forecasting leased line volumes in our base case analysis. We have also developed sensitivities around some of our modelling assumptions, which impact the implied cost-based charge control glidepath X values (as well as the level of cost recovery under our proposed charge controls) for active services in the LLA and IEC markets.

[297] This implies an assumption of one-to-one substitution from active IEC circuits to DFX circuits.

A14.85 Our 'low cost' (higher actives returns) forecasts are those where implied actives volumes are higher than in the base case, which reduces the unit costs of those services as the fixed costs are spread over a larger pool of volumes:

c) External DFA rentals in Area 3 are lower in 2028/29 than assumed in our base case, due to lower DFA rentals growth. This reduces the proportionate downward adjustment to external VHB active LLA rentals in Area 3.
d) DFX take-up at new DFX exchanges (across BT Only exchanges and BT+1 exchanges) is lower than assumed in our base case. This reduces the proportionate downward adjustment to volumes of the substitute active IEC rental services.

A14.86 Conversely, our 'high cost' (lower actives returns) forecasts are those where implied actives volumes are lower than in the base case, which increases the unit costs of those services as the fixed costs are spread over a smaller pool of volumes:

a) External DFA rentals in Area 3 are higher in 2028/29 than assumed in our base case, due to higher DFA rentals growth. This increases the proportionate downward adjustment to external VHB active LLA rentals in Area 3.
b) DFX take-up at new DFX exchanges (across BT Only exchanges and BT+1 exchanges) is higher than assumed in our base case. This increases the proportionate downward adjustment to volumes of the substitute active IEC rental services.

Efficiency

A14.87 As part of our cost forecasting, we take a view on the cost savings (efficiency) we expect BT to achieve over the review period.

A14.88 To arrive at our operating cost efficiency targets we have:

a) Analysed changes in component costs via sets of 'pairwise' comparisons over the historic period 2020/21 to 2022/23 using BT regulatory accounting information.[298]
b) Analysed both historical and forecast Openreach management accounting information over the historic period 2020/21 to 2022/23 and forecast period 2023/24 up to 2028/29.

A14.89 Capital cost efficiency has an immaterial impact on the outputs and so we propose to use the same capital cost efficiency targets used in the WFTMR21 Statement.

A14.90 Within our modelling we have used the below efficiency rates:

For WLA services:

i) A base case assumption of 3% with a low high range of 1% to 4% per annum for our operating cost efficiency target; and
ii) A base case assumption of 3% with a low high range of 1% to 5% per annum for the capital cost efficiency target.

For business connectivity services:

iii) A base case assumption of 6% with a low high range of 4% to 7% per annum for our operating cost efficiency target; and

[298] Consistent with how we have modelled costs, cumulo and Service Level Guarantee (SLG) costs have been removed from this analysis.

iv) A base case assumption of 4.5% with a low high range of 3.0% to 6.0% per annum for the capital cost efficiency target.

BT regulatory accounting pairwise comparisons

A14.91 The basic methodology that underpins our analysis has not changed from that used within the WFTMR21 Statement. We have analysed sets of pairwise[299] component costs movements from BT's RFS by estimating the impact of inflation and changes in volumes on the annual movement in component costs and assuming efficiency accounts for any remaining movement. We have again used the formulae that underpin the cost forecast model, estimating the effects of volumes using CVEs[300] and specific inflation assumptions for each year.[301]

A14.92 Consistent with previous charge controls, we consider that our regulatory accounting pairwise comparison analysis provides an important source of evidence when assessing efficiency levels Openreach has achieved in the past and attach a relatively high weight to it in forming our efficiency assumptions. This analysis has the benefits that it is consistent with the way we model costs and covers the same services. We estimate the average annual cost savings achieved between 2020/21 and 2023/24 had a compound annual growth rate (CAGR) of 3.4% for copper services and 7.0% for leased line services.[302]

A14.93 Our analysis showed, for leased line related components, there were large cost decreases in 2022/23. Upon investigation cost decreases related to [✂][303] And [✂].[304] These appear to be justified efficiency gains and so have been included in our CAGR calculation of 8.0%. However, we might not expect them to continue in future years at a similar level.

Openreach management accounting analysis

A14.94 We consider our analysis of Openreach's historical and forecast internal management accounting data should also provide relevant and reliable evidence for forming our efficiency assumptions for this review period.

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[299] We look at both the published data and the restated data in each RFS e.g. within the 2023 RFS we have compared cost movement between 2022/23 published and 2021/22 Restated data. The reason for looking at the movements to restated numbers is that both sets of numbers will be prepared under the same methodologies. Were we to compare the 2022/23 published data (from the 2023 RFS) with 2021/22 published data (within the 2022 RFS) cost movements arising from methodology changes would be incorrectly picked up in our efficiency numbers.

[300] CVEs have been calculated in the same way as discussed in paragraphs A14.102 to A14.122.

[301] A number of adjustments have been made to the underlying component cost data to ensure like for like comparisons are made in each set of pairwise years.

[302] BT response to questions B1, B2 and B3 of the s135 notice dated 02 May 2024, BT response to questions in Section B of the s135 notice dated 19 August 2024.

[303] BT response to question B13 of the s.135 dated 19 August 2024.

[304] BT response to question B12 of the s.135 dated 19 August 2024.

A14.95 This analysis provides a view of both Openreach's recent past efficiency achievements and its forecast internal efficiency and cost transformation targets out to 2028/29.[305] [306]

A14.96 We have reviewed Openreach's unadjusted PVEO[307] analysis and have also restated the results using our estimates of inflation.[308]

A14.97 Openreach's unadjusted analysis suggested efficiency of 4.9% p.a. has been achieved historically and forecasts efficiencies of 2.3% p.a. going forward. Restating inflation to be consistent with the assumptions in the cost forecast model and removing Openreach's assumptions for 'other'[309], suggested efficiency of 7.7% p.a. has been achieved historically and 3.8% p.a. going forward. We attach a relatively high weight to this analysis in forming our efficiency assumptions but recognise that these efficiencies are levels achieved by Openreach as a whole and are not specific to our relevant services.

Asset Lives

A14.98 In informing the asset lives in our Top-Down cost modelling, and in any cost modelling exercise for charge control purposes more generally, we are interested in understanding the economic life of the modelled network assets. This represents the time period over which we would expect an efficient operator to use an asset in light of the asset's physical life as well as the possible technological developments which could accelerate the asset's replacement.

A14.99 Consistent with previous charge controls, we are largely of the view that depreciation as a proportion of the gross replacement cost of the asset is a reasonable proxy for the economic life of the modelled assets. The exception to this in previous controls has been for GEA DSLAMs and Poles.[310]

A14.100 In the 2018 WLA[311] we undertook analysis to assess the actual replacement time of GEA DSLAM cabinets and concluded that the appropriate asset life to use for this asset was within the range of 7.1 to 9.1. In this Consultation we have not updated this analysis but do propose to continue to adjust the asset life for GEA DSLAM cabinets from [✂] years to instead be within the range of 7.1 to 9.1 years.

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[305] Consistent with the WFTMR21 Statement, we have not performed the analysis required to weight the management accounts to attempt to make them specific to our relevant services as has been done in other earlier charge controls.

[306] Openreach response to questions D1 & D2 of the s135 notice dated 14 May 2024.

[307] PVEO analysis breaks down movements in costs between two periods into cost changes caused by price (P), volume (V), efficiency (E) and other (O).

[308] We have overwritten the inflation assumptions to ensure consistency with the inflation assumptions used within the forecast model.

[309] Historically we have found that other does not relate to one-off items which we might want to exclude from our efficiency calculations. Were we to not remove other from the PVEOs the analysis would suggest efficiency of 7.1% historically and 1.5% forecast efficiency.

[310] Ofcom WFTMR21 Statement Annex 14 paragraph 109.

[311] See Annex 14, paragraphs A14,143 to A14.148 of the 2018 WLA Statement.

A14.101 In this Consultation we propose to not use the implied asset life of [✂] years for Poles, which would be based on 2022/23 GRC divided by 2022/23 OCM depreciation, and instead assume a 40-year asset life, consistent with our approach in Annex 17.

Asset volume elasticities (AVEs) and cost volume elasticities (CVEs)

Overall approach to calculating AVEs/CVEs

A14.102 We would expect changes in the volume of a service provided to impact the costs associated with providing that service. However, where fixed or common costs are incurred, costs may not change by the same proportion as volumes. Therefore, when we forecast costs, we need to appropriately reflect the underlying relationship between forecast changes in service volumes and changes in the number of assets and costs of providing those services.

A14.103 We convert forecast changes in service volumes to changes in network component volumes using usage factors. The impact the change in these forecast network component volumes have on forecast costs (before considering the impact of inflation or cost savings) is determined by AVEs and CVEs.

A14.104 Consistent with the approach taken in the WFTMR21 Statement, we have used LRIC to FAC ratios as a proxy for AVEs and CVEs based on BT's LRIC model outputs. In the short run, marginal costs can be lumpy, but in the long run, marginal costs are less lumpy; many inputs that in the short run may have been fixed for certain output ranges are treated as fully variable and scalable in the long run. For the purposes of charge controls, we focus on the long-run marginal costs, which thus abstract from a degree of the lumpiness that may be observed in the short run.[312]

A14.105 The underlying principle of how we calculate CVEs and AVEs using BTs LRIC data remains the same as that in previous reviews. However, within the WFTMR21 Reporting statement Ofcom removed the regulatory requirement for BT to maintain its LRIC model from 2021/22 inclusive. The result of this is that the last available LRIC data is from 2020/21. As our LRIC data source is from 2021, we need to capture i) newly introduced components and ii) any change in cost mixes that might have occurred in existing components.[313]

A14.106 As a starting point we have taken the LRIC to FAC ratios for key cost categories from BT's 2021 LRIC model. [314] Our next step is to map these key cost categories from BTs LRIC model through to the key cost categories BT now uses within its RFS. This mapping allows us to

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[312] 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.

[313] Different cost types have a different LRIC:FAC ratio so where a cost mix within a component changes we would also expect the weighted average LRIC:FAC ratio for that component to change.

[314] BT defines a 'cost category' within its LRIC model as a "Grouping of costs into unique cost labels by identical cost driver for use in the LRIC model." See page 33 of BT, 2016, *Long Run Incremental Cost Model: Relationships & Parameters*.

generate 2021 LRIC:FAC ratios for the cost categories within BTs current RFS. These RFS costs category ratios are calculated both at a market level and a component specific level.

A14.107 We then weight the LRIC:FAC ratios for the RFS cost categories to reflect the fact that each component will have a different amount of costs within each RFS cost category and these costs proportions may change in each year. For components that existed in 2021 we use the component specific RFS cost category LRIC:FAC ratios and for new components we use the relevant market specific RFS cost category LRIC:FAC ratios[315] [316].

Cross checks and adjustments to the 2021 LRIC model

A14.108 We have checked that all the estimated CVEs and AVEs are between zero and one.[317] In a small number of cases the estimated CVEs and AVEs are outside of this range. In these cases we have adjusted any negative CVEs or AVEs up to zero and we have adjusted any CVEs or AVEs which are above one down to one.

Adjustment for cumulo

A14.109 We have excluded cumulo costs when calculating non-pay CVEs as these are forecast separately to other non-pay costs in the cost forecast model.

Adjustment to non-pay CVE for Openreach Admin Fee component

A14.110 As in the WFTMR21 Statement, we set the non-pay CVE for the component Openreach Admin Fee (CO801) to one. This is because the Openreach Admin Fee costs are attributed to service revenues[318] and we would therefore expect that, in the long run, changes to these costs (after removing inflation) are likely to be closely correlated to changes in revenues and hence, to changes in service volumes.

Adjustment to AVE FTTC Fibre Rollout Funding component

A14.111 The component 'FTTC Fibre Rollout Funding' works in combination with the component 'FTTC Funded Fibre Rollout Spend' to capture the cost and subsidy of the non-commercial FTTC build.[319]

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[315] There are some instances where a single component that existed in 2021 has since been separated into two components. In these instances, we determine the 2021/22 and 2022/23 AVEs and CVEs for the two current components based on the RFS cost category LRIC:FAC ratios of the single original component.

[316] There are some cases where a component existed in 2021 but some of its component specific RFS cost category LRIC:FAC ratios are zero, solely because both LRIC and FAC were zero in 2021. Applying these zero ratios when calculating component CVEs and AVEs can skew the overall component CVEs and AVEs downwards. Therefore, in these cases we have replaced these 'pure zero' LRIC:FAC ratios with the RFS cost category LRIC:FAC ratios for the market associated with the 2021 component.

[317] We generally expect that the relationship between component volumes and costs is, as a maximum, equi-proportionate (i.e. a 10% increase in volume for a component leads to a maximum increase of 10% in cost for that component). We also expect that the relationship is, as a minimum, zero (i.e. an increase in volumes for a component should not lead to a decrease in total cost for that component).

[318] See the description of the base LICENCEFEE in BT's 2017 AMD, page 47.

[319] The 'FTTC Fibre Rollout Funding' component captures the funding received by BT for its subsidised non-commercial FTTC build, while the 'FTTC Funded Fibre Rollout Spend' component captures the costs incurred by BT for its spending of this funding (on subsidised non-commercial FTTC build) as well as costs incurred from the clawback (repayment) of some of this funding.

A14.112 Within the WFTMR21 Statement we decided to set the AVE for the component FTTC Fibre Rollout Funding to zero as we did not anticipate there to be any further subsidised FTTC build and hence no further funding associated with any changes in FTTC rentals volumes. We propose to make this same adjustment in this Consultation for the same reason.

A14.113 By setting the AVE of the component that captures the subsidy to zero while keeping the AVE of the component that captures the spend and clawback of the subsidy as non-zero will result in an increase in the cost base for FTTC lines. This is what we would expect as the demand for FTTC increases: activity that had been funded will eventually become more "commercial" and require repayment of previously received subsidies.

Adjustment to AVEs for Access Fibre cost category

A14.114 We make an adjustment to the AVEs for access fibre similar to, and for the same reasons as, the one we made in the WFTMR21 Statement and 2019 BCMR Statement.[320] We have restated the explanation of the adjustment (which aligns with these past Statements) below.

A14.115 Access fibre costs are used by a number of Ethernet and FTTC components and are an important element of the respective baskets' cost stacks. Using BT's LRIC model outputs and our standard methodology, the estimated AVE for access fibre costs used by the following components is very low suggesting costs are very inelastic to volumes, see column 1 in Table A14.12 below.

A14.116 We consider that our standard approach of using BT's LRIC model outputs is likely to understate the AVEs in these cases, as we consider that the decremental approach used in BT's LRIC model approach is not suitable for estimating the access fibre elasticity. We consider costs are likely to respond differently to volume increases than to volume decreases: while volume increases would be likely to require an increase in the footprint of the network, volume decreases would be unlikely to result in assets being completely removed. Instead, we would expect less intensive use of existing assets.

A14.117 In this Consultation we propose to use the adjusted AVEs below (column 2 in Table A14.12) for access fibre. The estimates shown in column 2 capture the adjusted AVEs specifically for access fibre costs used by each of the components. Column 3 shows the overall AVE for each component, which is a weighted average across all cost category specific AVEs relevant to that component (including the adjusted access fibre cost category AVEs shown in column 2). We present a range for confidentiality reasons.

A14.118 Using our adjusted point estimates for the AVE of access fibre costs used by the affected components (from column 2) results in a revised estimate of the overall AVE for the affected components (in column 3) of:

[320] See paragraphs A18.75 of the 2019 BCMR Statement.

Table A14.12: Adjusted component AVEs

	2020/21 BT LRIC model Component AVE output[321]	Ofcom Calculated AVE Access Fibre	Ofcom Calculated Component AVE (2022/23)
Legacy Ethernet – Spine fibre and Legacy Ethernet – Distribution fibre	([✂]) 0-0.1	([✂]) 0.6-0.8	([✂]) 0.6-0.8
Legacy FTTC – DSLAM	([✂]) 0-0.1	([✂]) 0.2-0.4	([✂]) 0.2-0.4
Legacy FTTC – Distribution fibre	([✂]) 0-0.1	([✂]) 0.4-0.6	([✂]) 0.4-0.6
Legacy FTTC – OLT	([✂]) 0-0.1	([✂]) 0.4-0.6	([✂]) 0.8-1.0
Legacy FTTC – Spine fibre	([✂]) 0.4-0.6	([✂]) 0.4-0.6	([✂]) 0.4-0.6

A14.119 We have used these values across all our cost modelling scenarios.

Adjustment to CVEs and AVEs for PIA components

A14.120 For all components relating to PIA services, we do not have suitable cost data available for each RFS cost category with which to weight LRIC:FAC ratios. For all output years (2020/21 to 2022/23) we have therefore set the CVEs and AVEs for each PIA component equal to the CVEs and AVEs calculated for the Physical Infrastructure super-component based on 2020/21 data from BT's LRIC model. This approach ensures that all PIA components have the same pay CVEs, non-pay CVEs and AVEs.

Dynamic AVEs/CVEs

A14.121 If the same set of component AVEs and CVEs are used to forecast the impact of changes in volumes on costs in each year of the charge control period (i.e. 'static' AVEs and CVEs), then this assumes that fixed and common costs are a constant proportion of total costs throughout the review period. Forecast changes in volumes would therefore result in forecast changes in the level of fixed and common costs. This may be a reasonable simplifying assumption if volume growth is likely to be low over the charge control period.

A14.122 However, as volumes are forecast to change quite significantly, then this approach will assume significant change in costs that should be fixed. To ensure that this does not occur, we have implemented 'dynamic' AVEs and CVEs which allow our elasticity assumptions to vary year-on-year and maintain a fixed level of fixed and common costs across all years. This is the same approach taken in the WFTMR21. In the presence of rising volumes, our AVEs/CVEs will grow over time, representing the smaller proportion of total costs that fixed and common costs represent over time. The reverse is true when volumes are falling.

Input price inflation

A14.123 In our model, costs in each year are adjusted using our estimates of the impact of inflation, changes in volumes and cost savings (efficiency). In this subsection, we describe the inflation assumptions we have used for the different cost items. We consider pay operating

[321] Ofcom calculations on BT LRIC model.

cost inflation, non-pay operating cost inflation, and asset price inflation separately. This approach to forecasting inflation is consistent with that adopted in the WFTMR21 Statement.

Pay operating cost inflation

A14.124 We consider a range of evidence when setting our pay cost inflation assumptions, including historical and forecast BT data and external pay cost indices. We have also made adjustments to reflect the National Insurance changes which were announced within the October 2024 UK Budget. We propose to adopt a pay cost inflation rate within our forecasts which has a compound annual growth rate of 3.1% per annum across the forecast period.

Non-pay operating cost inflation

A14.125 To estimate non-pay cost inflation assumptions that reflect the cost mix for the services in the top-down model, we weight separate inflation estimates for energy, accommodation and all other non-pay costs. We adopt a non-pay cost inflation rate within our forecasts which had a compound annual growth rate of 0.6% per annum across the forecast period.[322]

Asset price inflation

A14.126 For duct, copper and pole assets, we propose to adopt asset price change assumptions that ensure duct, copper and pole assets are valued consistently with how they are revalued for current cost accounting (CCA) purposes in BT's RFS. Historically from 2012/13, RFS duct, copper and pole assets have been indexed using the Retail Price Index (RPI). From 2026/27 we are proposing to change the CCA methodology to index duct, copper and pole assets using a flat 2% rate (see Volume 6).

A14.127 Reflecting our proposed changes, within our forecasts for the period up to and including 2025/26, we propose to use the OBR's RPI forecasts.[323] For all forecast years from 2026/27 inclusive we are proposing to use 2% p.a.

A14.128 For all other assets including those for fibre assets[324], we propose to model these assets to stay constant in nominal terms.

WACC

A14.129 The cost forecast model requires an estimate of the appropriate forward-looking weighted average cost of capital (WACC) for active services. The WACC is also an important input to our estimates of both inter-exchange and access dark fibre prices.

A14.130 We propose to use a pre-tax nominal WACC base case of 7.6% with a low high range of 6.6% to 8.6% for Other UK Telecoms, which would cover LLA actives, IEC actives and FTTP (including G.Fast) and a pre-tax nominal WACC base case of 7.1% with a low high range of 6.1% to 8.1% for Openreach, which would cover copper access lines, DFA, DFX, PIA and

[322] This non-pay growth rate includes a negative CAGR for electricity over the period which is the driver for the low non-pay cost inflation.

[323] OBR Economic and fiscal outlook - October 2024, Detailed forecast tables: economy (RPI forecast)

[324] Fibre assets have been forecast to stay constant in nominal terms to align with our decision in the BCMR 2019 Statement to use a HCA value for the CCA valuation.

FTTC services. Please see Annex 20 for more detail on how the WACC rates have been calculated.

Costs forecast separately

Cumulo

A14.131 Cumulo rates are the non-domestic rates BT pays on its rateable assets (primarily passive assets such as duct, fibre, copper and exchange buildings) in the UK. It is called a 'cumulo' assessment because all the rateable assets are valued together. They are usually calculated by multiplying a Rateable Value (RV) for the property by a 'rate in pound'.[325] RVs are specific to each property and are assessed by the relevant rating authority in each nation, for example, the Valuation Office Agency (VOA) in England and Wales. They are reassessed every few years, with the latest reassessment in England, Wales and Scotland and Northern Ireland in 2023. The next reviews for all nations are expected to take effect in 2026.[326]

Forecasts of BT's cumulo rates costs

A14.132 We have forecast BT's cumulo rates costs in a way that is very similar to that we adopted in the WFTMR21 Statement. We have taken BT's latest published RVs, applied assumptions about rates in the pound, and estimated the impact of the English, Welsh and Scottish transition scheme.[327]

A14.133 The 2017 revaluation in England, Wales, Scotland and Northern Ireland increased BT's cumulo RVs from £602m at 1 April 2017 to £671m from 1 April 2023.[328] For the Statement we will update the RVs with the latest valuation information for each nation. We assume these rateable values remain the same during the control period up to 2030/31. Based on information received from BT, we do not expect any material changes in circumstances (MCCs) at the moment. The implicit assumption within our constant RV assumptions is also that BT's cumulo RVs are not revised as a result of future reviews – for example the future revaluations in 2026 and 2029. We have no evidence to support what the impact of these future reviews might be.

[325] Rates in the pound are set centrally by each nation and are the same for all ratepayers in a nation. By rate in the pound (sometimes also called the rate poundage) we mean the standard non-domestic rating multiplier. For an introduction to how rates liabilities are calculated see https://www.gov.uk/introduction-to-business-rates. Northern Ireland is different in that the rate poundage in each of the 11 districts is made up of two separate rates: a regional rate poundage that is the same in each district and a district rate poundage that is different for each district [accessed 11 December 2024].

[326] See for example England: Greater transparency in valuation information – Valuation Office Agency; Wales: Non-domestic rates stakeholder update: October 2024 | Business Wales;Scotland: Revaluation of rateable value - mygov.scot.

[327] See for example: England The Non-Domestic Rating (Chargeable Amounts) Regulation: The Non-Domestic Rating (Chargeable Amounts) (England) Regulations 2016; Wales Non-Domestic Rates – Transitional Rates Relief for the 2023 Revaluation: Non-Domestic Rates – Transitional Rates Relief for the 2023 Revaluation | Business Wales; Scotland Transitional Reliefs: Transitional Reliefs - mygov.scot [accessed 11 December 2024].

[328] The values in England and Wales, for example, can be found on the Central list pages of the OVA website here: https://www.gov.uk/government/collections/the-central-rating-list [accessed 11 December 2024].

A14.134 We have used the rates in the pound published over the period 2017/18 to 2024/25 and have forecast them forward as we did in the WFTMR21 Statement by indexing by CPI out to 2030/31.

A14.135 We have again estimated the effect of the English, Welsh and Scottish transition scheme. The scheme is complex, but essentially limits increases on a ratepayer's bill, compared to their payments in the previous rating list. We do not expect the transition relief to affect BT's payments in England and Scotland, but they will see slight reductions due to the relief in Wales.

A14.136 Overall, we forecast BT's cumulo costs increased from around c£310m[329] in 2021/22, to c£345m[330] in 2023/24 and will increase further to c£375m in 2025/26 and then to c£405m in 2030/31.

Attributions of BT's cumulo costs

A14.137 We have updated our approach for attributing BT's cumulo costs to align with updated information received from BT regarding their modified attribution model. This approach is similar, but a simplified version, to the one adopted in the 2021 WFTMR Statement. Rather than allocating cumulo costs to network components costs and then onto services, we attribute them directly to services.

A14.138 Our attribution method includes attributing the cumulo costs across services using the Profit Weighted Net Replacement Methodology (PWNRM).[331] This requires forecasts of NRCs for all BT's services that attract attributions of BT's cumulo costs. For services within the cost forecast model we have used the forecast growth in service NRCs generated from the cost forecast model. For services outside the cost forecast model we have derived growth rates from a simple analysis of trends in NRCs for the relevant markets based on information from BT's RFS.[332]

[329] Page 21 BT 2023 RFS https://www.bt.com/bt-plc/assets/documents/about-bt/policy-and-regulation/our-governance-and-strategy/regulatory-financial-statements/2023/regulatory-financial-statements-2023.pdf.
[330] Page 19 BT 2024 RFS https://www.bt.com/bt-plc/assets/documents/about-bt/policy-and-regulation/our-governance-and-strategy/regulatory-financial-statements/2024/regulatory-financial-statements-2024.pdf.
[331] 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 multiplied by the return for that asset (the profit weight). The return is the ratio of profit to capital employed, which is measured in BT's regulatory accounts. Multiplying the return by the NRC produces an estimate of the relative "profit" likely to be generated by that rateable asset. This approach is consistent with that adopted by the rating authorities when valuing BT's assets.

[332] Some cumulo costs are attributed to services outside the cost forecast model, which are in non-SMP (non-regulated) markets. To generate an appropriate growth rate for NRCs for these non-SMP services we have analysed the average annual change in the total non-current assets attributed to their associated non-SMP markets over the period 2019/20 to 2022/23 in additional data requested from BT based on the Attribution of Wholesale Current Cost Mean Capital Employed schedules published annually in BT's RFS. We have calculated the overall average annual growth rate for the associated markets, and we have used that as the annual growth in NRCs over the charge control period for all of the non-SMP services that are outside the cost forecast model.

Table A14.13: Attributions of BT's cumulo costs:

	2026/27	2027/28	2028/29	2029/30	2030/31
MPF	[✂] £50m to £100m	[✂] £50m to £100m	[✂] £0m to £50m	[✂] £0m to £50m	[✂] £0m to £50m
FTTC	[✂] £50m to £100m	[✂] £50m to £100m	[✂] £50m to £100m	[✂] £0m to £50m	[✂] £0m to £50m
FTTP	[✂]	{✂]	[✂]	[✂]	[✂]
Other	[✂] £0m to £50m	[✂] £0m to £50m	[✂] £0m to £50m	[✂] £0m to £50m	[✂] £0m to £50m
Total	£376m	£383m	£391m	£398m	£405m

Ethernet provision Service Level Guarantee (SLG) costs

A14.139 Ethernet provision SLG costs are directly correlated to Ethernet connection volumes and prices. We would expect more connections overall to lead to more connections that incur an SLG payment and, because SLG payments are a function of monthly rental prices[333], we would also expect higher SLG payments if monthly rental prices increase. Because these operating costs are not driven directly by efficiency and cost inflation, we forecast them at a service level rather than component level.

A14.140 Consistent with the decision made in the WFTMR21 Statement, we have removed Ethernet provision SLG costs from the base data and then add our forecasts of Ethernet SLG costs back into our total operating cost for each year in the model at a service level. This results in each service being forecast individually with its own forecast volume and forecast price changes driving the cost.

A14.141 Our treatment of Ethernet SLG costs is similar to our treatment of BT's cumulo costs, except that Ethernet SLG costs also form part of the costs for dark fibre services.

Sale of scrap copper

A14.142 To ensure that BT does not double recover costs that have previously been recovered through rental and connection charges, consistent with the WFTMR21 Statement, we have made an adjustment to the copper line services to reflect the other operating income BT will receive when they sell any scrap copper.

A14.143 Within the 2018 WLA Statement[334] we explained that historically, BT has received proceeds from the sales of copper recovered from its core network where that copper was no longer required or had been replaced. We concluded that it was copper in the E-side[335] network

[333] We note that this introduces an endogenous element to our calculations, as forecast rental prices are an output of the model. We ran the model to get an initial output (assuming no rental price change for the SLG forecast) and then used this output to inform the input assumption of rental prices for SLG forecasts in final runs of the model.

[334] 2018 WLA Statement, Annex 22.

[335] Exchange side - network linking the local exchange to the primary cross connection point.

where value could be achieved from copper extraction as costs of extracting copper from the D-side[336] network would outweigh any possible other operating income.

A14.144 We remain of the view that it is the E-side where value extraction can occur as customers migrate away from copper services. We have obtained the latest forecast[337] from Openreach of the expected net benefit from the sale of scrap copper[338] out until 2028/29 and forecast this forward for the remainder of the control period. The amount of operating income in nominal terms for the five year review period which has been added to our cost forecasts (as a negative cost) is [✂]. We have allocated this other operating income to copper line services based on volumes.

Accelerated copper depreciation

A14.145 BT's full copper retirement means that there is a possibility not all capital expenditure spent on copper assets, which have an asset life of 20 years, will be able to be recovered through depreciating assets over their useful lives (this is commonly referred to as 'asset stranding').

A14.146 We propose that it is appropriate and in line with our objectives to give Openreach the opportunity to recover any efficiently incurred costs which may become stranded.

A14.147 To allow BT to fully recover its forward-looking capital expenditure on copper assets, we propose to accelerate the depreciation and return on capital profiles for all copper assets capitalised from 2026/27 through to the end of the charge control in 2030/31.[339]

A14.148 Under our proposal, we assume that any additional depreciation that is required to bring the asset's net book value to zero after 2030/31 would be recovered in this charge control period.[340] We refer to the recovery of these additional required costs[341] as 'accelerated depreciation'. To avoid over-recovery, we propose that, to the extent we set charge controls in the future, we would not allow any further recovery of this capital expenditure post 2030/31; we also propose that the accelerated depreciation be spread across the 5 years of the charge control and all copper line services based on volumes.

A14.149 We have ensured that the net present value of the costs added are equal to the net present value of the remaining costs yet to be recovered were the assets to be recovered over their normal book lives to allow full recovery of the accelerated deprecation brought into the charge control period. Consistent with the WFTMR21 Statement, we have

[336] Distribution side - network linking the primary cross connection point to the distribution point.

[337] The Openreach forecast reflects estimates for copper available for extraction, extraction costs and copper prices.

[338] Openreach response to question C1 to the s.135 dated 26 September 2024.

[339] Forecast copper capital expenditure has been calculated using actual copper capital expenditure for 2023/24 from Openreach response to Tranche 1.2 s.135 sent 14 May 2024 question F1 forecast forward using our assumed copper efficiency, inflation and the AVEs calculated from BTs 2020/21 LRIC model for components 'D-side copper capital', 'E-side copper capital', Dropwire capital & analogue NTE' and 'NGA E-side copper capital' applied to our forecast copper volumes.

[340] We do not expect these assets to become stranded in 2031. However, are proposing to allow Openreach to recover all costs relating to these assets in this review period.

[341] Both depreciation and return on capital.

modelled the additional costs such that the costs in the final year of the charge control are at the correct level to allow full recovery via a glide path.

A14.150 Within this review period we have adjusted the costs to ensure that any accelerated depreciation for copper assets capitalised pre 2026/27 that had costs fully accelerated in the WFTMR21 Statement have been removed from our cost stack.

A14.151 Table A14.14 below shows the accelerated fully allocated costs (FAC) for the relevant stranded assets that have been brought into the charge control period offset by the removal of previously accelerated FAC from the WFTMR21 Statement for the 2026-27 - 2030/31 period.[342]

Table A14.14: Modelled accelerated FAC brought into the charge control period

	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Net Accelerated Costs	£32m	£35m	£37m	£40m	£42m	£186m

RAV adjustment

A14.152 BT's Rav adjustment was introduced to avoid BT over recovering the value of assets when the valuation change from HCA to CCA occurred for Duct and Copper assets in 1997.

A14.153 The impact of the RAV adjustment is to reduce the value of BTs duct assets. As copper assets have an accounting life of 20 years, all pre 1997 assets would have a zero net book in our current review period. However, as Duct assets have an accounting life of 40 years there will still be pre 1997 assets with values, and the associated RAV adjustment (credits) required to reduce these assets values, in BTs accounts.

A14.154 We would expect that the size of the (negative) RAV adjustment should reduce between the base year and 2030/31 as the assets to which the RAV adjustment relate would only have 6 years or less left of their asset lives compared to 14 years or less in our base year cost stack for 2022/23. Forecasting at a component level the same as all other components would result in the RAV adjustment increasing which is why we have forecast these costs separately at a service level.

A14.155 We have calculated the RAV adjustment by:

a) First, forecasting forward the total RAV adjustment for our relevant services at a total level for the charge control period.
b) Next, we forecast the RAV adjustment forward for each individual service using the change in the individual service volumes.
c) Finally, we scale the individual service level RAV forecasts from (b) to ensure that the total RAV adjustment for our relevant services is the same as that calculated in (a).

A14.156 This method ensures that the change in service mix is captured. While also ensuring that, at a total level, the RAV adjustment is declining as would be expected.

Revenue forecasting

[342] FAC costs presented in nominal terms and includes both return on capital and depreciation.

A14.157 In the cost forecast model, we also forecast revenue in each year until the end of the review period. These forecasts are based on two inputs: the charges for each service that we expect to be in place during the period and the projected volumes of each service.

A14.158 We forecast revenues to the final year of the review period (2030/31) by applying our volume forecasts for each year to the forecast prices at the beginning of the period (i.e. by assuming prices would remain constant over the period in real terms, accounting for CPI inflation). We then compare the projected revenues and costs in the final year of the period to work out the value of X that is needed for revenues to glide into alignment with costs by that year, under a cost-based CPI-X charge control.[343]

A14.159 We have explained our method for producing volume forecasts above. Our approach to forecasting service level prices is described below.

Prices

A14.160 The price forecasting model forecasts prices from their estimated year-average levels in either 2023/24 or 2024/25 (as explained below, depending on the service) through to the start of 2026/27.

A14.161 Openreach currently offers unconditional price discounts for some of the WLA services in the cost forecast model (specifically, there are discounts for some bandwidths of FTTC rentals, G.fast rentals, SOGEA rentals and SOGfast rentals).[344] These discounted prices are indexed with CPI inflation and are due to expire on 31 March 2026.[345]

A14.162 We recognise that we need to calculate two different price forecasts for our modelling. The first we refer to as the 'headline price' and the second the 'discounted price'.

a) The headline price is needed to calculate the 'X' for which the list prices on the Openreach price list need to change under a cost-based charge control.
b) The discounted price is the price we should look at when considering Openreach's potential over- or under- recovery as this is the average price Openreach is expected to actually charge.

Headline prices

A14.163 For most services in the cost forecast model, Openreach provided the list price as of 1 April 2024.[346] For services (i.e. RFS service codes) encompassing multiple products on the price list, Openreach provided a volumes-weighted average list price (using 2023/24 outturn

[343] In cases where a starting charge adjustment (SCA) is applied, additional steps are required. We first forecast revenues assuming that an SCA applies on 1 April 2026 and that following the SCA prices remain constant in real terms thereafter throughout the period (2026-31). We then compare the projected revenues and costs in the final year of the period (2030/31) to work out the value of X that is needed for revenues to glide (from their post-SCA position) into alignment with costs by that year, under a cost-based CPI-X charge control.
[344] Openreach response dated 28 May 2024 to s135 notice dated 14 May 2024, question G1.

[345] Information about the discounted prices available for the period 1 September 2025 to 31 March 2026 can be found here.

[346] Openreach response dated 8 July 2024 to s135 notice dated 14 May 2024, question E1.

volumes for the weighting). We have assumed that the list prices on 1 April 2024 are representative of the average list prices that will be charged in 2024/25.[347]

A14.164 For some services, Openreach was not able to provide a 1 April 2024 volumes-weighted list price and instead provided average 2023/24 prices based on the 2023/24 RFS.[348]

A14.165 For all services, we have forecast that prices will increase by CPI[349] in 2025/26. For those services whose base prices are from 2023/24, we have forecast that prices will increase by CPI[350] in 2024/25. This approach is consistent with the CPI-0% charge controls imposed across many services in the WFTMR21.

A14.166 For the headline 2026/27 start prices we take the headline prices calculated for 2025/26 and increase them by forecast CPI inflation.

A14.167 In Volume 4 Section 1 and Volume 4 Section 6, we explain the proposed charge controls that we will apply to GEA FTTC 80/20 rental services and SOGEA 80/20 rental services for the first time. We explain how we propose to use the prevailing discounted market prices (as of 1 April 2026[351]) as the starting headline prices in the charge control.

A14.168 We have therefore adjusted the forecast headline 2026/27 start prices of the relevant RFS service codes (which include FTTC 80/20 and SOGEA 80/20 services) downwards, to reflect our proposals to use the prevailing market discounted prices as the starting prices in the charge control. This approach ensures that forecast revenue is not overstated for FTTC and SOGEA services in the cost forecast model.

Discounted prices

A14.169 Our approach to forecasting the discounted prices for a given RFS service code depends on whether there are any Openreach pricing special offers currently applicable to that service code.

A14.170 For those RFS service codes which do not have any associated Openreach pricing special offers, we set the forecast discounted prices equal to the forecast headline prices for all years, thereby ensuring consistency between the headline prices and discounted prices.

A14.171 For those RFS service codes which do have associated Openreach pricing special offers, we apply the following approach:

- As a starting point for our discounted price forecasts, we have used the 2023/24 average RFS[352] prices for each relevant RFS service code.

[347] We note that Openreach adjusted many of its list prices for inflation on 1 April 2024, and since made relatively few changes to its list prices.

[348] Openreach response dated 8 July 2024 to s135 notice dated 14 May 2024, question E1.

