Business Connectivity Market Review – Annexes 1 to 13

Review of competition in the provision of leased lines

Redacted for publication ✂

Statement

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Contents

Annex 1

List of respondents to our consultations

A1.1 On 1 April 2014, we published a Call for Inputs (the April 2014 CFI) to announce the start of the BCMR 2016, to provide stakeholders with an overview of the project timetable and to seek stakeholders' views on a number of topics.[1] The closing date for responses was 27 May 2014 and the following stakeholders responded in writing:

- BT;
- Cinven Partners LLP;
- City of London Corporation;
- Colt;
- Grange Hotels;
- KCOM;
- MBNL, EE, Three (combined response);
- SSE plc;
- Sky;
- Talktalk;
- The Bit Commons;
- UKCTA;
- Verizon;
- Virgin Media (Virgin);
- Vodafone; and
- One other respondent who requested anonymity.

A1.2 Where respondents provided non-confidential versions of their responses, we have published them on our website.[2]

[1] http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity-market-review/summary/Business-Connectivity-Market-Review.pdf
[2] http://stakeholders.ofcom.org.uk/consultations/business-connectivity-market-review/

A1.3 On 8 October 2014 we published a consultation on data analysis (the October 2014 BCMR Consultation) setting out an explanation of the data we had requested from CPs and the methods that we had used to check and clean the data. We also presented an indicative set of network reach and service share calculations in order to assist stakeholders in commenting on our data processing methods.[3] The closing date for responses was 19 November 2014 and the following stakeholders responded in writing:

- BT;
- Colt;
- MBNL, EE, Three (combined response);
- Sky;
- Surf;
- Verizon;
- Virgin Media (response confidential); and
- Vodafone.

A1.4 Where respondents provided non-confidential versions of their responses, we have published them on our website.[4]

A1.5 On 5 November 2014, we published a preliminary consultation on passive remedies (the November 2014 BCMR Consultation) discussing the framework for assessing the role of passive remedies, the potential costs and benefits of passive remedies and the high level aspects of the design and scope of any passive access product.[5] The closing date for responses was 5 January 2015 and the following stakeholders responded in writing:

- BT;
- CityFibre;
- Colt;
- FCS;
- GTC;
- Hyperoptic;

[3] http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-data-analysis/summary/BCMR_Data_Consultation.pdf
[4] http://stakeholders.ofcom.org.uk/consultations/bcmr-data-analysis/
[5] http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-passives/summary/BCMR_passives.pdf

- INCA;
- KCOM;
- Level 3;
- MBNL, EE, Three (combined response);
- Passive Access Group;
- Six Degrees Group;
- Sky;
- TalkTalk;
- The Bit Commons;
- Telefónica;
- UKB Networks;
- Updata (response confidential);
- Virgin Media;
- Vodafone;
- WarwickNet; and
- One other respondent who requested anonymity.

A1.6 Where respondents provided non-confidential versions of their responses, we have published them on our website.[6]

A1.7 On 15 May 2015, we published the main consultation document for our Business Connectivity Market Review (the May 2015 BCMR Consultation) setting out our proposals for market definitions, market power determinations and remedies.[7] The closing date for responses was 31 July 2015 and the following stakeholders responded in writing:

- Airwave;
- BT;
- CityFibre;
- Colt;

[6] http://stakeholders.ofcom.org.uk/consultations/bcmr-passives/?showResponses=true
[7] http://stakeholders.ofcom.org.uk/consultations/bcmr-2015/

- GTC;
- Hyperoptic;
- IIG;
- JRC;
- KCOM;
- Openreach;
- Passive Access Group;
- Scottish Futures Trust;
- Six Degrees Group;
- Sohonet;
- Sky;
- SP Energy Networks;
- TalkTalk;
- Towerhouse;
- UKB Networks;
- UKCTA;
- Virgin Media;
- Vodafone; and
- Nine other respondents who requested anonymity.

A1.8 Where respondents provided non-confidential versions of their responses, we have published them on our website.[8]

A1.9 On 12 June 2015 we published our leased lines charge control and dark fibre pricing consultation (the June 2015 LLCC Consultation) setting out our proposals for the charge controls on BT's wholesale leased line services and our guidance on the pricing of dark fibre.[9] The closing date for responses was 7 August 2015 and the following stakeholders responded in writing:

- BT;

[8] http://stakeholders.ofcom.org.uk/consultations/bcmr-2015/?showResponses=true
[9] http://stakeholders.ofcom.org.uk/consultations/llcc-dark-fibre/

- CityFibre;
- GTC;
- Infrastructure Investors Group;
- Passive Access Group;
- UKB Networks;
- UKCTA;
- Sky;
- TalkTalk;
- Virgin Media;
- Vodafone; and
- Four other respondents who requested anonymity.

A1.10 Where respondents provided non-confidential versions of their responses, we have published them on our website.[10]

A1.11 On 12 June 2015 we also published the Review of BT's Cost Attribution Methodologies Consultation[11] (June 2015 CAR Consultation), which set out the analysis we have undertaken to review BT's current set of cost allocation rules. The closing date for responses was 7 August 2015 and the following stakeholders responded in writing:

- BT;
- UCKTA;
- Sky;
- TalkTalk;
- Virgin Media; and
- Vodafone.

A1.12 Where respondents provided non-confidential versions of their responses, we have published them on our website.[12]

[10] http://stakeholders.ofcom.org.uk/consultations/llcc-dark-fibre/?showResponses=true
[11] http://stakeholders.ofcom.org.uk/binaries/consultations/cost-attribution-review/summary/review-bt-cost-attribution-method.pdf
[12] http://stakeholders.ofcom.org.uk/consultations/cost-attribution-review/?showResponses=true

A1.13 On 13 November 2015, we published an update to our charge control proposals consulting on specific revisions to our approach to the charge controls (The November 2015 LLCC Consultation).[13] The closing date for responses was 14 December 2015 and the following stakeholders responded in writing:

- BT;
- GTC;
- Passive Access Group;
- Sky;
- TalkTalk;
- Virgin Media; and
- Vodafone.

A1.14 Where respondents provided non-confidential versions of their responses, we have published them on our website.[14]

A1.15 On 13 November 2015 we also published the second Review of BT's Cost Attribution Methodologies Consultation[15] (November 2015 CAR Consultation) to gather stakeholders' views on further proposed changes to some of BT's attribution methodologies. The closing date for responses was 14 December 2015 and the following stakeholders responded in writing:

- BT;
- UCKTA;
- Sky;
- TalkTalk;
- Virgin Media;
- Vodafone; and
- Passive Access Group

[13] http://stakeholders.ofcom.org.uk/consultations/bcmr-update-proposed-leased-lines-charge-controls/
[14] http://stakeholders.ofcom.org.uk/consultations/bcmr-update-proposed-leased-lines-charge-controls/?showResponses=true
[15] http://stakeholders.ofcom.org.uk/binaries/consultations/BT-cost-attribution-review-second-consultation/summary/BT_Cost_Attribution_Review_Second_Consultation.pdf

A1.16 Where respondents provided non-confidential versions of their responses, we have published them on our website.[16]

[16] http://stakeholders.ofcom.org.uk/consultations/BT-cost-attribution-review-second-consultation/?showResponses=true

Annex 2

Regulatory framework

Introduction

A2.1 This annex provides an overview of the market review process to give some additional context and understanding of the matters discussed in this statement, including the legal instruments published at Annex 35.

A2.2 Market review regulation is technical and complex, and requires us to apply legislation and take into account a number of relevant recommendations and guidelines This overview identifies some of the key aspects of materials relevant to this market review, but does not purport to give a full and exhaustive account of all materials that we have considered in reaching our decisions on this market.

Market review concept

A2.3 A market review is a process by which, at regular intervals, we identify and analyse relevant markets appropriate to national circumstances 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.

A2.4 In carrying out this work, we act in our capacity as the sector-specific regulator for the UK communications industries, including telecommunications. Our functions in this regard are to be found in Part 2 of the CA03.[17] We exercise those functions within the framework harmonised across the European Union for the regulation of electronic communications by the Member States (known as the CRF), as transposed by the CA03. The applicable rules[18] are contained in a package of five EC Directives, of which two Directives are particularly relevant for present purposes, namely:

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

A2.5 The Directives require that NRAs (such as Ofcom) carry out reviews of competition in communications markets to ensure that SMP regulation remains appropriate and proportionate in the light of changing market conditions.

A2.6 Each market review normally involves three analytical stages, namely:

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

[18] The Directives were subsequently amended on 19 December 2009. The amendments have been transposed into the national legislation and applied with effect from 26 May 2011 and any references in this document to the CA03 should be read accordingly.

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

Market definition procedure

A2.7 The Communications Act 2003 (CA03) provides that, before making a market power determination[19], 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. [20]

A2.8 The Framework Directive requires that NRAs shall, taking the utmost account of the Relevant Markets Recommendation[21] and SMP Guidelines[22] published by the EC, define relevant markets appropriate to national circumstances, in particular relevant geographic markets within their territory, in accordance with the principles of competition law.[23]

A2.9 The Relevant Markets Recommendation identifies a set of product and service markets within the electronic communications sector in which *ex ante* regulation may be warranted. Its purpose is twofold. First, it seeks to achieve harmonisation across the single market by ensuring that the same markets will be subject to a market analysis in all Member States. Second, the Relevant Markets Recommendation seeks to provide legal certainty by identifying in advance the markets to be analysed.

A2.10 However, NRAs are able to regulate markets that differ from those identified in the Relevant Markets Recommendation where this is justified by national circumstances, by demonstrating that three cumulative criteria referred to in the Relevant Markets Recommendation (the three-criteria test) are satisfied.

A2.11 The three criteria, which are cumulative, are:

- the presence of high and non-transitory structural, legal or regulatory barriers to entry;

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[19] The market power determination concept is used in the CA03 to refer to a determination that a person has SMP in an identified services market.
[20] CA03, section 79.
[21] EC, *Commission Recommendation of 9 October 2014 on relevant product and service markets within the electronic communications sector susceptible to ex ante regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services, (2007/879/EC),*
[22] EC, *Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services* (2002/C 165/03), 11 July 2002, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2002:165:0006:0031:EN:PDF.
[23] Article 15(3) Framework Directive

- a market structure which does not tend towards effective competition within the relevant time horizon, having regard to the state of infrastructure-based and other competition behind the barriers to entry; and

- competition law alone is insufficient to adequately address the identified market failure(s).[24]

A2.12 The fact that an NRA identifies the product and service markets listed in the Relevant Markets Recommendation or identifies other product and service markets that meet the three-criteria test does not automatically mean that regulation is warranted. Market definition is not an end in itself but rather a means of assessing effective competition. The three-criteria test is also different from the SMP assessment because it focuses on the general market structure and market characteristics.

A2.13 The SMP Guidelines make clear that market definition is not a mechanical or abstract process. It requires an analysis of any available evidence of past market behaviour and an overall understanding of the mechanics of a given market sector. As market analysis has to be forward-looking, the SMP Guidelines state that NRAs should determine whether the market is prospectively competitive, and thus whether any lack of effective competition is durable, by taking into account expected or foreseeable market developments over the course of a reasonable period. The SMP Guidelines clarify that NRAs enjoy discretionary powers which reflect the complexity of all the relevant factors that must be assessed (economic, factual and legal) when identifying the relevant market and assessing whether an undertaking has SMP.

A2.14 The SMP Guidelines also describe how competition law methodologies may be used by NRAs in their analysis. In particular, there are two dimensions to the definition of a relevant market: the relevant products to be included in the same market and the geographic extent of the market.

A2.15 While competition law methodologies are used in identifying the relevant markets *ex ante*, the markets identified will not necessarily be identical to markets defined in *ex post* competition law cases, especially as the markets identified *ex ante* are based on an overall forward-looking assessment of the structure and the functioning of the market under examination. Accordingly, the economic analysis carried out for the purpose of this review, including the markets we have identified, is without prejudice to any analysis that may be carried out in relation to any investigation pursuant to the Competition Act 1998[25] (relating to the application of the Chapter I or II prohibitions or Article 101 or 102 of the Treaty on the Functioning of the European Union[26]) or the Enterprise Act 2002.[27]

[24] Relevant Markets Recommendation, paragraph 2.
[25] http://www.legislation.gov.uk/ukpga/1998/41/contents
[26] Previously Article 81 and Article 82 of the EC Treaty, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2010:083:FULL:EN:PDF.
[27] http://www.legislation.gov.uk/ukpga/2002/40/contents

Market analysis procedure

Effective competition

A2.16 The CA03 requires that we carry out market analyses of identified markets for the purpose of making or reviewing market power determinations. Such analyses are normally to be carried out within 2 years from the adoption of a revised recommendation on markets, where that recommendation identifies a market not previously notified to the EC, or within 3 years from the publication of a previous market power determination relating to that market.[28]

A2.17 In carrying out a market analysis, the key issue for an NRA is to determine whether the market in question is effectively competitive. The Framework Directive clarifies the meaning of that concept:

> "[it] is essential that ex ante regulatory obligations should only be imposed where there is not effective competition, i.e. in markets where there are one or more undertakings with significant market power, and where national and Community competition law remedies are not sufficient to address the problem".[29]

A2.18 The definition of SMP is equivalent to the concept of dominance as defined in competition law. In essence, it means that an undertaking in the relevant market is in a position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers, and ultimately consumers. The Framework Directive requires that NRAs must carry out their market analysis taking the utmost account of the SMP Guidelines, which emphasise that NRAs should undertake a thorough and overall analysis of the economic characteristics of the relevant market before coming to a conclusion as to the existence of SMP.

A2.19 In that regard, the SMP Guidelines set out, additionally to market shares, a number of criteria that can be used by NRAs to measure the power of an undertaking to behave to an appreciable extent independently of its competitors, customers and consumers, including:

- the overall size of the undertaking;
- control of infrastructure not easily duplicated;
- technological advantages or superiority;
- absence of or low countervailing buying power;
- easy or privileged access to capital markets/financial resources;
- product/services diversification (e.g. bundled products or services);
- economies of scale;

[28] Section 84A, CA03
[29] Framework Directive, Recital 27.

- economies of scope;
- vertical integration;
- highly developed distribution and sales network;
- absence of potential competition; and
- barriers to expansion.[30]

A2.20 A dominant position can derive from a combination of these criteria, which when taken separately may not necessarily be determinative.

Sufficiency of competition law

A2.21 As part of our overall forward-looking analysis, we also assess whether competition law by itself (without *ex ante* regulation) is sufficient, within the relevant markets we have defined, to address the competition problems we have identified. Aside from the need to address this issue as part of the three-criteria test, we also consider this matter in our assessment of the appropriate remedies which, as explained below, are based on the nature of the specific competition problems we identify within the relevant markets as defined. We also note that the EC SMP Guidelines clarify that, if NRAs designate undertakings as having SMP, they must impose on them one or more regulatory obligations.

A2.22 In considering this matter, we bear in mind the specific characteristics of the relevant markets we have defined. Generally, the case for *ex ante* regulation is based on the existence of market failures which, by themselves or in combination, mean that the establishment of effective competition might not be possible if the regulator relied solely on *ex post* competition law powers which are not specifically tailored to the sector. Therefore, it may be appropriate for *ex ante* regulation to be used to address such market failures along with any entry barriers that might otherwise prevent effective competition from becoming established within the relevant markets we have defined. By imposing *ex ante* regulation that promotes competition, it may be possible to reduce such regulation over time as markets become more competitive, allowing greater reliance on *ex post* competition law.

A2.23 *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. This is particularly the case when addressing the effects of network externalities, which generally reinforce a dominant position. As noted above, under *ex post* competition law there is no prohibition on the holding of a position of dominance in itself and it is, therefore, normally more appropriate to address the impact of network externalities through *ex ante* obligations.

[30] SMP Guidelines, paragraph 78.