[349] ONS October 2024 CPI (2.3%) (source: ONS, CPI ANNUAL RATE 00: ALL ITEMS 2015=100).

[350] ONS October 2023 CPI (4.6%) (source: ONS, CPI ANNUAL RATE 00: ALL ITEMS 2015=100).

[351] As explained in Volume 4 Section 1, we propose to calculate the prevailing discounted market price for 2026/27 by taking the FTTC 80/20 discounted price (or for SOGEA services, the SOGEA 80/20 discounted price) in 2025/26 and uplifting it by CPI (using 2025's October 12 month CPI rate).

[352] BT's 2024 RFS.

- Consistent with our approach to forecasting headline prices, we have forecast that discounted prices will increase by CPI[353] in 2024/25 and 2025/26.
- For the 2026/27 discounted start prices we take the discounted prices calculated for 2025/26 and increase them by forecast CPI inflation.

Summary of modelling assumptions in our low cost and high cost scenarios

A14.172 As part of our modelling we have developed low cost and high cost scenarios based on plausible ranges for each of the main input parameters. These scenarios are combined with our base case assumptions (as described in this annex) to generate our proposed ranges for any cost-based price controls we are proposing.

A14.173 Table A14.15 shows how the cost forecast model's input parameters differ from our base case assumptions in the low cost and high cost scenarios.

Table A14.15: Low cost and high cost scenario parameters assumed

	Base cost	Low cost	High cost
WACC	Other UK Telecoms: 7.6% Openreach: 7.1%	Other UK Telecoms: 6.6% Openreach: 6.1%	Other UK Telecoms: 8.6% Openreach: 8.1%
Efficiency	WLA operating costs: 3% WLA capital costs: 3% LLA and IEC operating costs: 6% LLA and IEC capital costs: 4.5%	WLA operating costs: 4% WLA capital costs: 5.0% LLA and IEC operating costs: 7% LLA and IEC capital costs: 6.0%	WLA operating costs: 1% WLA capital costs: 1.0% LLA and IEC operating costs: 4% LLA and IEC capital costs: 3.0%

[353] As done for the headline price forecasts, we have applied the ONS recorded rates for CPI in October 2023 (4.6%) and October 2024 (2.3%).

	Base cost	Low cost	High cost
Volumes	WLA+WFAEL: for details of base case modelling assumptions see paragraphs A14.49 to A14.53 above. LLA and IEC: for details of base case modelling assumptions see paragraphs A14.56 to A14.83 above.	WLA+WFAEL: lower altnet impact and slower migration to FTTP, for details see high volume assumptions in paragraph A14.54 above. LLA: external DFA rentals in Area 3 are lower than in base case, resulting in higher actives volumes. For details see paragraph A14.85 above. IEC: DFX take-up at new DFX exchanges is lower than in base case, resulting in higher actives volumes. For details see paragraph A14.85 above.	WLA+WFAEL: greater altnet impact and faster migration to FTTP, for details see low volume assumptions in paragraph A14.54 above. LLA: external DFA rentals in Area 3 are higher than in base case, resulting in lower actives volumes. For details see paragraph A14.86 above. IEC: DFX take-up at new DFX exchanges is higher than in base case, resulting in lower actives volumes. For details see paragraph A14.86 above.
Operating cost inflation	Pay operating costs: 3.1% Non-pay operating costs: 0.6%	Pay operating costs: 2.6% Non-pay operating costs: 0.1%	Pay operating costs: 3.6% Non-pay operating costs: 1.1%

Outturn profitability evidence

A14.174 The outturn profitability of Openreach services is of contextual relevance for our revenue and cost modelling for active legacy services.

A14.175 We have reviewed the level of profitability of LLA and IEC services in 2021-24, as measured via the Return on Capital Employed (ROCE)[354], using BT's published Regulatory Financial Statements (RFS)[355] and Regulatory Financial Commentary (RFC).[356]

LLA market profitability

A14.176 Table A14.16 below shows BT's unadjusted ROCE for the total LLA market in the HNR Area, Area 2 and Area 3. It also shows BT's adjusted ROCE for the total LLA market across the HNR Area, Area 2 and Area 3 combined.

A14.177 Adjusted ROCEs are reported in BT's RFC, and they adjust ROCE to account for fluctuations in RPI inflation, specifically through a re-calculation of in-year holding gains on copper and duct assets assuming that RPI inflation had been 2.4% in each year. As we discuss further in Volume 6, a limitation of unadjusted ROCEs is that they can be significantly impacted by annual movements in RPI inflation, which can obscure the underlying profitability trends in markets such as LLA. Given that RPI inflation was very high in the year to March 2023, we

[354] Return on Capital Employed (ROCE) means the ratio of accounting profit to capital employed.
[355] By published RFS, we mean the published annual statements which BT is required to produce under the obligations contained in its SMP conditions.
[356] By published RFC, we mean the commentary on the RFS that BT has published annually since 2018. The content of this document and its publication do not form part of BT's regulatory reporting obligations arising from its SMP conditions.

consider that in this instance adjusted ROCE provides a more informative view than unadjusted ROCE of profitability levels and trends. However, in those cases where adjusted ROCE data is unavailable[357], we consider that unadjusted ROCE still provides some useful information about relative levels of profitability across geographic markets in a given year.

A14.178 For clarity, the ROCE data shown for each LLA geographic market uses the geographic market boundaries defined in Schedule 3 of our WFTMR21 Statement.

Table A14.16: Unadjusted ROCE and adjusted ROCE for the LLA market, 2022-24[358]

	Unadjusted ROCE		Adjusted ROCE	
	2022/23 (restated)	2023/24	2022/23 (restated)	2023/24
LLA market (HNR Area, Area 2 and Area 3 combined)	15.9%	16.7%	11.6%	16.0%
LLA market (HNR Area)	11.5%	12.9%	N/A	N/A
LLA market (Area 2)	14.1%	14.8%	N/A	N/A
LLA market (Area 3)	21.0%	21.4%	N/A	N/A

Source: BT 2024 RFS and BT 2024 RFC.

IEC market profitability

A14.179 Table A14.17 shows BT's unadjusted ROCE for the total IEC market at BT Only exchanges and BT+1 exchanges. It also shows BT's adjusted ROCE for the total IEC market across BT Only exchanges and BT+1 exchanges combined. We have reported both unadjusted ROCE and adjusted ROCE (where available) for similar reasons as those mentioned for LLA market profitability above.

A14.180 For clarity, the ROCE data shown for BT Only exchanges and BT+1 exchanges uses the BT exchange classifications defined in Schedule 4 of our WFTMR21 Statement.

Table A14.17: Unadjusted ROCE and adjusted ROCE for the IEC market, 2022-24[359]

	Unadjusted ROCE		Adjusted ROCE	
	2022/23 (restated)	2023/24	2022/23 (restated)	2023/24
IEC market (all SMP exchanges)	91.4%	90.3%	81.5%	88.4%
IEC market (BT Only exchanges)	108.5%	111.4%	N/A	N/A
IEC market (BT+1 exchanges)	71.6%	62.8%	N/A	N/A

[357] Adjusted ROCE data is only published within BT's RFC for the combination of LLA geographic markets in which BT was found to have SMP by the WFTMR21 (i.e. the HNR Area, Area 2 and Area 3).
[358] BT's 2024 RFS and 2024 RFC do not report restated ROCE for 2021/22, so this is not shown here. However, BT's 2023 RFS and 2023 RFC indicate that LLA market ROCE was at a broadly similar level in 2021/22.
[359] BT's 2024 RFS and 2024 RFC do not report restated ROCE for 2021/22, so this is not shown here. However, BT's 2023 RFS and 2023 RFC indicate that IEC market ROCE was also high in 2021/22.

Source: BT 2024 RFS and BT 2024 RFC.

A15. Fibre network cost modelling

A15.1 We developed a bottom-up cost model for the WFTMR 2021 (the 2021 Fibre Cost Model) that allowed us to estimate the costs of deploying a fibre network in different geographic areas and at different scales and network configurations.

A15.2 In this annex we summarise the approach we have taken in the Fibre Cost Model for the 2026 TAR (the 2026 Fibre Cost model) and set out how we have used it to inform our WLA charge control proposals, set out in Volume 4, Section 1. Specifically, to:

- verify that our proposed charge controls for WLA Area 2 are consistent with our policy objective of promoting investment in gigabit-capable networks by other telecoms providers (i.e. the 'entrant cost cross-check'); and
- help estimate the potential returns for Openreach following investment in a fibre network for WLA Area 3.[360]

A15.3 This annex is structured as follows:

- Our general modelling approach;
- The model structure; and
- Our 2026 Fibre Cost Model assumptions and outputs, including:
  - > Our approach to updating the model; and
  - > WLA Area 2 entrant cost check.

Our general modelling approach

A15.4 In this section, we summarise the general approach and structure of the 2026 Fibre Cost Model, which is largely consistent with the 2021 Fibre Cost Model.

Bottom-up approach to cost modelling

A15.5 The model is based on a bottom-up modelling approach. A bottom-up model estimates how much network equipment is needed for a forecast level of volumes or traffic based on technical assumptions in relation to network capacity and dimensioning algorithms. It then calculates total network costs using evidence of the capital and operating costs of each piece of equipment. In contrast, a top-down model uses total network cost data and allocates these costs to services based on service usage factors.[361]

A15.6 We have taken a bottom-up approach to modelling a fibre network. We consider that a bottom-up approach provides better flexibility to assess the costs across different geographies and for different scales of deployment.

[360] We use our estimate of the cost to deploy an FTTP network alongside our estimate of the cost of Openreach's copper network to understand Openreach's potential returns in WLA Area 3. Annex 16 sets out our modelling approach for the WLA Area 3 RAB calculation.

[361] A top-down model does not rely on detailed assumptions about how the network is constructed, instead it is based on estimated cost-volume elasticities which determine how network costs change as demand changes.

Services and network scope

Services in scope

A15.7 The model dimensions a fibre network that offers FTTP services and has the functionality to dimension a network of varying scales and geographic areas.

A15.8 The model also had the functionality to dimension a fibre network that could offer leased line services, dark fibre and DPA services. However, we do not consider that this is needed for this consultation and therefore we have switched-off this functionality in the Fibre Cost Model. This is because:

- it is unlikely that a competing network provider would offer DPA services so for our rival network cost cross check we assume that no DPA services are offered.
- Network elements specific for supplying leased lines (and dark fibre) are incremental to FTTP deployment and likely to be driven by take-up (as opposed to coverage). However, we have not included demand for leased lines in our cross-check. Therefore, to the extent that leased lines help in the recovery of common costs of deploying a fibre network providing coverage in a geographic area, this is likely to overstate the FTTP cost estimates that we use in our cross-check (and thereby provide greater reassurance of satisfying the entrant cost cross-check).

Network scope

A15.9 The model spans the following network segments:

- The access segment, which we model for all the services in scope. This is split into three segments: Segment 1 is from the Access Node to the Splitter Node; Segment 2 is from the Splitter Node to the Distribution Point; and Segment 3 is from the Distribution Point to the Customer Premises.
- The segment from the Access Node to an Aggregation Node (i.e. Inter-Exchange fibre connections to deliver dedicated business services using leased lines or dark fibre). However, as noted above, we are not modelling leased lines so the inter-exchange fibre costs are not captured in our analysis.

Network coverage

A15.10 The model offers the flexibility of estimating the costs of deploying a fibre network with national or subnational footprints (i.e. particular geographic areas only).

A15.11 We have used postcode sectors as the geographic unit for our cost modelling. This aligns with our proposed approach to assessing competition in geographic areas as set out in Annex 7.

Scorched node/scorched earth approach

A15.12 Given we are interested in understanding the costs of deploying a fibre network at different scales and for different footprints, the model can support both a scorched node and a scorched earth approach.

- Under the scorched node approach, the fibre network is deployed assuming the location of existing Access Nodes. This has the advantage of being more grounded in reality; recognising that network operators are likely to place importance on the topology of their existing networks when deciding how to deploy a new fibre network.
- Under a scorched earth approach, the network is dimensioned so that the location of the Access Node minimises the costs of deployment. A scorched earth approach may be more

appropriate when modelling the costs of deploying a fibre network for a new entrant which starts with a network of limited scale or has no network at all.

A15.13 We have used scorched node for our modelling of Openreach fibre investments in WLA Area 3 and scorched earth for our entrant cost cross-check in WLA Area 2.

Reuse of existing physical infrastructure

A15.14 Physical infrastructure, such as ducts and poles, is a key input in the building of a fibre network.

A15.15 An operator deploying a fibre network can either: (i) reuse Openreach's existing physical infrastructure; (ii) build new physical infrastructure; or (iii) a combination of both. Our model allows the functionality to estimate the costs of deploying a fibre network under any of these scenarios.

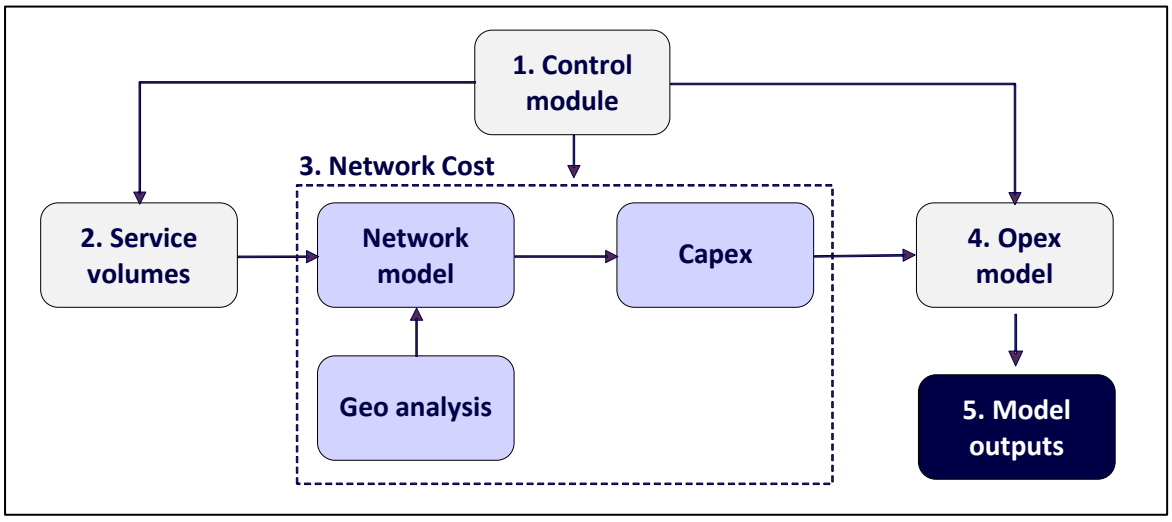
A15.16 Notwithstanding this, we consider that an operator planning to build a fibre network would seek to reuse as much physical infrastructure as possible (given the higher costs of building new physical infrastructure).

A15.17 Therefore, our general approach is to model a fibre network which reuses existing Openreach physical infrastructure where it exists and spare capacity is available and only builds new physical infrastructure where this is not available or feasible.

Model structure

A15.18 The model comprises four modules 'Control', 'Service Volumes' and 'Opex' and 'Network Cost'. The 'Network Cost' module was originally developed by Cartesian for the 2021 Fibre Cost Model. The module structure for the 2026 Fibre Cost Model is shown in the figure below.

Figure A15.1 Module structure for the 2026 Fibre Cost Model



A15.19 Each module is responsible for the following:

i) **Control** – this consolidates the key assumptions that are used across all the other modules. It is used to calculate the final outputs under different scenarios and assess the sensitivity of our modelled assumptions.

ii) **Service volumes** – computes the speed of fibre deployment to end customers by geographic area (i.e. premises passed) and calculates the associated volumes of

each relevant fibre service (e.g. number of rentals, connections, and ancillary services) in each modelled year.

iii) **Network Cost** – combines the service volumes with network capacity and coverage parameters to dimension the fibre network. It then calculates the capital expenditure required to build the dimensioned fibre network.

iv) **Opex** – uses the outputs from the Network Cost module (along with the Volumes module) to calculate the ongoing costs of running the modelled network.

v) **Model outputs** – Combines the outputs from all modules to calculate model outputs for the WLA Area 2 entrant cross-check and the WLA Area 3 RAB calculation.

A15.20 We set out more information on the workings of these modules below.

2. Service volume forecasts

A15.21 Service volumes are a function of network deployment and take-up. In our approach to forecasting service volumes, we first make assumptions about the scale of FTTP network deployment, i.e. how many premises are reached in the long run, and the speed of network deployment (which we discuss further below). This allows us to determine the coverage of the network in each year. We then apply a take-up profile to the modelled deployment to determine the number of connections.

A15.22 We expect take-up to vary by geographic area, for example, due to the differing levels of network competition. For example, we expect the long-run take-up for the average entrant to be between 30-40% in WLA Area 2, i.e. a roughly equal share for three competing networks, and 95% for Openreach in WLA Area 3, i.e. full market share but accounting for mobile-only households.

A15.23 When determining the deployment scenario and take-up profile used for our WLA Area 2 entrant cross-check and WLA Area 3 RAB calculation, we have ensured that the fibre volumes are consistent with the copper volumes produced by our top-down modelling.

A15.24 We set out later in this annex our 2026 Fibre Cost Model deployment and take-up assumptions for our WLA Area 2 entrant cross check.

3. Network costs and dimensioning

A15.25 The Network Cost model dimensions the size of the fibre network based on the service volume forecasts and network deployment assumptions; and estimates the capex for the dimensioned network.

A15.26 The Network Cost model was originally built by Cartesian for our 2021 Fibre Cost Model, and further details of this can be found in the Cartesian report that was published as part of our WFTMR 2021.[362]

A15.27 The Network Cost model comprises four inter-related modules:

Geospatial analysis

A15.28 The Geospatial analysis processes the location of all the premises in the UK, road topologies and relevant network assets to calculate a set of output parameters which are consumed by the Network Model to dimension the target network appropriately.

[362] Fixed Telecom Access: Full Fibre Cost Modelling: Model Report, Cartesian, March 2021.

A15.29 We have not updated the geospatial analysis for the 2026 Fibre Cost Model since we consider that the analysis used in our 2021 Fibre Cost Model is sufficiently robust and accurate for our purposes.

The infrastructure module

A15.30 The Infrastructure Module takes the outputs from the Geospatial analysis, the service demand and the premises coverage forecast (both provided by Ofcom), to dimension the underground physical infrastructure, i.e. new duct, existing duct, in Segments 1 and 2.

A15.31 We have retained the rules for dimensioning physical infrastructure from the 2021 Fibre Cost Model. Our cross-check with Openreach's internal FTTP modelling tool indicates that these continue to be robust and accurate.

The Network module

A15.32 The Network module takes the outputs from the Geospatial analysis, the service demand, the premises coverage forecast and Infrastructure Module to dimension the network.

A15.33 We have reviewed the network dimensioning rules using an updated version of Openreach's internal FTTP modelling tool. Based on that review, we consider that the 2021 Network module is consistent with this evidence. Therefore, the 2026 Network module is unchanged from the 2021 version.

The Capex module

A15.34 The Capex module calculates the capital expenditure required to build the dimensioned network.

A15.35 We set out below our approach to updating the capex module in the 2026 Fibre Cost Model.

Network dimensioning

A15.36 The size of the FTTP network is first dimensioned based on coverage and then capacity.

A15.37 The model can sequence network deployment by ranking the postcode sectors from lowest to highest cost to deploy. It then uses the geospatial analysis to calculate the number of metres of fibre cable, splitter nodes and aggregation nodes required to pass all premises within each postcode sector. However, in 2021 we considered this approach to sequencing deployment to be too simplistic and unlikely to reflect how networks are deployed in the real world.

A15.38 Alternatively, the model can sequence network by ranking whole exchange areas from lowest to highest cost to deploy (i.e. an exchange area approach). More specifically, the model includes a ranking of groups of postcode sectors by exchange area and assumes that the network is deployed from the lowest to most expensive exchange area. This is aimed to better reflect how an operator might deploy its network.

A15.39 Network elements such as fibre and duct can span across multiple postcode sectors. For example, to connect a customer to an Access Node, a network operator may need to deploy duct and fibre across more than one postcode sector.

A15.40 The model also has the functionality to estimate the costs for any possible coverage scenario, i.e. coverage scenarios are not predefined in the model. Such flexibility comes at a cost as there is the risk that network elements which span across multiple postcode sectors are counted more than once when selecting a broader coverage scenario.

A15.41 To deal with this issue, the model dimensions the network across the whole of UK first and then apportions the network infrastructure elements to each postcode sector based on the relative length of the underlying infrastructure. Although this reduces the accuracy of our cost estimates for small geographic areas, it avoids the problem of double counting costs when assessing the costs for broader geographic areas. We consider this to be an acceptable trade off given the primary aim of the model is to assess relatively broad geographic deployments for an entrant in WLA Area 2 or Openreach in WLA Area 3.

A15.42 Below, we set out our specific 2026 Fibre Cost Model coverage assumptions for the WLA Area 2 entrant cross-check.

Determining the amount of new physical infrastructure

A15.43 Once the total amount of fibre cables needed to satisfy the demand of the FTTP network is calculated, the model calculates the amount of physical infrastructure required to carry these fibre cables. Physical infrastructure, such as ducts and poles, is a key input in the building of a fibre network.

A15.44 An operator deploying a fibre network can either: (i) reuse existing physical infrastructure; (ii) build new physical infrastructure; or (iii) a combination of both. As noted above, in general, we assume that an operator planning to build a fibre network would seek to reuse as much physical infrastructure as possible (given the higher costs of building new physical infrastructure).

A15.45 The model has the flexibility to change the balance of new physical infrastructure versus reuse of physical infrastructure by varying the assumptions around spare existing capacity. These assumptions are applied at the Exchange Geotype level.

A15.46 To work out the amount of new infrastructure, we have maintained the 2021 assumptions whereby the model compares the amount of physical infrastructure required against the capacity assumed to be available in existing infrastructure. This is done at a postcode sector level. If enough capacity was found to be available, the model assumed no new physical infrastructure is required. If there was not enough capacity, the model assumed new physical infrastructure will need to be built.

A15.47 Where the modelled network reuses existing physical infrastructure, we include the costs of renting the space used in the physical infrastructure as an operating cost at the level of Openreach's Physical Infrastructure Access (PIA) charges.

A15.48 Below, we set our specific assumptions on duct and pole reusage for the WLA Area 2 entrant cross-check.

4. Opex model

A15.49 Once the Network Cost model has dimensioned the network and calculated capex, we calculate the opex required for running the network.

A15.50 We have assumed the following opex costs are incurred by the modelled network:

- Repair costs – costs of repairing network faults arising at both the passive and active layers of the network;
- Maintenance costs – costs associated with maintenance activities across the network, including those associated with the monitoring of network performance;
- Power and accommodation – costs in relation to the power and physical space taken by the equipment located at the network node/exchange;

- General Management – corporate overheads such as management, finance and legal costs;
- PIA payments – costs associated with the use of Openreach's PIA services;
- Systems and per order processing costs – costs associated with processing and recording new orders;
- Provisions costs – costs associated with the provisioning of new services not captured in the capex model; and
- Service Level Guarantee (SLG) costs – costs faced by the network provider when it fails its service level guarantees.
- Cumulo – the business rates operators need to pay in deploying a fibre network.

A15.51 For operating costs where we have identified a clear driver – PIA payments, systems and per order processing costs, provisions costs, SLG costs and cumulo – we have combined those drivers with model unit costs to calculate the total operating costs for those network elements. We set out those drivers and updated unit costs in Table A15.2 below.

A15.52 For the costs for which a clear cost driver could not be identified, we have modelled these as a percentage of the network's Gross Replacement Cost (GRC), i.e. the cumulative network investment in a given year. These 'other opex' costs include repairs, maintenance, power and general management costs. We consider this approach is appropriate given that we expect these costs to be proportionate to the size of the network, which can be proxied by the GRC.

A15.53 To estimate PIA payments for the modelled network we have used the following approach.

- PIA Duct: we use Openreach's PIA rental charges, in line with our proposed PIA charge control, for different duct types. For Segment 1, we use the proposed two bore PIA rental charge for multi-bore duct. For Segment 2, we use the proposed PIA rental charge for single-bore duct. For Segment 3, we use the proposed PIA rental charge for lead-in duct with a revised method for calculating those charges (as explained below). For other costs associated with the use of PIA (e.g. facility hosting, ancillary PIA charges), we load these costs into our per metre cost assumptions by applying a 40% uplift based on the FAC estimates in our PIA model.
- PIA Poles: we use the Openreach's PIA rental charges, in line with our proposed PIA charge control, for single and multi-user pole attachments[363]. We then divide this unit cost by 50 metres to convert to a per metre cost.

Efficiency

A15.54 Having estimated base year (2023/2024) opex costs, we take into account expected efficiencies in future years by applying MEA cost trends. In our base case we assume:

- an efficiency factor of 1.5% for capex cost elements such as fibre, duct, passive components and civils[364], and
- 3% for opex cost elements such as SLG, system and processing costs.

[363] We calculate a blended charge based on the national profile of single and multi-user pole attachments.
[364] Efficiency factors relating to capex for network equipment are not applied since these are already captured in the price trends assumed for these network assets.

- for opex cost elements modelled as a percentage of GRC, we have not applied an efficiency factor but note that the change to the assumed opex cost trend results in these costs reducing by 1% per annum.[365]

2026 Fibre Cost Model assumptions and outputs

Our approach to updating the model

A15.55 We have developed our 2026 Fibre Cost Model to inform our WLA charge control proposals, set out in Volume 4, Section 1:

- In WLA Area 2, we proposed a pricing continuity approach that sets a charge control on MPF and GEA FTTC 80/20 that is at a level which supports investment by a rival competitor deploying a fibre network.
- In WLA Area 3, we propose to adopt a forecast RAB approach to support BT's deployment of a fibre network where it does not face the potential of material rival competition.

A15.56 We used the 2021 Fibre Cost Model as the starting point and updated the following:

- Geographic area boundaries
- Network element unit costs
- Opex costs

Geographic area boundaries

A15.57 We updated the geo-boundaries to reflect the new proposed WLA Area 2/Area 3 split set out in Volume 2 Section 4, reflecting that we are proposing WLA Area 2 will be considerably larger than in 2021-2026 with 28.7m premises (representing c. 90% of premises), with WLA Area 3 being considerably smaller with 3.2m premises (representing 10% of premises).

Network element unit costs

A15.58 We updated the Network Cost Model to a new base year of 2023/24. This involved updating the network element unit costs in the Capex Module as follows:

- Where we were able to obtain comparable information on Openreach's 2023/24 network element costs[366] under formal information gathering powers,[367] we updated on this basis (see Table A15.1 below); and
- For all other network elements, we inflated the 2019/20 costs by the annual CPI in October for each year until 2023/24.[368] We note that these elements comprise a small proportion of the total capex and hence the factor by which their costs are inflated has a minimal impact on the final rental cost per line.

[365] The GRC measure captures efficiencies applied to capex elements which then indirectly gets applied to 'other opex'.
[366] Specifically Openreach's internal FTTP modelling tool entitled [✂]. It replaced the Openreach document "Modelling Rules & Costs, Fibre to the Cabinet (FTTC), Fibre to the Premises (FTTP), Fibre to the Remote Node (FTTRN)" commonly referred to as the Chief Engineer's NGA model assumptions which became obsolete in December 2019.
[367] Openreach response to question I1 of the s135 dated 14 May 2024, received on 24 June 2024.
[368] OBR, Economic and fiscal outlook – October 2024. CPI forecasts can be found in the supplementary economy tables, tab 1.7.

- For years prior to 2023/24, we assume the network element unit costs to be as forecast in the 2021 Fibre Cost Model, which was based on 2019/20 network element unit costs, calibrated with operator information, and captured the impact of inflation, general efficiency, and capex cost trends.

Table A15.1: Network elements rebased using Openreach information (£, nominal)

Network Element	Unit Cost (2021)	Unit Cost (2023/24)	Unit
EXCH_FTTP_OLT_SBCard	[✂]	[✂]	Each
EXCH_OCR_Tie_Cable	[✂]	[✂]	Per cable
EXCH_CCJ_Tie_Cable	[✂]	[✂]	Per cable
BCKH_Business_Serv_Mainlink_Fibre	[✂]	[✂]	Per metre
BCKH_Business_Serv_Mainlink_Fibre_Testing	[✂]	[✂]	Per fibre
Business_Serv_UG_Fibre (Segments 1, 2 and 3)	[✂]	[✂]	Per metre
Business_Serv_OH_Fibre (Segments 1 and 2)	[✂]	[✂]	Per metre
SEG1_Aggregation_Node	[✂]	[✂]	Each
SEG1_Footway_Duct in New_Duct	[✂]	[✂]	Per linear metre
SEG1_Carriageway_Duct in New_Duct	[✂]	[✂]	Per linear metre
SEG1_FootwayBox_Aggreg_Node	[✂]	[✂]	Each
SEG1_FootwayBox_UG_Track_Joint	[✂]	[✂]	Each
SEG1_Sub-duct in Existing_Duct	[✂]	[✂]	Per linear metre
SEG1_Soft_Duct in New_Duct	[✂]	[✂]	Per linear metre
SEG2_FootwayBox_Splitter_1:32	[✂]	[✂]	Each
SEG2_Splitter_Node_1:32	[✂]	[✂]	Each
SEG2_FootwayBox_Splitter_1:16	[✂]	[✂]	Each
SEG2_Splitter_Node_1:16	[✂]	[✂]	Each
SEG2_FootwayBox_UG_DP	[✂]	[✂]	Each
SEG2_OH_Distribution_Point	[✂]	[✂]	Each
SEG2_UG_Distribution_Point	[✂]	[✂]	Each
Fibre Testing (Segments 1 and 2)	[✂]	[✂]	Per fibre
FTTP_UG_Fibre (Segments 1 and 2)	[✂]	[✂]	Per metre
FTTP_OH_Fibre (Segments 1 and 2)	[✂]	[✂]	Per metre
SEG3_Business_Serv_Fibre_Testing	[✂]	[✂]	Per fibre
SEG3_FTTP_Connection_Civils	[✂]	[✂]	Per connection

Source: Ofcom Fibre Cost Model

Opex costs

A15.59 We also updated some of the parameters in the Opex model: (i) PIA and cumulo costs; (ii) SLG costs, system and processing costs and provisions costs; and (iii) 'Other opex' costs (costs for which we could not identify a clear driver), as explained below.

(i) PIA and cumulo costs

A15.60 We have updated PIA costs as per the 2025 version of the PIA Charges Model. See Volume 4, Section 4 and Annex 18 for details on our proposals for cost-based PIA charges.

A15.61 We have also updated the cumulo cost as per the 2026 version of the Cumulo Model. See Annex 14 for details on our approach to forecasting cumulo costs.

A15.62 The 2021 Fibre Cost Model calculated the PIA charges for lead-in duct by multiplying a unit price per metre by the estimated metres of duct in Segment 3 nationally. However, reuse of Openreach's lead-in duct is charged on a per-line basis. We have amended the calculation such that PIA Duct Segment 3 costs are now based on the per-line lead-in duct charge, multiplied by the number of lead-ins where PIA is used. We consider that this will increase the accuracy of the PIA Duct Segment 3 (lead-in) cost calculations, particularly for sub-national deployment scenarios as the metres of Segment 3 duct varies by geo-type.

(ii) SLG costs, system and processing costs and provisions costs

A15.63 These are the operating cost categories for which we have identified a clear driver. We combine the drivers for each of the cost categories (summarised in Table A15.2 below) with modelled unit costs to calculate the total operating costs for those network elements.

A15.64 To update these opex unit costs to 2023/24 terms, we assume the costs to be as forecast by the 2021 Fibre Cost Model which was based on 2019/20 opex unit costs, calibrated with operator information, and captured the impact of inflation, general efficiency, and opex cost trends.

(iii) 'Other opex' costs (costs for which we could not identify a clear driver)

A15.65 In the 2021 Fibre Cost Model, following our calibration exercise to align with operators' data, we arrived at an opex per line excluding PIA of approximately £50 in 2025 (£46 for the national deployment and £49 for the subnational deployment).[369] Our analysis of BT's 2023/24 RFS indicates that this is similar to the level of opex (excluding the reuse of physical infrastructure costs and OCM depreciation) for Openreach's FTTC services (c. £49). We consider that this indicates that the FTTP opex per line (excluding PIA) in the 2021 model is too high as we would expect lower repair and maintenance costs for FTTP to result in lower overall opex per line than for FTTC.

A15.66 We have therefore adjusted 'other opex' costs to better reflect the lower repair and maintenance costs of FTTP. Based on information gathered under our formal information gathering powers, we estimate that FTTP repair and maintenance costs are [✂] per annum lower than for FTTC.[370] To reflect this, we have reduced the level of 'other opex' costs. Specifically, for the WLA Area 2 entrant cost check scenarios (described below) we assume:

[369] 2021 WFTMR, Annex 15: Tables A15.2 and A15.3
[370] [✂].

- 'other opex' costs to be 2% of GRC from 2025 onwards in the 'base' and 'high cost' scenarios;
- 'other opex' costs to be 3% of GRC from 2025 onwards in the 'low cost scenario'.

A15.67 For the WLA Area 3 RAB modelling (discussed in Annex 16), we assume other opex' costs to be 3% of GRC by 2025 for all scenarios.

A15.68 As in the 2021 model, consistent with operator data we assume 'other opex' is a higher proportion of GRC in the initial years of deployment. In line with our approach to capex, we have also updated the opex unit costs to 2023/24 prices. Table A15.2 below shows the updated opex unit costs in the base year for the Openreach national deployment scenario.

Table A15.2: Opex cost elements, drivers and unit costs (£ per year)

Opex cost element	Driver	Unit cost (2023/24)
SLG costs	New connections	£5.41
	Line rentals	£0.39
System and processing costs	Software configuration volumes	£2.32
Provisions costs	New connections	£15.47
PIA Duct – Segment 1	Metres of duct using PIA (seg 1)	£0.34
PIA Duct – Segment 2	Metres of duct using PIA (seg 2)	£0.49
PIA Duct – Segment 3	Line rentals using PIA	£11.09
PIA Poles	Metres of poles using PIA	£0.06
Cumulo	Line rentals	£10.27
Other opex: repair, maintenance, power and general management	% of GRC	£1.00

Source: Ofcom estimates

Modelling of the WLA Area 2 entrant cost check

Approach to updating the WLA Area 2 entrant cost check

A15.69 In the WFTMR 2021, we estimated the costs of an entrant deploying a fibre network in WLA Area 2. Our cost modelling was used to check that our charge control provided a set of prices that allowed a reasonably efficient operator to profitably offer a range of full-fibre services in the market.

A15.70 We have updated elements of our Fibre Cost Model to check that our proposed charge control allows a reasonably efficient operator the opportunity to profitably offer a range of full-fibre services in the market and continues to support our objectives of promoting competition and investment.

A15.71 In terms of the approach to this cross check, we highlight the following:

- We have revised elements of our Fibre Cost Model, where updated or actual information is available which can replace forecast assumptions that we used in our 2021 Fibre Cost Model. This includes updating network element costs and opex, as described above.

- We have also corrected modelling errors identified in the 2021 Fibre Cost Model to reflect our intention at the time. As detailed below, we identified an error within the take-up assumptions.
- We have not changed our assumptions relating to the network configuration of the hypothetical operator including scale of build, sequencing of build and PIA usage:
  - While our modelled network is unlikely to match the actual network configuration of any specific operator (and cannot match all operators), we consider the assumptions made in WFTMR 2021 provide a reasonable representation of a hypothetical entrant operator.
  - We are also mindful that the assumptions we used in our cost modelling in the WFTMR 2021 have provided investment signals to altnets (and Openreach). These signals will have informed choices around business models and investments – such as those relating to network design, where to deploy a network, and indeed choices not to invest. We consider that changing our assumptions regarding the network configuration of our hypothetical operator would risk undermining those investment choices made since 2021.
- For the cross-check, we take the cost outputs from our 2026 Fibre Cost Model and convert them into a cost per line. Since 2021, we have updated our assumption on how much of FTTP costs are recovered through a one-off connection charge.

A15.72 We summarise below the assumptions we have made in relation to the approach to cost recovery, network coverage, take up, infrastructure reusage and WACC.

Approach to cost recovery

A15.73 To convert our modelled capex and opex to a cost per line we have calculated a flat real annuity over the modelled period. In other words, we have calculated the monthly rental charge that an entrant would have to set in order to recover its incurred costs.

A15.74 We have excluded some costs from the annuity calculation. This is to mimic the price structure that we currently observe in the market where operators recover a portion of their costs upfront in the form of a one-off connection charge. We have assumed that c.£42.76 (in 2026/27 prices) of the final drop capex is recovered through connection charges. For years before and after 2026/27, the connection charge is adjusted by CPI annually.[371] We have based the level of the assumed connection charge on Openreach's average FTTP connection charge in WLA Area 2 in 2023/24 and this is the level of our proposed price cap for the FTTP 80/20Mbit/s price cap in WLA Area 2. All other FTTP costs are assumed to be recovered from rental charges.

Network coverage

A15.75 As discussed above, we have maintained our approach of sequencing network deployment by lowest to highest cost exchange areas in WLA Area 2. This is aimed to reflect how an operator might deploy its network by sequencing deployment across postcode sectors that are localised. We consider this is more realistic than assuming an operator would roll out in order of lowest to highest cost postcode sectors that are potentially scattered in different parts of the country.

[371] The connection charge of £42.76 is calculated as a weighted average charge to reflect the higher connection charge in premises that were categorised as Area 3 in 2021 but we are now proposing to categorise as Area 2. We use discounted prices published by Openreach under the Equinox schemes for 2021-22 and 2023-24.

A15.76 In terms of the scale of deployment, we maintain our 2021 Fibre Cost model assumptions:

- In our base case, the entrant rolls out to 5 million premises by 2028/29;
- In our low-cost scenario, the entrant rolls out to 2 million premises by 2025/26; and
- In our high-cost scenario, the entrant rolls out to 8 million premises by 2028/29.