A2.24 We generally take the view that *ex ante* regulation provides additional legal certainty for the market under review and may also better enable us to intervene in a timely manner. We may also consider that certain obligations are needed as competition law would not remedy the particular market failure, or that the specific clarity and detail of the obligation is required to achieve a particular result.

Remedies procedure

Powers and legal tests

A2.25 The Framework Directive prescribes what regulatory action NRAs must take depending upon whether or not an identified relevant market has been found effectively competitive. Where a market has been found effectively competitive, NRAs are not allowed to impose SMP obligations and must withdraw such obligations where they already exist. On the other hand, where the market is found not effectively competitive, the NRAs must identify the undertakings with SMP in that market and then impose appropriate obligations.

A2.26 NRAs have a suite of regulatory tools at their disposal, as reflected in the CA03 and the Access Directive. Specifically, the Access Directive specifies a number of SMP obligations, including transparency, non-discrimination, accounting separation, access to and use of specific network elements and facilities, price control and cost accounting. When imposing a specific obligation, the NRA will need to demonstrate that the obligation in question is based on the nature of the problem identified, proportionate and justified in the light of the policy objectives as set out in Article 8 of the Framework Directive.

A2.27 Specifically, for each and every SMP obligation, we explain why it satisfies the requirement in section 47(2) CA03 that the obligation is:

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

A2.28 Additional legal requirements may also need to be satisfied depending on the SMP obligation in question.[31] For example, in the case of price controls, the NRA's market analysis must indicate that the lack of effective competition means that the CP concerned may sustain prices at an excessively high level or may apply a price squeeze to the detriment of end-users. In that instance, NRAs must take into account the investment made by the CP and allow it a reasonable rate of return on adequate capital employed, taking into account any risks specific to a particular new investment, as well as ensure that any cost recovery mechanism or pricing

[31] As set out in sections 87 et seq of the Communications Act 2003

methodology that is mandated serves to promote efficiency and sustainable competition and maximise consumer benefits.

A2.29 Where an obligation to provide third parties with network access is considered appropriate, NRAs must take into account factors including the feasibility of the network access, the technical and economic viability of creating networks[32] that would make the network access unnecessary, the investment of the network operator who is required to provide access[33], and the need to secure effective competition[34] in the long term. In this review, we have given particular consideration to the form(s) of network access obligation, leading to the imposition of a passive dark fibre remedy. In this regard, Article 12 of the Access Directive specifies that "Operators may be required to give third parties access to specified network elements and/or facilities, *including access to network elements which are not active…*" (emphasis added).

A2.30 We demonstrate the application of these legal tests to the particular SMP obligations we have decided to impose in the parts of this document which set out our decisions on remedies. In doing so, we also assess how the performance of our general duties under section 3 of the CA03 is secured or furthered by our regulatory intervention, and that it is in accordance with the six Community requirements in section 4 of the CA03. This is also relevant to our assessment of the likely impact of implementing our conclusions.

Ofcom's general duties - section 3 of the CA03

A2.31 Under the CA03, our principal duty in carrying out functions is to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A2.32 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 CA03.

A2.33 In performing our duties, we are also required to have regard to a range of other considerations, as appear to us to be relevant in the circumstances. For the purpose of the BCMR, we consider that a number of such considerations are relevant, in particular:

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

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

A2.34 We have also had regard to the principles under which regulatory activities should be transparent, accountable, proportionate, consistent, and targeted only at cases in which action is needed, as well as the interest of consumers in respect of choice, price, quality of service and value for money.

A2.35 Ofcom has, however, a wide measure of discretion in balancing its statutory duties and objectives. In doing so, we have taken account of all relevant considerations, including responses received during our consultation process, in reaching our conclusions.

European Community requirements for regulation - sections 4 and 4A of the CA03 and Article 3 of the BEREC Regulation

A2.36 As noted above, our functions exercised in this review fall under the CRF. As such, section 4 of the CA03 requires us to act in accordance with the six European Community requirements for regulation. In summary, these six requirements are:

- to promote competition in the provision of electronic communications networks and services, associated facilities and the supply of directories;
- to contribute to the development of the European internal market;
- to promote the interests of all persons who are citizens of the EU;
- to take account of the desirability of Ofcom's carrying out of its functions in a manner which, so far as practicable, does not favour one form of or means of providing electronic communications networks, services or associated facilities over another (i.e. to be technologically neutral);
- to encourage, to such extent as Ofcom considers appropriate for certain prescribed purposes, the provision of network access and service interoperability, namely securing efficient and sustainable competition, efficient investment and innovation, and the maximum benefit for customers of CPs; and
- to encourage compliance with certain standards in order to facilitate service interoperability and secure freedom of choice for the customers of CPs.

A2.37 We consider that the first, third, fourth and fifth of those requirements are of particular relevance to the matters under review and that no conflict arises in this regard with those specific objectives in section 3 of the CA03 that we consider are particularly relevant in this context.

A2.38 Section 4A of the CA03 requires Ofcom, in carrying out certain of its functions (including, among others, Ofcom's functions in relation to market reviews under the CRF) to take due account of applicable recommendations issued by the EC under Article 19(1) of the Framework Directive. Where we decide not to follow such a recommendation, we must notify the EC of that decision and the reasons for it.

A2.39 Similarly, Article 3(3) of the Regulation establishing BEREC[35] requires NRAs to take utmost account of any opinion, recommendation, guidelines, advice or regulatory best practice adopted by BEREC.

A2.40 Accordingly, we have taken due account of the applicable EC recommendations and utmost account of the applicable opinions, recommendations, guidelines, advice and regulatory best practices adopted by BEREC relevant to the matters under consideration in this review.

Impact assessment – section 7 of the CA03

A2.41 The analysis presented in the whole of this document represents an impact assessment, as defined in section 7 of the CA03.

A2.42 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the CA03, which means that generally Ofcom has to carry out impact assessments where there is likely to be a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of its policy decisions. For further information about Ofcom's approach to impact assessments, see the guidelines, Better policy-making: Ofcom's approach to impact assessment, which are on the Ofcom website: http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf.

A2.43 Specifically, pursuant to section 7, an impact assessment must set out how, in our opinion, the performance of our general duties (within the meaning of section 3 of the CA03) is secured or furthered by or in relation to the regulation we impose.

A2.44 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects and practices on race, disability and gender equality. This assessment is set out in Annex 2.

Regulated entity

A2.45 The power in the CA03 to impose an SMP obligation by means of an SMP services condition provides that it is to be applied only to a 'person' whom we have determined to be a person having SMP in a specific market for electronic communications networks, electronic communications services or associated facilities (i.e. the 'services market').

A2.46 The Framework Directive requires that, where an NRA determines that a relevant market is not effectively competitive, it shall identify 'undertakings' with SMP in that market and impose appropriate specific regulatory obligations. For the purposes of EU competition law, 'undertaking' includes companies within the same corporate

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

group (for example, where a company within that group is not independent in its decision making).[36]

A2.47 We consider it appropriate to prevent a dominant provider to whom an SMP services condition is applied, which is part of a group of companies, exploiting the principle of corporate separation. The dominant provider should not use another member of its group to carry out activities or to fail to comply with a condition, which would otherwise render the dominant provider in breach of its obligations.

A2.48 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*".

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

Annex 3

Equality Impact Assessment

Introduction

A3.1 As referred to in Section 2 of this Statement, we have statutory duties to assess the potential impact of all our functions, policies, projects and practices on race, disability and gender equality. Equality impact assessments (EIAs) also assist us in making sure that we are meeting our principal duty of furthering the interests of citizens and consumers regardless of their background or identity.

A3.2 Unless we otherwise state in this Statement, it is not apparent to us that the outcome of our review is likely to have any particular impact on race, disability and gender equality. Specifically, we do not envisage the impact of any outcome to be to the detriment of any group of society.

A3.3 Nor have we carried out separate EIAs in relation to race or gender equality or equality schemes under the Northern Ireland and Disability Equality Schemes. This is because we anticipate that our regulatory intervention will not have a differential impact in relation to people of different gender or ethnicity, on consumers in Northern Ireland or on disabled consumers compared to consumers in general. Similarly, we are not envisaging making a distinction between consumers in different parts of the UK or between consumers on low incomes. Again, we believe that our intervention will not have a particular effect on one group of consumers over another.

The aim of our Business Connectivity Market Review

A3.4 The aim of our Business Connectivity Market Review is to assess the state of competition in the retail and wholesale leased lines markets and, if any relevant market is found not to be effectively competitive, to impose regulatory obligations designed to secure certain objectives, such as the promotion of competition.

Equality impact assessment

A3.5 We have considered whether the remedies we are implementing in the relevant markets we have identified will have an adverse impact on promoting equality. In particular we have considered whether the remedies will have a different or adverse effect on UK consumers and citizens with respect to: age, disability, gender reassignment, pregnancy and maternity, race, religion, sex and sexual orientation, and, in Northern Ireland, religious belief and dependents.

A3.6 The intention behind our approach to regulating these markets is to impose a set of regulatory obligations on CPs with SMP that will, in particular, promote competition by requiring them to provide other CPs with access to their networks on regulated terms, and to protect consumers by preventing abusive conduct such as over-charging.

A3.7 We do not have detailed sectoral information on the businesses that purchase wholesale leased lines services or whether there is a correlation between the customers of their products or services and the defined equality groups. We also do

not have information on any correlation between retail leased lines services and the defined equality groups.

A3.8 However, we do not have any reason to suspect that the benefit of remedies we have imposed would not be the same for all consumers and businesses, nor that there would be a correlation between the affected consumers and businesses and any of the above defined equality groups. On that basis, we believe that it would be disproportionate to commission further research in relation to any impact on equality.

A3.9 We also have not found any reason to suspect that there would be potential for negative impacts against the defined equality groups.

Annex 4

Wholesale product market definition: overview

A4.1 This Annex describes our approach to wholesale product market definition for this review. We apply this approach to our assessment of product markets in Annexes 6 to 8 and Sections 4 to 6. Our product and geographic market assessments for CI core conveyance and TI trunk are set out in Annexes 14 and 15.

A4.2 The approach is largely the one we consulted on in Annex 8 of the May 2015 BCMR Consultation, but we have revised some sections for the sake of brevity and clarity, and to take account of stakeholders' comments. This section includes a summary of comments received on that Annex, and our replies to those comments.

Approach to product market definition for this review

A4.3 The purpose of market definition in this review is to structure and inform our forward looking assessment of whether SMP exists in any market(s) for the supply of relevant business connectivity services. Market definition is not an end in itself, but is carried out with the aim of understanding whether, during the course of the review period, the users of business connectivity services will be protected by effective competition, or whether *ex ante* regulation is required.

A4.4 In formulating our approach, we have taken account of the 2014 Recommendation on Markets[37], the accompanying explanatory memorandum (the "Explanatory Memorandum")[38] and the Commission's SMP Guidelines.[39]

A4.5 As in previous reviews, we inform our assessment of the market boundaries by considering the likely strength of competitive constraints from demand-side and supply-side substitution. The hypothetical monopolist test is a tool we use to assess such substitution possibilities. This approach considers whether a hypothetical monopolist could profitably impose a small but significant non-transitory increase in price (a SSNIP) in a candidate market. If demand-side substitution to, or supply-side substitution from, alternative services is sufficient to render the price increase unprofitable, then the market should be widened to include the closest substitute services.

A4.6 In order to define the relevant markets on a forward looking basis we have considered expected or foreseeable market developments over the review period as well as existing market conditions and past data where relevant.

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[37] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014H0710&from=EN

[38] http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=7056

[39] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52002XC0711(02)&qid=1399986405910&from=EN

A4.7 We apply the Modified Greenfield Approach when carrying out the market definition exercise. The market definition exercise is therefore conducted in relation to a hypothetical scenario in which there are no *ex ante* SMP remedies in the reference market(s), but *ex ante* SMP remedies in other markets continue to apply. For example, we assume that remedies imposed in the Wholesale Local Access (WLA) market apply[40] and that therefore BT is required to provide LLU, VULA, SLU and PIA.[41]

Stakeholders' comments on the approach to market definition for this review

A4.8 BT argued that our approach to market definition was inconsistent with the EC Explanatory memorandum. BT claimed that we had defined a leased line as a PtP (point-to-point) circuit whereas the Explanatory note states that leased lines can be both PtP (point-to-point) and PtMP (point-to-multipoint). BT also argued that we were inconsistent with the EC Explanatory note in including MNO and LLU backhaul in the TISBO and CISBO markets.

A4.9 BT also argued that unlike in the 2013 Review, we had not properly defined the term "leased line" for the purposes of market definition,[42] though we had recognised the importance of doing so in the data analysis context. In BT's view, the leased line "*should not be the focal product either upstream or downstream*".

A4.10 We respond to these points in turn below.

A4.11 We do not agree that our market definition is inconsistent with the EC Recommendation. Indeed, in the first sentence of the paragraph of the Explanatory note from which BT quotes, the EC Recommendation states that: "*The distinguishing product characteristics of leased lines are their ability to provide dedicated, and uncontended connections, and symmetrical upload and download speeds*".[43] In the next paragraph, it is stated that "*Most Member States have defined terminating segments of leased lines as the part between end-users' premises and the closest exchange of a service provider*." This is clearly consistent with our definition.

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[40] WLA refers to the fixed connection from the local exchange or access node to the end-user. We currently require BT to provide various WLA services such as Local Loop Unbundling (LLU) or Sub-Loop Unbundling (SLU) (for copper-based current generation access or 'CGA' services) and VULA (for fibre-based next generation access or 'NGA' services) on regulated terms. Physical Infrastructure Access (PIA) is a passive remedy that provides access to BT's access ducts. The set of WLA remedies allows other CPs to use BT's access network to provide competing voice and broadband services in the downstream markets.
http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/statement-june-2014/volume1.pdf

[41] One practical implication of this approach is that EFM-based services can be included in our market, even though CPs require access to BT's regulated WLA products in order to be able to supply such services.

[42] BT said "in contrast to the previous review, Ofcom does not appear to offer a precise scoping definition of what is a leased line", BT response, paragraph 10.8.

[43] This is on page 49 of the Explanatory note at
http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=7056

A4.12 However, it is the case that our definition is not precisely the same as the market for "wholesale high-quality access provided at a fixed location" since we exclude asymmetric services and define separate markets for TISBO and CISBO services. It is of course open for NRAs to depart from the markets in the EC's list where this is justified by national circumstances, without implying any necessary inconsistency.

A4.13 Finally, it appears to us that the conclusion of the discussion on page 51 of the Recommendation, from which BT quotes, is that it is not necessary to define a separate market for MNO backhaul precisely because MNOs' needs can be met by "*the provision of wholesale leased lines or equivalent inputs in the wholesale high-quality market*". This again is entirely consistent with Ofcom's conclusions.

A4.14 We define the term “leased line” in Section 3 of this statement.[44] In the 2013 Statement, we set out the "*scope of our assessment*" in paragraph 3.5 onwards. In paragraph 3.5, a leased line is defined as "*a service that provides dedicated symmetric transmission capacity to carry voice and/or data traffic. Dedicated in this context means uncontended, and symmetric means there are identical transmit and receive data rates*." This is the same as the definition used in this statement.

A4.15 In 2013, BT objected that this definition was arbitrarily narrow because we had started from an excessively narrowly-defined "focal product" (leased lines as defined above), and that this had led us to define excessively narrow markets. BT also suggested that we had erred in our market definition as we had based our analysis on point-to-point circuits, whereas most leased lines were in fact sold as part of multi-site solutions. BT's arguments and our response are set out in paragraphs 3.10 - 3.25 of the March 2013 BCMR Statement.

A4.16 We therefore believe BT to be making essentially the same points as it made in 2013 and which we do not accept again for the reasons set out in 2013. We also note that in general, as the "focal product" is the starting point for the hypothetical monopolist test, it is *necessarily* narrowly-defined.[45]

A4.17 As it suggests, BT made related points in its response to the October 2014 data analysis consultation. BT's arguments and our response were set out in Annex 15 of the May 2015 BCMR Consultation, in paragraphs A15.14 - A15.25 and Table A15.12 (comments 23 and 24). We explain that the definition of a leased line set out above was used in our information requests. We also explain why we did not agree with BT's contention that this had led to relevant data being omitted from CPs' responses.

Relationship between wholesale and retail markets

A4.18 The Explanatory Memorandum notes that for electronic communications sectors[46] in general there are at least two market levels to consider:

- *Retail markets:* for services or facilities provided to end-users, and

[44] See, for example, paragraphs 3.23 – 3.24.
[45] See the CMA guidelines on market definition, OFT 403, paragraphs 2.7, 2.9 etc.
[46] Page 7 of the Explanatory Memorandum, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=7056

- *Wholesale markets:* for upstream access to facilities and networks which are necessary for operators to provide competitive access services to end-users.

A4.19 This is a review of wholesale services, but the relationship between wholesale and retail markets is also an important factor in this market assessment. Demand for wholesale products derives from demand for retail services, and we therefore identify wholesale product markets by first analysing substitutability between products at the retail level. Where we find that two products are close substitutes at the retail level, this suggests that the wholesale market should include both products. Where we find products are not close substitutes at the retail level, then this finding is likely to follow at the wholesale level because the scope for direct substitution at the wholesale level is limited.[47]

A4.20 It then follows that, insofar as demand-side substitution is relevant to our wholesale product definition, it arises primarily from indirect constraints from retail markets. Indirect constraints arise because a wholesale price increase is likely to be passed on to the retail level, which may result in retail customers switching to goods which do not require the wholesale input.[48] If such retail substitution would be sufficient to limit the ability of a wholesale operator to profitably raise wholesale prices by any significant amount, then an indirect constraint exists. Such indirect constraints might lead to wholesale products being included in the same relevant market even if those products do not constrain each other directly at the wholesale level.

A4.21 Note that it is not necessary to formally define retail markets in order to define wholesale markets, provided that wholesale market definition takes into account any indirect constraints that exist.

A4.22 Our approach to retail and wholesale market definition is the same as in past reviews and is consistent with the relevant EC Guidelines. We have however simplified the way we present our market definition analysis for this review. Instead of going through the formal process of first defining retail markets in the absence of wholesale regulation, then in essence repeating the analysis for the upstream wholesale markets (as we did in 2013), we have presented the analysis only once. As before, the resulting wholesale market definitions are primarily determined by substitutability between products at the retail level and are not affected by this change, which is presentational.

[47] If a retail service A can only be provided by a matching wholesale service A, and another retail service B can only be provided by a matching wholesale service B, then direct substitution at the wholesale level is not possible. Any substitution between services A and B must therefore occur at the retail level. If retail services A and B are also not good substitutes at the retail level, and are therefore in separate retail markets, the corresponding wholesale services will then also be in separate markets.

[48] If the retail market were fully competitive then we would expect any industry-wide increase in the price of an input to be passed on to retail customers in full. We consider the competitive market assumption appropriate for market definition purposes.

Stakeholders' comments on the relationship between wholesale and retail markets

A4.23 BT supported our approach of proceeding straight to the definition of wholesale markets in Section 4 of the May 2015 BCMR Consultation.[49] However, KCOM characterised this as a departure from Ofcom's usual approach. KCOM stated that it expected an analysis of the retail leased lines market to be undertaken first, with the primary aim of assisting in the definition of wholesale markets that might attract regulation.

A4.24 We do not consider that KCOM has raised a substantive criticism of our approach. As explained above, this is purely a presentational matter and our definition of the upstream wholesale markets is, as usual, informed by an analysis of substitution possibilities at the retail level in the absence of wholesale regulations.

A4.25 BT also commented on the relationship between retail and wholesale markets in Section 10 of its response. We understand BT to be arguing in this section that our market definition is too narrow and that we should include VPNs and possibly other (downstream and upstream) services in the same markets as leased lines.

A4.26 To illustrate its thinking on the relationship between retail and wholesale services, BT presented a model of what it termed the "industry production chain", together with four different 'production paths' that combined different parts of the value chain to deliver a customer private network (CPN). BT then argued that, as (in its view) the end-user requirements were the same in each case, the products provided along the four technically different paths must be substitutes for each other (on either the demand-side or the supply-side). BT then submitted that, as customers could choose between products at different points along the value chain, products at all points in the value chain were subject to a common pricing constraint. It would then follow, in BT's view, that a downstream product like a VPN would constrain the prices of retail leased lines and vice versa, and that retail leased line prices would constrain the prices of wholesale leased lines and vice versa.[50]

A4.27 We consider that the general distinction between upstream and downstream, or retail and wholesale, markets is an important one.[51] We do not agree that, in general, end users will switch seamlessly between products at different levels in the value chain (for example in response to a SSNIP). One reason is that significant investment will often be required in order to use a more upstream product, as this will require the user to self-provide some functions which were previously purchased from an external supplier.

A4.28 On the specific question of VPNs, we have not changed our position from that in the March 2013 BCMR Statement, as we noted in Section 3. In particular, we consider that VPNs fall outside (downstream of) the retail leased lines market and that

[49] In the BCMR 2013 Statement there are separate sections covering first retail market definition and then wholesale market definition.
[50] BT states (paragraph 10.33) that "the only material difference between retail leased lines and wholesale leased lines is whether or not the customer is a CP."
[51] The distinction between retail and wholesale products also has some significance in the Commission's Explanatory Memorandum: see pages 7 and 15, amongst others.

neither of the two main types of VPNs should be regarded as a close substitute for leased lines for the following reasons:

- VPNs accessed via Internet links are unlikely to be close substitutes for point-to-point leased line networks as they are not able to offer the same service features,
- leased-line based VPNs appear to be more appropriately regarded as a service downstream of leased line markets as they involve not just the provision of a network but also of a network management function; and
- as wholesale leased lines are an input to such VPNs services, the ability of a retail supplier of VPNs to constrain a hypothetical monopolist supplier of wholesale leased lines is limited.[52]

A4.29 As we also noted in Section 3, BT saw an equivalence between the systems integration services which a user could buy from an external supplier and those which it could provide itself. BT regarded this as a "key observation". We consider that BT is here expressing, in a specific case, its general view that upstream and downstream services in the “industry production chain” are close substitutes from the point of view of the end user. For the reasons set out above, we do not agree that this will in general be the case.

Product market definition approach adapted to business connectivity markets

We consider a range of evidence when assessing demand and supply-side substitution

A4.30 We rely on a number of sources of evidence to inform our views about retail product markets, in particular the extent to which customers view different products as substitutes, including:

- *Technical or qualitative assessment:* we consider whether different types of service are good substitutes for each other, given any differences in product characteristics between services;
- *Pricing information:* in general, if two products perform a similar function and have similar prices it is more likely that they are substitutes than if prices are very different. If one has a higher price, both might still be sufficiently close substitutes to be included in the same market if the higher price reflects a higher quality;
- *Consumer survey evidence:* in order to assess whether consumers view services as good substitutes, we commissioned BDRC to conduct a consumer survey. We asked a number of questions to determine likely consumer preferences for different retail services and future intentions regarding purchases of Business Connectivity Services (BCS) that determine demand for leased lines. We asked

[52] For further discussion of VPNs, see paragraphs 3.75 to 3.86 of the June 2012 BCMR Consultation: http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/summary/condoc1-4.pdf

end-users about the key service characteristics they value (availability, reliability, bandwidth etc.) and how these vary depending on services they currently consume. We also asked consumers for views on likely switching intentions in future and whether they have particular concerns about switching to particular services.

- In the light of responses to the May 2015 BCMR Consultation, we commissioned BDRC to carry out a further telephone survey of 241 organisations focused on end-users of services that used Ethernet and WDM leased lines connections.[53]

  The purpose of this survey was to provide further evidence to inform our market definition and SMP, including:

  - the possible differences in end-users' demand requirements for different service types (including by bandwidth or technology);
  - the expected changes in their product requirements going forward;
  - end-users' willingness to switch between services and possible barriers to doing so;
  - what factors drive end-users' choice of supplier and whether there are any barriers to changing supplier; and
  - the awareness and consideration of alternative services, including dark-fibre.
  - We have published the findings of this research separately.[54]

- *CPs' approaches to marketing different business connectivity services and their views on market definition:* we also assessed how suppliers market different services. We also asked stakeholders about market definition in the April 2014 BCMR CFI and more directly in our market questionnaires; and

- *Barriers to switching:* even if there are general reasons why consumers might find products to be substitutes, there may be barriers to switching between the products either at the wholesale or retail level.

A4.31 We therefore rely on a range of evidence to inform our substitution analysis.

Chain of substitution analysis

A4.32 As set out in Section 3, the products and services under review cover a wide range of users (mobile, enterprises of varying size) and applications (data connections, telemetry, voice, storage/backup etc.). As a result, products are differentiated to meet the needs of specific uses and users, even though all are delivered over the same physical network (duct and fibre).

[53] Given the difficulties of identifying these customers based on a random sample of large UK businesses we relied on contact details from two of the main providers, including BT.
[54] http://stakeholders.ofcom.org.uk/consultations/bcmr-2015/statement2016

A4.33 The Explanatory Memorandum observes that superficially distinct high quality access services could fall within a single market if they are linked by a *chain of substitution* via an intermediate product(s). The Explanatory Memorandum explains that, if so, *"both ends of the chain belong to the same market as they are both constrained by the same product(s)".*[55] However, the Explanatory Memorandum also recognises that: *"the business retail market is characterised by considerable divergent national conditions. It is therefore for the NRAs to ascertain whether any breaks in the chain of substitution can be observed."*[56]

Homogeneity of competitive conditions

A4.34 Even if services are not demand-side or supply-side substitutes, it can sometimes be appropriate to analyse them as constituting part of the same market if competitive conditions in the supply of the two services are sufficiently homogeneous.[57] This approach can help streamline the subsequent market power analysis by avoiding the need to review multiple highly-similar markets. The homogeneous competitive conditions criterion is relevant for our product market definition analysis because, in leased lines markets, there are a number of closely related services which are supplied under homogeneous competitive conditions.

Stakeholders' responses

A4.35 Only BT commented in detail on our proposed approach to wholesale product market definition as set out in Annex 8 of the May 2015 BCMR Consultation. These comments form part of BT's argument that the former AISBO and MISBO markets should remain separate markets with no SMP in the MISBO market in at least some parts of the UK outside the CLA. Some of BT's arguments relate to the application of our framework to the facts, rather than the framework itself. We address BT's factual arguments in Section 4; its comments on our analytical framework are discussed below.

BT's Comments on the chain of substitution analysis

A4.36 BT argued that Ofcom should have carried out a SSNIP test where we rely on a chain of substitution analysis. BT cites paragraph 48 of the Commission's SMP guidelines in support of this contention.[58] BT also raised this point in a report produced by DotEcon.

[55] Page 50, Explanatory note to the EC Recommendation.
[56] Page 51, Explanatory note to the EC Recommendation.
[57] This approach was adopted in the BCMR 2013. We noted that, although homogeneity of competitive conditions is usually used in the context of geographic market definition as a reason for aggregating different areas not linked by demand or supply side substitution, it might also be used in the product market context. See paragraph 3.243 and footnote 187 of the BCMR 2013 statement.
[58] Paragraph 48 in fact refers to the test as the "hypothetical monopolist test" rather than the SSNIP test: however we believe these terms refer to the same conceptual framework.

A4.37 BT also argued that Ofcom's possible reasons for defining a single CISBO market set out in paragraph A8.17 of the May 2015 BCMR Consultation were not derived from relevant guidelines and not supported by evidence.[59]

Our response

A4.38 We consider that our market definition is consistent with the requirements of the Commission as set out in paragraph A4.33 above.[60] Our approach is consistent with that adopted by the Commission in identifying the market for wholesale high-quality access provided at a fixed location, which includes all wholesale terminating segments of leased lines, as a relevant market which at the European level is susceptible to *ex ante* regulation.

A4.39 We also consider that our approach is consistent with the CMA guidelines on market definition.[61] Although these guidelines are specific to the application of the Competition Act, similar market definition principles are used in the context of *ex ante* regulation. The guidelines make clear that the principles of market definition are not to be applied rigidly, and must take account of practicality, including the difficulty of obtaining evidence.

A4.40 Thus the CMA guidelines state that the appropriate market definition may not be unique, particularly when dealing with differentiated products: "*When markets contain differentiated products…there may not be a clear cut off point delineating the boundary of the market. This can mean that there is no clear distinction between products that are 'in' the market and those that lie outside it".*[62]

A4.41 As to BT's claim that Ofcom should have carried out a "SSNIP test" where we rely on a chain of substitution analysis, we explain in paragraph A4.5 above that our assessment of market boundaries is in fact informed by the hypothetical monopolist or SSNIP test.[63]

A4.42 It is possible that BT is criticising us for not calculating the price elasticity of demand i.e. a specific figure for the proportion of consumers that would switch in response to a 5% or 10% price increase. Insofar as this is BT's position, we disagree. BT has not presented any authority that it is necessary for us to do so.[64] Indeed the Commission's SMP guidelines state that "*Market definition is not a mechanical or abstract process but requires an analysis of any available evidence of past market*

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[59] Paragraph A8.17 of the May 2015 BCMR Consultation stated that "If the evidence suggests clear breaks in the chain of substitution then this could justify the definition of separate relevant product markets. Alternatively, there may be reasons to include the various differentiated products in the same market. In particular, definition of a single market may be appropriate if there are interactions between the various links of the chain, clear boundaries are difficult to determine, prices are conditioned by the choices of the firm that may have SMP, or if the boundaries are otherwise unstable as demand patterns evolve over time."

[60] This was paragraph A9.16 of the May 2015 BCMR Consultation

[61] OFT 403 "Market Definition", https://www.gov.uk/government/publications/market-definition

[62] Ibid. paragraph 5.10

[63] Paragraph A8.4 of the May 2015 BCMR Consultation

[64] While BT refers to paragraph 48 of the Commission's SMP guidelines, this imposes no such obligation on NRAs. BT's response to the May 2015 BCMR Consultation acknowledges that "*…it is not obligatory to do a SSNIP test…*" (Annex to Part A, paragraph 27).

behaviour and an overall understanding of the mechanics of a given sector" (paragraph 35). Further "*Although the SSNIP test is but one example of methods used for defining the relevant market and notwithstanding its formal econometric nature, or its margins for errors …, its importance lies primarily in its use as a conceptual tool for assessing evidence of competition between different products or services*" (footnote 26 to paragraph 40). In line with this guidance, we have used the SSNIP test as an intellectual framework when evaluating the evidence. We have considered whether or not there are breaks in the chain of substitution in a qualitative fashion. We consider that this is sufficient to support our findings on market definition. Attempting to go further by estimating a specific elasticity figure is unlikely to further illuminate our analysis and would instead represent spurious precision.[65]

A4.43 BT criticised the reasoning in paragraph A8.17 of the May 2015 BCMR Consultation in which we listed a number of practical justifications for including differentiated products in a single market.[66] BT said that these did not provide a basis for the definition of a single market in the absence of an effective chain of substitution. Although we consider that our reasoning was consistent with relevant guidelines, our conclusions are not dependent on the points made.

[65] BT submitted a paper in which Analysys Mason claimed to show that a SSNIP on either the 1Gbit/s or the 10Gbit/s price would not be constrained by customers switching between bandwidths, though without an explicit elasticity estimate. We do not consider that the SSNIP test applied by Analysys Mason in its report on market definition shows a break in the chain at 1Gbit/s for reasons we set out in detail in Section 4.

[66] See footnote 59 above.

Annex 5

Variations in competitive conditions within the CISBO market

Introduction

A5.1 In this Annex, we discuss variations in competitive conditions within the CISBO product market and how we expect them to develop over the market review period. We also summarise relevant comments received in response to the May 2015 BCMR Consultation, and include our replies to those comments.[67]

A5.2 As set out in section 4, we consider that there is a single market for all CISBO products. This finding is based primarily on evidence of demand-side substitution across the range of CISBO bandwidths. We also observe that, once in place, infrastructure can be used to supply the full range of CISBO services, and this also tends to mean that customers at a particular site will face similar competitive conditions regardless of the bandwidth they use. However, at the level of a geographic market area as a whole, we observe some variations in competitive conditions between sites and, in aggregate, between CISBO circuits of different bandwidths.