Take-up

A15.77 On the level and rate of take-up of FTTP for the entrant operator, we maintain our 2021 Fibre Cost Model assumptions:

- In our base case, the entrant achieves a take-up of 33% by year 5 of the deployment;
- In our low-cost scenario, the entrant achieves a take-up of 40% by year 5 of the deployment; and
- In our high-cost scenario, the entrant achieves a take-up of 30% by year 5 of the deployment.

A15.78 We identified an error in the 2021 Fibre Cost Model whereby the WLA Area 2 entrant cross check scenarios had assumed maximum take-up is achieved after 3 years. Our intention was that maximum take-up is achieved after 5 years, consistent with Annex 15 of the 2021 WFTMR Statement,[372] so we have corrected this error in the 2026 Fibre Cost Model.

Infrastructure reusage

A15.79 Consistent with the 2021 model, we assume:

- In our base case, 64% of the entrant's network (in total across all three Segments)[373] is built using Openreach's physical infrastructure (i.e. PIA).
- In our low-cost scenario, 69% of the entrant's network (in total across all three Segments)[374] is built using Openreach's physical infrastructure (i.e. PIA).
- In our high-cost scenario, 64% of the entrant's network (in total across all three Segments)[375] is built using Openreach's physical infrastructure (i.e. PIA).

WACC

A15.80 We have updated WACC to reflect the different competitive challenges and risks faced by a new entrant. While we still consider that an entrant is unlikely to face a different systematic risk profile to Openreach, we recognise that a new entrant WACC could differ from the OUKT WACC. For example, based on the performance of altnets to date, some parameters such as cost of debt could be higher than that used in the OUKT WACC, while others like the effective tax rate could be lower. To allow for the possibility that, for a new entrant, WACC could be higher than the OUKT WACC, in our base-case and high-cost scenarios we have applied an uplift to the updated OUKT WACC of 7.6% (estimated in Annex 20) from 2026 onwards. In summary, from 2026 we assume:

- In our low-cost scenario, the entrant WACC is the OUKT WACC of 7.6%;
- In our base case scenario, the entrant WACC is the OUKT WACC plus 0.5 percentage points, i.e. 8.1%;

[372] 2021 WFTMR Statement, paragraph A15.83.
[373] This splits out to 42% for Segments 1 and 2 and 89% for Segment 3.
[374] This splits out to 48% for Segments 1 and 2 and 88% for Segment 3.
[375] This splits out to 46% for Segments 1 and 2 and 90% for Segment 3.

- In our high-cost scenario, the entrant WACC is the OUKT WACC plus 1.0 percentage points, i.e. 8.6%.

A15.81 Furthermore, consistent with the 2021 modelling, we have made an adjustment to shorten asset lives for electronic and passive equipment. To reflect that an entrant operator may be required to pay its investment back sooner than an incumbent operator would, we have assumed a shorter asset life of 7 years for electronic equipment and 10 years for passive equipment (compared to 10 years and 20 years respectively for an incumbent operator). This is equivalent to increasing the WACC by a further 0.5 percentage points, (i.e. the effective WACC from 2026 is 8.1%/8.6%/9.1% in the low/base/high scenarios).

A15.82 Table A15.3 below summarises our proposed assumptions for our three scenarios for the WLA Area 2 entrant cross-check.

Table A15.3: WLA Area 2 entrant cross-check list of assumptions

	Low-cost scenario	Base case scenario	High-cost scenario
Network coverage	2m premises	5m premises	8m premises
Take-up (5 years)	40%	33%	30%
Infrastructure reusage	69%	64%	64%
WACC until 2025/26	7.8%	7.8%	7.8%
WACC 2026/27 onwards	7.6%	8.1%	8.6%
Electronics equipment asset life	7 years	7 years	7 years
Passive equipment asset life	10 years	10 years	10 years
Other opex as % of GRC by 2025	3%	2%	2%

Source: Ofcom Fibre Cost Model

Summary of WLA Area 2 entrant cross-check model outputs

A15.83 Based on the assumptions above, we estimate that the entrant operator in WLA Area 2 would have to charge between £11.22 to £17.03 per month (in 2024/25 prices) in order to recover its efficiently incurred costs over the modelled period.

Table A15.4: Forecast unit costs for WLA Area 2 entrant cross-check (2024/25 terms)

	Unit	Low-cost scenario	Base case scenario	High-cost scenario
Build capex	Per Premises passed	£300.41	£392.58	£442.10
Connection costs	Per connection	£296.72	£334.33	£333.21
Opex	Per customer, per annum	£36.56	£37.28	£39.84
Rental cost per line (real)	£/month	£11.22	£14.49	£17.03

Source: Ofcom Fibre Cost Model

A15.84 We are publishing a non-confidential version of the Fibre Cost Model as part of this consultation.

A15.85 The non-confidential model reflects all of the updates described above, e.g. new geographic boundaries, rebasing to 2023/24, new approach to PIA duct lead-in charge calculation, etc..

A15.86 Where input data is confidential, we have used randomised data to maintain its confidentiality:

- For new confidential data that we have used in the 2026 Fibre Cost Model, we have randomised by +/- 20%. These data include:
  - 2023/24 unit cost data for network elements in the Capex module; and
  - actual Openreach FTTP network coverage in WLA Area 3 as of July 2024.
- Where we continue to use input data from the 2021 Fibre Cost Model[376], we have used the same randomised data as in the 2021 Fibre Cost model, i.e. the 2021 Fibre Cost Model data randomised by +/- 20%.

A15.87 The non-confidential Fibre Cost Model is functionally the same and if the randomised data were replaced with the actual confidential data we have used, it would produce the same results as presented in Table A15.4 above.

[376] Non confidential 2021 Fibre Cost Model, updated 22 February 2023 to correct formula errors: https://www.ofcom.org.uk/phones-and-broadband/telecoms-infrastructure/2021-26-wholesale-fixed-telecoms-market-review/

A16. Modelling of the RAB in WLA Area 3

A16.1 In Volume 4, Section 1 we propose to adopt a RAB approach in WLA Area 3 which is a cost-based control that will support Openreach's incentives to invest while also protecting consumers and competition based on access to Openreach's networks. Our evidence suggests that pricing continuity will be consistent with our objectives, as set out in the remainder of this annex.

A16.2 By pricing continuity, we mean an approach where:

- An inflation indexed charge control is set on the anchor, i.e. MPF and FTTC 80/20 rentals (or FTTP 80/20 rentals where a copper-based service is not available).
- Other bandwidth rentals are subject to a requirement that charges are fair and reasonable.

A16.3 In this annex, we set out the modelling we have undertaken to assess cost recovery as part of the proposed RAB approach with pricing continuity where Openreach deploys a fibre network to 2.2m premises in WLA Area 3.

The RAB approach

A16.4 We are proposing to adopt a forecast RAB approach which continues the approach we adopted in the WFTMR21.

A16.5 The RAB approach is a cost-based control. In many ways it is similar to our typical approach to setting a CPI-X price cap, in that it is set in advance based on cost and revenue forecasts and remains for the duration of the control. However, it differs in the following respects:

- the cost forecasts are based on assumptions about Openreach's FTTP network that is still being deployed during the 2026-31 review period; and
- the price caps are intended to allow the forward-looking expectation of cost recovery across the FTTP and copper networks, in aggregate and over the lifetime of those networks.[377]

A16.6 Ultimately, our RAB modelling is used to assess the following:

- what is a reasonable level of cost recovery that is required during the review period, where Openreach commercially deploys FTTP in WLA Area 3, that would allow an expectation of cost recovery over the lifetime of the fibre and copper networks; and
- what this means in terms of setting charge controls on copper and fibre services over the review period.

[377] In contrast, Ofcom's historical approach has generally been to set pricing regulation to allow for cost recovery on each individual network/technology separately. See 2021 WFTMR Statement, Volume 4, Section 2 for further discussion.

High level approach

A16.7 Our modelling calculates the present value of costs and revenues over a 20-year period, across both the fibre and copper networks. Our modelling has the following components:

- **FTTP costs:** the costs of building and operating a FTTP network reaching 2.2m premises in WLA Area 3 over the lifetime of the network (which we model over a 20-year period).
- **Copper costs:** the costs of operating the copper network (providing MPF, WLR and FTTC services) in WLA Area 3 over the lifetime of the network. The copper service cost estimates use input data on the costs of copper services from the 'cost forecast model' (which is described in more detail in Annex 14).
- **Volume and revenue assumptions:** covering our assumptions on the migration from copper to FTTP services and our revenue estimates over the lifetime of our modelled networks.

A16.8 In the WFTMR21, we used a RAB approach that considered cost recovery relating to Openreach deploying a fibre network in WLA Area 3 from 2021 and reaching 7m premises by 2031. For this review period, we are proposing a smaller WLA Area 3 and are therefore considering the cost recovery relating to Openreach deploying a fibre network where build started in 2021 and reaches 2.2m premises by 2031.[378]

A16.9 To estimate cost recovery over the lifetime of the modelled network, we need to model costs and revenues in the period 2021-26 and several future periods.

- For the 2021-26 period, we use our forecasts (fibre and copper service costs and revenues) from the 2021 RAB model but re-scaled based on Openreach deploying a fibre network that reaches 2.2m premises by 2031.
- For 2026 onwards, we follow our typical approach to setting cost-based controls by rebasing our modelling estimates to allow us to estimate forward-looking costs and revenues. To inform this rebasing exercise we have considered information on Openreach's outturn volumes, costs and revenues, and recent forecasts gathered under our formal powers. More specifically, we have updated:
  - Copper network costs based on 2021/22 to 2023/24 outturn data and our proposed charges in the cost forecast model for the 2026-31 period;
  - Fibre network cost forecasts using our 2026 Fibre Cost model;
  - Openreach's fibre network deployment to reflect its actual build in WLA Area 3 as of July 2024;
  - Forecasts of copper and FTTP volume of lines and prices based on outturn information and cross checked against recent Openreach forecasts.

A16.10 We then combine the forecasts for the 2021-26 period (based on the 2021 model) and the 2026-41 period (based on the 2026 model) to assess expected cost recovery over the total 20-year recovery period.

[378] In the WFTMR21, we assumed 2m of the 9m premises in Area 3 were not commercially viable. Since 2021, around 1m of those 2m premises have been deployed to by altnets using public subsidy and have been re-categorised as WLA Area 2. This leaves around 1m premises in our proposed WLA Area 3 that are considered as not commercially viable thus 2.2m commercially viable premises.

A16.11 Our approach of rebasing our modelling to provide a forward-looking path of cost recovery is consistent with allowing Openreach a fair bet on its investment by keeping any upside in earlier review periods if it outperforms our forecasts or incurring the downside if it underperforms our forecasts.

A16.12 Consistent with this approach, to calculate the present value of costs and revenues over the lifetime of the modelled network we have discounted the cashflows as follows:

- For the 2021-26 period, we use our WACC assumptions from the WFTMR 2021. This means:
  - For copper services we use a pre-tax nominal WACC for Openreach (applicable to copper services) of 7.0% to discount copper service costs and revenues; and
  - For FTTP services: we have used a pre-tax nominal OUKT WACC of 7.8% to discount FTTP costs and revenues.
- From 2026 onwards, we use our proposed WACC estimates. This means:
  - For copper services we use a pre-tax nominal WACC for Openreach (applicable to copper services) of 7.1% to discount copper service costs and revenues; and
  - For FTTP services: we have used a pre-tax nominal OUKT WACC of 7.6% to discount FTTP costs and revenues.

A16.13 Below, we provide details of the modelling approach:

- First, we set out our cost and revenue estimates for the 2021-26 period, based on the 2021 RAB model; and
- Second, we set out our cost and revenue estimates for the 2026-41 period, based on the 2026 RAB model.

Cost and revenue estimates for the 2021-26 period

2021-26 cost estimates

A16.14 To estimate costs for the 2021-26 period, we use the modelling assumptions from WFTMR 2021 to calculate costs for the fibre and copper network where Openreach deploys a commercial fibre network to 2.2m premises in WLA Area 3.

A16.15 Fibre network costs are estimated using our 2021 Fibre Cost model. This model calculates the total cash costs of deploying and running a FTTP network by estimating the number of network components needed to deploy the FTTP network (e.g. civil costs, fibre, exchange equipment) and combining this with estimates of the capital and operating costs for each component.

A16.16 Consistent with our approach in the WFTMR21, we assume:

- Deployment of the fibre network starts in 2021 and finishes in 2031 (albeit to 2.2m premises). FTTP build to the remaining c.1m premises in WLA Area 3, in the hardest to reach postcode sectors, i.e. with the highest costs, will require public subsidy and are not included in our RAB assessment.
- The fibre network is deployed across postcode sectors in alphabetical order. This is to reflect that Openreach's FTTP deployment is likely to contain a mixture of lower- and higher- cost premises, so ordering by cost would not be appropriate, and deployment will likely be sequenced according to BT exchange areas.

- Openreach reuses existing physical infrastructure, such as ducts and poles, where spare capacity is available and only builds new physical infrastructure where this is not available or feasible. We assume Openreach can reuse:
  - 70% of existing ducts and poles in our high-cost scenario,
  - 80% of existing ducts and poles in our low-cost scenario, and
  - 75% in our central scenario.
- Operating costs are driven by customer connections and/or number of customers. We have maintained our assumptions regarding rate of connections and customer numbers (rescaled to a fibre network of 2.2m premises)

A16.17 For copper services, we take forecast Fully Allocated Costs (FAC) from the 2021 cost forecast model. To be consistent with our modelling for the 2026-41 period, we have included the costs of copper connection services and SMPF. As the 2021 cost forecast model did not include connection services or SMPF, we have applied a simplified uplift to rental service costs.[379]

A16.18 We then calculate depreciated costs for fibre and copper services combined for the 2021-26 period by calculating the:

i) present value of fibre and copper costs combined for the 20-year period using the WACC assumptions for the 2021-26 period outlined above (7.0% for copper services and 7.8% for fibre services);
ii) present value of fibre and copper volumes combined for the 20-year period using the WACC assumptions for the 2021-26 period; and
iii) annual flat annuity per line of the 20-year fibre and copper costs by dividing (i) the present value of costs by (ii) the present value of volumes, then multiplying by five to get depreciated costs for the 2021-26 period.

A16.19 Based on the above, we estimate the following costs for the 2021-26 period:

Table A16.1: 2021-2026 costs for a 2.2m Area 3 deployment – Low scenario (£bn)

	20-year copper and fibre costs	20-year copper and fibre volumes (m)	Annual flat annuity per line (£)	5-year costs (2021-26)
Cash costs (nominal)	8.2	47	175.67	2.4
Present value (2021/22 prices)	4.7	27		2.1

[379] We estimated costs for connection services and SMPF by uplifting rental service costs based on the average proportion of total costs coming from connection and SMPF services in the 2026 modelling.

Table A16.2: 2021-2026 costs for a 2.2m Area 3 deployment – Central scenario (£bn)

	20-year copper and fibre costs	20-year copper and fibre volumes (m)	Annual flat annuity per line (£)	5-year costs (2021-26)
Cash costs (nominal)	8.9	47	190.23	2.6
Present value (2021/22 prices)	5.1	27		2.3

Table A16.3: 2021-2026 costs for a 2.2m Area 3 deployment – High scenario (£bn)

	20-year copper and fibre costs	20-year copper and fibre volumes (m)	Annual flat annuity per line (£)	5-year costs (2021-26)
Cash costs (nominal)	9.8	47	210.80	2.9
Present value (2021/22 prices)	5.7	27		2.5

2021-26 revenue estimates

A16.20 To estimate revenues for the 2021-26 period, we use our forecasts and assumptions from the 2021 RAB model[380] but re-scaled based on Openreach deploying a fibre network that reaches 2.2m premises by 2031. In summary:

- We assume Openreach's commercial FTTP deployment reaches c.2.2m premises by 2031;
- Fibre take-up reaches a maximum of 90%, 8 years after deployment with customers migrating from copper services;
- We assume copper rental prices increase in line with the forecast of CPI in the 2021 RAB model;
- We assume fibre rental prices will be higher than copper prices by c.£1.75-£4.00 and that these will follow the trend of copper prices; and
- We assume a fibre connection charge of £27 per connection.

A16.21 Consistent with the cost estimates, we also included an uplift to revenues to account for connection and SMPF services.

[380] See WFTMR 2021, Annex 16, paragraphs A16.51-A16.63.

Table A16.4: 2021-2026 revenues for a 2.2m Area 3 deployment (£bn)

	Low scenario	Central scenario	High scenario
Undiscounted (nominal)	2.1	2.2	2.2
Present value (2021/22 prices)	1.9	1.9	1.9

Cost and revenue estimates for the 2026-2041 period

A16.22 Consistent with our typical approach to setting cost-based controls, we have rebased our modelling to estimate forward-looking costs and revenues. We refer to this as our 2026 RAB model and we use this to assess cost recovery for the 2026-41 period.

2026-41 cost estimates

A16.23 We have used our Fibre Cost Model to estimate the costs of Openreach commercially deploying a fibre network to c.2.2m premises by 2031 in our proposed WLA Area 3.

A16.24 For our 2026 RAB model, we have adjusted our fibre network deployment assumptions so that coverage reaches [✂] premises by 2024/25 to reflect Openreach's completed build in our proposed WLA Area 3. We have also adjusted our take-up assumptions to reflect outturn take-up and our latest FTTP rental forecasts in Area 3.

A16.25 For our 2026 RAB model, we have also updated some of the assumptions on fibre costs based on recent information we have gathered from operators. These updated assumptions are largely the same as those we made for the cross-check of the WLA Area 2 REO cost range, set out in Annex 15. They include:

- CAPEX: For network elements where we had comparable information, we updated network element unit costs based on Openreach 2023/24 cost information. For other network elements, we assumed costs increased in line with CPI.
- OPEX: We updated PIA Duct Segment 3 (lead-in) costs to more accurately reflect that this is charged on a per line basis (rather than a per metre charge).
- OPEX: We have lowered "other opex" costs to reflect evidence indicating that FTTP repair/maintenance costs are £[✂] per line per annum lower than FTTC.

A16.26 Table A16.5 sets out our 2026 RAB model estimates of build and connection capex for a commercial deployment to 2.2m premises in WLA Area 3.

Table A16.5: Forecast unit build and connection capex for 2.2m commercial WLA Area 3 FTTP deployment (2021/22 prices)

Cost type	Unit	Low cost	Central cost	High cost
Build costs	**Per premises passed**	486	667	804
Connection costs	**Per connection**	475	475	475
Lead to cash opex	**Per connection**	19	19	19
Other opex	**Per customer, per annum**	42	44	45

Source: Ofcom 2026 Fibre Cost Model

A16.27 Copper network costs are taken from our cost forecast model. Our estimates are based on FAC which include operating costs, depreciation, holding gains/losses and a return on capital.

A16.28 For the 2026-31 period, we directly use the cost forecast model (detailed in Annex 14) to forecast the costs of copper services. In the 2026 RAB model, we include the costs of connection services, SOGEA, G.fast and SMPF. These were not included in the 2021 model, although in the case of SOGEA these volumes were effectively captured as standard FTTC, i.e. FTTC service purchased with MPF or WLR service. We consider it appropriate to include the cost of all copper services to assess cost recovery under the RAB approach.

A16.29 For the 2031-41 period, we have used a simplified cost forecasting approach. We consider that this is a practical approach given that these costs are heavily discounted and there is a high degree of uncertainty when forecasting far into the future. Consistent with the 2021 RAB model, this simplified approach assumes that the cost stack moves in line with volumes according to the weighted average CVEs for MPF and FTTC services, and that it will inflate each year by CPI and reduce by the efficiency rate. We assume that copper retirement will have concluded by the end of 2035/36, meaning copper volumes and costs are assumed to be zero from this point onwards.

A16.30 Having forecast costs for fibre and copper services using the 2026 RAB model, we then calculate depreciated costs for fibre and copper services combined for the 2026-41 period following the same approach detailed above. Tables A16.6-A16.11 below set out our cost estimates.

Table A16.6: 2026 model forecast of costs for a 2.2m WLA Area 3 deployment – Low scenario (£bn)

	20-year copper and fibre costs	20-year copper and fibre volumes (m)	Annual flat annuity per line (£)
Cash costs (nominal)	9.0	53	170.08
Present value (2021/22 prices)	5.3	31	

Table A16.7: 2026 model forecast of depreciated costs: 2026-41 – Low scenario (£bn)

	2026-31 costs	2031-36 costs	2036-41 costs
Cash costs (nominal)	2.5	2.0	1.8
Present value (2021/22 prices)	1.5	0.8	0.5

Table A16.8: 2026 model forecast of costs for a 2.2m WLA Area 3 deployment – Central scenario (£bn)

	20-year copper and fibre costs	20-year copper and fibre volumes (m)	Annual flat annuity per line (£)
Cash costs (nominal)	9.7	53	184.42
Present value (2021/22 prices)	5.7	31	

Table A16.9: 2026 model forecast of depreciated costs: 2026-41 – Central scenario (£bn)

	2026-31 costs	2031-36 costs	2036-41 costs
Cash costs (nominal)	2.7	2.1	1.9
Present value (2021/22 prices)	1.7	0.9	0.6

Table A16.10: 2026 model forecast of costs for a 2.2m WLA Area 3 deployment – High scenario (£bn)

	20-year copper and fibre costs	20-year copper and fibre volumes	Annual flat annuity per line
Cash costs (nominal)	10.4	53	198.26
Present value (2021/22 prices)	6.2	31	

Table A16.11: 2026 model forecast of depreciated costs: 2026-41 – High scenario (£bn)

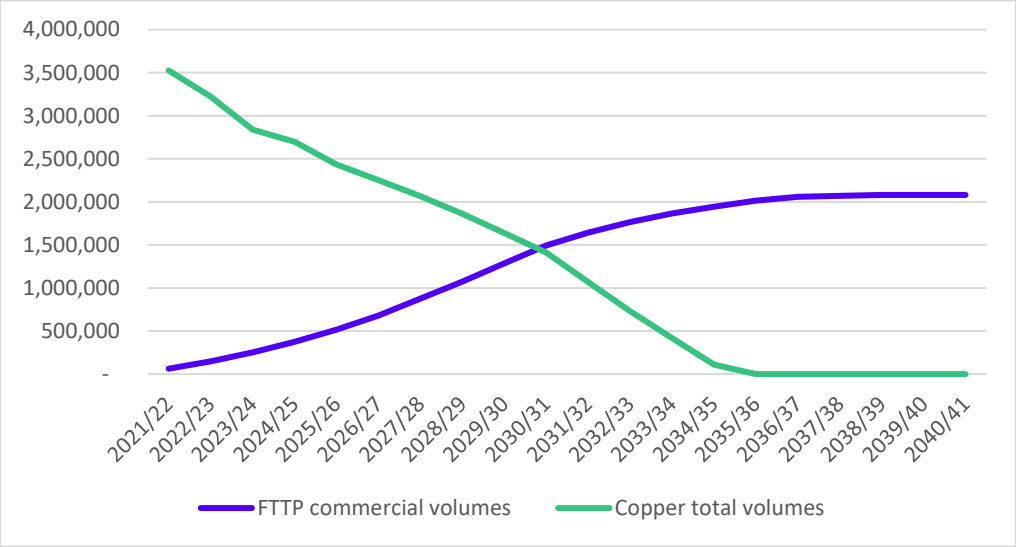
	2026-31 costs	2031-36 costs	2036-41 costs
Cash costs (nominal)	2.9	2.3	2.1
Present value (2021/22 prices)	1.8	1.0	0.6

2026-41 revenue estimates

A16.31 In the 2026 RAB model, we follow the same approach to forecasting volumes as in the 2021 RAB model detailed above. In summary, we assume:

- Openreach's commercial FTTP deployment reaches c.2.2m premises by 2031;
- Fibre take-up reaches a maximum of 95%, 9 years after deployment with customers migrating from copper services; and
- Copper volumes decrease in line with this and are forecast to be zero from 2035/36 onwards.

Figure A16.1: Forecasts of WLA Area 3 fibre and copper service volumes



Source: Ofcom estimates and forecasts, 2025 WLA Volumes Module and Fibre Cost Model

A16.32 To estimate copper rental and connection service revenues for 2026-31, we have taken the 'discounted' starting prices from the cost forecast model as explained in Annex 13. We then assume that our proposed pricing continuity approach applies and that prices increase with forecast CPI in each year during this period. From 2031-41 when copper volumes reach zero, we assume copper prices remain flat in nominal terms.

A16.33 In relation to fibre rental prices, for the years 2026/27, 2027/28 and 2028/29, we have taken our central estimate based on the [✂][381]. For 2029/30 and 2030/31, we assume that

[381] [✂]

the average fibre rental price will increase in line with CPI. For 2031-41, we assume that the average fibre rental price remains flat in nominal terms. To estimate low and high revenue estimates, we have scaled the differential between the central estimate of fibre rental prices in each year and the average copper rental price by plus and minus 50%.

A16.34 For fibre connection prices, we have taken Openreach's 2024/25 Equinox 2 wholesale discounted connection charge in Area 3 for "Migrating existing customers with the same provider to FTTP (80/20 or above)" of £81.58 and inflated with forecast CPI in each year to estimate the average connection price for 2026-31. As with rental prices, we assume it remains flat in nominal terms for 2031-41.

A16.35 Figure A16.2 sets out our projections of copper rental prices and fibre rental prices for 2026-41.

Figure A16.2: Assumed average rental prices (£ per month – nominal terms)

[✂]

Source: Ofcom RAB model

A16.36 Tables A16.12-A16.14 sets out our 2026 RAB model estimates of revenues across fibre and copper services for 2026-41.

Table A16.12: 2026-2031 revenues for a 2.2m WLA Area 3 deployment (£bn)

	Low scenario	Central scenario	High scenario
Undiscounted (nominal)	3.1	3.2	3.3
Present value (2021/22 prices)	1.9	1.9	2.0

Table A16.13: 2031-2036 revenues for a 2.2m WLA Area 3 deployment (£bn)

	Low scenario	Central scenario	High scenario
Undiscounted (nominal)	2.6	2.8	3.0
Present value (2021/22 prices)	1.1	1.2	1.3

Table A16.14: 2036-41 revenues for a 2.2m WLA Area 3 deployment (£bn)

	Low scenario	Central scenario	High scenario
Undiscounted (nominal)	2.4	2.6	2.8

	Low scenario	Central scenario	High scenario
Present value (2021/22 prices)	0.7	0.7	0.8

Summary of results

A16.37 As set out above, our RAB modelling is used to assess whether our proposed pricing continuity approach for WLA Area 3 over the next 5 years sits within a reasonable range of forward-looking cost recovery profiles.

A16.38 For this assessment, we calculate the present value of costs and revenues over a 20-year period, across both the fibre and copper networks in WLA Area 3. Consistent with allowing Openreach a fair bet on its investment, for the 2021-26 period we assume the costs and revenues that we forecast in the WFTMR21 in our 2021 RAB model (scaled to the proposed WLA Area 3 of 2.2m premises) represent the actual costs recovered during this period. For 2026 onwards, we have rebased our modelling estimates using the latest available evidence to allow us to estimate forward-looking costs and revenues.

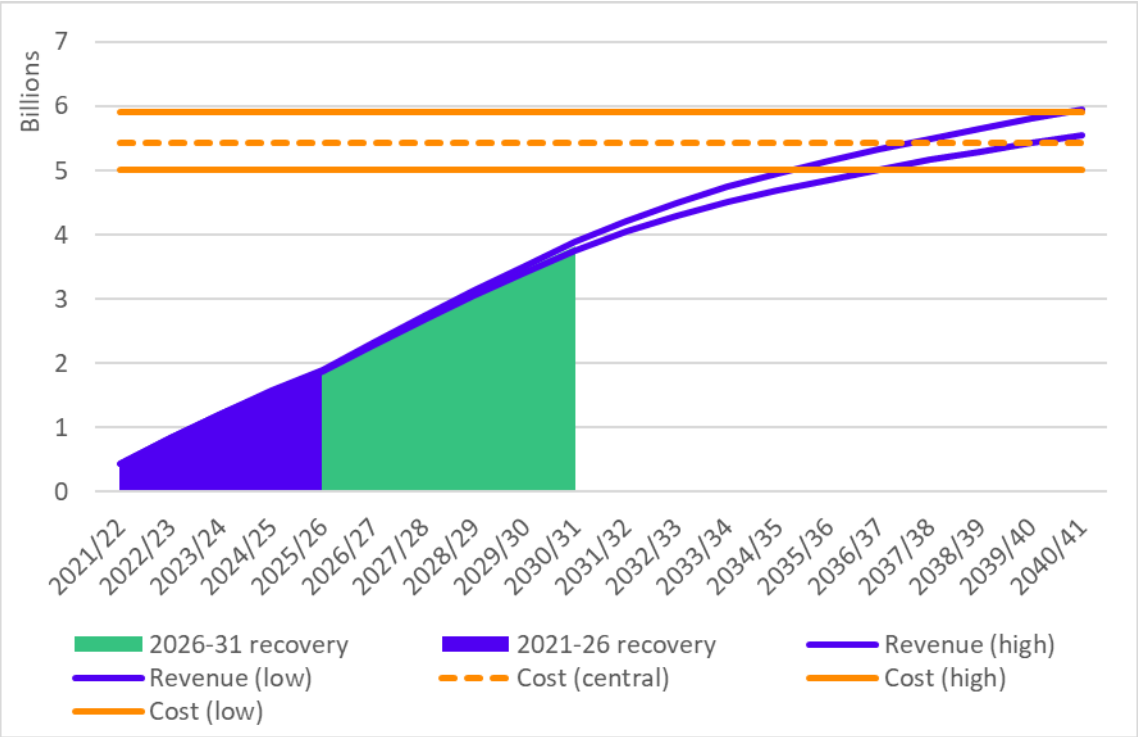
A16.39 Given the inherent uncertainty around forecasting for such long periods, we have not sought to determine a single estimate of the level of cost recovery required during the next control period and beyond (and thereby a single level of copper prices needed to allow for that cost recovery). Rather, our modelling seeks to understand what a plausible range of costs for fibre and copper services is over the lifetimes of those networks and whether indexed pricing over the next 5 years sits within a reasonable range of cost recovery profiles. With this purpose in mind, we present our long-term forecasts of total fibre and copper revenue and costs in Table A16.15 below.

A16.40 Table A16.15 and Figure A16.3 set out our cost and revenue forecasts over the 2026-31 review period and over the lifetime of the networks.

Table A16.15: Summary of revenue and cost forecasts for 2026-31 and 20-year lifetime (£bn, present value in 2021/22 prices)

	2026-31 revenues	20-yr revenues (2021-41)	20-yr costs (2021-41)	NPV
Central	3.8	5.7	5.4	0.3
Low	3.7	5.5	5.0	-0.4
High	4.0	5.9	5.9	0.9

Figure A16.3: Estimated fibre and copper cost recovery with pricing continuity (£bn, present value basis)



Source: Ofcom RAB model

A16.41 Based on the above, we consider that pricing continuity over the next review period sits within a reasonable range of cost recovery profiles. Our estimates indicate that:

- With a commercial fibre network covering 2.2m premises in WLA Area 3 by 2031, Openreach's total costs across fibre and copper services will range between £5.0bn and £5.9bn on a present value basis over 20 years.
- During the 2026-31 review period, our proposed pricing continuity approach will allow cost recovery of £1.9bn to 2.0bn across fibre and copper services on a present value basis.
- Our 2021 RAB model assumes that Openreach would have already recovered £1.9bn across fibre and copper services on a present value basis during the 2021-26 review period.
- Our modelling indicates total revenues of between £5.5bn and £5.9bn on a present value basis over a 20-year period. These estimates fall within our cost and hence we consider that pricing continuity is likely to be consistent with cost recovery over the lifetime of the networks.

A17. Dark fibre cost modelling

A17.1 In Volume 3 Sections 7 and 8, we set out the proposed requirements for Openreach to provide network access to dark fibre services connecting to the local exchange (dark fibre access or DFA) in Area 3 and inter-exchange connectivity (dark fibre inter-exchange or DFX) from BT Only exchanges and BT+1 exchanges.

A17.2 In Volume 4 Sections 2 and 3, we propose that the charges for DFA and DFX should continue to be cost-based and should continue to be set based on Openreach's costs.

A17.3 In Volume 4 Section 5, we propose that the charges for dark fibre ancillary services should continue to be charge controlled at CPI-0%.

A17.4 This annex sets out our approach to modelling dark fibre costs and the detail of our dark fibre charge controls.

Summary of the charge controlled dark fibre services

A17.5 We propose to set the charge control for dark fibre services in relation to the underlying segments needed for a circuit, i.e. we set a charge control for:

a) Dark fibre access (DFA) segment which is defined as dark fibre for the supply of leased line access, i.e. between the customer end site and the nearest BT exchange, in Area 3.

b) Dark fibre inter-exchange (DFX) segment which is defined as dark fibre for the supply of inter-exchange connectivity from BT Only exchanges and BT+1 exchanges.

c) All combinations of DFA and DFX segments.

A17.6 For DFA services, we propose to set charge controls for per circuit connection charges and per circuit annual rental charges.

A17.7 For DFX services, we propose to set charge controls for per circuit connection charges, per circuit annual rental charges and distance-related (per metre) annual main link charges.

A17.8 We also propose to set charge controls for the following ancillary services that are specific to dark fibre:

- Patch panel charges – To provide DFA and DFX, Openreach needs to install some form of passive NTE to hand over the service to the purchasing telecoms provider. We would expect a patch panel charge to only occur when a patch panel is necessary.
- Initial testing charges – A dark fibre circuit needs to be tested when it is connected for the first time.
- RWT (Right When Tested) charges – A RWT charge is billed when a purchasing telecoms provider experiencing a fault on its dark fibre circuit reports that fault to Openreach, after which an Openreach investigation finds that the line tests as 'OK' when tested remotely or by an onsite engineer visit.
- Cessation charges – A cessation charge is billed when a circuit is physically ceased by an engineer to stop it from being used when it is no longer being charged for.

Combinations of DFA and DFX segments

A17.9 When a dark fibre circuit requires a combination of DFA and DFX segments, the rental and connection charges of the DFX segment should be excluded to avoid double counting of costs. As such, the costs of a dark fibre circuit that spans between two customer sites, where each customer site is connected to a different BT exchange, would be derived as:

- twice the DFA segment rental and connection charges; plus
- the appropriate number of patch panel and initial testing charges; plus
- the DFX segment main link rental charge.

Charge controls for dark fibre ancillary services

A17.10 In Volume 4 Section 5, we propose that the charges for dark fibre ancillary services should continue to be charge controlled at CPI-0%. This is consistent with our general approach to charge controlling ancillary services.

Charge controls for DFA and DFX services

Cost standard

A17.11 We propose to set a cost-based charge control with reference to the relevant components of Openreach's underlying passive infrastructure, as opposed to adopting an active-minus approach.

A17.12 To inform our choice of cost standard, we note that setting all charges at incremental cost for a multiproduct firm with economies of scope would not be sustainable as the firm would not be able to recover its common costs.

A17.13 Charges set on a CCA FAC standard have the advantages of being transparent and practicable to implement as Openreach's costs are known and are based on the BT RFS which is publicly available to stakeholders each year. We therefore consider it appropriate to start from BT CCA FAC data and use data from BT's RFS where possible when estimating the unit FAC for DFA and DFX.

A17.14 We note that BT currently reports financial data for DFA and DFX services within the RFS. We have assessed whether it would be more robust to use this data directly for estimating the unit FAC for DFA and DFX, or instead to repeat the approach used in the WFTMR 2021 of using RFS data for benchmark active Ethernet services to estimate the unit FAC for DFA and DFX.

A17.15 We have identified some limitations in the DFA and DFX data reported to date within BT's RFS, and we consider that using RFS data directly at the current time could hinder the robustness of our dark fibre unit FAC estimates. We are continuing to engage with BT about its approach to cost allocation and future RFS reporting for DFA and DFX services.

A17.16 Overall, we consider that repeating the approach used in the WFTMR 2021 provides the most robust estimates of dark fibre unit FAC at the current time. We therefore propose to use this approach, as set out below.

Basing costs on active Ethernet services

A17.17 Openreach's wholesale Ethernet products (or EAD) are the main products that Openreach currently supplies for a range of services spread across lower bandwidths and some VHB circuits. We consider that Ethernet products provide a suitable benchmark for calculating dark fibre costs for DFA and DFX. This is because Ethernet products are effectively a combination of dark fibre and active equipment (including electronics). As explained in further detail below, we can split the cost of providing Ethernet products into active component costs, passive component costs and shared component costs. We can therefore understand the approximate costs associated with dark fibre by removing active component costs from the EAD cost stack.

A17.18 The typical charging structure for Openreach's EAD product is a one-off connection charge, an annual rental charge per circuit, and a distance-related annual main link charge which applies if the two ends of an EAD circuit are served by different BT exchanges.[382][383]

Dual fibre circuits

A17.19 We propose to require Openreach to offer both single fibre and dual fibre dark fibre circuits. We propose that the per circuit rental, connection, and main link charges for the two fibre variants should be twice those for the one fibre variant.

Calculation of ancillary charges for dual fibre circuits

A17.20 We would expect a dual fibre circuit not to require twice as much initial testing. Therefore, the initial testing charge (which is per connection) should be the same for both single and dual fibre circuits. The same applies to the dark fibre cessation and RWT charges. We note that the patch panel charges are per panel so independent of whether single or dual fibre circuits are purchased.

Methodology for estimating efficient costs

A17.21 We propose to construct the cost stack for dark fibre connection, rental and main link services from the following two elements:

- **Element A:** Costs relating to passive infrastructure required for a dark fibre circuit. For example, this would include the costs of the fibre that runs between exchanges; or between the customer end site and an exchange.
- **Element B:** Other costs (e.g. overheads) that are required for, but not specific to, a dark fibre circuit as they are shared across multiple services. For example, this would include the costs of service centre staff who manage provision and maintenance queries or product management people. The costs of such people are generally allocated across a range of different services.