A5.3 We do not place significant weight on homogeneity of competitive conditions, at this level, to support our definition of a single product market therefore. Nevertheless, recognising that the relevant European Commission guidelines (particularly the Explanatory Note) place some weight on differences in competitive conditions, we set out in this annex our analysis on this point.[68]

A5.4 In summary, we consider that:

- There are differences in service shares as between VHB and lower bandwidth CISBO services. In the LP in particular, these differences are marked;
- However, service shares are only one indicator of competitive conditions, and we have reservations over the weight that can be attached to them in light of the small number of VHB circuits used to calculate these shares and the even smaller number of sites to which these circuits correspond;
- We also consider that such differences in service shares could have been driven at least in part by historic regulation and CPs' pricing decisions, and would expect any difference to narrow over time as end-users migrate up the bandwidth chain.

[67] Variations in competitive conditions between segments of the CISBO market were discussed in Section 4 of the May 2015 BCMR Consultation.

[68] In the 2013 BCMR, we did not need to consider in detail whether the differences in competitive conditions we observed at that time were sufficiently clear and sustainable to define separate product markets. This was because we found the break in the chain of substitution on the demand-side to be sufficiently marked that it provided strong grounds in its own right for defining separate markets.

This narrowing could be accelerated in the absence of regulation, and current differences would be unlikely to be sustained in a deregulated market.

- Even if some differences in competitive conditions will not be removed during the course of this market review period, we do not consider that this would be a basis for defining the VHB CISBO segment as a separate market, given that we find services within the CISBO market to be linked by a chain of substitution.

- Moreover, any residual variations in competitive conditions have been taken into account in our remedy assessment.

Summary of the consultation

A5.5 In the May 2015 BCMR Consultation, we argued that competitive conditions would naturally tend to be homogeneous across leased lines of different bandwidths and interface types. This was because, once a CP has infrastructure in a given area, it will be able to supply services across the range of bandwidths and interface types in that area. The ability of CPs to compete using this infrastructure will be similar across the product range, and therefore in a given area we would expect competitive conditions across the product range to be broadly similar. We noted that CISBO services themselves differ only in the equipment at the circuit ends, and where circuits use the same interface but offer different bandwidths the equipment is virtually identical.

A5.6 We acknowledged that, in practice, CPs' shares of supply may differ across services, because these will also reflect the prevailing prices and margins associated with different products, or the niche being targeted by a particular CP, and perhaps also the effects of existing regulation. But we considered that such differences were unlikely to indicate any inherent and sustainable difference in the ability of CPs to compete across the various services and we expected the ability of CPs to compete across the product range provided using the same infrastructure to reassert itself over time as prices change and users move between products, and particularly in the absence of regulation.

A5.7 We also recognised that, so far as we were able to observe, BT's share of the VHB CISBO segment was lower than its share of other segments. We considered that this was, at least in part, a result of BT's pricing policy, which featured prices which increased with bandwidth whilst the incremental costs of network extension – which formed the majority of costs of providing services – generally did not vary with the bandwidth of the circuit. We argued that this combination of prices which rose with bandwidth and costs which varied with bandwidth to a much lesser degree was encouraging greater entry by OCPs in higher bandwidth CISBO segments. At lower bandwidths, despite the presence of rival infrastructure which was equally capable of providing services at all bandwidths, BT's lower margins were associated with higher BT shares and less entry by OCPs.

A5.8 We noted that, in the March 2013 BCMR Statement, we had identified a separate product market for VHB CISBO services, then known as MISBO services. This was primarily because there was then a clear break in the demand-side chain of substitution between 1Gbit/s Ethernet services on the one hand, and higher bandwidth Ethernet and WDM services on the other hand. Given this, it was appropriate to reflect the differences in competitive conditions we observed in our market definitions.

A5.9 By contrast, in the May 2015 BCMR Consultation, we proposed that there was no longer a "clear break" in the chain of substitution. In addition, we identified factors tending to lead to convergence of competitive conditions over time, including customer migration from lower to higher bandwidth circuits. This combination of circumstances led us to propose a single market for CISBO services.

A5.10 Because this was a significant change to our market definition compared to 2013, we explained why we did not consider that BT's lower shares for very high CISBO implied a "fundamental and sustainable" difference in competitive conditions compared to those in CISBO up to and including 1Gbit/s. There were two main reasons:

- we considered that service shares in very high CISBO might not provide a good indication of competitive conditions in that segment; and
- we found that other indicators were consistent with a lack of effective competition for very high CISBO, as well as for CISBO at up to and including 1Gbit/s.

Limitations of service share analysis of very high CISBO

A5.11 We noted that estimation and interpretation of service shares in the very high CISBO segment were subject to a number of limitations which reduced their reliability as an indicator of competitive conditions. These limitations included:

- **Missing information on on-net provision** - Some operators, including [✂ ✂], could not provide information on whether circuits were on-net or off-net for a large proportion of very high CISBO services. We therefore classified very high CISBO services as supplied on-net where the operator had a flexibility point within 200m of the site to which the service was supplied. While we considered this an appropriate way of dealing with the missing information, we recognised that this raised the uncertainty surrounding our estimates.
- **Limited volumes** - The volumes of very high CISBO services were limited, particularly so in some geographic areas. This meant that service share estimates likely provided an unreliable indication of current and future competitive conditions, particularly given that significant numbers of circuits might have been accounted for by a small number of large contracts. In the light of the high expected growth in volumes, we considered that observed shares could therefore change quickly.
- **Migration** - migration from medium/high to very high CISBO was expected to have a material impact on service shares in very high CISBO over the market review period. We noted that medium/high CISBO volumes were significantly greater than those of very high CISBO. If CPs were able to retain customers as they upgraded bandwidth (e.g. due to the advantage of having an existing connection to customer premises), migration would likely increase the shares of CPs with significant sales of lower bandwidth CISBO circuits (BT, most prominently).
- **Pricing and positioning** - observed service shares were affected to a material degree by CPs' pricing and positioning of their CISBO products.
    - BT's prices increased with bandwidth whilst costs varied with bandwidth to a much lesser degree, encouraging greater entry by OCPs in the higher

bandwidth CISBO segments, with the result that, as far as we were able to observe, BT's share of the supply of higher bandwidth services tended to be relatively low;

- BT and another supplier of higher bandwidth CISBO services [✂] positioned their products differently. We noted that [✂] had successfully used its [✂] to compete both with BT's WDM services and its 1Gbit/s Ethernet services.

Other indicators were consistent with a lack of competition in very high CISBO

A5.12 We found that other evidence did not suggest that very high bandwidth CISBO provision was competitive outside the CLA.

- In the RoUK there was only one large rival to BT, with Virgin accounting for the large majority of the alternative sales of very high CISBO. We thought the presence of one major rival was unlikely to offer an effective constraint on BT as the segment evolves.
- BT's profits and prices in this segment continued to be very high. BT's return on capital employed (ROCE) on provision of MISBO services (equivalent to very high CISBO) in the UK outside the WECLA increased sharply from 11% in 2012/13 to 32%[69] in 2013/14, well above BT's cost of capital and consistent with prices being well above the competitive level and with a lack of effective competition.
- We did not consider that the differences we observed in service shares between CISBO up to and including 1Gbit/s and very high bandwidth CISBO in a given area implied any fundamental and sustainable difference in competitive conditions. We considered that competitive conditions should be similar across bandwidth segments within the same area.
- We considered that BT's strong position across the CISBO range was likely to reassert itself over time as prices changed and users moved between bandwidth segments. We recognised that, in the short run, OCPs appeared to be winning a large share of very high CISBO and said that we would take this into account when deciding on which remedies were appropriate.

Summary of responses to our consultation and our further analysis

A5.13 In this section we consider and address the responses which we received to the May 2015 BCMR Consultation relating to competitive conditions and the definition of the CISBO market as a single product market without bandwidth breaks. We begin with a brief overview, before turning to more detailed points and our responses.

A5.14 Seven CPs broadly agreed with our proposed product market definition. These were Vodafone, Six Degrees Group, [✂], Hyperoptic, Sohonet, GTC and Scottish Futures Trust.

[69] This figure has since been revised to 45%

A5.15 BT, Virgin, CityFibre and IIG opposed our proposed CISBO product market definition on a number of grounds including the existence of what they considered to be significant variations in competitive conditions within the market.[70] They argued that the VHB CISBO segment should be considered as a separate market, drawing attention to the difference in service shares between the VHB segment and other CISBO segments. They argued that weight could and should be put on these service shares as an indication that the VHB segment was more competitive than other segments. Moreover, they considered that these differences would be sustained over time. BT pointed out that it was not even the largest supplier of VHB services.

Service shares do not provide sufficiently strong evidence of sustainable differences in competitive conditions

A5.16 BT and Virgin argued that service shares show significant differences in competitive conditions between VHB and lower bandwidth CISBO services. In addition, BT claimed that the evidence of differences in service shares has been dismissed for vague and unsubstantiated reasons.[71] It added that an assessment of very high CISBO (taking account of comments on service shares and third party dark fibre) suggests that the market would fail the three criteria test (i.e. it is not a market susceptible to *ex ante* regulation).

A5.17 BT further argued that the difference in service shares between the former AISBO and MISBO markets "demonstrates that, from a demand-side perspective, there is limited switching" between them.

A5.18 We have not dismissed the evidence on services shares, but we do not think we should rely on them as a basis for defining the VHB segment as a separate market.[72] This is because:

- there is clear evidence of a single market on the basis of demand-side substitution; and
- the service shares themselves are not a reliable indicator of competitive conditions.

We acknowledge that, to date, OCPs have been more successful in winning customers and share in the VHB segment, and may indicate some differences in competitive conditions between VHB and lower bandwidth services. However, we expect conditions to converge as customers migrate up the bandwidth chain, and particularly as VHB users become increasingly more like the current users of lower bandwidth services.

A5.19 We recognise that service shares may not converge completely during this market review period. But to the extent that differences in competitive conditions remain,

[70] We summarise and respond to comments on geographic market definition in Section 4 and Annex 16.
[71] See BT's response to the May 2015 BCMR Consultation, paragraph 5.6
[72] Strictly, there is a circularity in relying on market shares to define the market, since it is possible to calculate market shares only once a market has been defined.

we consider it more appropriate to take account of them in our assessment of remedies.

A5.20 As the VHB segment falls within a market which is on the EC's list of markets susceptible to *ex ante* regulation, there is no need to show that either the VHB segment or the market as a whole satisfy the EC's three criteria test.

A5.21 BT does not explain why difference in services shares would indicate limited demand-side substitution between VHB and lower bandwidth services. We do not consider this to be correct. Moreover, as noted above, we expect service shares to tend to converge as migration from lower bandwidths takes place.

OCPs' service shares reflect, at least in part, BT's pricing

A5.22 BT argued that it would not re-assert its dominance in the VHB segment in response to migration, as it had never been dominant in this segment.

A5.23 BT added that CPs' shares in the VHB segment do not reflect BT's pricing but rather reflect the ability and incentive to compete for the high value of business at sites where there is demand for VHB connections. BT did not consider itself to be the primary provider in the market in a 'leader follower' position. In fact, it claimed that it was constrained by EOI regulation, which effectively limits its ability to compete by departing from uniform pricing.[73]

A5.24 In light of BT's comments, we clarify what we meant in the May 2015 BCMR Consultation by "*BT re-asserting its position in VHB*". We consider that BT's strong position in lower bandwidth services means that it is likely to capture a large proportion of the customers migrating from lower bandwidth to VHB services.[74] We have clarified this and discussed this in more details in paragraphs A5.50 – A5.65 below. We also consider that, to the extent that BT is constrained by regulation in the way it suggests, the hypothetical absence of that regulation (as per the modified greenfield approach) would be likely to result in a strengthening of its market position, and this is also discussed further below.

A5.25 However, BT is not correct to say it has never held a dominant position in the VHB CISBO segment. In the BCMR 2013, BT was found to have SMP in the MISBO market outside the WECLA.[75] Possession of SMP is equivalent to the holding of a

[73] See BT's response to the May 2015 BCMR Consultation, paragraphs 12.67-12.69

[74] The February 2016 BDRC survey found that 60% of respondents using BT as their main supplier chose BT because "it already has a connection to our building". Moreover "chosen supplier already has a connection to our building" was more likely to be mentioned by those with VHB circuits and Ethernet at <=1Gbit/s than by those with lower bandwidth circuits (<=100Mbit/s).

[75] The analysis underlying this finding is set out at length in paragraphs 7.429 – 7.622 and summarised in Figure 7.16 of the 2013 BCMR Statement. It should also be noted that the finding of no SMP in the WECLA was based on an analysis of the CLA and the LP (as they are called in this review) as a single geographic market (the WECLA), but one in which nearly three quarters of all VHB CISBO circuits are in fact in the CLA. We recognised that the VHB segment of the CISBO market is subject to similar barriers to entry to the other segments. For example, in paragraph 7.475 of the BCMR 2013 Statement we stated that: "there are considerable barriers to entry and expansion in [the MISBO] market [in the WECLA] caused by the high sunk costs required to build network infrastructure".

dominant position, and the MISBO market (defined and analysed as a separate market) included the same services as the VHB CISBO segment.

A5.26 BT argued that competition is determined by the total margin available at a site and that margins are higher for VHB sites. We agree that, in principle it is reasonable to expect the incentive to compete to serve a site to be related to the expected profit margin available there. In fact, this incentive might depend on the profits available at a number of sites in a multi-site contract. However, the total profit margin at a site might not be well-correlated with VHB use, if the package includes other services and sites. Even if some correlation is likely, multi-service and multi-site packages seem to be a factor tending to blur market boundaries and reducing the importance of individual circuit bandwidth. In addition, as we explained in the May 2015 BCMR Consultation, margins on VHB services have been affected by BT's pricing policy,[76] so this would also apply to site value if that is correlated with VHB use as BT suggests. The customer profile of the VHB segment is also likely to change and smaller OCPs in particular may be less placed to compete for it.

Evidence does not show growing competition in the VHB segment

A5.27 Virgin argued that there is growing competition in the VHB segment. It argued that, despite some reservations about the accuracy of the service share data, it is clear that there is a competitive market, not only in service share data but also from market characteristics. For example, in a competitive tender, Virgin will typically compete against a number of alternative providers, including BT, for the business.

A5.28 Virgin noted that it is not the only competitor with whom BT competes in the very high bandwidth market. To illustrate this it mentioned that BT has 21% service share in the CBDs for the VHB segment, which is not only less than Virgin, but also less than the aggregate share of other CPs (excluding Virgin) in that market.[77]

A5.29 Virgin also argued that Ofcom has relied on evidence of high returns to suggest the market is not competitive. It added that BT has made significant price reductions in high bandwidth services.[78]

A5.30 Whilst Virgin may find it faces a number of competitors at the retail level when bidding for contracts, not all of these may be from providers with their own infrastructure. In the CLA, they may well be, but in other areas this is less likely because the number of OCPs with their own infrastructure is much smaller. Competition at the retail level does not necessarily indicate that there is also competition at the wholesale level in the CISBO market.[79]

A5.31 Apart from Virgin and BT, the shares of individual operators in the VHB segment outside the CLA and LP are very low. The combined shares of BT and Virgin tend to be very high, and the HHI also indicates that the segment is highly concentrated, as shown in Section 4. In the CBDs, the number of VHB circuits sold is very low,

[76] Several CPs told us that [✂].
[77] See Virgin's response to the May 2015 BCMR Consultation, paragraph 1.23
[78] Virgin argued that we proposed to take variations in competitive conditions into account when deciding on which remedies are appropriate, but it did not consider that this had occurred in practice. We consider competitive conditions in VHB in our impact assessment of remedies in Section 7.
[79] [✂]

which in itself suggests that competition is unlikely to be sustainable in this segment alone, because it would not be economic to invest in building network infrastructure for the very small number of circuits which an OCP might expect to win. It also suggests that service shares may change very rapidly, for example, due to migration from the much larger lower bandwidth segments. Moreover, our estimate of Virgin's share of the VHB segment appears to be misleading since, [✂]. Hence we place little weight on service shares of the VHB segment.

A5.32 We discuss BT's pricing policy for VHB services in more detail below. In our view the evidence does not suggest that price cuts have been brought about by competitive pressure. We note that:

- The prices of single service Ethernet circuits at >1Gbit/s have been subject to charge controls;
- Costs have fallen and these may have been passed through in prices;
- BT has also cut prices in lower bandwidth segments at <=1Gbit/s;
- [✂

✂]

A5.33 In addition, service shares in the VHB segment are not directly comparable with shares of the MISBO market set out in the March 2013 BCMR Statement because we have been able to obtain better data for this review than for previous reviews (see Annex 9).

A5.34 In the light of its response, we asked Virgin to provide evidence to support its view on growing competition, but it has not submitted any evidence that supports this.

Ofcom's Conclusions

Service shares indicate that differences in competitive conditions still remain between VHB and lower bandwidths

A5.35 Table A5.1 shows our estimates of BT's service shares for VHB and lower bandwidth CISBO services. [80] We present BT's service shares across the UK (excluding Hull) as well as broken down by geographic market area.[81]

[80] In response to the May 2015 BCMR Consultation BT commented that service shares underestimate competitive conditions because they exclude dark fibre. In Section 4 we explain why we do not include dark fibre sold to end users in the CISBO market. In any case, the volume of dark fibre sold to end users is small in relation to the volume of active CISBO services.
[81] Please refer to Section 4.3 for the definition of the geographic market areas

Table A5.1: BT service shares (very high bandwidth vs. lower bandwidth CISBO)

		Total UK - excl. Hull (UK)	Geographic Market Areas		
			Central London Area (CLA)	London Periphery (LP)	Rest of UK - excl. Hull (RoUK)
CISBO up to and including 1Gbit/s	Total number of circuits	298,467	30,597	11,705	256,165
	BT share	**57%**	**47%**	**50%**	**58%**
Very high CISBO	Total number of circuits	11,306	1,966	762	8,578
	BT share	**28%**	**12%**	**16%**	**32%**

Source: Ofcom analysis. Geographic areas used in the table – the CLA, LP, RoUK– are defined in section 4.3.

A5.36 The table shows that BT's share in VHB services is substantially lower than its share for CISBO services up to and including 1Gbit/s. For example, BT's average service share across the UK (excluding Hull) is 28% in VHB services compared to 57% in lower bandwidth services. Significant differences in BT's shares are also found in the three geographic areas considered, albeit to varying degrees.

A5.37 Service shares indicate that, where rivals have invested in their own network infrastructure, they have been relatively more successful in winning VHB customers. As discussed in Section 4, the highest investment in rival infrastructure is in the CLA, then the LP and followed at a distance by the RoUK (see Section 4 Table 4.4). BT's service shares in these areas, respectively, are 12%, 16% and 32% for VHB services compared to 47%, 50% and 58% for lower bandwidth services.

However, service shares are likely to overstate the fundamental differences in competitive conditions

A5.38 The service share analysis is subject to a number of limitations, which reduce their reliability as an indicator of variations in competitive conditions. While they indicate that *some* differences still remain, we have reservations on the *extent* of these differences and their *sustainability* in the absence of regulation.

Given the low volumes of VHB circuits, service shares may not be reliable indicators of competitive conditions

A5.39 The volumes of very high CISBO services are limited and typically correspond to a relatively small number of sites. For example, in the London Periphery there is a total of 762 VHB circuits only, which corresponds to approximately 100 sites.[82]

A5.40 This means that service share estimates are unlikely to provide a reliable indication of current and future competitive conditions. A significant number of VHB circuits may be accounted for by a small number of large contracts. Hence, only a few contracts would need to be won or lost by BT (or an OCP) for observed shares to change materially within this review period.

A5.41 Current service shares are particularly likely to be unreliable in light of the growing demand for VHB services. As discussed further below (see paragraph A5.50), we anticipate that a material proportion of 1Gbit/s users will upgrade to VHB services within this review period.

Shares of the VHB segment omit competitive interactions with products outside the segment

A5.42 Shares of the VHB segment are distorted because there are significant competitive interactions between services which we include within the VHB segment and other services outside it. An example of such a distortion arises from competition at 1Gbit/s between WDM services (in the VHB segment) and single-service 1Gbit/s Ethernet circuits (in a lower bandwidth segment). BT and another supplier of higher bandwidth CISBO services [✂] position their products differently. The other supplier uses WDM-based services to meet connectivity requirements for which BT offers its standard Ethernet 1Gbit/s services. Placing them in different markets would result in a distortion and reduce the reliability of service shares as an indicator of competitive conditions in each product segment.

Differences are partially explained by historic regulation and BT pricing

A5.43 The differences in service shares are *partially* attributable to the demand characteristic of the first wave of VHB customers, which made them a target for small niche operators offering bespoke solutions.[83] However, we consider that this does not fully explain the observed differences in service shares. These differences are also likely to reflect, at least in part, historic regulations and BT pricing.

A5.44 To date, BT has chosen to set prices so that margins over incremental cost are lower in the lower bandwidths and higher in the higher bandwidths (resulting in the so-called 'bandwidth gradient' described above). Some degree of bandwidth gradient is likely to be an efficient way of recovering common costs by relating the price for additional bandwidth to users' willingness to pay for it. However, the

[82] Excluding mobile backhaul, circuit ends are supplied to 111 unique postcodes in the LP in our dataset.

[83] As discussed earlier, we consider that the demand characteristics of the typical VHB customer are likely to change over the course of this review period due to migration from lower bandwidth services. We discuss the impact of this below (see paragraphs A5.50 – A5.65).

particular structure chosen by BT may be affected by strategic factors and market power, as well as concerns for efficient cost recovery. At any rate, it seems to have had the effect of encouraging greater entry by OCPs in the VHB segment than elsewhere.

A5.45 In Annex 9 we note that the market shares that we are able to observe will often reflect the effects of existing regulation. In some circumstances, regulation might allow rivals to an incumbent to build up significant market shares, but if the underlying competitive conditions are such that the incumbent still has SMP, these market shares might not be sustained if regulation were removed.

A5.46 There is some evidence that service shares in the VHB segment have been affected by regulation. Openreach told us that [✂].[84] In particular, in the absence of regulation, we might expect to see greater use of bespoke and unpublished prices in order to win back customers and market share.

A5.47 In addition, incentives for entry and competition at lower bandwidths will have been influenced by the charge control regulation that has been in place. In the March 2013 BCMR Statement, we imposed a charge control on BT's wholesale single-service Ethernet products at all bandwidths (outside the WECLA), but WDM services were not subject to the control. We considered that imposing such a control was likely to maintain CPs' incentives to invest in physical infrastructure, while applying appropriate constraints on BT's ability to charge high prices. While most VHB CISBO (then known as MISBO) services were delivered by installing WDM equipment at customers' premises, WDM technology was at that time still evolving rapidly.

A5.48 It is possible that the fact that WDM services were outside of the control has encouraged a relatively steep bandwidth gradient for products within the charge control basket. BT may have perceived an incentive to set relatively high prices for VHB single-service Ethernet products (within the charge control basket) in order to protect margins on the substitutable WDM service (outside the basket). The corollary would have been that lower bandwidth Ethernet circuit prices had to be kept relatively low in order to comply with the cap, which would have reduced the scope for entry and competition there. This pattern of price reductions would also have allowed BT to meet competition from EFM operators at low bandwidths. It is consistent with the idea that BT has targeted the price cuts it is required to make by the charge control at its competitors but, where it is not required by regulation to make price cuts, it appears to be less willing to do so, and seems prepared to lose share instead.

A5.49 If this is the case, we might expect to see a different pattern of prices in a hypothetical market without regulation, with some rebalancing of tariffs which would then feature a less pronounced bandwidth gradient. There might also then be a somewhat more even distribution of entry and competition across the bandwidth range.

[84] Meeting with Openreach 8th December 2014

Differences in service shares are likely to converge over time as the VHB segment becomes more standardised

The market is evolving – segments are converging as customers move to higher bandwidths

A5.50 The CISBO market is evolving. There is a trend for customers to demand increasing amounts of bandwidth over time and this is bringing with it a number of changes which we refer to collectively as "standardisation". We use this term because customer migration to higher bandwidths means that speeds which once were only used by a small number of "high-end" customers with specialised demands are increasingly being used by a much wider group of customers who are more typical of leased line users in general. This is already happening but we expect it to continue over this market review period, with important implications for the VHB CISBO segment in particular.[85]

A5.51 If we were to take a cross-section through the CISBO market now, at the very top end (10Gbit/s and above) we would see demand for connections between data-centres and specialised "high-end" customers in specific sectors, such as media and finance, which require high speeds and possibly low latency to support their niche applications .[86] High-end customers have a variety of needs. Some may want flexibility (for example, to change a service mid-contract) and may not want to be tied in for long periods whilst others may prefer the certainty of a long-term deal.[87] Because of their specialised needs, a relatively small operator that is nimble in responding to customer requirements may be well placed to serve them.[88] In addition, as the number of sites where VHB services were initially demanded was small and geographically concentrated, they could be served by a relatively small network and the high prices and margins on these services made it profitable for smaller CPs to invest in infrastructure to serve this demand. Over time the bandwidth demands of these "high-end" customers may increase to even higher bandwidths – 40Gbit/s or 100Gbit/s for a few customers, with 10Gbit/s increasingly the norm for connections between datacentres.

A5.52 Lower down towards 1Gbit/s we see increasing numbers of users from a wider variety of sectors, including retail customers, and increasing use for access connections. This itself is a change from the time of the last review in 2013, when

[85] Data on circuit volumes show clearly that the >1Gbit/s segment is growing much faster than other parts of the CISBO market. The independent forecasts set out in Tables A9.2 and A9.3 in Annex 9 of this Statement show that it is expected to continue to do so. The forecasts show expected average growth rates for the VHB segment of 29% - 43% per annum over the period 2015 - 2018, on top of average annual growth rates of 44% - 55% over the period 2013 - 2015. Forecasts for 2018 – 2020 suggest growth in the VHB segment is likely to be in the range 26% - 29% per annum.

[86] Low latency connections may be needed for some very-time sensitive financial transactions, for example. However one CP told us that "[✂]" (Meeting with Colt, 3 November 2015). The same CP told us that they were "[✂]".

[87] For example one CP said "[✂]" (Meeting with Zayo 4th November 2015). Another told us that [✂].

[88] One CP told us that [✂].

use of 1Gbit/s for access was less widespread, and is likely to reflect the effect of price reductions as well as the emergence of new uses.[89]

A5.53 As prices continue to fall and more new uses for capacity emerge over the next review period, we expect to see similar developments in the VHB segment. One source of expected growth in demand for higher bandwidths is the emergence of cloud technology and other applications which are driving a need to link distributed company sites or connect larger company sites to data centres with high bandwidth connectivity.

A5.54 At the same time, other developments are facilitating upward migration. There is evidence that CPs have responded to the anticipated growth in demand for VHB services by actively encouraging lower bandwidth users to migrate upwards. Thus, new VHB products have been introduced at lower prices that are more attractive to current users of lower bandwidth products. For example, Openreach has recently launched a 10Gbit/s Ethernet service at a considerably lower price point than its existing 10Gbit/s WDM service apparently in anticipation of growing demand for 10Gbit/s services. Openreach has stated that "*End customer bandwidth needs are increasing. This is driving inevitable (and already visible) growth in the demand for 10G connectivity in support of the Business and Infrastructure markets, including the mobile sector*."[90]

A5.55 Following publication of the May 2015 BCMR Consultation, we obtained, using formal powers, BT internal decision documents relating to the introduction and pricing of its EAD 10Gbit/s service. In these documents, Openreach stated that [✂].[91] We regard this as strong evidence of interactions between 10Gbit/s and 1Gbit/s demands and prices, whilst the impact of competitive pressure on margins is less evident.

A5.56 Similarly, in its response to the May 2015 BCMR Consultation, Vodafone referred to the availability of "stepping stone bandwidths at the retail layer e.g. increments of 1Gbit/s". It said that these, together with "user demand continuing up the bandwidth hierarchy [and] the reduction in price differential between bandwidths" meant that "there are no longer distinctions within the "CI" market, and that separate AI and MI bandwidth markets do not exist".

A5.57 The resulting trend in demand towards higher bandwidths services can be seen from figure A5.1 below. This shows Openreach's view of the changing make-up of the "Ethernet market" between 2012/13 and 2016/17. The steady customer migration to higher bandwidths services means that 1Gbit/s services were expected to account for 30% of the Ethernet market in 2016/2017 compared to only 22% in 2012/2013. In addition, the share of services at 10Gbit/s were expected to grow from 3% to 5% over the same period.

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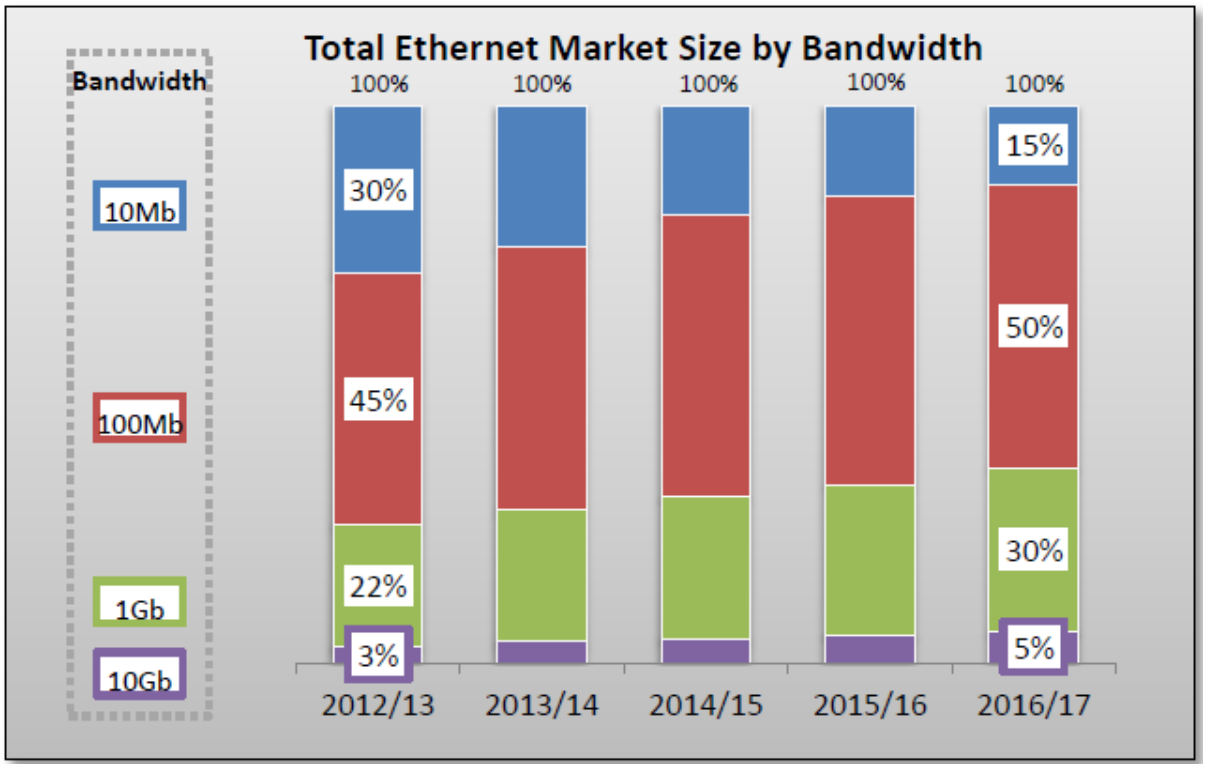
[89] In economic terms, there has been a movement down the demand curve as well as an outward shift in it. Some CPs felt the main effect of price changes would be on the timing of migration to higher bandwidths, whilst the decision to migrate itself was mainly driven by changing business needs.