A17.22 We consider that the relevant costs that BT incurs when providing an EAD circuit provide the best reference point for estimating the likely costs of a dark fibre circuit. We therefore propose to use CCA FAC information on EAD services derived from BT's RFS to inform our estimates of elements A and B.

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[382] The main link charge depends on the radial distance between the two BT exchanges.

[383] In order to avoid double counting of costs, we treat the initial testing charge for a dark fibre circuit as a dark fibre ancillary service that is separate from the dark fibre connection charge.

A17.23 We propose to estimate the unit FAC of DFA and DFX services in a given year by using the unit FAC of the following benchmark EAD services in that year:

- EAD LA 10 Gbit/s service to calculate the costs of elements A and B for the DFA segment; and
- EAD 10 Gbit/s service to calculate the costs of elements A and B for the DFX segment.

A17.24 Our proposed use of 10 Gbit/s EAD services is a change from our WFTMR 2021 approach of using 1 Gbit/s EAD services as a benchmark for estimating dark fibre costs. We propose to make this change to reflect our current view (taking account of the latest evidence) of the relative substitutability between different EAD bandwidths and dark fibre services. As explained further in Volume 4 Section 2, we consider that DFA services are most attractive as substitutes for active services at bandwidths above 1 Gbit/s. If DFA services are ultimately used by purchasing telecoms providers to deliver services primarily at bandwidths above 1 Gbit/s, then we consider that the estimated costs of DFA should be informed by the costs of EAD services above 1Gbit/s. This implies use of the 10 Gbit/s EAD LA service, which is the available EAD bandwidth above 1Gbit/s, as our proposed benchmark for DFA.

A17.25 We also note that the use of 10 Gbit/s EAD services as benchmark has only a small upward impact on DFA and DFX cost estimates relative to using 1 Gbit/s EAD services as a benchmark.

A17.26 Given the points raised above, and for consistency with our approach towards DFA, we propose to use the 10 Gbit/s EAD service as our benchmark for DFX.

A17.27 We first forecast the unit costs of DFA and DFX in 2025/26 and in 2030/31 respectively by using forecasts of unit FAC for the benchmark EAD services (which are taken from the top-down cost model) to estimate the unit FAC of DFA and DFX in each of those years.[384] We do this by downward adjusting the unit FAC of the benchmark EAD services to remove costs which are not relevant for DFA and DFX services, and we provide further details of this process later in this sub-section.

A17.28 Having generated estimated unit costs of DFA and DFX in 2025/26 and 2030/31, we then collate forecast prices for each service in 2025/26 and 2030/31 under an assumption of CPI-0% price increases in 2026-31.[385] Our next step is to estimate the magnitude of any proposed starting charge adjustments (SCAs) on 1 April 2026, which are informed by the gap between forecast prices and unit costs for each service in 2025/26. Lastly, we use the estimated unit costs in 2030/31 and the SCA-adjusted forecast prices[386] in 2030/31 to determine the proposed CPI-X glidepath charge controls needed to align DFA and DFX prices with their respective estimated unit costs by 2030/31.

[384] As explained in Annex 14, the top-down cost model uses restated 2022/23 RFS data for its estimation of base year costs, and it then forecasts the costs of relevant services in subsequent years using top-down cost modelling equations.

[385] This set of price forecasts incorporates (i) forecast prices under the existing 2021-26 dark fibre charge controls through to 2025/26 and (ii) forecast prices assuming CPI-0% price increases in 2026-31.

[386] This set of price forecasts incorporates (i) forecast prices under the existing 2021-26 dark fibre charge controls through to 2025/26 and (ii) forecast prices assuming that the proposed SCA applies on 1 April 2026 and is followed by CPI-0% price increases in each year of the 2026-31 period.

Adjustments to BT's RFS information

A17.29 In Annex 14, we set out the adjustments that we have made to BT's RFS information to reflect our view of BT's efficiently incurred costs. Our calculations of dark fibre costs are based on RFS information reflecting those base year adjustments.

Geographic scope of the benchmark EAD services

A17.30 We propose to use national CCA FAC information on EAD services derived from BT's RFS to inform our estimates of a national cost for dark fibre. This approach is consistent with our wider top-down cost modelling approach, which is based on national unit costs for each service.

A17.31 However, we propose to retain our WFTMR 2021 approach of excluding CLA from our national EAD cost estimates in this context. The CLA is an unregulated market, so it should not impact the charges we set in regulated markets. Therefore, we have removed CLA costs and volumes when estimating dark fibre costs.

A17.32 We also propose to exclude BT+2 exchanges from our national EAD cost estimates, as BT+2 exchanges are also unregulated. Therefore, we have removed costs and volumes relating to BT+2 exchanges when estimating dark fibre costs.

Classification of components

A17.33 We propose to classify the components used to provide EAD services in BT's RFS as relating either only to the active or passive elements of an EAD circuit or as being 'shared' between the active and passive elements. Below we set out our proposed classification for the components used to provide EAD and EAD LA services in BT's restated 2022/23 RFS.

A17.34 Our overall approach to the classification of components is very similar to the approach used in the WFTMR 2021, as summarised in Annex 17 of the WFTMR 2021 Statement.

A17.35 Active components relate to the active elements of an EAD circuit and do not appear to include any costs relevant to a dark fibre circuit. These include:

- Ethernet Electronics Current and Ethernet Access Direct (EAD) Electronics Capital, which covers costs associated with operating and maintaining active equipment, including the capital costs of that equipment (and overheads related to the Ethernet electronics).
- Ethernet Monitoring Platform, which covers costs associated with a platform that performs remote diagnostic testing and reconfigurations of EAD and OSA circuits.
- Cumulo, i.e. non-domestic rates (NDRs), are a form of property tax paid by ratepayers on their rateable assets which include telecoms assets such as fibre and duct.

A17.36 Passive components relate to the passive elements of an EAD circuit and may therefore include costs that are relevant to a dark fibre circuit (but may vary between the DFA and DFX segments). These include:

- Existing physical infrastructure assets such as ducts and poles;
- Interexchange Fibre, which covers costs associated with providing fibre connectivity between BT exchanges where the ends of an Ethernet circuit are in different BT exchange areas;
- Routing and Records, which covers costs associated with the physical verification and initial recording of routings within the network;

- Legacy Ethernet – Spine Fibre and Legacy Ethernet – Distribution Fibre, which cover costs associated with the fibre used to provide an access segment between a served location and its local BT exchange for EAD services, including the cost of duct that the fibre resides in; and
- Ethernet Excess Construction Capex, which covers costs associated with the construction of additional duct and fibre when there is no existing BT infrastructure connecting a served location to its local BT exchange.[387]

A17.37 Shared components relate to both the active and passive elements of an EAD circuit and so may include costs that are relevant to a dark fibre circuit. These include:

- Openreach Sales Product Management, which covers the costs of staff who work in the Sales Product Management division of Openreach;
- Openreach Systems & Development - Ethernet, which covers the development costs for Openreach Ethernet products which are predominantly related to software such as ordering, billing and task allocation systems;
- Openreach Service Centre Assurance (Ethernet), which covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints relating to fault reporting and repairs for Ethernet services;
- Openreach Service Centre Provision (Ethernet), which covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints relating to provisions for Ethernet services;
- SLG Ethernet Assurance and SLG Ethernet Provision, which cover costs associated with Service Level Guarantee (SLG) payments made to customers if Openreach fails to meet contractually agreed timescales for repair and provision activities respectively.
- Ofcom Administration Fee (Openreach), which covers the costs of the Network and Services Administrative Charges that Ofcom charges BT; and
- Notional debtors - Revenue receivables (Openreach non-copper), which cover part of the working capital for a service. These costs are an estimate of the amounts that service users (whether BT's own downstream businesses or other providers) owe to BT for each service based on BT's standard payment terms.

Table A17.1: Proposed classification of components required for dark fibre services based on EAD components found in BT's restated 2022/23 RFS

EAD component	Classification	Dark fibre connections	DFA circuit rental	DFX circuit rental	DFX main link rental
Ethernet Electronics (Current and Capital)	Active				
Ethernet Monitoring Platform	Active				
Cumulo	Active				

[387] Since 2014, we have directed BT to exempt EAD orders from excess construction charges (ECCs) below a threshold charge and to recover the resulting loss of revenue by including a balancing charge in the connection price.

EAD component	Classification	Dark fibre connections	DFA circuit rental	DFX circuit rental	DFX main link rental
PI RAV	Passive		✓		✓
PI Non RAV: • Spine Duct – 1 Bore • Spine Duct – 2 Bore • Spine Duct – 3+ Bore • Lead in Duct • Duct Network Adjustments • Manholes • Joint Boxes	Passive		✓		✓
PI Poles	Passive		✓		✓
Legacy Ethernet – Spine Fibre	Passive		✓		
Legacy Ethernet – Distribution Fibre	Passive		✓		
Interexchange Fibre	Passive				✓
Routing and Records	Passive	✓			
Ethernet Excess Construction Capex	Passive	✓[388]			
Openreach Sales Product Management	Shared	✓	✓	✓	✓
Openreach Systems & Development - Ethernet	Shared	✓	✓	✓	✓
Openreach Service Centre Assurance (Ethernet)	Shared		✓	✓	
Openreach Service Centre Provision (Ethernet)	Shared	✓			
SLG Ethernet Assurance	Shared		✓	✓	
SLG Ethernet Provision	Shared	✓			
Ofcom Administration Fee (Openreach)	Shared	✓	✓	✓	✓
Notional debtors - Revenue receivables (Openreach non-copper)	Shared	✓	✓	✓	✓

[388] We include ECCs for the DFA connection charge but exclude these costs for the DFX connection charge.

A17.38 We set out below the rationale for including and excluding these components in the various dark fibre services.

Passive infrastructure costs (element A)

A17.39 For each dark fibre service (e.g. connections, rental, main link) we propose to include in element A of the cost stack the unit FAC of any passive components used to provide the corresponding EAD or EAD LA service that we consider would also be required to provide DFX or DFA respectively.

Physical infrastructure assets

A17.40 We propose that:

- element A of the DFX main link rental service should include the full unit FAC of the PIA components attributed to the EAD main link rental service given that a (single fibre) dark fibre circuit uses up the same amount of space as an EAD circuit. For the same reason, element A of the DFA circuit rental service should include the full unit FAC of the PIA components attributed to the EAD LA circuit rental service.
- element A of the DFX circuit rental service should exclude the full unit FAC of the PIA components attributed to the EAD circuit rental service. EAD circuit rental services include duct costs that are not part of inter-exchange connectivity and thus not relevant for the DFX circuit rental service.

Legacy Ethernet – Spine Fibre and Legacy Ethernet – Distribution Fibre

A17.41 We propose that:

- element A of the DFX circuit rental service should not include the costs of the Legacy Ethernet Fibre components that are attributed to the EAD circuit rental service. DFX does not require any fibre other than that required to connect the circuit between the two BT exchanges. The costs of that fibre are included within the Interexchange Fibre component.
- element A of the DFA circuit rental service should include the full unit FAC of the Legacy Ethernet Fibre components that are attributed to the EAD LA circuit rental service. The dark fibre service from the served customer location to the BT exchange requires fibre.

Interexchange Fibre

A17.42 We propose that:

- element A of the DFX main link rental service should include the full unit FAC of the Interexchange Fibre component attributed to the EAD main link rental service,
- element A of the DFA cost stack should not include costs relating to the Interexchange Fibre component.

Routing and Records

A17.43 We propose that:

- element A of the DFX and DFA connection services should include the full unit FAC of the Routing and Records component that is attributed to EAD and EAD LA connections respectively. This is because we do not expect any significant difference in the time, and therefore cost, associated with routing and recording connections for dark fibre compared to EAD circuits.

Ethernet Excess Construction Capex

A17.44 We consider that there will be little, if any, extra construction work that will be required for DFX as the infrastructure supporting connectivity between BT exchanges is already in place. Therefore, we propose:

- not to include the costs of the Ethernet Excess Construction Capex component that are attributed to the EAD connection service in element A of the DFX connection charge.

A17.45 We consider that Ethernet Excess Construction will be relevant to DFA connections since there will be circumstances where infrastructure is needed to support connectivity between a customer site and a BT exchange. Therefore, we propose:

- to include the full unit FAC of the Ethernet Excess Construction Capex component that is attributed to the EAD LA connection service in element A of the DFA connection charge.

Other costs not specific to dark fibre services (element B)

A17.46 For both DFA and DFX, we propose to include in element B of the cost stack an appropriate proportion of the unit FAC of any shared components used to provide the corresponding EAD LA / EAD service. Below we set out our proposed treatment of the costs for each of the following components:

- Openreach Systems & Development - Ethernet;
- Openreach Service Centre Assurance (Ethernet) and SLG Ethernet Assurance;
- Openreach Service Centre Provision (Ethernet) and SLG Ethernet Provision;
- Openreach Sales Product Management;
- Ofcom Administration Fee (Openreach); and
- Notional debtors - Revenue receivables (Openreach non-copper).

A17.47 Some or all of the costs of the above components can be viewed as being common with active Ethernet services or indeed common with other non-Ethernet services.

Openreach Systems & Development – Ethernet

A17.48 For the WFTMR 2021 Statement we did not apply a scaling factor, meaning that we allocated the full unit FAC of Openreach Systems & Development – Ethernet costs for EAD LA to DFA, and we allocated the full unit FAC of Openreach Systems & Development – Ethernet costs for EAD to DFX. We reached this decision based on uncertainty over the systems and development costs required for dark fibre, while also noting the very limited impact of this decision on dark fibre charges.

A17.49 Given the continued low impact of this decision on dark fibre charges, we propose to retain the same approach (i.e. not apply a scaling factor) for the 2026-31 dark fibre charge controls.

Openreach Service Centre Provision (Ethernet) and SLG Ethernet Provision

A17.50 In BT's RFS, Ethernet Provision costs are attributed to Ethernet connection services based on service volumes.

A17.51 We do not consider there should be material differences in the number of provisioning-related calls made per circuit to Openreach customer contact centres (or the activities

involved in handling such calls) between EAD / EAD LA and dark fibre services. We therefore propose that:

- element B of the DFA connection service should include the full unit FAC of the Openreach Service Centre Provision (Ethernet) component that is attributed to EAD LA connections.
- element B of the DFX connection service should include the full unit FAC of the Openreach Service Centre Provision (Ethernet) component that is attributed to EAD connections.

A17.52 However, provisioning SLG payments for EAD / EAD LA circuits are currently a function of the rental price of the EAD / EAD LA circuit whose installation has been delayed. We have therefore adjusted the unit FAC of the SLG Ethernet Provision component based on the difference in rental charges between the DFX rental services and EAD rental services; and DFA rental services and EAD LA rental services.

A17.53 We adjust for differences in rental charges using the ratio of the sum of unit costs across rental and main link services as a proxy for rental and main link prices.[389] These unit costs exclude the costs of SLG Ethernet Provision and SLG Ethernet Assurance, as well as those of other components we estimate based on relative prices (e.g. Ofcom Administration Fee (Openreach) and Notional debtors - Revenue receivables (Openreach non-copper) as discussed below).

A17.54 We therefore propose:

- to include approximately [✂] (between 20% and 40%) of the unit FAC of the SLG Ethernet Provision component that is attributed to EAD LA connections in element B of the DFA connection service.[390]
- to include approximately [✂] (between 0% and 20%) of the unit FAC of the SLG Ethernet Provision component that is attributed to EAD connections in element B of the DFX connection service.[391]

Openreach Service Centre Assurance (Ethernet) and SLG Ethernet Assurance

A17.55 In BT's RFS, Ethernet Assurance costs are attributed to Ethernet rental services based on service volumes. We consider that the appropriate framework for estimating the unit costs of this component for dark fibre rental services is to consider the relative number of faults per circuit likely to be incurred on DFX or DFA relative to an EAD circuit or EAD LA circuit respectively.

A17.56 We have gathered information about the number of monthly reported EAD / EAD LA faults over a two-year period from April 2021 to March 2023, split by the clear code submitted by the Openreach engineer upon handling the fault.[392] We have used this information to form our own estimate of the proportion of EAD faults that do not primarily involve electronic equipment and would therefore be relevant for a dark fibre circuit.[393] We have estimated

[389] For clarity there is no main link price to include in the case of DFA and EAD LA rental services.
[390] The exact proportion of the EAD LA / EAD unit FAC included in element B varies across each forecast year.
[391] The exact proportion of the EAD LA / EAD unit FAC included in element B varies across each forecast year.
[392] Openreach response dated 10 June 2024 to s135 notice dated 14 May 2024, question C1.
[393] These estimates are based on our own methodology. We have treated all faults with an electronics category clear code as active circuit faults (i.e. not relevant for dark fibre) and all faults with a fibre category

that dark fibre faults occur approximately [✂] (between 50% and 70%) of the time for DFX circuits, and [✂] (between 50% and 70%) of the time for DFA circuits, when compared to EAD / EAD LA on a per circuit basis.

A17.57 We therefore propose:

- to include approximately [✂] (between 50% and 70%) of the unit FAC of the Openreach Service Centre Assurance (Ethernet) component that is attributed to EAD LA rentals in element B of the DFA circuit rental service.
- to include approximately [✂] (between 50% and 70%) of the unit FAC of the Openreach Service Centre Assurance (Ethernet) component that is attributed to EAD rentals in element B of the DFX circuit rental service.

A17.58 Repair SLG payments for EAD / EAD LA circuits are currently a function of the rental price of the EAD / EAD LA circuit whose repair has been delayed. Therefore, consistent with our approach to SLG Ethernet Provision, we have also adjusted the unit FAC of the SLG Ethernet Assurance component based on the difference in rental charges between the DFX rental services and EAD rental services; and the DFA rental services and EAD LA rental services.

A17.59 We therefore propose:

- to include approximately [✂] (between 20% and 40%) of the unit FAC of the SLG Ethernet Assurance component that is attributed to EAD LA rentals in element B of the DFA circuit rental service.[394]
- to include approximately [✂] (between 0% and 20%) of the unit FAC of the SLG Ethernet Assurance component that is attributed to EAD rentals in element B of the DFX circuit rental service.[395]

Openreach Sales Product Management

A17.60 For the WFTMR 2021 Statement we did not apply a scaling factor, meaning that we allocated the full unit FAC of Openreach Sales Product Management costs for EAD LA to DFA, and we allocated the full unit FAC of Openreach Sales Product Management costs for EAD to DFX. We reached this decision after having found insufficient evidence to suggest that a scaling factor is appropriate, while also noting the very limited impact of this decision on dark fibre charges.

A17.61 Given the continued low impact of this decision on dark fibre charges, we propose to retain the same approach (i.e. not apply a scaling factor) for the 2026-31 dark fibre charge controls.

Ofcom Administration Fee (Openreach) and Notional debtors - Revenue receivables (Openreach non-copper)

A17.62 In BT's RFS, the cost of the Ofcom Administration Fee (Openreach) is attributed to connection, rental and main link services based on revenue. Notional debtors - Revenue

clear code as passive circuit faults (i.e. relevant for dark fibre). This leaves faults listed under various other clear code categories, and we have assumed that a certain proportion of these faults (informed by the relative frequency of electronics and fibre faults) would occur on a dark fibre circuit.

[394] The exact proportion of the EAD LA / EAD unit FAC included in element B varies across each forecast year.

[395] The exact proportion of the EAD LA / EAD unit FAC included in element B varies across each forecast year.

receivables (Openreach non-copper) costs are also attributed to connection, rental and main link services based on revenue.

A17.63 We propose to adjust the unit FAC of the Ofcom Administration Fee (Openreach) and Notional debtors - Revenue receivables (Openreach non-copper) components to reflect the relative prices of EAD services and DFX services; and the relative prices of EAD LA services and DFA services. We consider that this approach would be consistent with BT's approach to attributing the costs of these components in its RFS.

A17.64 We propose:

- to include approximately [✂] (between 60% and 80%) and [✂] (between 40% and 60%) of the unit FAC (circuit rentals and connections respectively) for the Ofcom Administration Fee and Notional debtors - Revenue receivables (Openreach non-copper) component costs attributed to the EAD LA service within the unit FAC of element B of the corresponding DFA service.[396]
- to include approximately [✂] (between 0% and 20%), [✂] (between 0% and 20%) and [✂] (between 40% and 60%) of the unit FAC (circuit rentals, connections and main link respectively) for the Ofcom Administration Fee and Notional debtors - Revenue receivables (Openreach non-copper) component costs attributed to the EAD service within the unit FAC of element B of the corresponding DFX service.[397]

Treatment of non-domestic rates

A17.65 We provide more background on NDRs when discussing our approach to forecasting BT's cumulo costs (see Annex 14).

A17.66 In general, the NDR liability is calculated by multiplying a rateable value (RV) by a 'rate in the pound'. RVs are assessed by the relevant rating authority in each nation, for example the Valuation Office Agency (VOA) in England and Wales. In the case of BT, and some other telecoms providers, all contiguous rateable assets are valued together in what is called a 'cumulo assessment'. BT's NDR costs on its rateable network assets are therefore commonly referred to as its cumulo costs.

A17.67 With respect to fibre assets, rating precedent has determined that as a general rule of thumb, the party who lights the fibre is considered to be in rateable occupation. This means that if BT sells an active leased line service, it is liable for the NDRs, whereas if BT sells a dark fibre service, the purchasing telecoms provider is liable for the NDRs once it lights that fibre. Prices for dark fibre services should therefore not include any contribution to BT's NDR costs.

A17.68 As we adopt a cost-based approach to setting dark fibre prices in this control, we therefore do not include BT's attribution of its cumulo rates costs to EAD or EAD LA services in the cost stack for dark fibre services. This primarily affects rental services because relatively little of BT's cumulo costs are attributed to connection services.

[396] The exact proportion of the EAD LA / EAD unit FAC included in element B varies across each forecast year.
[397] The exact proportion of the EAD LA / EAD unit FAC included in element B varies across each forecast year.

Charge control design

A17.69 In Volume 4 Section 6, we set out details of our proposed charge control design for DFA and DFX. In summary, we propose:

- A 5-year control for DFA and DFX services.
- Single service charge controls for DFA and DFX.
- A starting charge adjustment (SCA) for DFA which will reduce the estimated gap between prices and unit costs by 75% at the start of the control period, followed by a glidepath charge control that aligns prices with estimated unit costs by 2030/31.
- A starting charge adjustment (SCA) for DFX which will reduce the estimated gap between prices and unit costs by 50% at the start of the control period, followed by a glidepath charge control that aligns prices with estimated unit costs by 2030/31.

A17.70 Table A17.2 below summarises our proposed charge controls for dark fibre connections, circuit rentals and main link rentals. It shows the impact of our proposed SCAs and CPI-X glidepaths on DFA and DFX prices under base cost, low cost and high cost scenarios. These scenarios are generated by varying certain assumptions in our top-down cost modelling. Further detail on how we have produced the higher cost and lower cost scenarios in our top-down cost modelling, which generate a range around our base case estimates, is provided in Annex 14.[398]

A17.71 The use of ranges in this Consultation is consistent with our approach in previous market reviews.[399] We intend to update our cost models ahead of publishing our Statement to incorporate more recent outturn data or new evidence from which we can derive updated cost estimates for 2025/26 and 2030/31. Should we decide to proceed with setting cost-based charge controls, we would use these updated cost estimates to determine the final figures for the SCAs and CPI-X glidepaths. The ranges included in this Consultation are intended to provide an indicative view of what those final figures may be.

[398] The higher cost and lower cost scenarios in our top-down cost modelling inform our proposed ranges for DFA and DFX services because we use top-down cost model forecasts for EAD LA 10 Gbit/s services and EAD 10 Gbit/s services as a benchmark for estimating the costs of DFA and DFX services respectively.
[399] These ranges are also reflected in our draft SMP Conditions at Volume 7.

Table A17.2: Summary of our proposed charge controls for dark fibre connections, circuit rentals and main link rentals

	High costs scenario		Base costs scenario		Low costs scenario	
Dark fibre service	**SCA[400]**	**CPI-X glidepath[401]**	**SCA**	**CPI-X glidepath**	**SCA**	**CPI-X glidepath**
DFA connection (per circuit)	-24%	CPI – 6.50%	-27%	CPI – 9.00%	-29%	CPI – 10.25%
DFA circuit rental (per circuit per year)[402]	+21%	CPI – 1.25%	+15%	CPI – 2.75%	+10%	CPI – 3.75%
DFX connection (per circuit)	-8%	CPI – 6.00%	-10%	CPI – 8.00%	-11%	CPI – 9.00%
DFX circuit rental (per circuit per year)[403]	-31%	CPI – 19.00%	-31%	CPI – 24.00%	-29%	CPI – 25.00%
DFX main link rental (per metre per year)	-11%	CPI – 2.25%	-14%	CPI – 3.50%	-17%	CPI – 4.75%

A17.72 For the avoidance of doubt, the proposed charge controls (i.e. the calibration of the SCA and CPI-X glidepath) for dual fibre DFA and DFX services are identical to those of the equivalent single fibre DFA and DFX services. Details of the expected pricing relativities for dual fibre circuits versus single fibre circuits are explained in paragraphs A17.19 and A17.20 above.

A17.73 Table A17.3 below summarises our proposed charge controls for dark fibre ancillary services.

[400] The proposed SCAs will be implemented on 1 April 2026.

[401] The proposed CPI-X glidepaths will apply in each year of the charge control. For those services where SCAs are proposed, the first year in which the CPI-X glidepath applies will be 2 April 2026 to 31 March 2027.

[402] For DFA circuit rental we note that the proposed SCA requires an increase in prices on 1 April 2026, which is then followed by below-inflation annual price increases (i.e. real-terms price reductions) under the glidepath charge control between 2 April 2026 and 31 March 2031. This occurs partly because the unit costs of DFA circuit rental are forecast to decline between 2025/26 and 2030/31. As noted in Volume 4 Section 6, our proposed partial (75%) SCA approach will provide a smoother overall glidepath for prices during the charge control period than a 100% SCA would.

[403] We note that for DFX circuit rentals, the downward price impact of the SCA is larger in the high costs scenario than in the low costs scenario, which may appear to be counterintuitive. This result is driven by the 2025/26 unit FAC allocated from the Openreach sales product management component to DFX circuit rentals being lower in the high costs scenario. One contributor to this unit FAC estimate is a negative mean capital employed (MCE) balance, and Openreach and BT have informed us that [✂]. BT has also informed us that amendments will be made in its 2025 RFS to [✂]. Sources: Openreach response dated 20 November 2024 to s135 notice dated 23 October 2024, question D4; BT response dated 27 November 2024 to s135 notice dated 23 October 2024, question D4; BT responses dated 25 February 2025 and 26 February 2025 to s135 notice dated 10 February 2025, question 3.

Table A17.3: Summary of our proposed charge controls for dark fibre ancillary services

Dark fibre service	Starting Charge Adjustment	CPI-X glidepath (cost-based)[404]
Patch panel at customer premises (per panel per year)	N/A (No SCA)	CPI – 0%
Patch panel at exchange (per panel per year)	N/A (No SCA)	CPI – 0%
Initial testing	N/A (No SCA)	CPI – 0%
Cessation charge	N/A (No SCA)	CPI – 0%
Right When Tested (RWT) charge	N/A (No SCA)	CPI – 0%
TRCs for dark fibre	N/A (No SCA)	Same as for actives
ECCs for dark fibre	N/A (No SCA)	Same as for actives

[404] The proposed CPI-X glidepaths will apply in each year of the charge control.

A18. Calculation of PIA Maximum Charges

A18.1 In Volume 4, Section 4 we propose the maximum charges for PIA rental services. We are proposing maximum charges for PIA rental services for the 2026-31 review period.

A18.2 These maximum rental charges are based on a 'cost based' approach using the fully allocated cost (FAC) valuation of PIA as recorded and audited within BT's Regulatory Financial Statement (RFS) and include a return on capital employed. The maximum charges we calculate for each year of the review period are rounded to the nearest penny, consistent with the approach adopted on Openreach's pricing website.

A18.3 This annex explains in more detail the calculations that we make to estimate PIA costs whilst Volume 4, Section 4 explains our proposals for PIA charges.

General approach

Network Adjustment costs

A18.4 As we explain in Volume 4, Section 4, we propose that the costs of network adjustments should be recovered across all SMP products that use the physical infrastructure, subject to a financial limit. We propose that the cost of network adjustments below the financial limit should be recovered over all users of Openreach's Physical Infrastructure; whilst costs above the limit should be recovered directly from the telecoms provider requesting the network adjustment.

A18.5 Therefore, our cost estimates include an allowance for the costs that Openreach incurs when making network adjustments below the financial limit (appropriately capitalised) in the regulatory cost base that we use to calculate PIA rental charges. Any expenditure above the financial limit is not included in this cost base.

A18.6 However, we no longer use our forecasts for external (i.e. non Openreach) network adjustments below the financial limit, which are based on outdated unit costs, as we consider it likely that Openreach's estimates are more accurate than our own. Furthermore, we consider Openreach's estimates to be consistent with recent actuals, as reported in the RFS, and note that its estimates are lower than our own.

PIA components and services

A18.7 We differentiate between what we call PIA cost components and PIA services. We propose maximum charges for PIA services. PIA cost components are the cost categories under which we collect costs and from which we derive maximum charges.

A18.8 The PIA cost components are lead-in duct, single bore spine duct, 2 bore spine duct, 3+ bore spine duct, manholes, junction boxes and poles. For some PIA services the component is the same as the service, e.g. single and multi-bore spine duct. However, for others the PIA component provides costs for several services. For example, the poles cost component provides costs for two poles PIA services: single- and multi-end-user attachments.

A18.9 We set out in detail how we forecast these PIA component costs and how these costs are then allocated to PIA services.

Base case cost forecasts

A18.10 PIA maximum charges are estimated using the following four steps:

- **Step 1:** Determine the regulatory cost base for every year of the review period for the relevant infrastructure (assets) being accessed. The regulatory cost base comprises a return on capital, depreciation (net of holding gains), and operating costs. The base cost data we have used has been derived from BT's 2022/23 RFS and we then make some adjustments to this.
- **Step 2:** We forecast the resulting capital and operating costs over the review period. These forecasts require various assumptions, notably about what future volume growth and capital expenditure will be.
- **Step 3:** Attribute the regulatory cost base between different PIA services. BT's systems do not record costs separately for different duct bore sizes or for footway boxes, so we attribute total duct and footway service costs to individual services in each year. Similarly, BT's systems do not record costs for the different pole services[405] so we attribute total pole costs to the single-end-user and multi-end-user pole attachment services.
- **Step 4:** Calculate unit costs for each component in each year and allocate a share of these unit component costs to rental charges using the fair shares proposed in Volume 4, Section 4. The unit costs are measures such as cost per metre of single bore duct or the costs of attachments per pole. Rental charges are calculated on a similar unit basis.

A18.11 Although, at a high level, these steps are the same for both duct and footway PIA services and for pole PIA services, there are some detailed differences. Below, we go through each of these steps separately for duct and footway box assets and for pole assets.

Duct and footway box assets

Step 1: Determination of the regulatory cost base for ducts and footway boxes

A18.12 The base data (2022/23) provided by BT included both operating costs and capital costs. BT currently capitalises most costs associated with duct and footway boxes and records these under the main duct class of work (LDD).[406]

A18.13 Operating costs were split as follows:

a) Pay and non-pay costs.[407] These include contributions from Openreach and corporate overhead costs.
b) CCA depreciation for LDD with HCA depreciation, Supplementary depreciation, Holding Gains and Losses, and Other CCA adjustments identified separately.

[405] These are single-end-user and multi-end-user attachments, as well as pole top equipment and cable up a pole services.
[406] Local Distribution Duct (LDD) class of work records the activities associated with building and maintaining Openreach's duct thus it reflects most of the capital costs associated with access, backhaul, and core duct.
[407] Costs excluded any of BT's cumulo rates costs as non-domestic rates are generally not payable on passive assets. It is only once "active" equipment is attached to these passive assets that a rating liability is triggered.

c) A small amount of CCA depreciation associated with other assets required to provide PIA services. This mainly consisted of depreciation associated with the funding of BDUK assets plus some support assets such as software. None of these other assets are revalued on a CCA basis within BT's RFS.

A18.14 Capital costs included the following items:

a) GRC (gross replacement cost) and NRC (net replacement cost) for LDD;
b) GRCs and NRCs for other assets;
c) Net Current Assets.

A18.15 The base data BT provided on duct and footway boxes was consistent with the way BT reports the costs of PIA assets in its RFS. It excluded CCA depreciation and capital costs on:

- Duct that connects copper cables to fibre cabinets since this infrastructure is used for cabinet connectivity only.
- ECCs and Repayment costs: the revenues for both activities recover any expenditure on assets "up front". Any spend on PIA assets associated with these revenue streams is not considered part of the PIA market and should not be recovered via PIA rental charges.

A18.16 We propose making the following adjustments to the base data:

- We split LDD costs (GRC, NRC and CCA depreciation) into those relating to assets installed before and after 31 March 2018.[408] For those installed before 31 March 2018, we split the assets into pre-1997 access, pre-1997 non-access and post-1997 assets using information from BT's Regulatory Asset Value (RAV) model.
- Adjust base year data to smooth certain costs that substantially vary each year, e.g. leaver payments and restructuring costs, which we increase for the 2022/23 base year to align with the higher average over recent years. For 2022/23 we have specifically uplifted PIA costs by £2.9m and £190k for leavers and restructuring costs, respectively, which we then allocate between duct and pole costs based on their relative opex.

A18.17 Unlike in the March 2021 Statement, we do not propose to adjust the allocation of wayleave costs to the physical infrastructure market, as reported in BT's RFS. The cost of a wayleave is not affected or driven by the services that use the duct or pole, so we consider it reasonable to allocate all wayleave costs to duct and pole components.

Step 2: Forecast the regulatory cost base over the review period

A18.18 We forecast the adjusted pay and non-pay operating costs in the base year over the review period applying our standard formulas.[409] We assume:

i) efficiency (or cost savings) of 3% per annum;
ii) a cost volume elasticity (CVE) of 0.74 for PIA pay and non-pay costs;
iii) operating cost inflation of CPI across both pay and non-pay operating costs; and
iv) volume growth to be the average change in year of installed base (rental) volumes, derived from our capex forecasts.

[408] By assets installed before 31 March 2018 we mean assets installed up to and including 31 March 2018.
[409] See for example Table A11.11, Annex 11 of the 2018 WLA market review, https://www.ofcom.org.uk/__data/assets/pdf_file/0018/112491/wla-statement-annexes-1016.pdf

A18.19 None of these assumptions are particularly critical to the final maximum charges we estimate as operating costs are a relatively low proportion of the duct and footway boxes cost base.

A18.20 We forecast the adjusted capital costs (GRCs, NRCs and CCA depreciation, including Holding losses and gains) from the base year over the review period as follows:

a) We assume all duct and footway box assets have a life of 40 years,[410] and that asset price inflation for all these assets is 2% per annum over the review period.
b) Capital costs associated with LDD assets installed before 31 March 2018: we forecast pre-1997 access assets, pre-1997 non access assets and post-1997 assets installed over the period 1997 to 2018 separately. We classify all these costs – OCM depreciation and mean NRCs – as associated with assets installed before 31 March 2018.
    i) For each we forecast opening and closing GRCs and NRCs for each year of the review period, and then calculate the mean NRC in each year as the average of the opening and closing balance.[411]
    ii) We forecast OCM depreciation and holding gains and losses using our assumptions about asset lives and asset price inflation noted above.
    iii) We assume that there are no write-outs (or disposals) associated with post 1997/98 assets, as these assets have a life of 40 years, but we do forecast some disposals of pre-1997/98 assets. We assume no new capex on these historical assets as this is forecast in the next category.
    iv) Other CCA adjustments have historically been very low and consistent with our approach in other top-down cost models we forecast these to be zero in the future.
c) Capital costs associated with "LDD" assets installed after 31 March 2018: we forecast these using the same process as for historic LDD assets except that we include the forecast capital expenditure. As explained in Volume 4, Section 4, we have used Openreach's forecasts for LDD assets and network adjustments below the financial limit. We assume there are no write outs over the period as these assets have a life of 40 years.
d) Capital costs associated with "non-LDD" assets: These are a mix of a "negative" assets, associated with the funding on BDUK assets, and support assets such as software and computing. As these assets are not revalued in BT's RFS for simplicity we assume both depreciation and NRCs are flat in nominal terms over the review period. This is not a critical assumption because these account for a small percentage of depreciation and an even smaller percentage of mean capital employed.
e) Net current assets are forecast using the standard formula of applying volume growth and asset price inflation.

A18.21 In the next step we attribute costs associated with assets installed before 31 March 2018 separately to those installed after that date. The final stage in this step is then to attribute all non-LDD costs to assets installed in one of those two periods. We attribute pay and non-pay operating costs and depreciation on non-LDD assets using the relative OCM

[410] However, where duct assets are heavily depreciated, we have used the implied asset life calculated as base year GRC/depreciation.
[411] To forecast opening and closing balances we use a very similar approach to that we have used in other top-down cost models and one that is consistent with BT's RAV model that is used for the valuation of duct assets on a CCA basis within BT's RFS.

depreciation on LDD assets installed before and after March 2018 in each year. We attribute other MCE and net current assets using the corresponding LDD NRC in each year.

A18.22 The output of the above process is two sets of operating costs (including depreciation and holding gains and losses) and mean capital employed (including net current assets). These form the regulatory cost base for assets installed before 31 March 2018 and the other for assets installed after 31 March 2018 respectively.

Step 3: Attribute the duct and footway regulatory cost base between different PIA services

A18.23 Openreach provided us with updated estimates of the attribution of its duct and footway costs between PIA cost components using a methodology analogous to what we and Openreach had used in previous market reviews. The attributions were in proportion to relative GRCs as estimated by a bottom-up evaluation using total installed volumes and standard unit costs[412] for each duct and pole component in 2022/23.

A18.24 We apply the "old" attributions used to set charges in the 2018 WLA review to costs associated with assets installed before 31 March 2018. For assets installed after 31 March 2018, we calculate revised attributions each year to take account of volumes of each duct and footway box component growing at different rates. The attributions over this period are estimated to be relatively stable.

A18.25 When calculating the revised "post 31 March 2018" attributions each year we have also:

- Assumed all unit costs increase by 2% per annum over the review period.
- Assumed the unit cost of lead-in duct remains the same as that for single bore spine duct.[413]

A18.26 In this step, for each year we:

i) Calculate the attribution to apply to the costs of assets installed before 31 March 2018 and after 31 March 2018;
ii) Attribute the forecast operating costs and mean capital employed associated with assets installed before 31 March 2018 using the pre-31 March 2018 allocation basis;
iii) Add the forecasts of duct and footway network adjustment costs, below the financial limit, to the forecast mean capital employed costs associated with assets installed after 31 March 2018;
iv) Attribute the overall forecast operating costs and mean capital employed associated with assets installed post-31 March 2018 using the post-31 March 2018 allocation basis for this year; and finally
v) Add the results of the two sets of attributions together and calculate a fully allocated regulatory cost base for each PIA cost component by adding together operating costs and a return on mean capital employed, using a weighted average cost of capital (WACC) of 7.1%.

A18.27 The outputs are a single set of fully allocated costs in each year of the review period for each PIA cost component. In the next sub-section, we shall refer to this as the regulatory cost base for each PIA cost component.

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[412] The standard unit costs were derived from Openreach's Network Inventory Management System.
[413] Openreach currently does not separately record the costs for lead in duct. However, Openreach has confirmed that this is a reasonable assumption to make by undertaking a bottom-up comparison of the activities and relative costs of installing a metre of lead-in duct and single bore spine duct.

Step 4: Calculate unit costs for each service in each year and set rental charges as a share of these unit costs

A18.28 First, we calculate a set of unit costs by dividing the regulatory cost base in each year for each cost component by the volumes forecast in each year for that cost component.

A18.29 We then estimate maximum charges that telecoms providers should pay as what we consider should be a fair share of this unit cost. We explain the reasoning for our proposed shares in Volume 4, Section 4. The shares we have used are given in Table A18.1 below.

Table A18.1: Fair shares for duct and footway PIA services

	Current fair shares	Proposed fair shares
Simplified lead-in duct	90%	46%
Single bore spine duct	50%	46%
2 bores spine duct	25%	25%
3+ bores spine duct	10%	10%
Facility hosting per manhole entry	3.3%	3.3%
Facility hosting per joint box entry	15%	15%

Source: Ofcom assumptions

A18.30 We propose to continue to set prices for ducted lead-in services as a flat charge per connection. This fixed price rental service will apply from the telecoms provider's optical distribution point all the way to the building entry point of the end-customer premises.

A18.31 The calculation of this charge requires information on maximum charges and average volumes per premise for each of the following PIA components:

a) Lead-in duct (charged per metre): this is any duct section that is dedicated to serving a single premise;
b) Shared duct (charged per metre): this is either shared spine duct or shared rider duct;
c) Facility Hostings to enter and exit the distribution point and pass through any intermediate footway boxes or chambers.

A18.32 For the 2021 WFTMR, Openreach provided us with the following estimates of these average volumes, calculated from a large and representative sample of 386,952 premises across the UK:[414]

- Lead in duct: 10.51m per premises;

[414] Openreach response of 10 December 2019 to question 2 of the s.135 notice titled *Promoting investment and competition in fibre networks* dated 2 December 2019.

- Shared duct: 8.69m per premises;[415]
- Joint Box exits: 0.45 (i.e. Facility Hostings) per premises.[416]

A18.33 We propose to use these estimates as we continue to consider them reasonable, we do not expect these distances to significantly vary over time, and have confirmed that they are the latest estimates that Openreach holds. The estimated charge for the ducted lead-in service each year is then calculated by multiplying the above average volumes by the estimated charge for the relevant PIA service in that year.[417]

Poles

Step 1: Determination of the regulatory cost base for poles

A18.34 Operating costs were split as follows:

a) Pay and non-pay costs.[418] These include contributions from Openreach and corporate overhead costs.
b) CCA depreciation for the main pole class work with HCA depreciation, Supplementary depreciation, Holding Gains and Losses, and Other CCA adjustments identified separately.
c) A small amount of CCA depreciation associated with other assets required to provide PIA services. This mainly consisted of depreciation associated with the funding of BDUK assets plus some support assets such as software. None of these other assets are revalued on a CCA basis within BT's RFS.

A18.35 Capital costs included the following items:

a) GRC and NRC for the pole class of work;
b) GRCs and NRCs for other assets;
c) Net Current Assets.

A18.36 We make the same adjustment to leavers and restructuring costs as we do for duct and footway services, as set out in paragraph A18.16 above.

Step 2: Forecast the regulatory cost base over the review period

A18.37 We forecast the adjusted pay and non-pay operating costs for poles in the same way as we do for duct, as set out in paragraph A18.17 above. We note that pole testing costs are now treated as capex in the regulatory accounts.

A18.38 We forecast capital costs - GRCs, NRCs and CCA depreciation, including holding losses and gains – from the base year over the review period as follows:

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[415] Openreach explained that, based on information on the 386,952 premises included in their inventory systems shared ducts are, on average, passed by 3 cables. The average length of shared duct is then calculated by using the average total lead-in cable length minus the lead-in duct element divided by 3.
[416] Based on information on the 386,952 premises included in their inventory systems Openreach estimates that there are 1.36 Facility Hostings per chamber. For the reasons explained in the previous footnote, this is again divided by 3 to provide a per lead-in cable price.
[417] Shared duct is priced at the single bore duct rate. We use the same average volumes in each year as those given above.
[418] Costs excluded any of BT's cumulo rates costs as non-domestic rates are generally not payable on passive assets. It is only once "active" equipment is attached to these passive assets that a rating liability is triggered.

a) We assume that the asset life of poles is 40 years, and that asset price inflation for the main pole asset is 2% per annum over the review period. We use this to generate revised GRCs, NRCs and CCA depreciation using CCA accounting principles.
b) We use Openreach's estimates for total volumes of poles from 2022/23 to 2030/31, broken down by how many of the new installs are replacement poles and how many are new poles. The volume growth we generate to forecast operating costs is calculated from the net additions, i.e. it reflects the new poles only, or total additions less replacements.
c) We also forecast the number of different types of poles (for example cable poles, distribution poles and feeder poles), attachments and manifolds. We do this by growing the volumes in the base year by the average annual growth rate of all poles. This keeps the number of attachments and manifolds per pole constant over the period.
d) We forecast opening and closing GRCs and NRCs for each year with the mean NRC in each year being the average of the opening and closing balance. To forecast opening and closing balances, we use a very similar approach to that we have used for duct and footway boxes by forecasting capital expenditure and CCA depreciation including price movements.
e) We use Openreach's capex forecast for poles, including network adjustments below the limit, as these forecasts are consistent with the volume forecasts and expected unit costs for poles. We note that the capitalised pole testing costs result in a similar per annum capex as the pole testing operating costs that we previously modelled.
f) Capital costs associated with other assets: these consist of a mix of assets, including some grant funded (negative) assets and support assets such as software and computing. For simplicity we assume these capital costs remain constant in nominal terms over the review period.
g) Net current assets: These are forecast by using the standard formulae that we have applied in other recent top-down cost models.

A18.39 The output of the above process is operating costs (including depreciation and holding gains and losses) and mean capital employed (including net current assets) in each year. In what follows we refer to this as the regulatory cost base for poles.

Step 3: Attribute the poles regulatory cost base between different PIA services

A18.40 The unit cost of a pole is attributed between the different attachment types. As set out in Volume 4, Section 4, we think it would be beneficial for PIA users to have fewer pole charges and note that both pole top equipment and cable up a pole (per cable) services (as found on Openreach's price list) represent a small proportion of overall cost recovery. We propose to simplify charges by setting the pole top equipment and the cable up a pole charges to zero, and instead recovering all costs from the single-end-user and multi-end-user attachment charges.

A18.41 We attribute the updated regulatory cost base for poles across attachments, and then calculate a fully allocated regulatory cost base for each poles service by adding together operating costs and a return on mean capital employed, using a WACC of 7.1%.

A18.42 The outputs of this step are then the regulatory cost base for each poles service in each year of the review period.

Step 4: Calculate unit costs for each service in each year and set rental charges as a share of these unit costs

A18.43 First, we calculate pole unit costs in each year by dividing the regulatory cost base allocated to each pole service (i.e. single-end-user and multi-end-user attachments) by the volumes forecast in each year. This produces a regulatory unit cost per pole for attachments.

A18.44 There are two different types of cable attachments depending on the number of end-users connected: single-end-user attachments and multi-end-user attachments. Some types of poles are only used to carry single-end-user attachments. These are 'pure' distribution point (DP) poles and 'pure' feeder poles. Similarly, cable poles are only used to carry multi-end-user attachments. There are also 'mixed' DP poles and 'mixed' feeder poles that carry both single- and multi-end-user attachments.

A18.45 We calculate unit charges and shares separately for the two types of attachments. The calculations are complex but are the same as those undertaken in the March 2021 Statement.

A18.46 Pole costs attributed to cable attachments are allocated between single- and multi-end-user attachments based on the average number of those attachments per pole. The output of this calculation is a set of relative unit costs, using the following four steps:

i) First, the regulatory costs for attachments are divided by the total number of poles to give the overall unit costs per pole for attachments (UCA).
ii) Second the number of attachments per pole is calculated separately for each type of attachment. For single-end-user attachments this is the number of single-end-user attachments on 'pure' DP and 'pure' feeder poles divided by the number of 'pure' DP and 'pure' feeder poles (=SAPP). For multi-end-user attachments it is the number of attachments on cable poles divided by number of cable poles.
iii) Third the average attachments per pole for multi-end-user attachments is increased by 2 reflecting the expected additional PIA attachments (=MAPP). The uplift by two attachments per pole is applied as we effectively achieve a fair share of 47.5% which we consider to be more appropriate.
iv) Last initial unit costs per attachment are calculated for single-end-user attachments (=UCSA) by dividing the unit costs per people for attachments (UCA) by the number of single-end-user attachments per pole (SAPP). Similar calculations are undertaken for multi-end-user attachments: the initial unit cost per attachment for multi-end-user attachments (=UCMA) is calculated by dividing UCA by MAPP.

A18.47 Rental charges are currently payable if the telecoms provider has a single-end-user attachment in place. This means that when a customer churns, the competing telecoms provider will continue to pay the rental charge unless it physically removes its equipment. Competing telecoms providers are unlikely to do so just to avoid paying rental charges as it is costly to perform this activity and is wasteful if the customer then subsequently churns back. Therefore, we continue to consider it appropriate to apply a discount rate to single-end-user pole attachments.

A18.48 The charge that telecoms providers pay is therefore 100% minus the discount (of 54%) to account for the possibility that the telecoms provider may continue to pay rental charges even after losing the end customer. For single end-user-attachments the share of the unit cost that we use when calculating our proposed PIA charge controls is therefore 46%.

A18.49 For multi-end-user it is effectively the ratio of the number of (Openreach) multi-end-user attachments per pole divided by the number of multi-end-user attachments per pole after the uplift for PIA use. This is equivalent to assuming a fair share of 47.5% over the review period.

Low and high cost forecasts

A18.50 Our proposed charge controls, reflecting our proposals relating to the cost modelling of PIA services, are set out in Table A18.2 below. We present ranges for all proposed cost-based charge controls to provide an indicative view of what the final figures might be from updated cost forecasts in our PIA charges model. This is consistent with our approach in previous market reviews.

A18.51 We intend to update our cost models ahead of publishing our Statement to incorporate more recent outturn data from which we can derive updated cost estimates for 2025/26 and 2030/31. Should we decide to proceed with setting cost-based charge controls, we would use these updated cost estimates to determine the final figures for the CPI-X glidepaths. The ranges included in this Consultation are intended to provide an indicative view of what those final figures may be. We have constructed low and high-cost forecasts by adjusting the following assumptions:

a) WACC: 6.6% to 7.6% (relative to a 7.1% base case)
b) Opex efficiency: 4% to 2% (relative to a 3% base case)
c) Capex forecasts: 20% lower or higher than our base case

A18.52 This results in the following proposed ranges for our charge controls for PIA services:

Table A18.2: Proposed CPI-X ranges for maximum PIA charges

	Low	Base Case	High
Simplified lead-in duct	CPI – 14.4%	CPI – 12.8%	CPI – 11.1%
Single bore spine duct	CPI – 2.1%	CPI – 0.1%	CPI + 2.2%
2 bores spine duct	CPI + 0.6%	CPI + 2.5%	CPI + 4.2%
3+ bores spine duct	CPI – 2.1%	CPI – 0.1%	CPI + 1.8%
Facility hosting per manhole entry	CPI + 2.8%	CPI + 4.8%	CPI + 6.8%
Facility hosting per joint box entry	CPI – 1.6%	CPI + 0.1%	CPI + 1.7%
Single-end-user attachments	CPI – 10.0%	CPI – 7.9%	CPI – 5.7%
Multi-end-user attachments	CPI – 3.9%	CPI – 1.6%	CPI + 0.6%

Source: Ofcom PIA charges model

A19. Cost of capital for BT Group

A19.1 This annex explains our proposals in relation to the cost of capital for BT Group. Estimating the cost of capital for BT Group is the starting point for setting the cost of capital for the relevant services, which are detailed in Annex 20.[419]

A19.2 In most market reviews the main purpose of estimating the cost of capital is to inform the appropriate rate of return on the mean capital employed (MCE) to be included in cost-based charges. This rate of return should reflect the return required by investors to remunerate them for the risks of investing in the relevant assets.

A19.3 In this review, we require an estimate of the appropriate rate of return on the MCE for those services that are subject to cost-based charge controls. In Volume 4 we explain our proposals to set cost-based charge controls on:

a) Area 3 dark fibre access (DFA) and active leased line access circuits of bandwidths 1Gbit/s and below (Section 2);
b) Dark fibre inter-exchange (DFX) circuits for BT Only exchanges and BT+1 exchanges (Section 3); and
c) PIA services (Section 4).

A19.4 We also require an estimate of the appropriate rate of return on the MCE for other services (MPF, FTTC, and FTTP), which are used as an input in the RAB for Area 3 (Volume 4, Section 1) and for modelling the revenues and costs for active legacy services (Annex 14).

A19.5 We use the Capital Asset Pricing Model (CAPM) to estimate the appropriate rate of return on equity. Under the CAPM the cost of equity (*Ke*) is a function of the risk-free rate (*RFR*), the expected return on the equity market above the risk-free rate i.e. the equity risk premium (*ERP*) and the systematic risk of the relevant activity i.e. equity beta (*βe*):

$$Ke = RFR + ERP * \beta e$$

A19.6 If the relevant business or project is entirely funded by equity, then the cost of equity is the cost of capital.

A19.7 In practice, most firms are funded by a combination of debt and equity. In this case the weighted average cost of capital (WACC) combines the cost of finance from debt (*Kd*) and equity (*Ke*), each weighted by their relative share of enterprise value (i.e. the sum of the value of debt and equity). The value of outstanding debt relative to enterprise value (gearing) is denoted by *g* in the formula below and the rate of corporation tax is denoted by *t*. The pre-tax WACC is obtained by scaling the post-tax cost of equity by 1 / (1 - *t*), the cost of debt already being pre-tax[420]:

$$WACC = \frac{Ke * (1 - g)}{1 - t} + Kd * g$$

[419] Relevant services refer to regulated services and services that are not explicitly regulated but are modelled as part of our overall regulatory approach e.g. services in Area 3 RAB.

[420] Given our cost modelling is done in nominal terms without explicit modelling of tax, we require a forecast of the pre-tax nominal WACC. This differs from the approach of some other UK regulators and that used by some equity analysts who may use the vanilla WACC or the post-tax WACC. The vanilla WACC is a weighted average of the post-tax cost of equity and the pre-tax cost of debt; while the post-tax WACC is a weighted average of the post-tax cost of equity and the post-tax cost of debt.

A19.8 The WACC provides a benchmark against which the (risk-adjusted) expected return on any investment is judged. As the WACC is a forward-looking concept, the cost of debt is the marginal cost of new borrowing for the project in question, at a given investment horizon. The cost of debt can typically be estimated with reference to observed market yields on corporate bonds. The observed yield differs from the expected return on bonds due to the risk of default in any corporate bond. However, when estimating the return necessary to cover the cost of capital, we reflect this risk of default in regulated prices since we are concerned with the costs faced by the issuer (in this case BT Group).[421]

A19.9 When setting the allowed return, we use a cost of debt which reflects both forward-looking and historical debt costs (for reasons explained later in this annex). In large part, this explains why the regulatory allowed return will not typically align with the forward-looking WACC.

A19.10 For consistency with previous notation and because the allowed return is most significantly determined by the forward-looking WACC, we typically refer to the WACC in this annex and in Annex 20.[422]

Summary of WACC proposals for BT Group

A19.11 Our proposed estimate of the BT Group WACC is shown in Table A19.1 below.

Table A19.1: Summary of WACC and component parameters

WACC component	BT Group	Source
Real (RPI-based) RFR	1.0%	See A19.29
RPI inflation forecast	2.5%	See A19.21
Nominal RFR	3.5%	= (1+ real (RPI-based) RFR)*(1+RPI inflation)-1
Real (CPI-based) total market return (TMR)	6.7%	See A19.40
CPI inflation forecast	2.0%	See A19.21
Nominal EMR	8.8%	= (1+real EMR)*(1+CPI inflation)-1
Nominal ERP	5.3%	= Nominal EMR – Nominal RFR
Debt beta (βd)	0.075	See A19.73
Asset beta (βa)	0.46	See A19.64
Gearing (forward looking) (g)	55%	See A19.72
Implied equity beta (βe)	0.93	= (βa - βd*g)/(1-g)

[421] In 2018, the UK Regulators Network (UKRN) published a study by academics and consultants on estimating the cost of capital for price controls (2018 UKRN Report). The 2018 UKRN Report noted that the difference between observed and expected yields was expected to be small (10 to 20 bps) for the credit ratings expected for UK regulated companies (i.e. A to BBB). 2018 UKRN Report, Section 4.7.1, pages 59 to 60.

[422] In the 2018 UKRN Report, one of the recommendations was to differentiate the WACC, i.e. the concept of a purely forward-looking expected cost of capital, from the regulatory allowed return (RAR) which represents the regulator's view on the appropriate return on capital employed. 2018 UKRN Report, page 6.

WACC component	BT Group	Source
Cost of equity (post-tax) (Ke)	8.5%	= Nominal RFR + Nominal ERP *βe
Cost of equity (pre-tax)	11.3%	= Ke / (1-t)
Corporate tax rate (t)	25%	See A19.76
Cost of debt (pre-tax) (Kd)	4.6%	See A19.56
WACC (pre-tax nominal)	**7.6%**	=(Ke*(1-g))/(1-t)+(Kd*g)
2021 WFTMR Statement	*7.8%*	

Source: Ofcom[423]

Key principles and methodology

A19.12 The key objectives guiding our cost of capital estimation include the following.

a) **Efficient price and investment signals** – the allowed return is an important input in setting cost-based regulated charges (particularly in capital intensive industries). Regulated charges should provide the regulated firm with the opportunity to finance efficient investment and provide access seekers with efficient 'build-vs-buy' price signals.
b) **Stability** – financing telecoms infrastructure and services involves making long-term investments where demand may be uncertain and wholesale prices are limited by ex-ante regulation. It is important for investors to be able to commit risky capital in the knowledge that our approach to price regulation provides an expectation, but not the guarantee of recovery of efficient costs, including the cost of finance.
c) **Consistency** – we aim to ensure that there is consistency in our decisions, both between parameters in a given decision and, as far as reasonably possible, with other regulatory decisions.
d) **Transparency** – we aim to clearly explain our approach to stakeholders and seek to avoid overly elaborate methodologies.

A19.13 We consider that these key objectives are consistent with our statutory duties, including our principal duty i.e. 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.

A19.14 Following our long-standing methodology for fixed-telecoms charge controls, we start by estimating the WACC for BT Group since we do not have a pure play comparator[424] which provides the relevant services in this review and the relevant services within BT represent a large part of the company.[425] Any disaggregated WACC for the lines of business should be

[423] Note: Intermediate calculations are unrounded. We round the pre-tax cost of equity, the pre-tax cost of debt and the pre-tax nominal WACC to one decimal point. For comparison purposes, the UKRN annual update reports real vanilla WACCs used by UK regulators. The real vanilla WACC (with respect to CPI inflation of 2.0%) is 4.2% for BT Group.
[424] A pure play comparator would be a listed company that only provides the relevant services in question.
[425] According to BT's 2024 Regulatory Financial Statements, markets in which BT was found to have SMP represented 59% of returns and 41% of MCE.

compatible with the overall WACC for BT Group (weighted by the relative value of the underlying assets for each line of business).

A19.15 For reasons explained in detail in Annex 20, we disaggregate the BT WACC between three lines of business, as in previous reviews.

A19.16 Our WACC estimates reflect our view of required returns over a relatively long investment horizon (reflecting the long asset lives of telecoms investments), accounting for the expected market developments over the market review period.

A19.17 Since the 2021 WFTMR Statement, the UKRN published its 'Guidance for regulators on the methodology for setting the cost of capital' (UKRN Guidance)[426] and we have regard to this when making our proposals. In addition, the CMA has made determinations in relation to the WACC in the water and aviation sectors, and other UK regulators have published decisions or consulted on proposals. Where relevant, we also refer to this regulatory precedent when making our proposals.

A19.18 The rest of this annex and Annex 20 set out our proposed WACC parameters for BT Group, Openreach and Other UK Telecoms. We intend to update these for the latest market evidence in our statement.

WACC parameters

Inflation assumptions

A19.19 Given our WACC estimates reflect our view of required returns over a relatively long investment horizon (reflecting the long asset lives of telecoms investments) we have used long run inflation expectations when calculating the pre-tax nominal WACC.

A19.20 Forecast CPI and RPI are available from the OBR until Q1 2030 where the OBR forecast CPI of 2.0% and RPI of 2.5%.[427] We note forecast RPI is expected to fall from 2.9% in Q4 2029 to 2.5% in Q1 2030.[428] The main reason for this fall is because the methodology for measuring RPI is expected to change to the same methodology as used to measure CPIH in February 2030. The OBR forecasts a long-term wedge of 0.4% between RPI/CPIH and CPI.[429]

A19.21 Based on this, we propose to use CPI of 2.0% and RPI of 2.5%.

Risk-free Rate (RFR)

A19.22 The UKRN Guidance outlines the approach UK regulators should take when estimating the RFR: "To estimate the real risk-free rate (RFR) within the CAPM, regulators should use recent yields on index-linked gilts, with a maturity which matches the assumed investment horizon for their sector."[430]

A19.23 Consistent with the UKRN guidance and our previous regulatory decisions, we propose to estimate the real RFR by reference to index-linked gilts (ILGs). We set out below that we propose to estimate the real RFR using ILGs with a maturity of between 10 and 20 years

[426] UKRN guidance for regulators on the methodology for setting the cost of capital, March 2023
[427] OBR, Economic and fiscal outlook – October 2024 - Office for Budget Responsibility.
[428] OBR, Economic and fiscal outlook – October 2024, Economy Detailed forecast tables October 2024, Table 1.7.
[429] OBR, Economic and fiscal outlook – October 2024, pages 38 and 39.
[430] UKRN Guidance, Recommendation 3, Page 15.

and to place weight on short term averaging periods. We propose to use a nominal RFR of 3.5% based on a real (RPI-based) RFR of 1.0% and assumed RPI inflation of 2.5%.[431]

Investment horizon

A19.24 As set out in the UKRN guidance, the maturity of the ILG chosen should match the assumed investment horizon for its sector. Assets associated with telecoms investments have relatively long lives and an efficient network operator would be expected to finance investments (whether network renewals or enhancements) steadily through time. For example:

a) BT's network infrastructure assets have accounting asset lives of between two and 40 years, [432] with a large proportion of the assets used to deliver relevant services towards the midpoint and upper end of this range e.g. duct (c.40% of Openreach MCE), copper (c.19%) and fibre (c.36%);[433]
b) Planned investments in FTTP involve long-lived assets, with the majority of the investment in assets with lives between 20 to 40 years;[434]
c) the average remaining maturity on BT's debt is around eight years;[435] and
d) the average maturity from issuance on BT's debt is around 17 years.[436]

A19.25 Recognising the long asset lives of fibre and duct, and the fact that the maturity at issuance on BT's debt has increased from the 2021 WFTMR Statement, we consider a reasonable investment horizon is between 10 and 20 years. This is why we propose to use evidence of yields on 10 and 20-year ILGs to estimate the RFR. We apply a consistent approach in estimating the cost of debt.[437] We think investment horizons towards upper end of this 10–20-year period would better reflect the investments associated with BT's relevant services.

Measurement period and market evidence on yields on index-linked gilts

A19.26 The UKRN guidance states that regulators should estimate the real RFR using recent yields on ILGs. In recent decisions, other UK regulators have typically considered yields using one to six-month averaging periods.[438]

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[431] This is equivalent to a real (CPI-based) RFR of 1.5%.
[432] Page 172 of BT's 2024 annual report shows the asset lives used by BT for network infrastructure assets.
[433] Ofcom analysis of 2024 BT Regulatory Financial Statements, Page 21.
[434] See Ofcom Fibre Cost Model for more detail on asset lives used in the modelling.
[435] Based on Ofcom analysis of BT's 2024 Annual Report (Page 209) and website. Note, hybrid instruments have been excluded in this calculation. Including hybrid instruments (using the non-call date, not the maturity date in line with the presentation on BT's website) results in an average remaining maturity on BT's debt of around seven years. See paragraph A19.52 for discussion on BT Group's recently issued hybrid securities.
[436] Based on Ofcom analysis of BT's 2024 Annual Report (Page 209) and website. Note, hybrid instruments have been excluded in this calculation. Including hybrid instruments (using the non-call date, not the maturity date in line with the presentation on BT's website) results in an average maturity from issuance on BT's debt of around 15 years. See paragraph A19.52 for discussion on BT Group's recently issued hybrid securities.
[437] In the 2021 WFTMR Statement the average remaining maturity on all BT's debt was around 10 years and the average maturity at issuance was 16 years.
[438] CAA used 1-month averages in its October 2023 final decision on NATS (Economic regulation of NATS (En Route) plc: Final Decision for the NR23 (2023 to 2027) price control review,(NR23) Page 129). The CMA used 6 month averages in the PR19 appeals (PR19 FD), (Final report, Page 790). In its July 2024 RIIO-3 Sector Specific Methodology Decision (2024 RIIO-3 SSMD), Ofgem decided to update its estimate of the RFR in the price control annually using 1-month averages (RIIO-3 Sector Specific Methodology Decision – Finance Annex, Page 62). In Ofwat's December 2024 PR24 final determinations (PR24 FD), it used a 1-month average (PR24-final-determinations-Aligning-risk-and-return-Allowed-Return-Appendix.pdf, Page 9).

A19.27 Spot yields on 10 and 20-year index-linked gilts were 0.8% and 1.4% respectively on 31 October 2024. Yields on these gilts over different averaging periods are shown in Table A19.2.

Table A19.2: Real (RPI-based) yields on 10 and 20-year gilts

Averaging period	10-year gilt %	20-year gilt %
Spot rate	0.8	1.4
1 Month	0.7	1.3
6 Months	0.6	1.2
1 Year	0.6	1.2

Source: Ofcom analysis based on data from the Bank of England. Figures rounded to 1 decimal place.

Our proposal

A19.28 We propose to base our estimate of the real RFR using a six-month averaging period. We think this ensures the real RFR reflects current market conditions while mitigating the risk of capturing market fluctuations that could be a feature of shorter averaging periods. This gives a range of 0.6% to 1.2%. We propose to use a point estimate above the mid-point (0.9%) of this range, which places slightly more weight on the longer-term investment horizon.

A19.29 As such we propose to use a real RFR of 1.0%.[439] Based on our RPI estimate of 2.5%, the implied nominal RFR is 3.5%.[440]

TMR and ERP

A19.30 The total market return (TMR) represents the sum of the RFR and the equity risk premium (ERP).[441] While the expected TMR and expected ERP are not directly observable, in recent decisions we have placed more weight on estimates of the TMR, consistent with a view that the long-run market return is likely to be more stable than the ERP.[442] In the 2021 WFTMR Statement we assumed a real (CPI-based) TMR of 6.7%.

A19.31 The UKRN Guidance is consistent with our previous approach, stating "*Regulators should estimate the equity risk premium (ERP) within the CAPM as the difference between the total market return (TMR) and the risk-free rate (RFR). We recommend that the TMR should be primarily based on historical ex-post and historical ex-ante evidence.*"[443]

A19.32 We propose to estimate the TMR and ERP in line with the UKRN Guidance and our previous approach. Historical *ex-post* approaches assume that realised equity returns are a good proxy for the TMR. Since equity returns are volatile, it is reasonable to consider long

[439] Rounded to 1d.p.
[440] Rounded to 1d.p.
[441] In the 2021 WFTMR Statement we used the terminology Expected Market Return (EMR) but consistent with the UKRN Guidance we refer to it as the TMR in this consultation.
[442] In section 4.4.1 of the 2018 UKRN report, the authors present evidence on the relative stability of long-run mean returns on mature stock markets, in contrast with considerably lesser stability of returns on other asset classes (such as bonds and cash), implying that the *ex-post* ERP has been far from stable. This suggests that assuming that the long-run market return is stable (rather than that the forward-looking ERP is stable) might be a reasonable methodology. Indeed, this is one of the recommendations of the 2018 UKRN Report (Page 48).
[443] UKRN Guidance, Recommendation 4, Page 21.

periods of history. Historical *ex-ante* approaches also use historical data but try to account for one-off good or bad 'luck' that investors might not expect to be repeated in the future.

A19.33 Based on the analysis set out below, we propose that a real (CPI-based) TMR of 6.7% remains appropriate.

Historical ex-post evidence

A19.34 We have estimated historical ex-post returns using historical equity returns from the 2024 edition of the Dimson, Marsh and Staunton (DMS) dataset. [444]

A19.35 In line with the UKRN Guidance,[445] we have deflated historical nominal equity returns from the DMS dataset using the following measures of CPI:

- 1900 – 1949: Consumption expenditure deflator (CED).[446]
- 1950 – 1987: Backcast CPI estimates from the ONS.[447]
- 1988 to date: CPI data from the ONS.[448]

A19.36 The UKRN Guidance recognises that there is general agreement that the expected return from historical data is the arithmetic average return and suggests two approaches to estimate the arithmetic average.[449] One approach is to take an arithmetic average of historical returns over holding periods consistent with the chosen investment horizon of, in our case, 10 to 20 years (which could include both overlapping and non-overlapping periods).[450] The other approach is to uplift the whole-period geometric average to reflect volatility in returns.[451]

A19.37 Based on the above guidance, we estimate the historical ex-post evidence suggests a real TMR (CPI) range of 6.6% to 6.8% (Table A19.3).

[444] Elroy Dimson, Paul Marsh and Mike Staunton, Triumph of The Optimists: 101 Years of Global Investment Returns, Princeton University Press, 2002, and Elroy Dimson, Paul Marsh and Mike Staunton, UBS Global Returns Yearbook, 2024, Zurich: UBS, 2024.
[445] UKRN Guidance, page 20.
[446] Sourced from tab A.47 of the workbook 'A millennium of macroeconomic data', available on the Bank of England website here: Research datasets.
[447] Consumer price inflation, historical estimates, UK, 1950 to 1988 – methodology. Data available for download under Figure 3.
[448] CPI annual rate 00: All items 2015=100 (ons.gov.uk).
[449] This is because, the expected return of a probability distribution is the arithmetic mean.
[450] Using overlapping periods has the advantage of more data points when compared to non-overlapping periods, but the individual data points will exhibit serial correlation. Using non-overlapping periods avoids the issue of serial correlation but typically leads to estimates that are volatile year-on-year due to small sample sizes. Given the volatility of these estimates, we have decided not to put any weight on estimates using non-overlapping holding periods. Other UK regulators have made similar arguments e.g. See Ofwat, PR24 FD, Page 35.
[451] UKRN Guidance, page 18.

Table A19.3: Ex-post arithmetic returns (real CPI)

Holding period	Arithmetic return
One-year	6.8%
10-year overlapping	6.6%
20-year overlapping	6.7%
Geometric + adjustment	6.7%[452]

Source: Ofcom analysis based on 2024 DMS data and Ofcom's inflation dataset.

Historical ex-ante evidence

A19.38 We propose to use the DMS 'decomposition' approach as adopted by the CMA in PR19 FD to estimate the historical ex-ante TMR.[453] This approach uses the 2024 DMS data on historical average dividend yield and adds this to the historical average of dividend growth. As this data is in geometric terms, an adjustment is made to convert this into an equivalent arithmetic average. On this basis, the DMS dataset, deflated using our historical estimates of CPI set out above, suggests a real TMR (CPI) of 6.7% (Table A19.4).

Table A19.4: Ex-ante historical returns (real CPI)

Calculation step	Description	
A	Geometric mean dividend yield	4.6%
B	UK real dividend growth rate	0.5%
C=A+B	Geometric ex-ante TMR	5.1%
D	Geometric-to-arithmetic conversion factor	1.6%
E= C+D	Ex-ante TMR (CPI terms)	6.7%

Source: Ofcom analysis based on 2024 DMS data and Ofcom's inflation dataset.

Regulatory precedent

A19.39 Recent views from other UK regulators on the TMR are summarised in Table A19.5. Note that each of these TMR estimates are real with respect to CPIH, while we have estimated a real TMR with respect to CPI. Historically, CPI has on average been slightly higher than CPIH[454] meaning that our estimate of the real TMR with respect to CPI could be slightly lower than the TMR estimated by other UK regulators.

[452] The geometric return is 5.1% in CPI terms, this is then uplifted by the geometric-to-arithmetic conversion factor (1.6%). The geometric-to-arithmetic conversion factor is estimated as half the variance of natural logarithmic total market returns between 1900 and 2023.
[453] PR19 FD, paragraph 9.341.
[454] For example, in the ONS back cast series (1950 – 1988), CPI was on average 0.6% points above CPIH.

Table A19.5: Recent estimates of the TMR by UK regulators

Regulator	Year	Real TMR range (CPIH)
CMA[455]	2021	6.15% - 7.46%
Ofgem[456]	2024	6.5% - 7.0%
Ofwat[457]	2024	6.68% - 6.98%

Source: UK regulators

Our proposal

A19.40 Based on the above analysis, we consider our WFTMR 2021 decision continues to represent a reasonable estimate of the real TMR as it sits within the range implied by the historical ex-post and ex-ante approaches. As such, we propose a real TMR of 6.7%. Combined with our forecast of CPI inflation of 2.0%, a real (CPI-based) TMR of 6.7% implies a nominal TMR of 8.8%. Combined with our estimate of the nominal RFR (3.5%), the nominal ERP proposed in this consultation is 5.3%.

Cost of debt

A19.41 We propose to estimate the cost of debt as a weighted average of the cost of new debt and an allowance for existing debt, informed by yields on benchmark BBB indices.[458] This is consistent with our approach in the 2021 WFTMR Statement and aligns with the UKRN Guidance which states that *"Regulators should estimate an allowance for an efficient company under the notional financial structure with actual debt costs suitably benchmarked against other market evidence."*[459]

A19.42 Based on the analysis below we propose a pre-tax cost of debt of 4.6% for BT Group.

Cost of new debt

A19.43 As at 31 October 2024, we estimate that BT's rated listed debt (all currencies) had an average maturity at issuance of around 17 years and an average outstanding maturity of around eight years.[460] Given this, we consider that recent yields on bonds with 10 and 20-year maturities would give a reasonable estimate of the cost of new debt and aligns with our approach on the RFR.

A19.44 Given that BT has been rated at least BBB- over the past 25 years, consistent with previous decisions we propose to rely on an index of BBB bonds.[461]

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[455] PR19 FD, paragraph 9.397. We note that the CAA used the same range as the CMA (albeit with respect to RPI) in its November 2023 decision on National Air Traffic Services. See Economic regulation of NATS (En Route) plc: Final Decision for the NR23 price control review, paragraph 5.66.

[456] 2024 RIIO-3 SSMD – Finance Annex, paragraph 3.149. Ofgem's 6.5% estimate was based on its ex-ante analysis and its 7.0% estimate was based on its ex-post analysis.

[457] PR24 FD, Page 37. Ofwat's range is based on the highest and lowest datapoints from its combined ex-ante and ex-post analysis.

[458] While we include the cost of existing debt in the allowance for cost of debt, it is based on a range informed by benchmark BBB indices. This means it might not necessarily align with BT's actual reported cost of debt.

[459] UKRN Guidance, Recommendation 8.

[460] See paragraph A19.25.

[461] The index covers bonds that are BBB-, BBB and BBB+ sourced from S&P Capital IQ Pro. We note that BT also issues hybrid securities which carry a lower credit rating. The UKRN guidance states 'regulators should estimate an allowance for an efficient company under the notional finance structure.' Our benchmark efficient

A19.45 Figure A19.1 shows how spot yields for an index of BBB bonds with 10 and 20-year maturities have increased significantly since the 2021 WFTMR Statement. Current spot yields are between 5.1% and 5.5%, while six-month averages, i.e. the same averaging period as used for the RFR, are between 4.9% and 5.3%.

Figure A19.1: Spot yields on an index of BBB bonds with 10 and 20-year maturities

Source: GBP - All Corporates – BBB - S&P Capital IQ Pro, Ofcom analysis. Data to 31 October 2024.

A19.46 We want to use an up-to-date figure for the cost of new debt while also using an estimate that will smooth out the volatility in spot rates.

A19.47 In line with our approach on the RFR, we propose to use a cost of new debt of between 4.9% (6-month average of the 10-year index) and 5.3% (6-month average of the 20-year index).

Allowance for existing debt

A19.48 In our 2021 WFTMR Statement we explained that we include an allowance for the existing cost of debt in the WACC to provide the regulated firm an opportunity to recover efficiently incurred debt costs, especially as debt financing in telecoms tends to be of relatively long maturity.[462] Our methodology for estimating the cost of existing debt is consistent with our approach in the 2021 WFTMR Statement.