[90] See Openreach slide deck named "EAD 10G - available to order now", available at https://www.ciz-openreach.co.uk/Business/content/309/EAD-10G-available-to-order-now-slide-deck

[91] BT response to S135 Notice under Communication Act, dated 16 October 2015

Figure A5.1: Openreach estimates of Ethernet market by bandwidth (2012/13- 2016/17)



Source: Openreach Ethernet Strategy Conference 2014[92]

A5.58 This is consistent with our estimates of the number of VHB circuits, which shows a rapid growth in the VHB segment. BT circuit volumes provided for the LLCC, suggest that demand for its VHB CISBO services has tripled over the last three years to reach around 7,600 circuits in 2014/15. Indeed, according to these data, BT's sales of VHB represented around 5% of its total circuit rentals in 2014/15. The trend growth is forecast to continue over the course of this review period from 2014/15, as we estimate VHB to grow by 191% to reach 22,000 circuits. This suggests that the VHB segment would represent 10% of forecast BT circuit rentals in 2018/19.[93] This is also consistent with stakeholders' views as well as other industry estimates.[94] For example, in its response to the May 2015 BCMR Consultation, Vodafone said that VHB CISBO volumes "are expected to rise to 10% of the market. We see this both from the demand of our customers and also from our own requirements for mobile and fixed backhaul. We expect that over the course of the coming market review period more users will "step up" a bandwidth from their current demand." [95] [✂[96]]

[92] Ethernet Strategy Conference 2014, https://www.openreach.co.uk/orpg/home/downloads/Ethernet_Strategy.pdf
[93] We note that these volume forecasts do not assume the availability of passive remedies such as dark-fibre, which is appropriate given the modified greenfield approach.
[94] For example, in a survey by Analysys Mason for Openreach Ethernet Strategy Conference 2014, 21% of end-user for services above 100Mbit/s up to and including 1Gbit/s expected to increase their bandwidth requirements over three years period (See Ethernet strategy conference 2014).
[95] Vodafone response to the May 2015 BCMR Consultation page 14.

A5.59 In addition, the 2016 February BDRC CI survey shows that a significant proportion of lower bandwidth customers (including 1G users) expect to migrate to VHB services over the next 3 years. For example, 27% of the sample of end-users currently using Ethernet leased lines at above 100Mbit/s and up to and including 1Gbit/s indicated that they were very likely or quite likely to upgrade to Ethernet leased lines above 1Gbit/s over the next three years, with 10% very likely to upgrade to services above 1Gbit/s.[97]

A5.60 Over time, as the VHB segment expands, the new VHB customers will increasingly be those migrating upwards from these lower bandwidths.[98] These will still be big customers who will quite likely expect, and receive, a bespoke treatment. But the nature of the demand is different from the first wave of "high-end" VHB customers served by the niche operators. They are more likely to have multi-site and multi-service demands in a wide range of locations and to be a large retail bank, supermarket chain or MNO. BT and other large CPs already have relationships with these customers and multi-site demand gives CPs with large networks – BT especially - a big advantage.[99] The existing niche operators will not be well placed to serve these customers as they do not have the geographic network reach and are unlikely to be geared to meeting the needs of these customers. [100]

A5.61 In light of the above, observed shares could change relatively quickly as this migration trend plays out, particularly in areas where rival infrastructure is less dense. To illustrate this, we can estimate the impact on service shares as the current customer base using 1Gbit/s services migrates to 10Gbit/s service. We have looked at two migration scenarios based on the evidence above to estimate possible impacts of upward migration on service shares:

- *Scenario 1: based on LLCC forecasts:* we assume for charge control modelling purposes that BT's VHB CISBO volumes increase by 191% over the charge

[96] Presentation (updated) by Virgin to Ofcom on 13 November 2015.
[97] In addition 7% said they were fairly or very likely to upgrade to WDM. A further 7% of users in the <=100Mbit/s segment said they were fairly or very likely to upgrade to WDM, and 8% to Ethernet at >1Gbit/s.
[98] The small size of the VHB segment means that even low rates of migration from the much larger segments at <=1Gbit/s affect it materially. To illustrate this, if we assume that 5% of the current customer base of lower bandwidth CISBO circuits migrate to VHB services, these new customers will account for around 60% of the total number of VHB circuits in the UK (excluding Hull). To put the 5% assumption in context, compare to the proportions of respondents to the February 2016 BDRC survey who said they were considering upgrading to VHB CISBO in paragraph A5.59 and footnote 97 above.
[99] A significant proportion of the sample interviewed for the February 2016 BDRC CI Survey mentioned historic links with the company (43%) and the chosen supplier already having a connection to the building (51%) as among the criteria for choosing a supplier. In addition, although price was mentioned by the largest number of end-users (85% of the sample), it seemed to be less significant for BT customers. Price was cited by 74% of BT customers compared to 93% of non-BT customers.
[100] For example, the February 2016 BDRC CI Survey shows that VHB customers are typically firms that have much larger turnover than customers for lower bandwidth services (£146mn for WDM users and £140mn for users of Ethernet services above 1G compared to £58mn for high bandwidth users and £55mn for medium bandwidth customers). It also shows that VHB end-users had above 530 employees on average, which is higher than end-users of high bandwidth and medium bandwidth (452 and 282 employees respectively).

control period. We assume that BT were to retain the same share of migrating customers as it has of lower bandwidth services on average.[101]

- *Scenario 2*: *migration rates implied by the consumer survey*: we rely on the consumer survey evidence that suggests that approximately 10 % of current users of CISBO services at >100Mbit/s and <=1Gbit/s considered it very likely that they would need to upgrade to a VHB service within the next three years.[102] We assume each CP retains these customers when they upgrade.[103]

A5.62 Table A5.2 shows the resulting BT shares in the VHB segment if these migration scenarios were to occur.

Table A5.2: Illustrative impact of upward migration on service share

	CLA	LP	CBDs in other cities	Rest of UK (excl. the Hull Area)	All UK (excl. the Hull Area)
Current BT shares in VHB segment	12%	16%	21%	32%	28%
New BT share – scenario 1 (LLCC forecasts)	35%	38%	38%	49%	39%
New BT share – scenario 2 (consumer survey evidence)	33%	37%	43%	51%	42%

Source: Ofcom 2016

A5.63 It is easy to calculate that this rate of growth is consistent with BT's share of this segment in the RoUK rising to 40% or more under either of the scenarios presented.

A5.64 Whilst we regard the current pattern of service shares as at least partly the result of BT's pricing structure and regulation, and do not believe niche operators will be well placed to benefit from migration to VHB services, some differences in share may be expected to persist and convergence is likely to be incomplete within this review period. One reason is that, once entrants have incurred the sunk costs needed to create a network and acquire customers, they may not easily be induced to exit the market if prices change (even if they might then prefer not to have entered).

[101] For example, in the RoUK, we assume that the VHB segment grows in proportion to the rates forecast in our charge control. We then calculate BT's expected share if we assume all of this demand is from migrating customers and if BT were to retain the same share of migrating customers as it has of lower bandwidth services on average (58% in the rest of the UK).
[102] Source: February 2016 BDRC CI Survey Section 5.3
[103] For each CP, we apply this 10% migration rate to its existing base of CISBO customers at >100Mbit/s and <=1Gbit/s. We then assume that each CP retains 100% of its customers that choose to upgrade to a VHB service.

A5.65 However, as we explain in Annex 16, the economies of scale and scope in leased line provision mean that a larger network providing a full range of services would be expected to have lower unit costs than a smaller network or one providing only a limited range of services. In many areas, a single market segment will be too small to support investment in an access network and a CP will need to get customers from across the CISBO market to recover the costs of the shared infrastructure. This is another reason for expecting convergence of competitive conditions across services provided using a common infrastructure.

Summary of our conclusions on competitive conditions in VHB CISBO

A5.66 Evidence on service shares suggests some difference remains between competitive conditions in VHB and lower bandwidth CISBO services.

A5.67 However, service shares are only one indicator of competitive conditions, and we have reservations over the weight that can be attached to them in light of the small number of VHB circuits used to calculate these shares and the even smaller number of sites to which these circuits correspond.

A5.68 We consider such differences as do exist to have been driven at least in part by historic regulation and CPs' pricing decisions, and expect any difference to narrow over time as end-users migrate up the bandwidth chain. This process of convergence could be accelerated in the absence of regulation, and current differences would be unlikely to be sustained in a deregulated market.

A5.69 We also recognise that competitive conditions are unlikely to converge fully during this market review period. However, we do not regard these differences as a basis for defining the VHB CISBO segment as a separate market, given that we find services within the CISBO market to be linked by a chain of substitution.

A5.70 We therefore consider it more appropriate to reflect differences in competitive conditions in our remedy assessment.

Annex 6

Wholesale product market definition: asymmetric broadband and Ethernet in the First Mile (EFM)

Introduction

A6.1 In Section 4 we summarise our analysis of whether asymmetric broadband and EFM (Ethernet in the First Mile) services are sufficiently close substitutes for either Ethernet or TI retail leased lines for them to be placed in the same product market. Our analysis is set out in more detail in this Annex. We conclude that (asymmetric) broadband services do not fall in the same market as any leased line services. We consider that EFM services are part of the same market as other Ethernet leased lines.

Table A6.1: Summary of findings

Factors considered	EFM	Asymmetric broadband
Qualitative assessment	No significant differences between EFM and fibre-based Ethernet leased lines. The distance of an end-user to an exchange limits the maximum speed of EFM. However, EFM is a feasible low-cost option for those with low bandwidth requirements as it is offered commercially at 30-40Mbit/s.	Technical and service features point towards differences between asymmetric broadband and leased lines.
Product positioning Marketing relative to leased lines	CPs' marketing of EFM on their websites positions it as a lower-cost type of leased line for end-users that do not require higher bandwidths.	Most CPs do not market asymmetric broadband as a leased line alternative, due to the service differences.
Pricing	Greater overlap in EFM and leased lines prices. Past reductions in Ethernet prices at 100Mbit/s may have been a response to emergence of EFM at low bandwidths.	Price comparisons show considerable differences between broadband and leased lines.
Barriers to switching	End-users with 'Ethernet-ready' infrastructure in place might not face significant barriers to switching.	End-users with large legacy networks and /or those who use specialised applications are likely to face higher switching costs in moving to broadband in the shorter term.
Migration/switching evidence	Significant increases in EFM volumes since the last review. Although there may be other factors, it seems reasonable to see the increase in EFM as a consequence of incentives for consumers to migrate to EFM as a lower cost substitute for low bandwidth CISBO.	BT and OCPs report few cases of significant ongoing migration from leased lines to asymmetric broadband. Consumer survey evidence suggests that a minority of users might *consider* switching to asymmetric broadband as an alternative to leased lines, but does not suggest they are close enough substitutes to be placed in a single market.

Source: Ofcom 2016

A6.2 Overall, our analysis suggests that EFM would be a good substitute for some leased lines customers, especially those currently using or considering migration to low bandwidth Ethernet services. Our analysis suggests that substitutability is insufficiently strong to include leased lines and asymmetric broadband in the same market, and that this will remain so over the course of the three-year review period. Nevertheless, in our SMP assessment, we do take into account the external constraint that might arise from leased lines users switching to broadband.

A6.3 The analysis is largely as set out in Annex 9 of the May 2015 BCMR Consultation, but we have revised some sections for the sake of brevity and clarity and updated others to reflect revised or updated analysis. We first explain our proposals as set out in the May 2015 BCMR Consultation, we then summarise stakeholder responses; finally we present our response to those comments and our updated analysis.

May 2015 BCMR Consultation

A6.4 In the May 2015 BCMR Consultation, we focused on the constraint that asymmetric broadband and Ethernet First Mile (EFM)[104] may provide on the prices of retail leased lines.[105] We did not consider the possibility of constraints in the other direction (on broadband prices), as this was assessed in the WBA Review where we concluded that broadband access services are not constrained by the prices of leased lines.[106] We did not include an analysis of symmetric digital subscriber lines (SDSL) services as they are no longer material given the volumes now sold.[107]

A6.5 Our analysis included a consideration of the changes in technology since the 2013 Review and expected future developments during this review period. In particular our analysis covered:

- a qualitative assessment of different technologies;

[104] For a description see the relevant sub-sections below.
[105] As well as NGA and EFM, there are various connectivity products used in niche applications (some circuits used for CCTV, broadcast and street access) that have some similarity to leased lines. These products are not alternatives for most leased line customers, due to their specialist technical characteristics. Moreover, they are small in volumes and in some cases have various non-leased line alternatives. As in the 2013 BCMR we have not included these products in our leased line product markets. This proposed approach was explained in Annex 9 of the May 2015 BCMR Consultation. No stakeholders commented on this proposal in their consultation responses.
[106] See Ofcom's "Review of the wholesale broadband access markets", statement, 26 June 2014, p. 68-71, at http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/statement/WBA-Statement.pdf
[107] SDSL is a technology that provides symmetric bandwidth (2Mbit/s upload and download) over a copper line. SDSL services were previously included within the TI market and subject to network access obligations. Although they were relatively low quality relative to a TI service, they were a low cost way to achieve symmetric services at low speeds and contention rates, so were sufficient for those that did not have a strong need for TI features. There is not expected to be a material volume of active subscribers throughout this review period. SDSL users are actively being encouraged by CPs to migrate to other services, notably EFM and Ethernet. According to BT, EFM or Ethernet will not cost more than SDSL, and will provide additional service features: https://www.btwholesale.com/pages/static/Products/Broadband/BT_IPstream/featuresandbenefits.htm BT has also retired SDSL from its portfolio: http://www.managedcomms.co.uk/2013/bt-retiring-sdsl-services-by-spring-2014/

- marketing, service features and pricing of each service;
- price comparisons and migration trends between services;
- evidence from consumers based on our consumer survey;
- views of stakeholders based on our market questionnaire and responses to our April 2014 BCMR CFI;
- supply-side substitution; and
- barriers to switching.

A6.6 We summarise our views in each of these areas below.

Asymmetric broadband services

Qualitative assessment

A6.7 We compared the technical and service characteristics of leased lines to those of the following fixed asymmetric broadband technologies which are available in the UK (as described in Section 3), namely:

- Current generation access (CGA) based on ADSL; and
- Next generation access (NGA) comprising:
  - fibre to the cabinet or premises (referred to collectively as FTTx); and
  - cable broadband.

A6.8 As discussed in Section 3, current generation access (CGA) services based on ADSL or ADSL2+ technology use a standard copper telephone line to provide asymmetric broadband data communications. They are asymmetric as they provide higher download than upload bandwidths. NGA technologies offer an upgraded access connection either through (i) fibre-to-the-cabinet (FTTC) which involves deploying fibre between the exchange and the street cabinet and then using copper to connect the end-user; or (ii) fibre-to-the-premises (FTTP) which involves the deployment of fibre all the way from the exchange to the end-user. Virgin's network provides NGA over its cable access network, which uses a hybrid coaxial/fibre network utilising Data Over Cable Service Interface Specification (DOCSIS) technology that connects each end-user using a common coaxial cable with separate access to asymmetric broadband data services.