A19.49 As explained above, we propose to consider an investment horizon of between 10 and 20 years, in part recognising that recent debt issuances have been of longer maturities and the long lives of regulated infrastructure assets. On this basis, for consistency, we consider evidence on the 10 and 20-year BBB indices and long-term trailing averages.[463]

A19.50 As at 31 October 2024, a simple 10-year average of yields was between 3.2% and 3.6% (for the 10 and 20-year BBB index respectively).[464] Longer term average yields are likely to be higher. For example, in the 2021 WFTMR Statement we said the simple 15-year average of

company has a BBB credit rating, therefore, we do not place weight on BT's hybrid securities when estimating the cost of new debt or an allowance for existing debt. See paragraph A19.52 for more information.

[462] 2021 WFTMR Statement, paragraph A20.96.

[463] Over the last 20 years BT has been rated at least BBB- per S&P Capital IQ Pro.

[464] Ofcom analysis of S&P Capital IQ Pro data.

a 10-year and 15-year BBB index was between 4.3% and 4.5% (for the 10 and 15-year BBB index respectively).[465]

A19.51 We consider that an allowance for the cost of existing debt of 4.0% would be reasonable, which is above the simple 10-year average (3.2% – 3.6%) but below the 15-year average cited in the 2021 Statement (4.3% - 4.5%).[466]

A19.52 An allowance of 4.0% for the cost of existing debt is comparable to the interest rate on fixed rate debt reported in BT's Annual Report. In BT's 2024 Annual Report, BT reported a weighted average effective fixed interest rate of 4.6% for 2024 and 4.0% for 2023.[467] A big driver of the increase in 2024 relates to the issuance of hybrid securities which have a higher interest rate and a lower credit rating, reflecting the fact that they have characteristics of both debt and equity. [468] Given the lower credit rating and equity like characteristics of this hybrid debt, the weighted average effective fixed interest rate of 4.0% reported for 2023 may better reflect the cost associated with BT's BBB rated debt.[469] On this basis, we think our allowance for the cost of existing debt is reasonable.

Weighting of existing and new debt

A19.53 Given that the charge controls being set are a combination of costs at the start and at the end of the control (depending on the service in question), we consider that a weighting of between 40% to 85% on existing debt (15% to 60% on new debt) seems reasonable.[470]

Our proposal

A19.54 Table A19.6 summarises our proposals on the cost of debt. Based on the cost of new and allowance for existing debt, and our view on weightings above, the cost of debt range is 4.1% to 4.8%.[471] We propose to use the midpoint of this range, i.e. 4.5%, to inform our cost of debt estimate.

[465] 2021 WFTMR Statement, paragraph A20.100. We consider the 15-year average yield we estimated in the 2021 WFTMR Statement (which used data from Bloomberg) gives a reasonable indication of longer-term average yields on BBB bonds.
[466] The midpoint between the two ranges is 3.9%.
[467] BT Group plc - Annual Report 2024, Page 212.
[468] These securities have components of both debt and equity e.g. interest payments can be deferred. On 25 March 2024, S&P rated BT's €500m hybrid security as BB+ with the two-notch downward difference reflecting deducting one notch for subordination and one additional notch for payment flexibility because the option to defer interest stands with the issuer. (BT Group's Junior Subordinated Hybrid Securities | S&P Global Ratings)
[469] During 2024, some debt was repaid, and four new bonds were issued. Three of the four bonds were hybrid securities.
[470] Based on the current capital structure, by the end of the five-year control c.60% of BT's existing debt will potentially be due for repayment (including call options on hybrid securities) while 15% will potentially be due for repayment by the beginning of the control. Therefore, over the control period existing debt will account for c.40% to c.85% of total debt.
[471] Rounded to one decimal point.

Table A19.6 Summary of our cost of debt proposals

	Low	High
Cost of new debt	4.9%	5.3%
Allowance for existing debt	4.0%	4.0%
Weighting on new debt	15%	60%
Cost of debt	4.1%	4.8%

Source: Ofcom analysis

A19.55 As in previous decisions, we propose to include an allowance for debt issuance costs since these costs are not included in operating costs within BT's RFS and so would not otherwise be included in charge controls based on BT's cost data.[472] We continue to allow a 10-basis point uplift to the cost of debt for issuance and liquidity.

A19.56 Taken together, we propose to use a pre-tax nominal cost of debt for BT Group of 4.6%.[473]

Equity beta, gearing and asset beta

A19.57 We have estimated betas in line with the UKRN Guidance which states "Regulators should estimate equity beta for the notional company using comparable listed companies and standard regression techniques (i.e. ordinary least squares (OLS)). Where the listed comparator has different gearing to the notional company, regulators should continue to de-lever and re-lever the raw equity beta."[474]

A19.58 We commissioned CEPA to provide updated estimates of beta and gearing for BT Group. We summarise CEPA's estimates below. Based on the updated evidence, we propose an asset beta for BT Group of 0.46, a forward-looking gearing of 55% and a debt beta of 0.075. Together these values translate into an implied forward-looking equity beta of 0.93 for BT Group.

Equity beta estimates

A19.59 CEPA has estimated 1-year, 2-year and 5-year daily equity betas for BT Group and relevant comparators (2025 CEPA Report).[475]

A19.60 Table A19.7 shows that BT's equity beta over different estimation windows and averaging periods has been between 0.92 and 1.00. Given the consistency of BT's equity beta estimates over time, CEPA said it would expect the combination of asset beta and gearing for BT to produce a forward-looking equity beta in the range 0.9 to 1.0.[476]

[472] See paragraph A21.71 of the 2018 WLA Statement.
[473] Midpoint of the cost of debt range plus 10 basis point uplift for debt issuance.
[474] UKRN Guidance, Recommendation 5, Page 25.
[475] See Annex 23 - Cost of Capital: Beta and Gearing for TAR 2026, CEPA, 6 February 2025. Note: The use of a daily sampling frequency ensures that there are sufficient observations for the beta estimate to be statistically robust and CEPA has performed statistical tests on BT Group and comparator companies.
[476] 2025 CEPA Report, page 23.

Table A19.7: BT equity betas measured against the FTSE All Share

Window \ Av Period	Spot	1yr	2yr	5yr	10yr
1yr	0.95	0.98	0.94	0.97	0.92
2yr	1.00	0.93	0.93	0.94	0.93
5yr	0.98	0.97	0.96	0.95	0.96

Source: CEPA[477] Data cut off 30 September 2024.

Asset beta estimates

A19.61 The asset beta is calculated by un-levering the equity beta for the effect of gearing. Taking account of systematic risk present in debt (i.e. the debt beta), we can derive the asset beta from the equity beta using the following equation: $\beta a = \beta e * (1 - gearing) + gearing * \beta d$, where βa is the asset beta, βe is the equity beta, gearing is the gross value of short-term debt and long-term debt as a proportion of enterprise value, and βd is the debt beta.

A19.62 CEPA has used the same methodology for calculating gearing as we used in previous reviews[478] and has used a debt beta of 0.075 to un-lever the equity beta for BT.[479]

Figure A19.2: Asset beta estimates for BT Group

Source: CEPA

A19.63 As can be seen above in Figure A19.2, BT Group's 1 and 2-year asset betas fell sharply when the UK referendum event fell out of the 1 and 2-year asset beta estimation windows. As such, in the 2019 BCMR Statement and WFTMR 2021 Statement, we placed weight on 5-year asset betas due to them resulting in a better trade-off between our objectives of

[477] 2025 CEPA Report, page 11.
[478] In the 2021 WFTMR Statement (A20.127), we said that in the future it would be appropriate to take gearing statistics as reported under IFRS 16, with all lease liabilities capitalised. Given IFRS 16 was implemented in 2019, CEPA has included IFRS 16 lease liabilities in gross debt from this date. This therefore means that asset betas using data from pre-2019 will exclude IFRS 16 leases.
[479] 2025 CEPA Report, page 10.

sending efficient price signals and regulatory stability than using shorter-term betas.[480] Since the 2021 WFTMR Statement, BT Group's 5-year asset beta has continued to fall and has almost converged with BT Group's 1 and 2-year asset betas (as can also be seen in Table A19.8). In its report CEPA states BT Group's 5-year asset beta was likely elevated while the referendum remained within the estimation sample from roughly 2016-2021. As such when estimating a range for BT Group's asset beta, they have placed most weight on asset beta estimates after the referendum effect fell out of the estimation window (i.e. 24 June 2018).[481]

Table A19.8: Estimates of asset beta for BT Group

Av Period / Window	Spot	1yr	2yr	5yr	10yr
1yr	0.37	0.38	0.39	0.42	0.53
2yr	0.39	0.39	0.41	0.44	0.56
5yr	0.41	0.43	0.44	0.52	0.62

Source: CEPA. Data cut off 30 September 2024.

A19.64 CEPA's range for BT Group's asset beta was based on the interquartile range of 2-year daily asset beta estimates for BT Group (0.42-0.48).[482] CEPA then uplifted the top end of this range based on a number of qualitative factors, resulting in an asset beta range of 0.42 to 0.50 for BT Group.[483] We agree with CEPA's overall range for BT Group as, based on the qualitative factors outlined in their report, it seems reasonable to uplift the top end of the 2-year asset beta range. We propose to use the midpoint of CEPA's range in this consultation i.e. 0.46. An asset beta of 0.46 is above current estimates of BT Group's asset beta and closer to longer run averaging periods but also reflects the fact that BT Group and European telecoms companies' asset betas have generally fallen since the 2021 WFTMR Statement.

Forward-looking gearing

A19.65 The UKRN Guidance with respect to gearing states "The notional gearing assumption should reflect the regulator's assessment of the balance of risks facing the regulated company, a wide range of benchmarks on gearing levels and overall regulatory policy objectives, not just that of the actual company (or companies) in question."[484]

A19.66 Based on the guidance and in line with our previous approach, we start by considering recent trends in BT's gearing and compare this against a range of benchmarks. Our view of forward-looking gearing for BT Group then informs our notional gearing assumptions for the disaggregated parts of BT, used to derive the appropriate WACCs for the different regulated services.

A19.67 Figure A19.3 shows the evolution of BT's market capitalisation, book value of gross debt and gearing over the last 10 years. In recent years there have been several step changes in

[480] 2021 WFTMR Statement, A20.114.
[481] 2025 CEPA Report, page 12.
[482] Daily beta observations since the UK referendum i.e. 24 June 2018.
[483] 2025 CEPA Report, page 23.
[484] UKRN Guidance, Recommendation 9, Page 33.

BT's gross debt i.e. in January 2016 following its acquisition of EE and in October 2019 when IFRS 16 was first adopted. As the chart shows, recent levels of gearing are relatively high due to significant falls in market capitalisation. The steady increase in gearing explains the fall in the implied asset beta (Figure A19.2), while the overall equity risk (as measured by the equity beta) appears to have stayed fairly stable over CEPA's measurement periods (as shown in Table A19.7 above).[485]

Figure A19.3: BT Group gearing, market capitalisation and gross debt

Source: S&P Capital IQ Pro

A19.68 Over the last 10 years BT's gearing has been as low as 15% and as high as 73%.

A19.69 CEPA's proposed asset beta range for BT Group is based on de-levering two-year equity betas and therefore it presents 2-year gearing estimates for BT Group. CEPA's interquartile 2-year gearing range is between 44% and 62%.[486]

A19.70 For other comparators, CEPA estimated the interquartile 2-year gearing range as follows:

a) Vodafone was between 54% and 69%;[487]
b) European telecoms was between 24% and 46%;[488] and
c) UK utilities was between 49% and 54%.[489]

A19.71 We propose that a reasonable forward-looking gearing level for BT Group, consistent with our view of its systematic risk, would lie between 45% and 60%, which broadly aligns with the interquartile 2-year gearing range for BT Group.[490] While BT's current gearing is

[485] This assumes that the systematic risk taken by debtholders (as measured by the debt beta) has stayed constant.
[486] 2025 CEPA Report, page 13. Current gearing estimates also include IFRS 16 leases as debt, whereas longer-run averaging periods will partially exclude such leases as they were not part of reported debt prior to 2019.
[487] 2025 CEPA Report, page 14.
[488] 2025 CEPA Report, page 16.
[489] 2025 CEPA Report, page 18.
[490] If we exclude BT Group's recently issued hybrid securities this takes gearing down to closer to 60%. See paragraph A19.52 for discussion on BT Group's recently issued hybrid securities.

currently a little higher than the top end of this range, we have placed some weight on the lower levels of gearing associated with European telecoms benchmarks.[491]

A19.72 Although in general, we would expect gearing for BT Group to be below UK utilities as theoretically these companies can support higher levels of gearing with a similar credit rating, having the top end of our BT Group range above UK utilities reflects the fact that BT's actual gearing has been higher than UK utilities in recent years. We propose to use a forward-looking gearing assumption on 55%. This is slightly above the midpoint of the 45% - 60% range (i.e. 53%), as we place weight on the fact BT's gearing has been above both i) the midpoint of this range; and ii) UK utilities in recent years.[492]

Debt beta

A19.73 The debt beta is a measure of the exposure of debt holders in a firm to systematic risk. Generally, companies with higher gearing, lower credit ratings and/or more expensive debt commitments will tend to have higher debt betas. Debt betas are used to de-lever equity betas to estimate asset betas, and also to re-lever asset betas to estimate equity betas. In this consultation, we propose to use a debt beta of 0.075 in line with CEPA's approach to de-lever equity betas.[493]

Forward-looking equity beta proposal

A19.74 Given our proposals with respect to forward looking gearing, asset betas and the debt beta, the proposed forward looking equity beta is 0.93.[494] We note this estimate for the equity beta is in the 0.9 and 1.0 range, i.e. consistent with estimates of BT's equity beta set out in Table A19.7.

Corporate tax rate

A19.75 We require an estimate of the effective rate of tax BT faces as our WACC estimate is in pre-tax nominal terms. Typically, we would expect the statutory tax rate to be a reasonable approximation of the average effective tax rate faced by BT Group over the market review period. In its 2024 Annual Report BT said that it expects its sustainable effective tax rate before specific items to be around the UK rate of corporation tax.[495]

A19.76 We therefore propose to use the prevailing statutory corporate tax rate of 25% in this consultation.[496]

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[491] We also recognise that recent gearing also includes IFRS 16 leases. Given our approach to cost modelling i.e. where leases are still treated as operating expenditure, it makes sense to exclude IFRS 16 leases in our forward-looking gearing assessment. This has the effect of reducing gearing.

[492] If we were to adopt a higher forward-looking gearing (e.g. higher than 65%, which is around the latest one-year average for BT), we would need to consider if the debt beta assumption remains appropriate (moderating the increase in the cost of equity), and whether BT could sustain its current credit rating. As we noted, most European telecoms companies operate at lower gearing compared to BT's current gearing.

[493] 2025 CEPA Report, page 10.

[494] Equity beta = (asset beta – debt beta*gearing)/(1-gearing), so 0.93 = (0.46 – 0.075*55%)/(1-55%).

[495] BT Plc, 2024 Annual Report, Page 53.

[496] The main rate of corporation tax is 25%. See Corporation tax rates and allowances.

Our proposed WACC for BT Group

A19.77 Based on our proposals above the resultant pre-tax nominal WACC is 7.6% for BT Group.

A19.78 We invite stakeholders to comment on our overall approach to calculation of the BT Group WACC which as discussed above is the starting point for calculating the WACC for the relevant services.

A20. Cost of capital for the relevant services

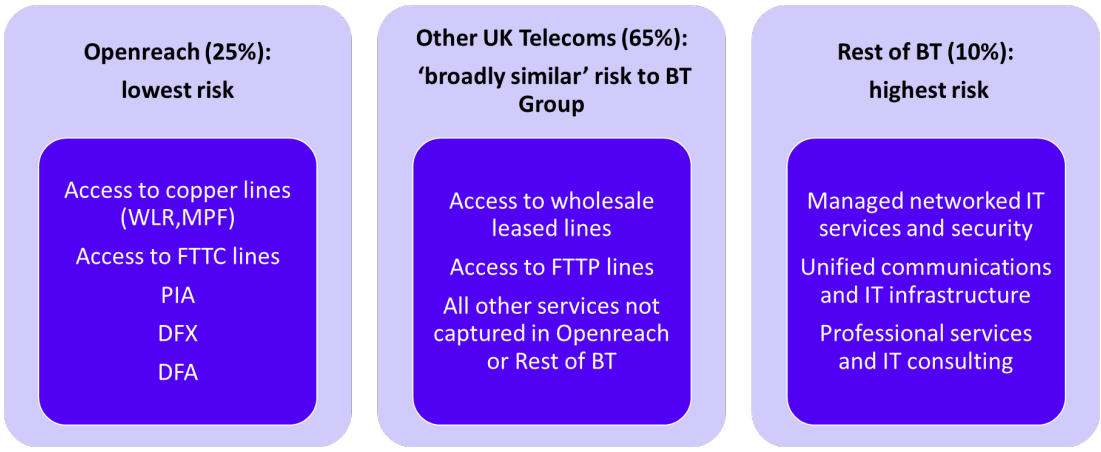
A20.1 In this annex we explain our approach to estimating the cost of capital for relevant services.[497] Generally, this means we disaggregate the BT Group cost of capital to estimate the appropriate rate of return for the relevant services.

Summary of our BT disaggregation approach

A20.2 In recent reviews we disaggregated the BT Group asset beta and cost of debt into three parts, based on our assessment of the relative risk of different services provided by BT.

A20.3 In the 2021 WFTMR Statement, we decided to keep the three parts of the BT Group disaggregation in line with our previous reviews but proposed some revisions to the services included in each and the weightings. The three broad categories are summarised in Figure A20.1.

Figure A20.1: Disaggregation approach used in 2021 WFTMR Statement[498]



A20.4 For this consultation, we propose to apply the same approach to disaggregation of the BT Group asset beta and cost of debt as set out in the 2021 WFTMR Statement.

Openreach

A20.5 We consider that the Openreach category should continue to capture services associated with lower systematic risk than BT Group overall. This category largely reflects risks associated with core connectivity to broadband networks, which are increasingly seen as a necessity by customers. Consistent with our approach in the 2021 WFTMR Statement, we propose to include access to copper only (i.e. MPF and WLR) and FTTC lines, PIA, DFA and DFX services in this category.

[497] Relevant services refer to regulated services and services that are not explicitly regulated but are modelled as part of our overall regulatory approach e.g. services in Area 3 RAB.

[498] We previously referred to the Openreach category as 'Openreach – copper' but now use 'Openreach' as shorthand as this category covers more than just copper services. For the avoidance of doubt, this category does not include all services that Openreach provides, only those we deem have lower systematic risk than the BT Group.

A20.6 In the 2021 WFTMR Statement the Openreach WACC was used for setting cost-based charge controls for DFX, DFA and for PIA services. We also used the Openreach WACC for the creation of the RAB in Area 3 and in some of our cross-checks in Area 2. We propose to use the Openreach WACC largely for the same purposes in this consultation. See Volume 4, Sections 2-4 for DFX, DFA and PIA cost-based charge controls and Volume 4, Section 1 for our Area 3 RAB approach. We also propose to use the Openreach WACC in modelling the revenues and costs for active legacy services (Annex 14).

Rest of BT (RoBT)

A20.7 We propose to continue to treat BT's ICT activities as sufficiently distinct from other telecoms services provided by BT, with an asset beta and WACC higher than BT Group. The RoBT WACC is not applied to any of the relevant services but provides a sense check on the other parts of our disaggregation.

Other UK Telecoms (OUKT)

A20.8 We propose that all remaining services (e.g. FTTP, cross market ancillaries) remain in OUKT, with an asset beta and WACC equal to BT Group. We recognise that the range of activities captured within the OUKT category is quite broad, and that the asset beta (and WACC) for BT's FTTP services could be higher than for OUKT. However, we explain below why we think it is reasonable to include FTTP in OUKT and, given we are not setting cost-based charges for FTTP services, for this review we propose not to disaggregate further.

A20.9 In the 2021 WFTMR we used the OUKT WACC for the creation of the RAB in Area 3, and in some of our cross-checks in Area 2. We propose to use the OUKT WACC largely for the same purposes in this review. See Volume 4, Section 1 for our Area 3 RAB approach. In addition, the OUKT WACC will be used for setting cost-based charge controls for Area 3 active leased line access circuits of bandwidths 1Gbit/s and below (Volume 4, Section 2) and for modelling the revenues and costs of active legacy services (Annex 14).

Summary of disaggregated WACC estimates

A20.10 Table A20.1 summarises our proposed disaggregated WACC estimates.

Table A20.1: Summary of WACC and component parameters

WACC component	Openreach	OUKT	RoBT	Source
Real (RPI-based) RFR	1.0%	1.0%	1.0%	See A19.29
RPI inflation forecast	2.5%	2.5%	2.5%	See A19.21
Nominal RFR	3.5%	3.5%	3.5%	= (1+ real (RPI-based) RFR)*(1+RPI inflation)-1
Real (CPI-based) TMR	6.7%	6.7%	6.7%	See A19.40
CPI inflation forecast	2.0%	2.0%	2.0%	See A19.21
Nominal TMR	8.8%	8.8%	8.8%	= (1+real EMR)*(1+CPI inflation)-1
Nominal ERP	5.3%	5.3%	5.3%	= Nominal TMR – Nominal RFR
Debt beta (βd)	0.075	0.075	0.075	See A19.73
Asset beta (βa)	0.40	0.46	0.65	See A20.65, A20.68 & A20.69
Weighting	25%	67%	8%	See A20.55, A20.56 & A20.57
Gearing (forward looking) (g)	55%	55%	55%	See A20.71
Implied equity beta (βe)	0.80	0.93	1.35	= (βa - βd*g)/(1-g)
Cost of equity (post-tax) (Ke)	7.8%	8.5%	10.7%	= Nominal RFR + ERP *βe
Cost of equity (pre-tax)	10.3%	11.3%	14.2%	= Ke / (1-t)
Corporate tax rate (t)	25%	25%	25%	See A19.76
Cost of debt (pre-tax) (Kd)	4.4%	4.6%	5.2%	See A20.77
WACC (pre-tax nominal)	**7.1%**	**7.6%**	**9.3%**	=(Ke*(1-g))/(1-t)+(Kd*g)
2021 WFTMR Statement	*7.0%*	*7.8%*	*10.2%*	

Source: Ofcom[499][500]

[499] Note: Intermediate calculations in general are unrounded, however we round the pre-tax cost of equity, pre-tax cost of debt and pre-tax nominal WACC to one decimal point.

[500] For comparison purposes, the UKRN annual update has previously reported real vanilla WACCs used by UK regulators (where the vanilla WACC represents a weighted average of the post-tax cost of equity and the pre-tax cost of debt) with respect to CPI. The real vanilla WACC (with respect to CPI inflation of 2.0%) is 3.8%, 4.2%, and 5.6% for Openreach, Other UK Telecoms and RoBT respectively.

Framework for assessing relative risk

A20.11 We propose to maintain the same framework for assessing relative risk as in the 2021 WFTMR Statement. We explain the key elements of this framework in this section.

A20.12 We disaggregate the BT Group asset beta, cost of debt and WACC to reflect differences in the systematic risk of the different activities within BT Group.

A20.13 The original evaluation framework for disaggregating the BT Group asset beta was established in 2005. [501] The two key aspects of this framework were:

- there were a priori reasons for why the systematic risk faced by the business in question would be different from that of the overall company (e.g. different income elasticities of demand and/or stability of cash flows); and
- there was evidence available to assess variations in risk.[502]

A20.14 Based on this framework we first split the BT Group beta in 2005 between Openreach's copper access network and the rest of BT (including in the latter voice call services, broadband and leased lines).[503] In the 2016 BCMR Statement, we further separated out services provided primarily by BT's Global Services division into a new 'Rest of BT' category, with all other services falling into 'Other UK Telecoms'.[504]

A20.15 The original decision to separate out only copper access was appropriate in a world where voice and internet access (dial-up or copper broadband) were sold as an "add-on" to basic copper line rental. To make calls or use an internet access service, customers needed to rent a copper line – which was separately charged for. We also reasoned (from historical demand estimation) that access services tended to have lower income elasticities of demand than call services which would imply a lower asset beta.[505]

A20.16 Given the decline in fixed voice usage and the integration of broadband with the line rental service (i.e. not sold as an overlay to fixed lines), we recognised in the 2021 WFTMR Statement that the previous access and usage distinction was becoming less relevant.[506]

A20.17 Based on the evidence around broadband usage, we noted in the 2021 WFTMR Statement that: i) broadband was becoming the 'basic building block' for communications services consumed at a fixed location, ii) customers were consuming ever more data (and hence

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[501] Ofcom's approach to risk in the assessment of the cost of capital, August 2005 (August 2005 Statement), paragraph 5.24.

[502] Examples included: a) it was possible to identify benchmark firms that were close to 'pure play' comparators in terms of having similar risk characteristics to individual projects within BT; b) it was possible to use other quantitative analysis (such as quantified risk assessments or the analysis carried out by PwC at the time on behalf of Ofcom to assess variations in risk); and c) data was available at a disaggregated level (e.g. via separated accounts).

[503] August 2005 Statement, paragraph 1.22.

[504] In the 2018 WLA Statement and the 2019 BCMR Statement we also expanded 'Openreach copper access' to include PIA and DFX respectively, and we now simply refer to this category as 'Openreach.'

[505] Ofcom's approach to risk in the assessment of the cost of capital - first consultation, January, paragraph 5.39 to 5.40.

[506] Evidence of this includes: a) In November 2017, the Advertising Standards Agency ruled that when targeting businesses Plusnet plc must ensure they make clear the overall monthly cost of their broadband packages, for instance by merging the monthly cost and line rental into one all-inclusive price. This ruling applies to all broadband providers; and b) In 2005 there were 7.5m homes with broadband whereas at the end of 2023 there were 28.5m broadband connections.(2005 Communications Market Review and Communications Market Report 2024: Interactive data - Ofcom).

required services capable of delivering that growing data usage) and iii) customers rarely downgraded their broadband service. Against this backdrop, we considered that systematic risk associated with overall broadband demand was likely to be relatively low, and that it would be appropriate to associate the basic building blocks of broadband, i.e. PIA, copper lines and FTTC in the lower risk Openreach category, alongside dark fibre products which support fixed broadband and mobile networks.

A20.18 It is within this context that we assess the relative risk of relevant services below.

A20.19 Consistent with our 2021 WFTMR Statement, we have considered where relevant services sit in the disaggregation by taking account of the following characteristics:

- **Systematic demand risk:** services that exhibit more demand risk (greater income elasticity of demand) would be expected to have higher asset betas while services that have less demand risk (i.e. services that are 'necessities') would have lower asset betas; and
- **Operating leverage: There is not one single measure of operating leverage**, but services that have greater operating leverage (i.e. require significant upfront investments or have a higher proportion of fixed costs) are more exposed to systematic risk and thus would have higher asset betas.[507]

A20.20 We have considered the above points on access versus usage, systematic demand risk and operating leverage to inform our assessment of in which disaggregated category (i.e. Openreach or OUKT) relevant services would best fit, not to precisely calculate differences in asset beta.

A20.21 Based on this framework, we first present our assessment of the relative risk of the different relevant services to inform our disaggregation, and then we discuss our proposals on the appropriate weights and asset betas for each disaggregated part of BT.

Relative risk assessment of relevant services

Relative Risk: PIA

A20.22 PIA services represent the basic building blocks supporting multiple downstream services and remain an essential input regardless of the medium of connection (copper or fibre) and regardless of the bandwidth consumed. We consider that operating leverage for PIA services is likely to be relatively low compared to BT Group as most of the PIA network is a sunk asset. We also consider systematic demand risk is likely to be low compared to BT Group as we would expect PIA services to have relatively stable demand from BT's downstream operations while external volumes (which currently represent a small proportion of total volumes) are expected to increase moderately over the control period.[508]

A20.23 Therefore, we consider PIA services would face lower systematic risk than BT Group overall and propose to put PIA services in the Openreach category consistent with our approach in 2021 WFTMR Statement.

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[507] Brealey and Myers, Principles of Corporate Finance. Chapter 10, 9th Edition, page 250.

[508] For example, per BT's 23/24 regulatory financial statements, external lead-in duct represented c.2% of total lead-in duct volumes in 2023/24. Therefore, even if external volumes increase moderately, overall volumes will not increase significantly in percentage terms.

Relative Risk: Copper based services

A20.24 In the 2021 WFTMR Statement we put copper and FTTC services in the Openreach category. This reflected our view that systematic demand risk for services over FTTC was likely to have converged with systematic risks previously associated with basic copper lines. We consider that the evidence continues to support our 2021 WFTMR Statement position. Indeed, the broadband market is currently centered on FTTC – in 2023/24 FTTC lines accounted for 63% of total Openreach lines (See Annex 14), which suggests an FTTC connection is the main reason that demand for copper access lines remains, i.e. as it allows consumers to obtain superfast broadband.[509]

A20.25 While we expect demand for FTTC to decrease as FTTP is rolled out, during most of the review period FTTC will continue to be the main way that many consumers use broadband. To the extent systematic demand risk for FTTC could be affected by the migration to FTTP, this will be mitigated in Area 3 at least by our RAB approach.

A20.26 We think an assessment of systematic demand risk would therefore support continuing to place copper and FTTC services in the Openreach category.

A20.27 In relation to operating leverage, in the 2021 WFTMR Statement we said that as commercial FTTC roll out was complete, we considered FTTC services were unlikely to be associated with higher operating leverage compared to copper only services. We also considered that evidence on profit margins suggested that operating leverage was unlikely to be a significant differentiating factor between FTTC and copper only services.[510] Updating this analysis on profit margins for our latest modelling is consistent with our position in the 2021 WFTMR Statement.[511]

A20.28 On this basis we consider an assessment of operating leverage supports FTTC and copper services being in the same disaggregation category (i.e. Openreach based on our assessment of demand risk).

A20.29 Based on the above analysis, we propose to continue including copper access and FTTC services in the Openreach category within our disaggregation.

[509] See Annex 14, Table A14.10 (sum of MPF + GEA FTTC, WLR+ GEA FTTC and SOGEA).

[510] 2021 WFTMR Statement, paragraph A21.38.

[511] Based on Ofcom modelling using our base year costs (excluding holding gains) for MPF and FTTC services, the allowed return accounts for [✂] of the cost stack for FTTC and [✂] for MPF, suggesting that operating leverage is unlikely to be a significant differentiating risk factor between the two services.

Relative Risk: Openreach copper network (copper/FTTC) and BT FTTP

A20.30 In our 2021 WFTMR Statement, we put FTTP in the OUKT category as we considered it would likely face higher systematic demand risk and operating leverage than 'copper-based' services.[512]

A20.31 We consider it remains reasonable to associate FTTP with higher systematic risk than copper-based services in this review period, though we expect this difference to reduce over time. Once the FTTP network is rolled out, and the copper network is retired, the FTTP network will become the only means of providing fixed connectivity to most premises in that exchange area (given our proposals to continue to support gradual withdrawal of copper-based services). This means that over the long run there is likely to be stable and enduring demand for core connectivity to broadband networks, and this demand will be increasingly met via FTTP networks (either built by Openreach or altnets).

A20.32 Evidence in relation to systematic demand risk for higher speed broadband is mixed. For example, in Annex 8 we note that despite price being a vital concern for customers, they are very unlikely to downgrade their broadband speed in the face of cost-of-living pressures or to save money. To convince a customer to downgrade their service, the price differentials have to be very large.[513] We also note the prices of FTTP services have reduced considerably since 2021 and prices for standalone fixed broadband FTTP services are much closer to the price of FTTC services despite the quality of services and average speeds being much better for FTTP. [514] On the other hand, we also find that family households and particularly affluent families, are the most likely to be engaging in high bandwidth or data intense activities such as streaming or gaming, which indicates they may require more expensive faster speed services.[515] To the extent that some customers are prepared to pay more for FTTP, this could be linked to levels of household income, suggesting some of the higher demand risk of FTTP compared to copper-based services could be systematic in nature.

A20.33 We also think it remains reasonable to assume FTTP currently faces higher operating leverage than copper-based services. FTTP is still in the build phase, with relatively low revenues but significant fixed cash outflows as the network is developed (implying relatively high operating leverage). This might point to greater sensitivity of cash flows and returns to macroeconomic shocks compared to FTTC and copper, and hence greater systematic risk. Rolling out new FTTP networks requires significant upfront cost. For example, in 2021 BT indicated that it could cost up to £15bn to roll-out FTTP to 25m homes over the following decade,[516] which is significant in the context of the value of the existing copper-based network (with an MCE of c.£10bn).[517] As we noted earlier, projects with a relatively higher proportion of fixed costs to overall project value would be expected to have higher asset betas. However, BT announced in 2024 that it had passed peak capital

[512] We call copper access and FTTC services 'copper-based' in the remainder of this annex.
[513] See Annex 8.
[514] See Volume 2, Section 2.
[515] See Annex 8.
[516] On 13 May 2021, BT announced it had decided to roll out to 5m additional homes (25m in total) for an estimated £15bn.
[517] Based on BT Regulatory Financial Statements 2024, page 21. Note: Sum of MCE for PIA (£7.15bn), WLA Area 2 (£4.89bn) and 3 (£2.90bn) markets less Fibre MCE (£5.12bn) in those markets.

expenditure on its FTTP rollout, which indicates operating leverage effects could reduce going forward.[518]

A20.34 On balance we consider that these factors suggest FTTP services could be associated with higher systematic risk than copper-based services during this review period. However, the extent to which the risk is higher is difficult to quantify. Comparing the systematic risk of FTTP to other services provided by BT Group is even more difficult.

A20.35 Within our current disaggregation framework, the OUKT category captures 'average risk' activities of telecoms companies, with the OUKT beta benchmarked to a wide sample of UK and European telecoms companies. FTTP networks are the future of fixed broadband connectivity, with incumbents in Europe at different stages of upgrading their fixed networks to FTTP and many altnets investing in new FTTP networks.

A20.36 Identifying an explicit beta for BT's FTTP services is difficult because of the absence of listed pure play FTTP comparator companies. As noted in the 2021 WFTMR Statement, any separate modelling to derive an explicit beta for FTTP requires significant assumptions, therefore using market evidence on betas for telecoms companies engaged in building FTTP networks, including BT, is a reasonable starting point. This is because, given the quantum of the investment and future importance of FTTP returns to BT, investors will likely place significant weight on expected FTTP returns when deciding to invest in BT. As such BT Group's asset beta will likely be heavily influenced by these expected future returns. Therefore, it seems reasonable to assume that the BT Group asset beta provides a reasonable starting point when considering the systematic risk associated with BT's FTTP services. On this basis, consistent with our approach in 2021 WFTMR Statement, we propose to include FTTP services within OUKT.

Relative Risk: leased lines (active and dark fibre)

A20.37 In the 2021 WFTMR Statement we included active leased lines in OUKT (both interexchange connectivity (IEC) and access services), and DFA and DFX in Openreach. We propose the same categorisation in this review, for the reasons set out below.

Active leased lines

A20.38 In previous reviews we included active leased lines in OUKT on the basis that some of the demand was driven by business customers, which might be more cyclical than demand from residential customers. This means the systematic demand risk for these services is likely to be higher than copper-based services. As such, we propose to retain this classification for this review and keep active leased lines in OUKT.

A20.39 With respect to the distinction between IEC and access active circuits, we recognise that demand drivers for IEC circuits might be slightly different to those for access circuits. If demand for IEC circuits is largely driven by backhaul requirements of other telecoms providers aggregating consumer and mobile data traffic, the overall demand risk could be lower compared to the demand for access leased lines.

A20.40 However, we are not proposing to set cost-based charges on IEC active circuits in this review. IEC circuits also account for a small percentage of total revenues and MCE (c.4% of Openreach SMP revenues and less than 1% Openreach SMP MCE), which means our proposal on which WACC to associate with IEC circuits will not materially affect the

[518] BT Group, Results for the full year to March 31 2024, 16 May 2024.

weightings.[519] Therefore, we propose to keep IEC active circuits in OUKT, together with access leased lines. Even if this slightly overstates the risk (and hence the WACC) for IEC circuits, this does not affect our approach to price regulation for these services or our proposed WACC for other relevant services.

DFX

A20.41 In the 2019 BCMR and 2021 WFTMR Statements we considered that passive leased lines were lower risk than active leased lines and put DFX services in the Openreach category. We reasoned that DFX services were associated with lower systematic risk because changes in bandwidth requirements in the access part of the network were unlikely to translate into significant changes in demand for DFX, since a single DFX connection could be used to serve foreseeable bandwidth requirements.[520] We continue to think this reasoning applies to DFX services and therefore propose to put these services in the Openreach category consistent with previous reviews.

DFA

A20.42 In the 2021 WFTMR Statement, we considered that DFA services were lower risk than active leased lines and put them in the Openreach category. We reasoned that DFA services were agnostic to bandwidth meaning they had low systematic demand risk and the cost structure meant there was no fixed expenditure on electronics meaning operating leverage was low.

A20.43 However, given DFA was a new service, we recognised it was difficult to predict all the ways DFA services could be used and therefore it was difficult to judge how the systematic demand risk of DFA services compared to active leased lines.

A20.44 As discussed in Volume 4, Section 2, DFA is still a relatively new service and take-up has been low to date.[521] Stakeholders have indicated that there are several barriers that have discouraged the take-up of DFA. DFA provides high bandwidth (VHB) users with greater benefits than active leased lines and is a more flexible input for downstream services compared to Openreach's active leased lines. We expect demand for DFA VHBs to increase over the forecast period as DFA appears to be particularly well-suited as a substitute for VHB connections, for example for providing connectivity to mobile base stations (i.e. mobile backhaul). [522]

A20.45 Given this, consistent with the 2021 WFTMR Statement, we propose to put DFA services within the Openreach category**.**

Cross market ancillaries

A20.46 Cross market ancillaries refers to services relating to cablelink, accommodation and electricity charges. Previously, cross market ancillaries have been implicitly included within OUKT as OUKT includes all relevant services not in the Openreach category. It is possible that systematic demand risk for some cross market ancillaries could be lower than other services included within OUKT as they are used to support delivery of other relevant services.