A6.9 We considered the different service characteristics of asymmetric broadband services and leased lines.[108] We noted that our consumer survey[109] asked

[108] Note, here when we use the term leased line we are referring to both TI and Ethernet services. We make this simplification because although some performance differences between leased lines services remain, the differences between an NGA service on the one hand, and either an Ethernet or

respondents to rank these by importance. According to the results of our consumer survey, availability – a term used in this context to describe a measure of reliability – was ranked almost twice as high in importance as the next most important service attribute.[110] Resilience and speed – both download and upload – were among the next highest-ranked characteristics. This was followed by having a dedicated (uncontended) connection and latency. End-users also ranked speed and availability as the most important factors going forward.[111] End-users ranked jitter among the service features with lower importance. We did not ask end-users to rank the relative importance of security in the consumer survey, although other evidence in the survey suggests it is important to some users.[112]

A6.10 In relation to speed characteristics, we stated that the nature of inter-site traffic for a business is such that sufficient capacity to cope with high volumes of traffic is often needed in both directions. But for many users exact bandwidth 'symmetry' *per se* is not required. They simply need the necessary upload and download bandwidths to meet their needs.

A6.11 We provided a summary table of service characteristics for leased lines and NGA services. Table A6.2 below presents this comparison, but updated to reflect any changes in the market since the May 2015 BCMR Consultation.

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a TI service on the other, are likely to be much more marked. We ignore WDM-based services in our assessment, as NGA is only likely to be a relevant constraint at lower bandwidths.

[109] References in this Annex are to the May 2015 BDRC Consumer Survey rather than the February 2016 BDRC CI consumer survey unless indicated otherwise.

[110] In the consumer survey we asked respondents to rank services in terms of relative importance to each other based on Max Difference technique. See Figure 7.1, page 35, BDRC Business Connectivity Services Review, March 2014. http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

[111] Figure 7.2, page 37 of BDRC Business Connectivity Services Review. http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

[112] For example, around 8% of users with leased lines that had concerns about switching to asymmetric broadband mentioned uncertainty about the security as a factor.

Table A6.2: Service characteristics of asymmetric broadband and leased line services

	ADSL	FTTC	FTTP/Cable Modem	Leased Lines
Geographic availability	BT has nationwide coverage for ADSL (99.8%) and covers 92% of UK premises with ADSL 2+;[113] TalkTalk covers approximately 96%.[114]	NGA to 83% of UK premises.[115] BDUK target for NGA coverage of 95% by 2017.[116] Numerous smaller deployments by other companies across the UK. Virgin's cable network covers 45% of UK premises.[117] However, 63% of businesses (SMEs) have access to 'superfast broadband' relative to 83% of premises overall.[118]		Nationwide (subject to ECCs)
Headline bandwidths	Download 24Mbit/s/, upload 1.4Mbit/s	Download 80Mbit/s/ upload 20Mbit/s.[119]	FTTP: Download 300Mbit/s, upload 20Mbit/s. Virgin now offers download speeds of up to 300Mbit/s in some areas and upload speeds of up to 15Mbit/s.[120]	64kbit/s up to 100Gbit/s + symmetric capacity available
Bandwidth limitations	Bandwidth decreases based on distance of customer site to the exchange. Practical limit ≈ 3km (ADSL2+) to 5km (ADSL). For FTTC, the effect is much less than ADSL due to shorter local loops.			Not distance limited
Contention	The amount of contention can be varied by provision of backhaul capacity, depending on end-user requirements, Contention typically varies between 20:1 to 50:1	The amount of contention can be varied by provision of backhaul capacity depending on end-user requirements.		Uncontended
Latency / Jitter	Variable - dependent on the bandwidth capacity of the network and traffic at any given point in time, specified levels cannot be guaranteed			Low
Resilience	Not deployed to support resilience options			Resilience available
Security	Perceived as less secure as carried over a shared infrastructure			Medium to High
Synchronisation	Not supported		Supported on FTTP, unsupported on Cable	Supported

Source: Ofcom 2016 (updated for changes to speed and coverage)

[113] BT Group annual report 2014, p. 42, at http://btplc.com/Sharesandperformance/Annualreportandreview/pdf/2014_BT_Annual_Report.pdf

[114] TalkTalk Group annual report 2015, p. 2, at http://www.talktalkgroup.com/~/media/Files/T/TalkTalk-Group/2015/Annual%20Report%202015/Annual%20Report%202015%20Final.pdf

[115] http://stakeholders.ofcom.org.uk/binaries/research/infrastructure/2015/downloads/connected_nations2015.pdf

[116] https://www.gov.uk/guidance/broadband-delivery-uk

[117] http://stakeholders.ofcom.org.uk/binaries/research/infrastructure/2015/downloads/connected_nations2015.pdf

[118] Ibid, paragraph 2.9.

[119] BT is testing technology that may significantly increase the maximum download and upload speeds (see discussion in A6.87).

[120] http://www.choose.net/media/guide/features/virgin-media-xxl-broadband-50mb.html

A6.12 We noted that the maximum upload speed a user might expect with current generation broadband was up to 1.4Mbit/s.[121] We therefore focused on NGA technologies as closer substitutes to leased lines. We noted that for some users, NGA could be considered to provide an acceptable alternative to a symmetric service with a maximum bandwidth equal to the upload bandwidth of the broadband service. Table A6.2 showed that a leased line user with bandwidth requirements of 20Mbit/s could potentially buy a FTTC (or FTTP) service with download speeds running at up to 80Mbit/s (300Mbit/s FTTP) and upload bandwidth of up to 20Mbit/s (20Mbit/s FTTP). We explained that these FTTx services could be considered as broadly 'equivalent' in bandwidth terms to a lower bandwidth symmetric leased line service.

A6.13 However, we also noted a number of differences in service features between NGA and leased lines. These include differences in terms of contention, latency and jitter, the level of security, resilience options, SLAs/SLGs and synchronisation support (for FTTC). We also noted that because NGA services are still being rolled out, they do not currently have the same geographic availability as leased line services, although they are expected to be widely available by the end of the three-year period covered by this review. Similar quality issues apply to both FTTx and cable products.[122]

A6.14 The analysis above suggests that, at least in terms of headline speeds, NGA services can be seen as potential substitutes to leased lines services. Indeed, some users of low bandwidth TI leased lines (bandwidths of 2Mbit/s and below) in principle could in fact experience an increase in speed by moving to NGA. However, some leased line service features are not fully matched by those of NGA services.

A6.15 Cable broadband can match (or even exceed) lower bandwidth AI and TI leased line services in terms of download speed, but upload speeds are usually lower and there are still key differences in other service features. Where these features are required, cable broadband is unlikely to be a close substitute for a leased line. Indeed Virgin's business website positions Ethernet leased lines and business broadband as suitable for different business applications with significant price differences between Virgin's business broadband over cable (from £25 per month)[123] and its managed internet access over dedicated Ethernet connections (from £325 per month).[124]

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[121] Upload bandwidth is also distance dependent but, because upload bandwidths are lower, they are not necessarily impacted by distance from the exchange to the same extent as download bandwidths.

[122] Virgin delivers, on average, relatively high actual speeds, but not always for headline rates at peak times, see http://media.ofcom.org.uk/news/2015/broadband-speeds-november2014/. There are also a number of differences in the service features, as is the case with other asymmetric broadband technologies. These include differences in terms of contention, latency, and jitter, the level of security, resilience options, SLAs/SLGs and synchronisation support.

[123] http://www.virginmediabusiness.co.uk/Products-and-solutions/Broadband-and-Internet-Services/Business-Broadband/

[124] http://www.virginmediabusiness.co.uk/Products-and-solutions/Broadband-and-Internet-Services/Managed-Internet-Access/ppc/?gclid=CjwKEAjwp7WgBRCRxMCLx8mMnDMSJADncxS2BKBzXtmo_0jhCvmKuI6dYywM7JQ4RBtcDWZ2WtpUkxoCsoHw_wcB

Marketing and pricing

A6.16 We discussed the results of our research [125] of CPs' marketing and pricing of asymmetric broadband packages, including their positioning of these services relative to leased lines.

A6.17 Our research suggested that providers do not usually position business broadband as a close substitute for leased lines. We found that CPs that provide both broadband and leased lines typically position leased lines as a premium service. For instance, Easynet described its leased lines proposition as *"a service for those organisations that regard their Internet connectivity as absolutely mission critical"*, whereas it did not attach the same description to its broadband proposition.[126] TalkTalk described an Ethernet leased line as *"Simply the best there is"* across all of its propositions.[127] BT mentioned that while fibre broadband can be used for a dependable internet connection *"… some businesses just need something more"*.[128]

A6.18 We observed that a common marketing approach is to match the typical end-user 'types' to different services such as asymmetric broadband or leased lines. We referred to examples of 'types' of businesses, often distinguished by the number of employees they have, by the level of usage the overall business normally makes, ranging from light to heavy, or by how critical reliable data is to the business. In general, smaller firms with less business-critical data services are matched to asymmetric broadband and larger businesses with business-critical data services are matched to leased lines.[129]

A6.19 Overall, we considered that the marketing evidence suggested that broadband services are not simply characterised as a cheap substitute for leased lines but are aimed at end-users who demand different service characteristics.

A6.20 We also researched retail prices of business broadband offers on CPs' websites. We explained that the prices of two services performing broadly similar functions should themselves be similar if they are close substitutes. On the other hand, if there are large differences in price between them, it is less likely that users regard them as close substitutes.

A6.21 Our research covered 39 CPs' broadband packages with advertised download speeds of between 512kbit/s and 100Mbit/s.[130] The analysis suggested that the annualised price of asymmetric broadband rarely exceeds £1,500 and is generally less than £1,000 on average.[131] For our price comparison, we focused on the lower

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[125] Based on available information on CPs' websites
[126] See http://www.easynetconnect.net/products-and-services/internet/fibre-leased-lines/
[127] See http://www.talktalkbusiness.co.uk/products-and-services/connectivity-networking/ethernet/
[128] See http://business.bt.com/broadband-and-internet/leased-lines/why-leased-lines/
[129] For example, Virgin's business website has different product offerings and distinguishes between 'business' customers up to 99 employees and 'enterprise' customers with 100+ employees. http://www.virginmediabusiness.co.uk/business-types/
[130] Note that although Virgin offers higher speeds than 100Mbit/s packages, it does not offer them to business users.
[131] The only examples of retail services above this level are for low contention asymmetric broadband services. However, contention *per se* is not the reason for significantly higher prices (i.e. greater than

bandwidth leased lines services more likely to be considered as alternatives to asymmetric broadband.

A6.22 Our analysis highlighted the range and variety of business broadband packages available, even allowing for the difficulties of comparing prices. But in general there was a marked gap between broadband prices and the prices of even the cheapest leased lines.[132] We estimated that asymmetric broadband services are significantly (up to three to four times) cheaper than an illustrative price for a leased line of the same (but symmetric) headline speed.[133] The price evidence did not therefore suggest that there is a 'chain of substitution' linking the higher quality asymmetric broadband services sold to businesses to low bandwidth leased lines.

A6.23 We also noted that most CPs marketing asymmetric broadband did not typically characterise it as a cheap substitute for leased lines. In general, it seemed to be positioned as appealing to end-users with different requirements.

Consumer survey analysis

A6.24 We then considered evidence from the consumer survey conducted by BDRC on behalf of Ofcom.[134] However, we noted that there were a number of important caveats when it comes to interpretation of the survey.[135] Due to very low samples available by individual leased line types (Ethernet and SDH/PDH) most results are reported for all leased line users.

A6.25 In the consumer survey, we asked users of leased lines:

- for those who had switched in the past, what alternatives they considered;
- what were the main motives for selecting leased lines over other services and what factors might become more important in future;

£1,500) in general as, for example, Total Web Solutions offered an uncontended headline 20Mbit/s downstream speed connection for as little as £21.99 a month.

[132] For leased lines, we relied on wholesale input prices as these are published by BT. We explained that an equivalent retail leased lines access circuit would be priced higher because it would include a contribution to the recovery of retail costs and a margin over and above the wholesale input prices. Hence, any gap between retail asymmetric broadband and wholesale leased lines prices would be more marked when compared against retail leased lines prices.

[133] We noted that the comparison was only illustrative because the upload speed of the asymmetric broadband package will be significantly lower than its headline download speed. In addition, the leased line price used is a wholesale input price excluding retail margins. The comparison also included two examples of leased line prices, one for a 10km link and one with no distance component. In practice, an asymmetric broadband service consists of access to the internet, which entails a CP providing any access and backhaul necessary to get to its internet access points on its core. For leased lines the equivalent depends on network configuration, so we showed prices for leased lines services within a typical range of distances.

[134] http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

[135] See A9.28 to A9.29 of the May 2015 BCMR Consultation.

- whether, when they switched services, they had considered NGA and whether they would have any specific concerns about switching to this service in future; and

- which services they might consider switching to in future.

A6.26 Overall, we thought that the results of the consumer survey (discussed below) were consistent with asymmetric broadband falling outside of the market. Nevertheless, the overall findings of the consumer survey suggested that NGA may be attractive to customers that attach more importance to cost savings than to performance. However, overall the results did not suggest to us that leased lines and NGA services were sufficiently close substitutes to regard them as part of the leased lines markets.

Detailed summary of results

Relatively small numbers of leased lines users that recently changed service had considered asymmetric broadband.

A6.27 We asked all those that changed service technology or supplier in the last three years what alternative service types they had considered. Among those users with leased lines[136] that said they had considered alternatives, other types of leased lines were most commonly mentioned (17%) with only 6% mentioning ADSL. One third of current users who selected leased lines had not considered any alternatives when they last changed services. Among the key factors driving end-users with leased lines to eventually select the service they did were price and changing business requirements (40% of respondents mentioned each of these factors) with perceived quality as the next most important (25%).

A6.28 We asked a number of users more directly about whether they had considered asymmetric broadband when they had last reviewed their contracts. A large proportion of those asked said that they had not actively considered asymmetric broadband as an alternative to their current service (82%) or had actively rejected it (8%). Very few respondents (6%) said that they had actively considered it and would plan to switch to NGA at the end of their contract.[137] This suggested that a significant number of respondents did not consider broadband to be a close substitute (or had not considered it at all).

Concerns about asymmetric broadband services

A6.29 We asked users directly about the challenges or concerns which they perceived about switching from leased lines to broadband.[138] 42% had no particular concerns;

[136] Leased lines or VPNs mainly underpinned by leased lines. Table 230 of May 2015 BDRC consumer survey results.
[137] These results are for users with any type of business connectivity, results are the same for leased lines users except for those that had not actively considered (81%) - Table 251 of May 2015 BDRC consumer survey results.
[138] In terms of general switching behaviour in the past three years, 36% of respondents currently with a BCS had made no changes to their service; 38% changed the speed; over a quarter (26%) said that they had changed the service or technology; a significant number changed other factors, such as

whereas 17% listed upload speeds; 15% had concerns about reliability; 10% were concerned about download speeds and 9% were concerned about available SLA/SLGs. A further 10% considered that the prices offered for asymmetric broadband relative to leased lines were not attractive/worth switching for.

A6.30 In addition, speed and reliability were listed as important factors behind the choice of current service. As NGA only addresses symmetric demand at very low bandwidths (as it only currently offers 'up to 20Mbit/s' upload), and as it also has lower levels of reliability than a leased line, this suggested that NGA is not likely to be viewed as a good alternative for many users .[139] At higher speeds, and certainly above 10Mbit/s, EFM or fibre-based Ethernet services were likely to be the most attractive in terms of providing reliable bandwidth.

Some users, when asked directly about switching to NGA, said that they would be likely to consider switching in future.

A6.31 We asked all of the users who had *not* actively considered NGA as an alternative; how likely they would be to *consider* switching to NGA in the future. Relatively few (8%) said they were very likely to consider switching; 23% said they were quite likely; 17% were neutral; 25% said they were quite unlikely to consider switching; and 23% were very unlikely to do so.[140]

A6.32 Taking the first two categories together, we estimated some 31% of those that had not actively considered NGA in the past said they were likely to consider switching to NGA. This was a smaller proportion than the share that were either quite or very unlikely to switch (48%). In addition, we noted that:

- these answers did not tell us how users would respond to changes in the relative prices of NGA and leased lines, which is the relevant question for market definition purposes;[141]
- we further explained that, in general, users tend to overstate their likely or intended actions. In addition, answers to other questions in our survey suggested that rates of switching might be lower:
  - as noted in paragraph A6.27, only 6% actively planned to switch to NGA;
  - the 31% who said they would consider switching to an NGA service, were presented with NGA as the only service option. The results did not tell us the other services that would also be considered and possibly switched to in preference to NGA;

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supplier (32%); contract terms (32%); change in SLAs (21%). Table 228 of May 2015 BDRC consumer survey results.