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[519] Ofcom analysis based on BT Regulatory Financial Statements 2023/24, Pages 17 and 21.
[520] 2019 BCMR Statement, Annex 21, paragraph A21.184.
[521] With one exception ([✂]), current users of DFA tend to be small and medium-sized business-focused telecoms providers.
[522] See Volume 4, Section 2.

A20.47 However, we are not proposing to set cost-based charge controls on cross market ancillaries in this review. They also account for a small percentage of total revenues and MCE (c.3% of Openreach SMP revenues and 1% Openreach SMP MCE), which means our proposal on **which WACC to associate with** cross market ancillaries will not materially affect the weightings.[523] Therefore, we propose to keep cross market ancillaries in OUKT.

Proposed disaggregation of services

A20.48 Table A20.2 summarises our proposals on the categorisation of the wholesale services subject to ex ante regulation in this review.

Table A20.2: Proposed categorisation of regulated wholesale services

Openreach	OUKT*	RoBT
Copper access lines, FTTC, DFA, DFX, PIA	LL active access circuits, LL IEC active circuits, FTTP, cross market ancillaries	N/A

**Note that the summary here excludes other wholesale and retail services (including mobile and pay-TV)*

Asset beta weights

A20.49 In the 2021 WFTMR Statement, to estimate the relevant weightings for our three-way disaggregation, we:

- Reviewed the preceding 5 years' average Openreach[524] EBITDA share of BT Group and net replacement cost of copper and FTTC services as a proportion of total enterprise value. From this we decided to use a 25% weighting for Openreach;
- Reviewed the preceding 5 years' average EBITDA share of BT Group for BT's ICT and managed network (ICT) activities. From this we attributed a 10% weighting to RoBT which captured BT's ICT operations; and
- used the remainder (65%) for the OUKT weighting (including FTTP services).

A20.50 Based on a review of updated evidence, we propose to maintain the same 25% weighting on Openreach but to slightly reduce the weighting on RoBT from 10% to 8%. The resulting weighting on OUKT is 67%.

Openreach

A20.51 Table A20.3 below reports weightings based on EBITDA and the ratio of net replacement cost to enterprise value (NRC/EV) for Openreach (as defined for the purposes of our disaggregation) as a proportion of BT Group.

Table A20.3 Estimated share of Openreach[525] within BT Group

	2019/20	2020/21	2021/22	2022/23	2023/24	5Y Average
EBITDA	31%	27%	20%	26%	28%	26%

[523] Ofcom analysis based on BT Regulatory Financial Statements 2023/24, Page 17.
[524] As defined in Table A20.2.
[525] As defined in Table A20.2.

	2019/20	2020/21	2021/22	2022/23	2023/24	5Y Average
Regulatory NRC/EV	30%	32%	28%	27%	27%	29%

Source: Ofcom analysis of BT Regulatory Financial Statements, BT Annual Reports and S&P Capital IQ Pro.

A20.52 In estimating the relevant weightings, we have considered the relative size of Openreach in relation to BT Group. On average over the five-year period the NRC/EV metric would imply 29% weighting for Openreach and the EBITDA metric 26%.

A20.53 For a steady state network, historical data may be a reasonable proxy for the future. However, we are concerned with forward-looking risks and weights of the various activities provided by BT.

A20.54 We expect changes in the mix of broadband lines offered by Openreach in the future, with the overall proportion of copper only and FTTC lines falling from around 82% (in 2023/24) to 26% (in 2030/31),[526] while the share of FTTP lines is expected to increase. This effect would point to selecting a lower value from the average of historical metrics in Table A20.3 and suggests that the ratio of NRC to EV for Openreach (as defined for the WACC) could be lower in the future.

A20.55 Taken in the round, we propose to attribute a 25% weighting to Openreach.

RoBT

A20.56 BT's ICT operations (which are captured in our RoBT disaggregated asset beta) are carried out by its Business division. To estimate the weightings of RoBT, we asked BT to provide EBITDA figures for the relevant ICT services. Our analysis suggests that over the past five years, EBITDA for BT's ICT services represented between [✂] of BT Group EBITDA and [✂].[527] This would imply a weighting of 10% on the RoBT. BT said it has started to carve out global activities from its Business division to focus on UK business.[528] It has also been reported that BT's global division is up for sale. The global business provides managed network, security and business solutions, enabling multinational organisations' digital transformations.[529] In February 2025, BT started this process with the sale of its wholesale and enterprise business unit in Ireland.[530] These factors indicate that BT's EBITDA from its ICT activities could decrease over the review period. As such we propose to place a slightly lower weighting on RoBT compared to the 2021 WFTMR Statement and propose a weighting of 8% for RoBT.

OUKT

A20.57 Given our proposed weights for Openreach and RoBT, the implied weight for OUKT is 67%.

[526] See Annex 14, Tables A14.10 and A14.11 (sum of MPF,WLR, WLR+SMPF, MPF + GEA FTTC, WLR+ GEA FTTC and SOGEA).
[527] BT Group response dated 18 December 2020 to question 1 of the s.135 notice dated 4 December 2020 (for 2019/20) and BT Group response dated 9 September 2024 to question I1 of the s.135 notice dated 19 August 2024 (for 2020/21 to 2023/24).
[528] BT Earnings call 11/7/2024.
[529] https://www.bt.com/about/bt/our-company/group-businesses/business.
[530] https://newsroom.bt.com/bt-enters-agreement-with-speed-fibre-group-for-the-sale-of-its-wholesale-and-enterprise-business-unit-in-ireland/

Asset beta by segment

Market evidence on comparator betas

A20.58 We commissioned CEPA to estimate asset betas for comparator companies. CEPA estimated the asset beta for each comparator against a home index[531] using different estimation windows (1,2,5 years) and averaging periods (spot, 1,2,5,10 years). CEPA said that spot betas, especially those estimated on short histories of data, can be volatile, and relying too heavily on them risks placing excessive weight on 'noise'. CEPA said the inclusion of averages over multiple lookback periods allows it to incorporate different views on how betas have changed over time.[532] CEPA placed most weight on 2-year betas following the UK referendum (for the reasons discussed in A19.63) when deriving their mechanistic ranges. They then adjusted some of these ranges based on qualitative factors as outlined in their report. We agree with the revisions to the mechanistic ranges based on the qualitative factors outlined in CEPA's report.

A20.59 Table A20.4 summarises the various estimates produced by CEPA.

Table A20.4 Asset beta and gearing for comparator groups

	Asset beta range	2-year gearing	
		IQ Range	Median
UK Utilities	0.30-0.35	49% - 54%	51%
Vodafone	0.30-0.50	54% - 69%	66%
European telecoms	0.30-0.50	25% - 46%	36%
ICT	0.65-0.93	8% - 20%	13%
BT Group	**0.42-0.50**	**44%-62%**	**59%**

Source: CEPA.[533] IQ range = interquartile range.

[531] UK listed companies were measured against the FTSE All Share Index and European telecoms and ICT companies against the Stoxx TMI ex-UK.
[532] 2025 CEPA Report, page 11.
[533] 2025 CEPA Report, pages 4, 14, 16, 18 and 19.

Our proposals

Asset beta for Openreach

A20.60 The Openreach category is meant to capture the lowest risk services provided by BT Group, which includes most of the wholesale regulated services offered over legacy network infrastructure.

A20.61 As in previous reviews, our starting point is that the appropriate asset beta would be below the beta for BT Group, but above that for UK utilities. The telecoms industry is characterised by greater technological innovation, and while the overall demand risk associated with core connectivity is likely to be low, we do not consider it would be as low as for a water or an energy network. The asset beta range proposed by CEPA for UK utilities is between 0.30 and 0.35, compared to the asset beta range of 0.42-0.50 for BT Group – the midpoint between the two is 0.40.[534]

A20.62 We would also expect the asset beta for Openreach to be below that of other UK telecoms providers, although we recognise that Vodafone is the only other UK listed telecoms company now. Vodafone is also an imperfect comparator as it derives a relatively small proportion of overall revenue from the UK (c.19%) and does not wholesale copper networks in any of the countries it operates.[535]

A20.63 CEPA's range for Vodafone is between 0.30 and 0.50 (midpoint 0.40).

A20.64 We also draw on the much larger sample of European telecoms companies. While BT appears to have a somewhat higher asset beta than most of its European counterparts, we think it unlikely that the asset beta for BT's least risky services (i.e. those in Openreach) would be above the midpoint of the range proposed by CEPA for an average European telecoms company (0.30 - 0.50, midpoint: 0.40).

A20.65 Given the asset beta ranges proposed by CEPA for Vodafone and European telecoms we propose to set the Openreach asset beta at the midpoint of the range between UK utilities and BT Group (i.e. 0.40). This also represents the midpoint of the European telecoms and Vodafone asset beta ranges.

Asset beta for OUKT

A20.66 In the 2021 WFTMR Statement we used an asset beta for OUKT of 0.62 which was equal to the BT Group asset beta. We thought this was reasonable as OUKT captures most of BT Group's activities. An asset beta of 0.62 was slightly lower than the asset beta used in the previous statement (2019 BCMR Statement), reflecting the downward trend in asset betas but it was in the asset beta range for European telecoms.

A20.67 Since the 2021 WFTMR Statement, telecoms asset betas (including BT Group) have declined significantly, in part due to increased gearing. Based on CEPA's report, EU telecoms' and Vodafone's asset betas are between 0.30 and 0.50.

A20.68 Given OUKT captures most of BT's activities (including FTTP services), we propose to continue to use the same asset beta for OUKT as used for BT Group (0.46). An asset beta of 0.46 reflects the decline in telecoms asset betas since the 2021 WFTMR Statement and is within the range for Vodafone and European telecoms companies.[536]

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[534] Based on the midpoint of both ranges, rounded to 1 d.p.

[535] For revenue analysis see Vodafone 2024 Annual Report, page 22.

[536] While the proposed OUKT asset beta is towards the top end of the European telecoms range, an asset beta lower than that for BT Group could imply a RoBT asset beta outside of a credible range.

Asset beta for RoBT

A20.69 Given our proposals on the relative weights and the asset betas for Openreach and OUKT, the resulting asset beta for RoBT is 0.65.[537] We note that CEPA's asset beta range for ICT companies is between 0.65 and 0.93 and therefore our estimate is at the bottom end of CEPA's range. We think it is appropriate to have a RoBT asset beta towards the lower end of the range given our gearing assumption (set out below) is higher than most ICT benchmarks.[538]

Gearing for each part of BT Group

A20.70 In the 2021 WFTMR Statement we revisited whether we should include a different gearing assumption for each constituent part of BT.[539] We recognised that lines of business with different levels of systematic risk could have different optimal gearing levels. However, we said that estimating different levels of gearing for different parts of BT introduced further judgement into the WACC estimation, which needed to be balanced against the likely materiality of assuming different levels of gearing on the overall WACC. Given the overall impact on the WACC would not be significant we decided that applying our estimate of BT Group gearing to each of the different parts of BT was reasonable and appropriate.

A20.71 We propose to maintain this approach and use a forward-looking gearing assumption of 55% across the different parts of BT.

Summary of asset beta disaggregation

A20.72 Table A20.5 summarises our proposals on asset betas, weights and gearing for different parts of BT Group.

Table A20.5: Summary of asset betas and gearing for the different parts of BT

	BT Group	Openreach	OUKT	RoBT
Asset beta	0.46	0.40	0.46	0.65
Debt beta	0.075	0.075	0.075	0.075
Weighting	100%	25%	67%	8%
Gearing (forward looking)	55%	55%	55%	55%
Implied equity beta	0.93	0.80	0.93	1.35

Source: Ofcom analysis

Disaggregation of BT Group cost of debt

A20.73 Consistent with previous market reviews, we consider that a firm facing lower systematic risk could attract a higher credit rating for a given level of gearing than a firm facing higher systematic risk. This implies that BT's services with lower systematic risk (i.e. those

[537] Given the relatively low weight on RoBT, the asset beta for RoBT is quite sensitive - e.g. a 0.01 reduction in the OUKT asset beta would increase the RoBT by c.0.08.
[538] We also recognised this in the 2021 WFTMR Statement, paragraph A21.112.
[539] 2021 WFTMR Statement, A21.117 to A21.123.

included within Openreach) would face a lower cost of debt than OUKT or the RoBT (at the same level of gearing).

A20.74 We propose to adopt the same as approach as in the 2021 WFTMR Statement:

a) Estimate the Openreach cost of debt by assuming it could achieve a one notch uplift to BT Group's credit rating;
b) Apply the BT Group cost of debt to OUKT (given we assume the systematic risk of OUKT is the same as BT Group); and
c) Derive the RoBT cost of debt by using the weightings from the asset beta disaggregation.

A20.75 BT Group is currently rated BBB. To estimate the Openreach cost of debt we have considered debt spreads for BBB and A-rated benchmark indices (10 years and 20 years).[540] Table A20.6 outlines the spread of different debt indices. Assuming a one notch uplift to Openreach from the BT Group rating, Openreach might be able to reduce its cost of debt by around 0.03 percentage points to 0.33 percentage points relative to BT Group.[541]

A20.76 We propose to take the midpoint of this range and therefore propose Openreach's cost of debt would be 0.2 percentage points (rounded to 1 decimal place) lower relative to BT Group.

Table A20.6: Spread between BBB and A-rated benchmark indices (10 years and 20 years)

	One-year average	Two-year average
BBB vs A ratings	0.12% to 0.69%	0.24% to 0.99%
UK Utilities BBB vs A ratings	0.10% to 0.66%	0.20% to 0.88%

Source: S&P Capital IQ Pro, Ofcom analysis using data to 31 October 2024. BBB indices are GBP - All Corporates – BBB and A - 10Y & 20Y. UK Utilities are GBP – Utilities – BBB & A – 10Y and 20Y.

A20.77 Based on a cost of debt for BT Group of 4.6% estimated for this consultation, we propose to use a cost of debt of 4.4% for Openreach and 4.6% for Other UK Telecoms. Based on the same disaggregation weightings used for the asset betas above, this implies a cost of debt of 5.2% for RoBT.[542]

Our proposal on the disaggregated WACC

A20.78 Table A20.7 summarises the pre-tax nominal WACC for each constituent part of BT Group under the three-way disaggregation approach based on the proposals above. We invite stakeholders to comment on our relative risk assessment and overall disaggregation approach.

[540] We propose to use corporate bond indices of 10- and 20-year maturities in line with our approach to calculate BT Group's cost of debt.
[541] There are effectively three ratings notches between BBB rated debt and A rated debt and therefore one-notch estimates have been derived by dividing the figures in the table by three.
[542] ROBT cost of debt is calculated for presentation purposes only since we do not regulate services supplied within what we describe as RoBT. 25% x 4.4% [Openreach] + 67% x 4.6% [Other UK Telecoms] + 8% x 5.2% [RoBT] = 4.6% [BT Group].

Table A20.7: Pre-tax nominal WACC for disaggregated lines of business

	Openreach	OUKT (same as BT Group)	RoBT
Pre-tax nominal WACC	7.1%	7.6%	9.3%

Source: Ofcom.

A21. Impact assessments

A21.1 In this Annex we explain where we have taken into account the impact of our proposals in this consultation, and set out the Equality Impact Assessment and the Welsh Language Impact Assessment in relation to the proposals in this Consultation, pursuant to our duties under the Communications Act 2003 (the "Act"), the Equality Act 2010 (the "2010 Act") and the Northern Ireland Act 1998 (the "1998 Act").

Impact Assessment

A21.2 Section 7 of the Act requires us to carry out and publish an assessment of the likely impact of implementing a proposal which would be likely to have a significant impact on businesses or the general public, or when there is a major change in Ofcom's activities.

A21.3 More generally, impact assessments form part of good policy making and we therefore expect to carry them out in relation to a large majority of our proposals. We use impact assessments to help us understand and assess the potential impact of our policy decisions before we make them. They also help us explain the policy decisions we have decided to take and why we consider those decisions best fulfil our applicable duties and objectives in the least intrusive way. Our impact assessment guidance sets out our general approach to how we assess and present the impact of our proposed decisions.

A21.4 The relevant duties in relation to the proposals on which we are consulting are set out in Volume 1 and Annex 5. The proposals apply to fixed telecoms markets and underpin broadband and business connections, and the connections used by communications providers, including mobile operators, to support their services.

A21.5 In line with our strategy since 2016, our proposals are designed to continue to promote competition and investment in high quality gigabit-capable networks.

A21.6 Since the WFTMR21, we have seen significant progress towards achieving the objectives set out in our strategy, as detailed in Volume 3, Section 1, and we expect our proposals in this review to result in continued investment and further development of network competition.

A21.7 The network competition we are seeking to promote should bring longer term benefits from innovation, choice, and stronger incentives to price keenly to attract customers and to further improve quality of service, as set out in more detail in Volume 3, Section 1.

A21.8 Investment in faster, more reliable, future-proof networks has a direct positive impact on consumers and businesses that use these networks for work, accessing public services and entertainment, while also driving economic growth, as set out in more detail in Volume 3, Section 1. We therefore expect our proposals to have an overall positive impact for all businesses and consumers.

A21.9 Below, for the purpose of section 7 of the Act, we provide an overview of our proposed remedies and identify the specific sections of the document where we have undertaken a detailed assessment of the likely impact of each of our proposed remedies.

General remedies

A21.10 As set out in Volume 3, Section 4, we are proposing to retain the existing suite of general remedies in all markets where we have provisionally identified BT to have SMP. The primary general remedy is a requirement on Openreach to provide access to its network on reasonable request. The proposed general remedies also include non-discrimination requirements to ensure that Openreach does not unduly discriminate between different customers when supplying access products.

A21.11 The analysis of the likely impact of our proposals for general remedies is presented in Volume 3, Section 4. For the requirement to provide access on reasonable request see Paragraphs 4.7-4.10, and for EOI and non-discrimination see Paragraphs 4.48-4.55.

Physical Infrastructure Access

A21.12 As set out in Volume 3, section 5 and Volume 4, Section 4, we propose to maintain the requirement on Openreach to offer wholesale access to BT's duct and poles (known as PIA), our key upstream remedy.

A21.13 We propose to continue to charge-control PIA at cost, to ensure that other network providers have access to PIA services on terms that provide a level playing field with Openreach's own use while allowing Openreach to recover its costs. We also propose to maintain our approach of requiring it to be provided subject to a strict no undue discrimination obligation.

A21.14 The analysis of the likely impact of our proposals for the physical infrastructure access market is presented in Volume 3, Section 5, Paragraphs 5.13-5.21, and Volume 4, Section 4, Paragraphs 4.37-4.38 and 4.70-4.71.

Wholesale Local Access

A21.15 As set out in Volume 3, section 6 and Volume 4, Section 1, in addition to the general network access requirement set out above, we propose a specific requirement on Openreach to offer WLA products (MPF and VULA) in WLA Area 2 and Area 3.

A21.16 In WLA Area 2, we propose a pricing continuity approach to set an inflation-indexed charge control on MPF and FTTC 80/20 rentals (or FTTP 80/20 rentals where a copper-based service is not available).

A21.17 In WLA Area 3, we propose to continue to adopt a RAB approach to provide pricing continuity by setting an inflation-indexed charge control on MPF and FTTC 80/20 rentals (or FTTP 80/20 rentals where a copper-based service is not available).

A21.18 Finally, given the potential incentive on Openreach to seek to stifle the emergence of new competitors, we propose to prohibit geographic pricing within WLA Area 2 for wholesale broadband rental charges, connection charges and retail inducements which amounts to undue discrimination. We are also proposing that Openreach is required to notify certain proposed commercial terms.

A21.19 The analysis of the likely impact of our proposed remedies for WLA is presented in Volume 3, Section 4, Paragraphs 6.11-6.19. The analysis of the likely impact of the proposed charge controls on MPF and FTTC 80/20 rentals (or FTTP 80/20 rentals where a copper-based service is not available) is set out in Volume 4, Section 1, Paragraphs 1-37-1.70 and the analysis of the likely impact of our proposal on geographic pricing within WLA Area 2 and Openreach's notification requirement is presented in Volume 3, Section 9, Paragraph 9.105.

Copper retirement

A21.20 As set out in Volume 3, Section 2, we propose to maintain our existing approach to copper retirement in this market review, which entails a gradual deregulation of Openreach's WLA copper-based services using thresholds based on Openreach coverage in each exchange area.

A21.21 The analysis of the likely impact of our proposals for copper retirement is presented in Volume 3, Section 2, Paragraphs 2.30-2.62, 2.98-2.114.

Exchange exit

A21.22 In Volume 3, Section 3 we note the ongoing commercial negotiations between Openreach and providers, which we will continue to monitor. We propose to maintain our existing suite of regulation to mitigate risks to competition and consumers during the review period. In particular, we are maintaining our regulation in relation to MPF. In relation to IEC, we also propose changes to the SMP conditions to ensure the obligations to provide DFX and active IEC services cease when telecoms providers have exited an exchange.

A21.23 The analysis of the likely impact of our proposed approach to exchange exit is presented in Volume 3, Section 3, Paragraphs 3.44-5.57.

Leased Line Access

A21.24 As set out in Volume 3, Section 7, we propose to continue to require Openreach to offer active leased lines in the LLA Area 2, LLA Area 3 and the HNR area.

A21.25 In LLA Area 2, we propose to maintain our existing approach to remedies (a CPI-0% charge control on active leased lines, and no requirement to provide dark fibre access (DFA)).

A21.26 In LLA Area 3, we propose to retain our requirement for Openreach to offer cost-based DFA. We also propose to amend the existing charge control on active LL to set a cost-based charge control on lower bandwidth services, and to retain a CPI-0% control on very high bandwidth services.

A21.27 Finally, we propose to continue to prohibit geographic pricing which is unduly discriminatory and require Openreach to notify certain commercial terms that are conditional on the volume/range of services purchased in LLA Area 2.

A21.28 In the HNR Area, we propose to maintain our position that Openreach charges should be subject to a fair and reasonable requirement only.

A21.29 The analysis of the likely impact of our proposed remedies for LLA is presented in Volume 3, Section 7, Paragraphs 7.13-7.16, 7.37-7.40, 7.45-7.55 and 7.63-7.64. The analysis of the likely impact of the proposed LLA and DFA charge controls is set out in Volume 4, Section 2, Paragraphs 2.14-2.30 and the analysis of the likely impact of our proposal on regulating discounts and other commercial terms is presented in Volume 3, Section 9, Paragraph 9.105.

Inter-exchange connectivity

A21.30 We propose to maintain the requirement on Openreach to provide active IEC services from all regulated exchanges. We also propose to extend the DFX remedy to all regulated exchanges.

A21.31 We propose a cost-based charge control on DFX at BT Only exchanges and BT+1 exchanges. We also propose to maintain a CPI-0% charge control on all active IEC services at both BT Only and BT+1 exchanges.

A21.32 The analysis of the likely impact of our proposed remedies for IEC is presented in Volume 3, Section 8, Paragraphs 8.12-8.18 and 8.30-8.42. The analysis of the likely impact of our proposed charge controls for active IEC services and DFX is presented in Volume 4, Section 3, Paragraphs 3.45-3.57.

Quality of Service (QoS)

A21.33 As set out in Volume 5, we propose to make an adjustment to our existing minimum QoS standards on Openreach's FTTC and MPF network access products[543] in WLA Area 2 and WLA Area 3. For the obligations on Openreach to comply with QoS standards for FTTC/MPF installations and repairs, we propose keeping the same standards applied UK-wide[544] but that Openreach is no longer required to meet these standards in each of seven management regions. We propose to continue to require Openreach to report on its performance in installing and repairing FTTC/MPF connections by management region as well as the UK as a whole.[545]

A21.34 We propose introducing new minimum QoS standards on FTTP in WLA Area 3 from 1 April 2027 using the same metrics which we have found effective for regulating legacy copper-based network access products but set at levels adjusted to the specifics of the product and geography. We propose to enhance transparency and reporting requirements on Openreach's performance in installing and repairing FTTP in WLA Area 2 and 3 including, specifically, in relation to how Openreach performs in delivering more complex FTTP installations.

A21.35 The analysis of the likely impact of these proposed QoS remedies in WLA markets is presented in Volume 5, Section 3.

A21.36 We propose retaining existing minimum QoS standards for LLA Area 2, LLA Area 3 and IEC BT Only and BT+1 exchange markets and associated transparency and reporting obligations.

A21.37 The analysis of the likely impact of our proposed QoS remedies in LLA and IEC markets is presented in Volume 5, Section 4.

Regulatory financial reporting

A21.38 As set out in Volume 6, we propose to continue to impose financial reporting obligations on BT. We also propose an accounting separation obligation and cost accounting obligations.[546]

A21.39 The analysis of the likely impact of our proposed remedies for regulatory financial reporting is presented in Volume 6, Section 3.

[543] Including Openreach's G.fast, SOGEA, SOG.fast and SOTAP products.
[544] Excluding the Hull Area so meaning the whole of WLA Area 2 and 3.
[545] Excluding the Hull Area.
[546] We also propose a set of five directions to implement our detailed regulatory reporting requirements.

Equality Impact Assessment

A21.40 Section 149 of the Equality Act 2010 (the "2010 Act") imposes a duty on Ofcom, when carrying out its functions, to have due regard to the need to eliminate discrimination, harassment, victimisation and other prohibited conduct related to the following protected characteristics: age; disability; gender reassignment; marriage and civil partnership; pregnancy and maternity; race; religion or belief; sex and sexual orientation. We refer to groups of people with these protected characteristics as 'equality groups'. The 2010 Act also requires Ofcom to have due regard to the need to advance equality of opportunity and foster good relations between persons who share specified protected characteristics and persons who do not.

A21.41 Section 75 of the Northern Ireland Act 1998 (the "1998 Act") also imposes a duty on Ofcom, when carrying out its functions relating to Northern Ireland, to have due regard to the need to promote equality of opportunity and have regard to the desirability of promoting good relations across a range of categories outlined in the 1998 Act. Ofcom's Revised Northern Ireland Equality Scheme explains how we comply with our statutory duties under the 1998 Act.

A21.42 To help us comply with our duties under the 2010 Act and the 1998 Act, we assess the impact of our proposals on persons sharing protected characteristics and in particular whether they may discriminate against such persons or impact on equality of opportunity or good relations.

A21.43 When thinking about equality we think more broadly than persons that share protected characteristics identified in equalities legislation and think about potential impacts on various groups of persons (see paragraph 4.7 of our impact assessment guidance).

A21.44 In particular, section 3(4) of the Communications Act also requires us to have regard to the needs and interests of specific groups of persons when performing our duties, as appear to us to be relevant in the circumstances. These include:

A21.45 the vulnerability of children and of others whose circumstances appear to us to put them in need of special protection;

a) the needs of persons with disabilities, older persons and persons on low incomes; and

b) the different interests of persons in the different parts of the UK, of the different ethnic communities within the UK and of persons living in rural and in urban areas.

A21.46 We examine the potential impact our policy is likely to have on people, depending on their personal circumstances. This 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 and identity.

A21.47 In this Equality Impact Assessment, we have identified the policy proposals which we consider more likely to have an impact on equality groups. These are our proposals which relate to the general investment in gigabit-capable networks, copper retirement and exchange exit. We do not consider that the other policy proposals regarding the WLA market, the IEC market, the LLA market and the physical infrastructure market will affect any specific groups of persons (including persons that share protected characteristics under the 2010 Act or the 1998 Act) differently to the general population.

Investment in gigabit-capable networks across the UK

A21.48 Our strategy and the regulatory stability that we have provided since the last review of the wholesale fixed telecoms market in 2021 has supported significant build by a wide range of companies, putting the UK on course to deliver wide availability of gigabit-capable networks. Since May 2021, the number of premises with access to full-fibre has increased from 6.9m premises (24%) to 20.7m (69%) in July 2024, while coverage of gigabit-capable networks has increased from 11.6m premises (40%) to 25m premises (83%).[547]

A21.49 Full-fibre coverage in each of the four nations has also risen well above 50%, with Northern Ireland having the highest level of full-fibre coverage of the four nations at 93%.[548]

A21.50 Our proposals seek to promote continued investment in the deployment of gigabit-capable networks and network competition between gigabit-capable networks where this is viable. In the long term all consumers and businesses will benefit from the higher speed and better-quality services provided by gigabit-capable networks, as described in Volume 1, Section 1, Paragraph 2.10. As a result, we expect our proposals to have a positive impact on all consumers, including those in equality groups.

A21.51 We expect further network build in both urban and rural areas, with some operators increasingly turning their attention in the 2026-31 review period to premises that are harder-to-reach and/or more costly.

A21.52 We recognise that private sector investment in gigabit-capable networks is unlikely to deliver everywhere. We acknowledge that consumers living in hard-to-reach rural areas and in nations with a significant proportion of the population living in these areas may experience a slower roll-out or may not benefit from the same level of investment compared to urban areas.

A21.53 We have considered ways to mitigate these potential impacts. For the consumers living in areas where the roll-out might be slower, we have proposed that existing services will remain in place until gigabit-capable services are made available. As a result, while it may take longer for these areas to see the benefits of new network deployment, both the existing copper-based network and the QoS requirements that they are subject to, ensure that services remain in place and are provided to an appropriate level of quality.

A21.54 For the consumers living in areas that are unlikely to see the emergence of competing networks, our proposals are intended to promote competition based on access to Openreach's network which allows downstream providers to offer consumers a choice of retail services. To provide these consumers with the benefits of an upgraded network and improved services and thereby mitigate the potential impacts on them, in these areas we seek to promote investment by Openreach in gigabit-capable networks. Additionally, we propose to set minimum QoS standards on Openreach FTTP in these areas, as a backstop to ensure the quality of their service is not degraded due to a lack of network competition, as set out in Volume 5.

A21.55 We also note that we expect consumers living in rural areas and some nations and regions of the UK to benefit from public subsidy programmes. To date, these have delivered significant gigabit-capable build across hard-to-reach areas often located in rural settings in the UK.

[547] Ofcom. 2021. Connected Nations 2021; Ofcom. 2024. Connected Nations 2024. These figures are based on coverage of residential premises.
[548] See fn. 5 above.

Copper retirement/eventual withdrawal of legacy services

A21.56 Over time, customers currently using Openreach's legacy copper-based networks will migrate, either to Openreach's FTTP network or to rival networks. Eventually Openreach's copper-based network can be decommissioned to avoid the costly running of two parallel networks. We want our regulation to support a smooth transition away from Openreach's copper-based network, while facilitating the wider objectives of this review. Consistent with the approach taken in the WFTMR21, we propose that our regulation should continue to support this transition by progressively transferring regulation (including price protections) from copper to FTTP services, as set out in Volume 3, Section 2.

A21.57 We consider that in the long term the transition from copper to FTTP services that our proposals facilitate is likely to have a positive impact on all consumers, including those in equality groups. Consumers will ultimately benefit from being moved off ageing technology which is at higher risk of faults.[549] More generally, in the longer term we expect that any savings made from Openreach decommissioning the copper-based network will flow down to consumers on its network.

A21.58 However, in the short term, we recognise that our proposal for the regulatory transition from copper-based broadband services to FTTP-based broadband services may have an adverse impact on some equality groups. In particular, it may impact older consumers and people from different socio-economic groups/backgrounds, including those that might be financially vulnerable, due to the general risks that are associated with migrations and to the risk of higher retail prices for copper-based and FTTP services, as we explain below.

A21.59 As set out in Volume 3, Sections 2, the detail of our framework for the regulatory transition from copper to FTTP services provides Openreach with the tools to stop selling new copper-based services and, at least two years later, to raise wholesale prices on copper-based services at premises where FTTP is available, in exchange areas where Openreach has reached complete coverage (less exclusions) (this is known as the 'second threshold').

A21.60 The migration to FTTP that our proposals facilitate enables the withdrawal of the supply of copper-based access services by Openreach. As experience from the PSTN retirement shows, ceasing services is complex, involves significant risk to some consumers and needs to be effectively managed, particularly for vulnerable consumers. The migration to FTTP might therefore negatively impact consumers, especially the most vulnerable ones.

A21.61 Additionally, when the second threshold is met Openreach will have the ability to increase price for copper-based network access at the wholesale level to incentivise a transition to ultrafast services, and this may lead to higher retail broadband prices for copper-based services. Increases in retail prices for copper-based services may have an adverse impact on people from different socio-economic groups/backgrounds, including those that might be financially vulnerable who already find it difficult to afford fixed broadband service.[550] Higher retail prices may also have an adverse impact on consumers who are at least 65 years old, as they are significantly more likely to report having standard broadband than people who are under-65s. [551] [552]

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[549] Ofcom. 2023. Connected Nations 2023. Page 60.
[550] Ofcom. 2024. Communications Affordability Tracker.
[551] Ofcom. 2024. Technology Tracker 2024. QE12, Table 149.
[552] Standard broadband refers to broadband provided through a phone line or cable service – which is not superfast, so the download speed is less than 30Mbps, as per the definition provided in the Technology Tracker 2024 (Table 149).

A21.62 We have considered the following ways to mitigate these potential impacts:

- To protect consumers from the risks associated with migrations, we are adopting a gradual process in the transition of regulation from copper-based broadband services to FTTP-based services.
- We propose to retain the existing requirement for Openreach to publish and provide Ofcom with four notifications at specified points in the process of transition for each local exchange area, as detailed in Volume 3, Section 4, Paragraph 1.130. This will allow ISPs to plan for and mitigate impacts on end-users, especially the most vulnerable ones, on an exchange-by-exchange basis.
- We are seeking industry views on how best to protect vulnerable consumers in the context of our regulatory support for copper retirement, where, for example, FTTP is available, but there is a barrier to these customers migrating and the Second Threshold Notice has been issued, as set out in Volume 3, Section 2, Paragraph 2.103-2.104.
- We propose to set charge controls on Openreach's wholesale charges, as set out in Volume 4, Section 1, which will in turn protect consumers from price rises for copper-based and FTTP services at the retail level. The charge controls will apply to legacy copper services (in particular MPF and the FTTC 80/20 product), where these remain widely available, but will transition to the FTTP 80/20 anchor product as Openreach progresses its copper retirement in each area.[553]

A21.63 In addition to the above, financially vulnerable consumers may also be eligible for social tariffs, i.e. cheaper broadband and phone packages that can help households to afford their communications services and thereby mitigate the potential negative impacts stemming from higher retail prices.[554]

Exchange exit

A21.64 During this review period Openreach will start to exit exchanges and is currently negotiating with providers on specific terms of exit in the Priority 108 exchanges that are due to close in the 2026-31 review period, as discussed in Volume 3, Section 3. We are broadly supportive of the exchange exit programme, which should provide the opportunity for both Openreach and other providers to move to a more cost efficient and sustainable network which should flow through to benefits for all UK consumers and citizens in the long term.

A21.65 However, in the short term we recognise that Openreach's exchange exit programme may have an adverse impact on consumers relying on copper broadband services served from the local exchange, specifically broadband provided on MPF.

A21.66 If MPF lines were ceased to facilitate exchange exit, consumers might lose access to the services provided over MPF lines. This might disproportionately affect people with disabilities and older people, as they are more likely to be slower to migrate to FTTC/FTTP services.

[553] We are proposing that charge controls will apply to FTTP when Openreach meets the First Threshold, and charge controls will be removed from copper-based services at premises where FTTP is available when Openreach meets the Second Threshold. See Volume 3, Section 2 for further details, including the definition of the First Threshold and Second Threshold.

[554] Ofcom. 2024. Affordability of communications services.

A21.67 To mitigate the potential impacts of Openreach's exchange exit programme and protect consumers from losing access to services provided over MPF lines, we propose to retain our existing regulation on MPF. This means Openreach will not be able to unilaterally withdraw these services.

A21.68 However, we consider that Openreach has the levers it requires to achieve exchange exit by reaching commercial agreement with providers to stop using MPF and to migrate consumers on MPF lines to an alternative product. The need for agreement from providers in this process should mean that end users' needs are taken into account and vulnerable consumers are better protected.

A21.69 We are aware that Openreach is currently in negotiation with providers on commercial terms for exchange exit. We expect Openreach and providers to work together in good faith to identify solutions to support the transition away from the current exchange footprint allowing for the benefits of exchange exit to be realised while also delivering good outcomes for all consumers, including those in equality groups.[555]

A21.70 In addition, the requirement to provide MPF access may be disapplied in circumstances where Ofcom provides consent. We would consider any request for consent by Openreach on a case-by-case basis taking into account the particular circumstances at the relevant time, in accordance with our duties. We would likely take into account a number of factors in deciding whether to consent in any particular instance, including potential impacts on vulnerable consumer groups, and any protections that have been put in place for them.

Welsh language impact assessment

A21.71 The Welsh language has official status in Wales. To give effect to this, certain public bodies, including Ofcom, are required to comply with Welsh language standards in relation to the use of Welsh, including the general principle that Welsh should not be treated less favourably than English in Wales. Accordingly, we have considered the potential impact of our review on (i) opportunities for persons to use the Welsh language; and (ii) treating the Welsh language no less favourably than the English language. To the extent we have discretion in the formulation of our proposals in this Consultation, we have considered the potential impacts on opportunities to use Welsh and treating Welsh no less favourably than English where relevant. We do not consider that, under our SMP powers, we are able to specify a language requirement in relation to Openreach's publication requirements as set out in Volume 3, Section 2 and Section 4 and in Volume 5, Sections 3 and 4. However, noting that Openreach operates across the United Kingdom, we invite Openreach to consider the needs of its customers in Wales. To this extent, we consider our proposals are likely to have positive effects or increased positive effects on opportunities to use Welsh and treating Welsh no less favourably than English.

Consultation question(s)

[555] We consider that the additional measures set out by Ofcom in the General Conditions of Entitlement and associated Guidance issued in relation to the planned retirement of the public switched telephone network (the PSTN switch-off) will also contribute to the mitigation of the adverse impacts that may result from the removal of copper-based products following the closure of an exchange.

Question A21.1: Do you agree with our assessment of the potential impacts on specific groups of persons? Please provide reasons for your response, with any supporting evidence.

Question A21.2: Do you agree with our assessment of the potential impacts on Welsh language? Please provide reasons for your response, with any supporting evidence.

A22. Glossary

This annex aims to define many of the terms found in the main document, especially terms relating to telecoms regulations. The reader is also advised to refer to Annex 6: Overview of telecoms networks for more details on the technical aspects which underpin telecoms networks.

Term	Description
2014 EC Recommendation	The 2014 European Commission (EC) Recommendation on relevant product and service markets.
2022/23 restated CCN data	The 2022/23 restated data within BT's published 2024 Change Control Notification (CCN).
2022/23 published RFS	The 2022/23 information reported in the Regulatory Financial Statements (RFS) which BT produced in July 2023, under the obligations contained in its SMP conditions.
5G	The term used to describe the fifth generation of mobile networks beyond 4G Long Term Evolution (LTE) mobile networks. 5G is expected to deliver faster data rates, lower latency and a better user experience.
Access aggregation node	Telecoms equipment, at an operational building (such as at a local exchange), used for the purpose of aggregating traffic from multiple customer sites within a local area.
Access Change Notice (ACN)	A notice issued by Openreach of any amendment to the charges, terms and conditions on which it provides network access, or in relation to any charges for new network access.
Access connections	Connections between customer premises and an access aggregation node or between customer premises.
Access network	Access network provides the connection between an access aggregation node and a customer site or an end-user site. This connection may comprise of various elements including a customer lead-in, network flexibility point, network termination equipment, series of cables, and other network connections and equipment (e.g. at a footway box, on a pole, within a street cabinet, or in an operational building).
ADSL (Asymmetric Digital Subscriber Line)	ADSL is a technology with download speeds of up to 24 Mbit/s which uses copper wires to connect the local exchange to a customer. ADSL is asymmetric, which allows higher speeds in the downstream direction (towards the customer) compared to the upstream direction (towards the local exchange).
AFI (Additional Financial Information)	Detailed financial information provided in confidence to Ofcom as part of BT's Regulatory Financial Statements.

Term	Description
AISBO (Alternative Interface Symmetric Broadband Offering)	Legacy name for a CI leased line – symmetric refers to the same upload and download speeds on the same line, rather than asymmetric which is typically used in residential broadband where download speeds are typically faster than upload speeds.
Altnet	Altnet is short for alternative network provider which is not Openreach or Virgin Media O2. An altnet is an organisation operating within the UK that builds its own network infrastructure for wholesale and/or retail provision of broadband services. Some altnets also offer leased lines services.
AMD (Accounting Methodology Document)	A document prepared by BT which sets out the methodologies used to attribute its costs to prepare the Regulatory Financial Statements.
Anchor pricing	An approach that sets the upper bound for charges of existing services by reference to the cost of providing those services using existing technology. This ensures that the introduction of new technology which is intended to provide a greater range of services does not inappropriately lead to an increase in the cost of the existing services.
ATI regulations	Access to Infrastructure (ATI) regulations set out measures intended to reduce the cost of deploying high-speed electronic communications networks (capable of delivering broadband access services at speeds of at least 30 Mbit/s). These measures include sharing the physical infrastructure of telecoms network providers as well as infrastructure operators in other sectors including gas, electricity, water and sewage and drainage systems, heating and transport services.
AVE (Asset Volume Elasticity)	The percentage increase in capital costs required for a 1% increase in volume.
Backhaul	A transmission link within a telecommunications network, typically connecting: an access aggregation node to a backhaul aggregation node, between backhaul aggregation nodes, or from a backhaul aggregation node to a core network node.
Bandwidth	Bandwidth typically refers to the capacity of a transmission link i.e., it is the maximum amount of data that can be transmitted over a transmission link in a given period of time. Often expressed in Mbit/s or Gbit/s.
Basket	A term used in relation to the structure of charge controls, where the charge control is applied to the total revenue from a group of services in a given year, subject to a specified compliance formula.

Term	Description
BDUK	Building Digital UK. An executive agency of the UK government (Department of Science, Innovation and Technology), providing government assistance to help deliver fast and reliable broadband and mobile coverage to hard-to-reach places across the UK.
Bearer	A transmission link that carries one or more multiplexed smaller capacity connections. For example, if a system using wavelength-division multiplexing (WDM) technology is used to carry several 1 Gbit/s services over a single fibre connection, we would consider the WDM system as the bearer.
BEREC	Body of European Regulators for Electronic Communications.
BES (Backhaul Ethernet Services)	A legacy Openreach Ethernet service providing high bandwidth inter-exchange connectivity, superseded, for example, by Openreach's EBD and EAD products.
Broadband	Broadband commonly refers to high-speed internet access that is faster than legacy (narrowband) dial-up access.
BT	British Telecommunications plc.
BT Cablelink - External	A legacy BT product, which was designed to provide a connection for external (outside) use. The external part was superseded by Cablelink External in 2005.
BT CCN (Change Control Notification)	BT's annual publication of methodology changes affecting the Regulatory Financial Statements.
Business customer site	A business customer site to be served by a telecoms provider. For example, a business premises or a mobile base station.
Cablelink External	A fibre cable connecting to a telecoms provider's equipment within a BT exchange to a network 'just outside' the BT exchange via an external Openreach footway box. This is also referred to by Openreach as an External Cablelink product.
CAGR	Compound Annual Growth Rate, typically quoted as a percentage.
CAPM	Capital Asset Pricing Model.
Capex (Capital Expenditure)	The firm's capital investment in fixed assets.
CCA (Current Cost Accounting)	An accounting convention, where assets are valued and depreciated according to their current replacement cost while maintaining the operating or financial capital of the business entity.
CDD (Contractual Delivery Date)	A date provided by Openreach to a telecoms provider on which Openreach contracts for an order to become a completed order.

Term	Description
Certainty	A QoS standard based on the percentage of orders completed on or before initial Contractual Delivery Date (iCDD).
CI (Contemporary Interface)	A set of modern technologies used for delivery of leased line services (e.g. Ethernet, wavelength-division multiplexing) superseding legacy traditional interface (TI) services. May also be referred to as CISBO (CI symmetric broadband offering) in some previous regulatory documents.
CLA (Central London Area)	A geographic market in central London as defined by Ofcom (see main report).
CNI (Critical national infrastructure)	Infrastructure supporting essential services such as water or electricity provision, or access to emergency services.
Common costs	Costs which are shared by multiple services supplied by a firm.
Co-location	The provision of space and associated facilities, typically at a BT exchange, for telecoms provider equipment.
Co-mingling services	Co-mingling services provide communications providers with points of presence within a shared secure area of a BT exchange allowing for the installation of LLU equipment.
Copper-based broadband	A broadband service where the physical connection between the local access aggregation node and the network termination equipment (NTE) comprises copper wires either in whole or in part. Openreach products used to deliver copper-based broadband include, but are not limited to LLU, SLU, MPF/SMPF, FTTC, G.fast, SOTAP, SOGEA, and SOG.fast.
Copper-based service	A service where the physical connection between the local access aggregation node and the network termination equipment (NTE) comprises copper wires either in whole or in part. Openreach products used to deliver these or related services include, but are not limited to WLR, ISDN, LLU, SLU, MPF/SMPF, FTTC, G.fast, SOTAP, SOGEA, and SOG.fast.
Core network	A core network is made up of core nodes which are linked together using high-capacity connections. See also ‘core node’ definition.
Core node	Core nodes form part of a core network and are used to route (or switch) traffic between backhaul connections and/or between other core nodes and can also act as a point of interconnect to other networks or to other network services (such as data centres or internet peering sites).
CP (Communications Provider)	An organisation that provides electronic communications services and/or electronic communications networks. We often refer to them as a telecoms provider or a network operator.

Term	Description
CPE (Customer Premises Equipment)	Sometimes referred to as customer apparatus or consumer equipment. Equipment on customer's premises which is not part of the public telecommunications network but is directly or indirectly attached to it via a network termination equipment (NTE).
CPI (Consumer Price Index)	An official measure of inflation of consumer prices in the UK.
CSH (Customer Sited Handover)	CSH is an interconnection between BT and another telecoms provider which involves BT providing a point of handover (POH) at the site (e.g. operational building) of the telecoms provider (i.e. not at a BT exchange).
Cumulo rates	Used to describe the non-domestic rates (effectively a property tax) that BT pays on its rateable network assets in the UK. These assets include BT's passive infrastructure such as its duct, poles, fibre and copper cables and exchange buildings. It is called a cumulo assessment because the rates on all these assets are assessed together.
Customer lead-in	The final connection (physical link) to a point of handover at the customer site from a nearby network flexibility point. This may be to a communications room within a building or to a network termination equipment (NTE) within the customer's premises.
Customer site (or customer premises)	Any customer location to be served by a telecoms provider, for example, a residential property, a business premises, or a mobile base station.
Customer-specific network extensions	Business as usual connections where a telecoms provider extends its existing network to connect a specific customer site.
CVE (Cost Volume Elasticity)	The percentage increase in operating costs required for a 1% increase in volume.
CVR (Cost Volume Relationship)	The relationship of how cost and volumes move in relation to one another.
CWU (Communication Workers Union)	A union for the communications industry which represents members in postal, telecoms, mobile, administrative and financial companies.
Dark fibre	An optical fibre connection between two physical locations, that has no electronics attached to 'light' the fibre for data transmission i.e., it is passive.
Dark Fibre Access (DFA)	A regulatory requirement on Openreach to provide access to dark fibre in certain geographic areas of the leased lines (LL) access product market.
Dark Fibre Inter-exchange (DFX)	A regulatory requirement on Openreach to provide access to dark fibre for inter exchange connectivity (IEC).

Term	Description
Dark fibre service	A service which allows telecoms providers to lease only the optical fibre element of leased lines from a supplier, allowing them to attach equipment of their own to provide a range of leased lines products.
Data centre	Premises whose main purpose is to house computing, data and application hosting, and communications equipment. They tend to have multiple tenants and may be owned and operated by telecoms providers and/or run by third-party providers that are 'carrier neutral'. A carrier neutral data centre is owned and operated entirely independently of telecoms providers with interconnection to and between multiple telecoms providers.
Deemed consent	A contractual provision allowing Openreach to deem the consent of its customers to a change of the CDD in a range of circumstances as provided for in its contract.
Disposals	The assets that the firm disposes of (e.g. an asset that becomes fully depreciated or an asset that the firm sells) over the course of the financial year.
DLRIC (Distributed Long Run Incremental Cost)	The long-run incremental cost of the individual service with a share of costs which are common to other services over BT's core network.
DOCSIS (Data Over Cable Service Interface Specification)	A telecommunications standard that enables cable TV networks to support broadband internet access services over existing hybrid fibre coaxial (HFC) cable infrastructure.
DP (Distribution Point)	A flexibility point in an access network to which final connections to customer premises are connected. Usually, a connection point either in an underground chamber or on a pole.
DPA (Duct and Pole Access)	A wholesale access service giving a telecoms provider access to physical infrastructure, including the underground ducts and poles network of another telecoms provider.
DSAC (Distributed Stand Alone Cost)	An accounting approach estimated by adding a proportionate share of the inter-increment common costs to the DLRIC. Rather than all common costs shared by a service being allocated to the service under consideration, the common costs are instead allocated amongst all the services that share the network increment.
DSL (Digital Subscriber Line)	A family of technologies generically referred to as DSL or xDSL that enable the transmission of broadband signals over a pair of copper wires (known as a twisted copper pair).
EAD (Ethernet Access Direct)	An Ethernet product offered by Openreach providing high bandwidth, point-to-point connections.

Term	Description
EAD Local Access (EAD LA)	This refers to an EAD variant offered by Openreach which only runs from an end-user site to the local access serving exchange. An LA leased line has no main fibre link between exchanges.
EBD (Ethernet Backhaul Direct)	An Ethernet backhaul product offered by Openreach providing high bandwidth, inter-exchange connectivity between designated BT exchanges.
EBITDA	Earnings before interest, tax, depreciation and amortisation.
ECCs (Excess Construction Charges)	A charge levied by Openreach where additional construction of duct and fibre or copper is required to provide service to customer site. Provided either directly by Openreach or by a contractor.
EFM (Ethernet in the First Mile)	A DSL based network technology for the delivery of symmetric Ethernet services which is generally provided over copper access networks. This has generally been superseded by higher speed Ethernet services over FTTP and FTTC.
EMP (Equivalence Management Platform)	A set of operational support systems and associated processes put in place by Openreach.
ERP	Equity Risk Premium.
Ethernet	A standardised packet-based technology originally developed for use in Local Area Networks (LANs) but now also widely used in telecoms providers' networks for the transmission of data.
EV	Enterprise Value. A measure of a company's value, equal to its market capitalisation plus the value of debt less any cash holdings.
FAC (Fully Allocated Cost)	An accounting approach under which all the costs of the company are distributed between its various products and services. The fully allocated cost of a product or service may therefore include some common costs that are not directly attributable to the service.
Fibre channel	Standardised storage area network protocol operating at bandwidths between 1 Gbit/s and 128 Gbit/s.
Fixed Wireless Access (FWA) services	Broadband services delivered over a wireless connection from a provider's network to a fixed point at a customer's premises. This excludes WiFi connections used within a customer premises.
FTTC (Fibre-to-the-Cabinet)	An access network structure in which the optical fibre extends from the local exchange to the street cabinet. The customer is usually connected from the street cabinet to their premises via copper cables using twisted copper pairs. FTTC deployments in the UK typically use 'very-high speed digital subscriber line' (VDSL) technology.

Term	Description
FTTP (Fibre-to-the-Premises)	An access network structure in which the optical fibre runs all the way from customers' premises (either residential or business) to the local exchange. The optical fibre may be point-to-point or may be point to multi-point using, for example, a passive optical network (PON). FTTP can also be referred to as Fibre-to-the-Home (FTTH), Fibre-to-the-Building/Business/Basement (FTTB) or full fibre.
Gbit/s	Gigabits per second (1 Gigabit = 1,000,000,000 bits). A measure of bandwidth in a digital system. 1 Gbit/s=1,000 Mbit/s
GEA (Generic Ethernet Access)	Openreach's wholesale service providing telecoms providers with access to its FTTC and FTTP networks to supply higher speed broadband services. The GEA service meets BT's obligation to provide virtual unbundled local access (VULA).
Gigabit capable broadband	Gigabit capable broadband is a network connection to a customer's premises capable of delivering download speeds of 1 Gbit/s or more. In the UK, this is typically delivered over FTTP or hybrid fibre coaxial (HFC) cable networks.
GRC (Gross Replacement Cost)	The cost of replacing an existing tangible fixed asset with an identical or substantially similar new asset having a similar production or service capacity.
G.fast	G.fast is a DSL technology used to deliver higher broadband speeds than earlier DSL technologies, such as ADSL and VDSL. To deliver the higher speeds, G.fast equipment is often deployed near to the customer at a local distribution point (DP) using a copper connection to the customer premises, and using a fibre connection to connect between the DP and the providers network. G.fast equipment can also be deployed in a street cabinet (FTTC).
GPON (Gigabit Passive Optical Network)	GPON is a PON technology which has a capacity of 2.5 Gbit/s in the downstream direction (towards the end-user) and typically 1.25 Gbit/s in the upstream direction (towards the provider's network). Faster PON systems such as XGS-PON are also available.
HCA (Historic Cost Accounting)	The measure of the cost in terms of its original purchase price of the economic benefits of tangible fixed assets that have been consumed during a period. Consumption includes the wearing out, using up or other reduction in the useful economic life of a tangible fixed asset whether arising from use, effluxion of time or obsolescence through either changes in technology or demand for the goods and services produced by the asset.

Term	Description
HFC (Hybrid Fibre Coaxial)	An access network structure in which the optical fibre extends from the exchange or a hub to the street cabinet. The street cabinet is usually located only up to a few hundred metres from the customer's premises. The remaining part of the access network from the street cabinet to the customer is usually connected via coaxial cables. HFC deployments in the UK typically use DOCSIS technology.
HGL (Holding Gains and Losses)	The change in the value of the underlying assets used by the company over the course of the financial year.
HNR (High Network Reach) Area	Geographic areas with at least two rival leased lines providers within a specific distance from a business site, as defined by Ofcom (see main report).
Hull Area	The area defined as the 'Licensed Area' in the licence granted on 30 November 1987 by the Secretary of State under section 7 of the Telecommunications Act 1984 to Kingston upon Hull City Council and Kingston Communications (Hull) plc (KCOM).
iCDD (initial Contractual Delivery Date)	The iCDD is the first date provided to Openreach's customers by Openreach advising of the anticipated circuit completion date.
IEC (Inter Exchange Connectivity)	Leased line connections that carry traffic either between local access areas, often described as exchange areas, or as part of a backhaul network and/or core network.
IEC (Inter-exchange connectivity) market	IEC market refers to fixed connections between BT exchanges for the purpose of carrying backhaul and/or core network traffic.
Interconnect	The link used by telecoms providers to connect equipment at a location within a BT exchange either to another telecoms provider's network within an exchange or via an external Openreach footway box close to, but just outside, the BT exchange. This covers a number of products including, but not limited to: Bulk transport link, Cablelink (external), Cablelink (internal) and LLU Egress-External/BT Egress-External.
IP (Internet Protocol)	The communications protocol used for transmitting a data packet between a source and a destination on some data networks including the Internet.
ISDN (Integrated Services Digital Network)	A digital telephone service that supports telephone and switched low bandwidth data services.
ISP (Internet Service Provider)	A company that provides end-users with access to the internet and other related services such as data storage, email, and other cloud services.

Term	Description
ITU-T	The International Telecommunication Union Telecommunication Standardisation Sector (ITU-T) is one of the three sectors of the International Telecommunication Union (ITU).
Jitter	A measure of the variation of delay in transmission over a transmission path.
kbit/s	Kilobits per second (1 kilobit = 1,000 bits). A measure of bandwidth in a digital system. 1 Mbit/s=1,000 kbit/s
KPIs (Key Performance Indicators)	Specified information to be provided for the purposes of assessing performance and providing transparency of service provision by a dominant provider.
Latency	A measure of delay in transmission over a transmission path.
Leased line	A communications link normally delivered over fibre between two fixed locations, typically used by businesses. Leased line services tend to be high speed, uncontended (the capacity is guaranteed and not subject to reduction by the presence of other telecoms services), symmetric (the capacity is the same in both directions), and typically, dedicated to the customer's exclusive use.
Licence exemption	Ofcom is required to exempt radio equipment if its installation or use is not likely to result in undue interference to other radio equipment. Under this approach, a user does not need a licence as long as their device complies with specified technical parameters. This approach tends to be used for equipment where the risk of interference from uncoordinated use is low.
Light licensed	Light licences generally require no specific assignment or co-ordination by Ofcom and are available on request. This authorisation approach is appropriate where there is lower risk of interference between different users, interference can be managed through self-coordination or where a high quality of service (QoS) is not essential, but still allows Ofcom to manage any problems arising from devices interfering with each other.
LLA (Leased Line Access) market	LLA refers to the market for high-speed uncontended symmetric connections from a business premises to a provider's network. These include Ethernet (over point-to-point), WDM services, Ethernet over symmetric PON (such as XGS-PON), as well as dark fibre used to self-supply leased line services.
LLCC	Leased line charge control.

Term	Description
LLU (Local Loop Unbundling)	The mechanism by which a dominant (incumbent) provider's access network ('local loop') between a customer's site and an access aggregation node is available for connection to competing providers' network equipment. This enables operators other than the incumbent to use the local loop to provide services directly to their customers.
LLU Egress – External	A legacy BT product, that pre-dates and was used for the same function as a Cablelink External. Also known as BT Egress – External or BT Egress (Backhaul) Link
LRIC (Long Run Incremental Cost)	A measure of the change in the long-run total costs of the firm that arises from the provision of a discrete increment of output.
Mbit/s	Megabits per second (1 Megabit = 1 million bits). A measure of bandwidth in a digital system.
MBORC (Matters Beyond Our Reasonable Control)	MBORCs are usually raised when Openreach's network has experienced serious damage caused by extreme weather, or as a result of criminal or negligent damage caused by third parties.
MCE (Mean Capital Employed)	BT's definition of Mean Capital Employed is total assets less current liabilities, excluding corporate taxes and dividends payable, and provisions other than those for deferred taxation. The mean is computed using the start and end values for the period.
MDF (Main Distribution Frame)	A wiring frame, typically in an operational building such as a BT exchange, where copper local loops are terminated and interconnected.
MDF Site	A BT operational building containing an MDF. Also referred to as a Local Serving Exchange.
MDU	Multi Dwelling Unit (such as an apartment block).
MEA (Modern Equivalent Asset)	The approach to set charges by basing costs and asset values on what is believed to be the most efficient available technology that performs the same function as the current technology.
MEAS (Managed Ethernet Access Service)	This is a service provided by BT to provide connectivity from multiple mobile base station sites back to a mobile core network.
MNO (Mobile Network Operator)	A provider which owns a mobile network.

Term	Description
Mobile backhaul	Mobile backhaul is the network connectivity that carries mobile traffic between an MNO's base station and its core network nodes. Mobile backhaul typically consists of a fixed access connection from the base station to a fixed access aggregation node together with a fixed backhaul connection which then connects to the MNO's core network. While fixed leased lines (including dark fibre) are generally used for these connections, wireless links such as microwaves may be used in some cases.
Modified greenfield Approach	An approach to analysing markets using a hypothetical scenario in which it is assumed that there are no ex-ante SMP remedies in the market being considered or in any markets downstream of it.
MPF (Metallic Path Facility)	MPF services are a type of LLU product which allows communications providers to deliver voice and broadband services to their customers using Openreach copper cables.
MSAN (Multi Service Access Node)	A network access equipment associated with an IP-based network that provides network interfaces for voice, broadband and other services. MSANs are typically installed in a telephone exchange.
MTTP (Mean Time To Provide)	A QoS standard measuring the average time to provide an Ethernet circuit excluding customer caused delays.
NCA	Net current assets.
NDRs (Non-Domestic Rates)	A form of property tax paid by organisations and businesses to contribute towards the cost of local services.
Network expansion	A network expansion refers to any of the following types of network build: d) Customer-specific network extensions, e) New area rollout, f) Network infill.
Network flexibility points	Points in a network where connections can be made to, for example, an end-user premises. Network flexibility points may be inside a street cabinet, in an underground chamber, or on a pole. Network flexibility points can refer to both copper and optical fibre connectivity.
Network infill	Cases where a telecoms provider expands its network to fill gaps (wherein it is generally unable to serve customers by means of customer-specific network extensions) between or in areas where they already have network coverage. This excludes where only additional equipment has been added to existing network sites.

Term	Description
New area rollout	Cases where a telecoms provider builds a network across an area (for example, a town or a city) where it did not previously have any network coverage, i.e., it was not generally able to serve customers in that area by means of customer-specific network extensions.
NICC	A technical forum for the UK communications sector that develops interoperability standards for public communications networks and services in the UK. It is an independent organisation owned and run by its members. Ofcom participates in NICC as an observer member.
NGA	Next Generation Access. Mainly used to refer to access networks using fibre optic technology.
NMR	Narrowband Market Review. It covers wholesale markets that underpin the delivery of fixed voice telephone services.
Non-telecoms physical infrastructure	Any physical infrastructure which was built for purposes other than the deployment of telecoms networks such as electricity, water, or gas networks and other networks such as roads and railways.
NRA	National Regulatory Authority, such as Ofcom in the UK.
NRC (Net Replacement Cost)	Gross replacement cost less accumulated depreciation based on gross replacement cost.
NTE (Network Termination Equipment)	Equipment that connects the customer's broadband or telephone equipment to a telecoms provider's customer lead-in that comes into a residential or business premises.
Off-net	In the context of leased lines, off-net means instances in which a telecoms provider buys a leased line service from another telecoms provider, such as Openreach, and then uses it to provide leased line services to a business customer or another telecoms provider customer.
OHP (Openreach Handover Point)	Points in BT's network where other telecom providers can connect their own networks to the Openreach access network, allowing them to provide services to their customers.
On-net	In the context of leased lines, on-net means a leased line service that a telecoms provider provides by connecting its electronic equipment to physical links which it either: a) owns and operates, and/or b) leases from another company. In the case of (b) above, this generally refers to the long-term leasing of 'dark fibre' using an IRU (indefeasible right of use), but can also refer to the leasing of duct from an infrastructure provider to install their own fibre.

Term	Description
Openreach	The line of business of BT which comprises BT's access and backhaul network assets and the products and services provided using those assets. Openreach Limited, a wholly owned subsidiary of BT plc, has responsibility for operating and managing those assets on behalf of BT.
Opex	Operating expenditure – i.e. costs reported in the profit and loss account.
Optical Splitter	A passive device used in FTTP networks which splits a beam of light into many light beams (optical signals). Optical splitter plays a key role in passive optical networks (PONs) by allowing a single PON to be shared among many end-users.
OSA (Optical Spectrum Access)	An Openreach service which relies on a dedicated optical fibre link utilising the wavelength division multiplexing (WDM) technique in order to send multiple optical signals along an optical bearer (fibre optical cables and equipment). Openreach variants include Optical Spectrum Extended Access, OSA Filter Connect, and OSA 100G Single.
OSEA (Optical Spectrum Extended Access)	Openreach WDM services supporting circuits over a longer distance than OSA.
OTA2 (Office of the Telecommunications Adjudicator)	An organisation independent of Ofcom and the industry, tasked with overseeing cooperation between telecoms providers.
OTDR (Optical Time-Domain Reflectometer)	Test equipment used to monitor and check the performance of fibre links and detect problems, in particular, used to identify the location of a broken fibre.
OUKT	Other UK telecoms.
Overall network route length	The total length of the cabled network routes that comprise a telecoms provider's network excluding any cabled network routes which they rent from third parties irrespective of the number of ducts and/or cables deployed along that route. A cabled network route housed in third-party physical infrastructure should be counted.
Patch panel	For optical fibre connectivity, a patch panel is used to interconnect and manage fibre optic cables. For copper-based connectivity, a patch panel is used to interconnect and manage copper and coaxial cables.
PCO (Principal Core Operator)	A telecoms provider with its own network infrastructure, has a substantial (near-national) footprint, and offers a wholesale inter-exchange backhaul and core connectivity service to other telecoms providers.

Term	Description
Physical link	A connection between two points using: a) copper wire or coaxial cable without electronic equipment, or b) optical fibre without electronic equipment, or c) a point-to-point radio link.
PIA (Passive Infrastructure Access)	A remedy requiring BT to provide telecoms providers with access to its passive access network infrastructure (i.e. ducts and poles).
POH (Point of Handover)	A point (location) where one telecoms provider interconnects with another telecoms provider for the purposes of connecting their networks to provide services to third-party end-customers. May also be referred to as point of connection (POC).
PON (Passive Optical Network)	A shared point-to-multipoint fibre-optic network architecture for FTTP that uses passive optical splitters. In the UK, a mixture of GPON and XGS-PON are being widely deployed for FTTP services.
POP (Point of Presence)	A point (location) in a telecoms provider's network (such as an exchange or other operational building), generally used to serve customers in a particular locality.
Premises	A customer site where a telecoms network provider's network termination equipment (NTE) is located.
PSTN (Public Switched Telephone Network)	The circuit-switched telephone network (primarily copper-based) operated by BT and other electronic communications providers.
QoS (Quality of Service) standards	The level of performance standards that we have set Openreach to meet.
RAP (Regulatory Accounting Principles)	A set of principles with which BT's Regulatory Financial Reporting must comply.
RAB (Regulatory Asset Base)	A RAB approach involves the assets used to provide all of the operator's services being entered into a common pool known as the regulatory asset base (or RAB) which is recovered across charges on all of the firm's services in a particular area. This differs from an approach where the costs of providing a particular service are recovered only from the charges on that service.
RAV (Regulatory Asset Value)	The value ascribed by Ofcom to an asset or capital employed in the relevant licensed business.
RBS (Radio Base Station) backhaul	A legacy TDM circuit provided by BT which is used to provide mobile backhaul connectivity.
RFoG (Radio Frequency or RF over Glass)	An optical network system that is typically used to transport radio frequency (RF) signals over a Passive Optical Network (PON) rather than over hybrid fibre and coaxial cable.

Term	Description
RFR	Risk-free rate of return. Typically shortened to risk-free rate.
RFS (Regulatory Financial Statements)	The statements, plus the data and models supporting them, which BT is required to produce under the obligations contained in its SMP conditions set by Ofcom. They include the published RFS and additional financial information (AFI) provided to Ofcom in confidence.
RO (Reference Offer)	A document published by a telecoms provider setting out matters such as technical information, the terms and conditions for provisioning, SLAs and SLGs, and availability of other related services such as accommodation.
ROCE (Return on Capital Employed)	The ratio of accounting profit to capital employed.
RWT (Right When Tested)	When a line tests as 'OK' when tested remotely or tested by an onsite engineer visit.
SAC (Stand Alone Cost)	An accounting approach under which the total cost incurred in providing a product is allocated to that product.
SDH (Synchronous Digital Hierarchy)	A legacy TDM based digital transmission standard that has been widely used in communications networks and for leased lines but been largely replaced by Ethernet and WDM services. SDH was developed to replace older and less scalable Plesiochronous Digital Hierarchy (PDH) systems.
SDI (Serial Digital Interface)	A standard for transmitting uncompressed digital video and audio transmission over coaxial cable or optical fibre.
SDSL (Symmetric Digital Subscriber Line)	A DSL variant that allows broadband signals to be transmitted at the same rate from end-user to exchange (upstream) as from exchange to end-user (downstream).
Self-supply	Circuits that are provided by a telecoms provider using their own physical links, equipment and associated infrastructure. See also on-net.
SFP (Small Form-factor Pluggable)	A compact, optical module transceiver (laser) that can be plugged into network equipment for data transmission over a fibre connection.
SLA (Service Level Agreement)	A contractual commitment provided by a telecoms provider, such as Openreach, to a customer, which sets out the service standards such as time to provide and time to repair.
SLG (Service Level Guarantee)	A contractual commitment by Openreach to telecoms providers specifying the amount of compensation payable by Openreach to a telecoms provider for a failure to adhere to an SLA.

Term	Description
SLU (Sub Loop Unbundling)	A process by which telecoms providers can deploy their own equipment at a network distribution point (usually the location of the street cabinet) and use Openreach's lines from the street cabinet to the customer. Telecoms providers either share or rent the entire sub-loop (the connection between the street cabinet and the customer) from Openreach.
SME	Small and medium enterprise.
SMP (Significant Market Power)	Significant Market Power is equivalent to the concept of dominance as defined in competition law and is used to identify those telecoms providers which could act, to an appreciable extent, independently of the market. An entity found to have SMP may be subject to remedies.
SMPF (Shared Metallic Path Facility)	SMPF is a type of LLU product which allows communications providers to deliver broadband services to their customers over the top of a BT WLR voice connection.
SOGEA	Single Order Generic Ethernet Access (SOGEA) over FTTC is a standalone product variant that allows customers to buy a superfast broadband line without the need to buy the copper connection separately.
SOG.fast	Single Order G.fast (SOG.fast), also referred to as SOGfast, is a standalone product variant that allows customers to buy a G.fast line without the need to buy the copper connection separately.
SOTAP	Single Order Transitional Access Product (SOTAP) that delivers a copper path between the network termination equipment (NTE) at the customers' premises and the main distribution frame (MDF) at the exchange. SOTAP provides broadband and optional Voice over IP (VoIP) services over the existing copper line where an alternative fibre service is not available.
SOR (Statement of Requirements)	A BT process for submission and processing of requests for product/service enhancements.
Speed	The rate at which the data that can be transmitted between two points in a network. Often expressed in Mbit/s or Gbit/s. Speed may be less than the bandwidth or capacity of the transmission link if the link is shared between multiple users.
SPM (Sales Product Management)	A network cost component.

Term	Description
SSNIP (Small but Significant Non-transitory Increase in Price) Test	An element of the hypothetical monopolist test used in market definition analysis, in which the competitive constraints posed by potential substitutes for the service in question are tested by considering switching to the substitutes if the price of the service was increased by a small but significant non-transitory amount (often 5 to 10 per cent).
Sub-basket	A sub-basket refers to a control on a group of two or more charges.
Sub-cap	A sub-cap refers to a control on a single charge.
Superfast broadband	Broadband services capable of delivering a minimum download speed of at least 30 Mbit/s.
Supplementary depreciation	The additional depreciation charge to convert an HCA depreciation charge into a CCA depreciation charge.
TCO (Total Cost of Ownership)	The total price of a service, including all incurred charges, over a specified period.
TDM (Time Division Multiplexing)	A method of combining multiple data streams for transmission over a shared communication channel by means of time-sharing by allowing each data stream in turn to transmit data in different time slots. SDH is an example of a system that uses TDM.
Telecoms physical infrastructure	Physical infrastructure that is built for the purposes of deploying a fixed telecoms network. For example, ducts, poles and underground chambers. However, this excludes any copper cabling or optical fibre cabling making use of the physical infrastructure, and also excludes any physical infrastructure which is deployed to host radio transmission and reception equipment needed for wireless connections in a telecoms network (e.g. masts and antenna installations).
Telecoms provider	A person or an organisation which provides an electronic communications network or provides an electronic communications service. We sometimes refer to them as a communications provider or a network operator.
The Act	The Communications Act 2003.
TI (Traditional Interface)	TI circuits refer to legacy leased line TDM services such as SDH. These circuits have mostly been replaced by more up to date contemporary interface (CI) technologies such as Ethernet or WDM. TI can also be referred to as TISBO (TI symmetric broadband offering) in some previous regulatory documents.
TMR (Total Market Return)	TMR includes interest, capital gains, dividends and distributions derived from an investment over a given period of time, as opposed to just capital gains.

Term	Description
TRC (Time-Related Charge)	A charge raised by Openreach to recover costs incurred when Openreach engineers perform work not covered under the terms of the Openreach standard service.
Tribunal	The Competition Appeal Tribunal or CAT.
TTP (Time To Provide)	How long it takes Openreach to deliver an Ethernet circuit following acceptance of a customer's order.
Ultrafast broadband	Broadband services capable of delivering a minimum download speed of at least 300 Mbit/s.
UKRN	UK Regulators Network.
UPRN (Unique Property Reference Number)	Unique Property Reference Number, a unique numeric identifier for every addressable location in Great Britain.
USO (Universal Service Obligation)	In 2018, the Government introduced legislation for a broadband USO, to give homes and businesses the right to request a 'decent' and affordable broadband connection. A 'decent' broadband connection is currently defined by the Government as capable of delivering download speeds of at least 10 Mbit/s and upload speeds of at least 1 Mbit/s.
VDSL2	Second-generation very high-speed digital subscriber line (VDSL2) is a DSL technology currently used as the primary means of providing broadband over FTTC networks.
VHB (Very High Bandwidth)	Used to refer to bandwidths above 1 Gbit/s.
VOA (Valuation Office Agency)	An executive agency of HM Revenue & Customs (HMRC). Among other functions, it compiles and maintains the business rating and council tax valuation list for England and Wales.
VoIP (Voice over IP)	Voice over Internet Protocol (VoIP) is a technology that allows users to send voice calls using Internet Protocol data packets over the internet.
VPN (Virtual Private Network)	A technology allowing users to make inter-site connections over a public telecommunications network that is software partitioned to emulate the service offered by a physically separate private network.
VULA (Virtual Unbundled Local Access)	A regulatory obligation requiring BT to provide access to its FTTC and FTTP network deployments which allows telecoms providers to connect at an access aggregation node (the Openreach Handover Point) and are provided a virtual connection from this point to the customer premises.
WACC (Weighted Average Cost of Capital)	The rate that a company is expected to pay on average to all its security holders, both debt and equity, to finance its assets.

Term	Description
WAN (Wide Area Network)	A geographically dispersed telecommunications network, typically a corporate network linking multiple sites at different locations.
WBA (Wholesale Broadband Access) market	The WBA market concerns the wholesale broadband products that telecoms providers provide for themselves and sell to each other.
WES (Wholesale Extension Service)	A legacy Openreach Ethernet service that can be used to link customer site to a node in a communications network, superseded by Openreach's EAD product.
WEES (Wholesale End-to-End Extension Service)	A legacy Openreach Ethernet service that can be used to provide a point-to-point connection between two customer's sites, superseded by Openreach's EAD product. Also referred to as a wholesale end-to-end segment.
WDM (incl. DWDM) (Wavelength Division Multiplexing and Dense Wavelength Division Multiplexing)	Wavelength division multiplexing (WDM) is a transmission technology that enables multiple high-capacity circuits (typically 4 to 16) to share an optical fibre or a fibre pair by using a different optical wavelength for each circuit. Dense WDM (DWDM) takes WDM technology a step further by using even higher densities of wavelengths.
WFAEL (Wholesale Fixed Analogue Exchange Line)	The WFAEL market concerns the provision of wholesale analogue voice services.
WFTMR (Wholesale Fixed Telecoms Market Review)	WFTMR refers to the fixed telecoms market review which concluded in March 2021, with regulations covering the 2021-2026 review period. It is also sometimes referred to as WFTMR21.
WiFi	A short-range wireless access technology that allows devices to connect to the internet via a base station (such as a wireless router or a wireless access point), or directly between two devices.
WLA (Wholesale Local Access) market	WLA refers to the market for connections from a residential or business premises to a provider's network which are used to provide fixed broadband connectivity services.
WLR (Wholesale line rental)	WLR products give telecoms providers the ability to offer their own branded service to end-users (i.e., retail line rental services) using Openreach telephony products. The telecoms provider has responsibility for the commercial relationship with the end-user but Openreach will supply and maintain the lines to the end-user premises on behalf of the telecoms provider and will bill the telecoms provider.

Term	Description
XGS-PON	XGS-PON is a 10 Gbit/s symmetric PON technology ('XG' refers to 10 Gbit/s and 'S' for symmetric). Symmetric means XGS-PON has a capacity of 10 Gbit/s in both the downstream (towards the end-user) as well as the upstream (towards the provider's network) direction.