[139] The maximum symmetric bandwidth is equal to the lower of the upload and download speeds.

[140] Table 252 of the May 2015 BDRC consumer survey results.

[141] Whilst it is possible that some users would switch to NGA sooner if leased line prices increased, we have no evidence that any such effect would be large and indeed customers may not always be able to switch quickly, due for example to minimum contract terms or the need to change IT systems, which might constitute barriers to bringing forward their decision to switch away any faster. For a formal discussion of this see 'autonomous migration' Section 14.2 of Ecorys' report to the Commission: http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?doc_id=3148

- within the pool of potential switchers, we also noted that a number of users asked would be more likely to switch to leased lines or other services that are functionally closer to their requirements. For example, we noted that it was possible to combine the results of our survey on respondents likely to consider switching *and* those that have no concerns about switching to NGA. This might suggest that only 13% of current users of leased lines would be likely to consider switching to NGA and also would have no concerns about doing so.[142]

When asked more generally about switching intentions in the next 3-5 years, the results also do not suggest the inclusion of broadband in the market.

A6.33 We asked all users of leased lines a more general set of questions on how likely it was, in the next 3-5 years, that their organisation would replace current leased lines with a different service. 16% stated they were very likely to do so; 24% said they were quite likely; 12% were neutral; 25% were quite unlikely; and 21% were very unlikely to do so.[143]

A6.34 For the 40% of all leased lines users who said they were likely or very likely to change, the main drivers mentioned were speed 61%; cost 40%; reliability 22%; security 17%.[144] When asked about the service they were likely to replace their current leased lines with, 46% mentioned asymmetric broadband; 24% Ethernet; and 4% WDM.[145] We noted that the apparently high number mentioning asymmetric broadband needed to be set against the low overall proportion who considered it very likely they would switch (16%) and the large number that mentioned speed as an important driver of change (61%).

A6.35 Overall, the consumer survey results did not suggest leased lines and NGA services were sufficiently close substitutes for them to be regarded as part of the same market.[146] The overall findings of the consumer survey suggested that NGA services may be attractive to customers that attach more importance to cost savings than performance, but we considered that a high degree of sensitivity to relative prices is unlikely. We considered that this finding was consistent with NGA providing some (weak) competitive influence on lower bandwidth leased line services, which we noted we could take into account in our SMP analysis as an external constraint.

Market questionnaire and April 2014 BCMR call for inputs

A6.36 We referred to responses to questions on NGA in the April 2014 CFI and in our market questionnaire.

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[142] Based on 31% of users who said they were likely to consider switching to asymmetric broadband and, separately, the 42% of leased lines users that have no concerns about switching from leased lines to asymmetric broadband (i.e. 31% x 42% = 13%).
[143] Table 257 of the May 2015 BDRC consumer survey results.
[144] Table 258 of the consumer survey results.
[145] Table 259 of the consumer survey results.
[146] Below we only consider results for substitution between leased lines and asymmetric broadband. In the case of EFM, due to survey length limitations, and the small base of EFM users we were not able to test this part of the market.

April 2014 BCMR CFI responses

A6.37 Seven CFI respondents (BT, Colt, KCOM, Sky, Verizon, Virgin and Vodafone) commented on questions regarding use of asymmetric broadband services for business connectivity. It was generally accepted that some customers with low bandwidth needs and without a need for high quality had switched from leased lines to asymmetric broadband services. However, there was also generally widespread agreement that for most users, leased lines and broadband were not good substitutes and should remain separate markets, although there was less agreement about the reasons for this.

A6.38 BT, Colt, Easynet, [✂], KCOM, Verizon and Vodafone mentioned two types of constraint that limit the take-up of broadband as a substitute to leased lines: technical (such as latency, reliability and capacity) and service quality-based (such as poor SLAs). BT, Colt, KCOM, Verizon and Vodafone noted a third constraint, which is the limited roll-out of NGA in business areas.

- KCOM observed that its leased lines customers were unwilling to forgo the dedicated capacity and SLAs associated with leased lines.
- Colt did not consider that NGA-based products offered genuine business-class connectivity as carrier-grade leased lines had intrinsic security and resilience characteristics that are not substitutable by NGA.
- BT considered it too early to judge how significant NGA will prove to be by the end of the review period. BT observed migration from leased lines at or below 10Mbits/s (both legacy and Ethernet) to services based on ADSL and NGA, but not where the user requires dedicated capacity, low latency, resilience and high reliability. BT saw no major barriers to switching, but some technology constraints, including coverage issues (NGA roll-out and service quality in areas where older technologies (IPStream) were still used). BT also mentioned SLAs (an issue for utilities that require faster repair times), latency (important for traffic control and transport) and encryption and specialised requirements (defence and police).
- Verizon had not seen a significant swing away from leased line products to broadband services. It referred to a lack of availability of NGA as a barrier to take up, [✂] and repair SLAs are poor.
- Virgin considered that superfast broadband has an important role to play in providing connectivity to some small businesses, but it considered NGA and leased lines remain different products.
- Vodafone considered that the vast majority of customers who could switch to ADSL (current generation broadband) have already done so but recognised that slower ongoing substitution to NGA will continue to occur. However, Vodafone noted that as bandwidth demand increases it is likely that many customers will need to switch to a leased line service to have their bandwidth requirements fulfilled.

- Vodafone submitted that substitution had previously been limited by BT's approach to rolling out NGA (although Vodafone also mentioned QoS[147]). Vodafone noted that for multi-site customers, rather than adopting NGA alongside traditional connections, many customers are choosing to wait until availability of NGA is more widespread.

- The City of London Corporation was of the view that NGA based services could be used effectively for the delivery of business connectivity for start-ups and SMEs who cannot afford Leased Lines.

- [✂], a small provider, argued that it saw a growing trend of leased line customers opting for broadband solutions with a range of different services with QoS levels to meet their needs. It noted that the types of customer were mostly SOHO (small office/home office) and SMEs migrating from leased lines to broadband based products, but even some large customers are opting for NGA services instead of EAD circuits. It also noted that migration from ISDN and 2Mbit/s TI voice services to NGA was popular.

Market questionnaire responses with respect to NGA substitution

A6.39 There were sixteen responses to the market questionnaire, with seven providing specific views on NGA substitution (BT, Easynet, Surf Telecoms, EU Networks, Zen, [✂] and [✂]). Consistent with responses to the April 2014 BCMR CFI and wider evidence, most respondents said that they did not market ADSL/NGA as a replacement for leased lines.

- [✂] noted that it marketed ADSL/NGA as a much cheaper option than leased lines and with a much greater availability. But in general [✂] used it for IPVPN access to 'in-fill' the network where on-net connections were not possible or higher quality connections were not needed. Customers requiring these types of services are mostly multi-sited SME and corporate customers owning [✂]. [✂] believed that while some of its rivals were effective at marketing ADSL and/or NGA services as an alternative to leased lines the range of applications for which they are substitutes was extremely limited at the low end of the market.[148]

- [✂] noted strong interest in NGA from the high street sector, but given gaps in NGA coverage, it has relied on alternative services such as ADSL, EFM and leased lines to fill the gap. [✂].

- [✂] was an exception in that it exclusively uses NGA derived wholesale services, so customers were encouraged to "move away from leased lines and utilise

[147] Vodafone stated that *"the QoS wrap around NGA has also been designed with consumers rather than businesses in mind. This makes NGA unusable for key access services."*

[148] [✂ ✂] observed that business customers are quite specific about bandwidth and would prefer to pay a lower price for the same guaranteed bandwidth rather than upgrading their speed at a higher cost. To these consumers, more is not necessarily better. The key factors in this market are the technology, product characteristics, SLA, service and service surround. Some CPs have suggested that the lower quality of business broadband is a function of BT SLAs/SLGs. However, we note that BT's upstream inputs are available to support repair times comparable to those offered for leased lines.

Ethernet." It considered that, "to date we have not found any resistance to this strategy."

A6.40 Most users that responded thought that migration was more likely to be to Ethernet (from SDH) or by Ethernet customers looking to increase bandwidth and remaining on leased lines:

- [✂] thought most SDH users were switching to Ethernet and Ethernet users were upgrading their bandwidths.
- [✂] saw that most of the shift of low bandwidth leased lines users was towards Ethernet (rather than asymmetric broadband).
- [✂] also considered that when customers are looking to upgrade their capacity from a 2Mbit/s SDH/PDH service their first preference is to move to Ethernet as users value, for example, the ability to manage the priority of services. [✂] noted that the full set of features of Ethernet might not be so important for some enterprise customers with basic data needs, in which case a packet-based service might suffice, but most of its customers wanted leased lines.

A6.41 On the whole, responses to our April 2014 BCMR CFI and market questionnaire suggested to us that asymmetric broadband is not generally considered to be a close substitute to leased lines. With the advent of NGA, users at the low end, which previously only had the choice of a leased line to meet their bandwidth requirements reliably, have another option. Nevertheless, it appeared to us that a number of leased lines users at the low end still value the quality and service characteristics of a leased line.

Conclusions on demand-side substitutability for asymmetric broadband

A6.42 Our comparison of asymmetric broadband services and leased lines showed that:

- there are significant differences between their service characteristics, which are important to users;
- there are large price differences between them;
- they seem to be marketed to different groups of customers with different needs; and
- users do not appear to regard them as close substitutes and neither do CPs.

A6.43 Therefore we considered that asymmetric broadband services and leased lines were not sufficiently close demand-side substitutes to be considered part of the same market.

Ethernet First Mile (EFM)

Qualitative assessment

A6.44 We explained that EFM is a set of specifications that allow CPs to run Ethernet over one or more bonded copper pairs in the access segment to connect the "first mile" from the customer to the nearest node. In the UK, CPs most commonly lease BT's copper exchange lines to connect customer premises to the nearest local serving exchange.[149] From exchange locations, connectivity can then be provided in a similar manner to leased lines, using the CPs' backhaul and core transmission networks.

A6.45 We stated that EFM is presented to the customer with an Ethernet interface and provides dedicated symmetric capacity. The key difference between EFM and fibre-based Ethernet was the use of copper unbundled loops in the access segment and resulting impacts on the services offered. We noted that copper loops allow lower potential connection cost and faster connection times, both achieved by avoiding the need to dig or install a dedicated fibre link to the customer's premises.[150] However, similar to ADSL, the use of copper in the access segment means that the signal diminishes with distance from the exchange. This in turn impacts on the speed of a connection that can reliably be offered.

A6.46 The results of our qualitative assessment of the key features of EFM and leased line services are shown below in Table A6.3.

[149] BT is required to provide unbundled local loops as a remedy for its SMP in the wholesale local access market.

[150] Although this benefit may not always be realised where multiple bonded copper lines are required.

Table A6.3: Key features of EFM and leased line services

	EFM	Leased Lines
Geographic availability	Coverage estimated at approximately 90% of business premises[151]	Nationwide
Bandwidth	2Mbit/s up to 35Mbit/s symmetric capacity offered by CPs, distance dependent	64kbit/s up to 100Gbit/s symmetric capacity available
Bandwidth limitations	Bandwidth decreases according to local loop length e.g. distance from the customer premises to the exchange. Higher bandwidth available up to 1.2km[152], after which lower bandwidth is available up to 4.5km[153] from the exchange. Customers can purchase more copper pairs to reduce the distance effect.[154]	Not limited
Contention	Uncontended	Uncontended
Latency / Jitter	Low	Low
Resilience	Resilience options available[155]	Resilience options available
Security	Medium to High[156]	Medium to High
Synchronisation	Not supported, although technically feasible	Supported

Source: Ofcom 2015

A6.47 We considered that the qualitative assessment suggested that a customer who requires the lower bandwidths offered by EFM would find the characteristics

[151] In the May 2015 BCMR Consultation, we referred to a BT Wholesale data sheet which said that BT planned to cover 90% of business premises by Spring 2015. BT's latest such datasheet at time of writing, issued in June 2015, contains a similar statement: see https://www.btwholesale.com/shared/document/Promotions/EFM/BTW_Wholesale_Ethernet_EFM_Datasheet.pdf

[152] See http://www.btlnet.co.uk/media/1357550/btl-btwholesale.pdf

[153] See https://www.btwholesale.com/shared/document/Promotions/EFM_Proactivemonitoring/EFM_DATASHEET_V14.pdf

[154] For instance, TalkTalk guarantees minimum symmetrical speeds of 2Mbit/s, going up to 10Mbit/s over two copper pairs and up to 20Mbit/s bandwidth on four copper pairs. See http://www.talktalkbusiness.co.uk/Resources/CON161%20EFM%20Datasheet%20WH.pdf

[155] EFM is more resilient than other copper based solutions, as the service can continue to operate if there is a fault on a single copper pair. See http://www.talktalkbusiness.co.uk/Resources/CON161%20EFM%20Datasheet%20WH.pdf

[156] EFM offers comparable security to leased lines, in that the connection is private, though in other respects it may be somewhat less secure. For instance, it may be easier to gain access to the EFM network nodes at the exchange as well as at the street cabinet, which could be considered a risk.

comparable with those of an Ethernet leased line. However, like other DSL services, bandwidth depends on the distance of the customer premises from the exchange and the maximum bandwidths for a given number of cable pairs[157] would only be achievable for premises close to the exchange.

A6.48 We considered there was likely to be a practical limit for the speeds that EFM might address. However, we presented evidence that showed that 86% of businesses are within two kilometres (km) of an exchange and 96% within three km. We noted that most operators quote a practical limit for EFM of about four km. At this distance, bandwidth using eight cable pairs is likely to be limited to around 8Mbit/s.

A6.49 In addition, one CP [✂] had explained to us that the final speed available to the customer cannot always be determined until the line is installed. This unpredictability in speed means that CPs were reluctant to offer EFM at higher bandwidths with associated SLA/SLGs.

Marketing and pricing of EFM

A6.50 The way EFM is marketed also suggested it is likely to be seen as a low cost leased line service. We referred to various operators' marketing quotes: *"EFM is an ideal upgrade for SDSL or Leased Lines making [customers'] access more resilient and compatible with future technologies"* (TalkTalk)[158]; and *"*[EFM is a] *lower-cost version of BT's leased line service."* (BT)[159] Smaller CPs also marketed EFM as the *"ideal leased line replacement"* (Spitfire).[160]

A6.51 Hence, the marketing we reviewed positioned EFM as a low-cost type of leased line service, and we did not find any marketing that suggested the contrary. In particular, we did not see EFM positioned as similar to ADSL. It was generally described as well-suited to SMEs that need the technical characteristics of leased lines (such as low latency and high reliability) and their service quality characteristics (SLAs), but whose smaller size means that they can compromise on bandwidth requirements.

A6.52 For example, Updata noted the following 'use cases' for EFM:

"There are two primary scenarios where customers choose EFM:

- As access for a national network - use of 2 & 4 pair EFM to backhaul data onto our MPLS network. Updata offers symmetrical bandwidths up to 16mb with a maximum distance of 4km between serving exchange and customer site. Our network enhancement roadmap includes up to 8 pairs, which will increase both the distance and support symmetrical bandwidths up to 30mb.

- As an access for a closed regional network deployment - Updata currently supports up to 8 pair EFM, however this will soon be extended to 12 pairs,

[157] EFM services use multiple access network cable pairs (generally between two and eight) and are capable of supporting bandwidths of up to about 35Mbit/s using eight cable pairs, 20Mbit/s using four cable pairs and 10Mbit/s using two cable pairs.
[158] See http://www.talktalkbusiness.co.uk/Resources/CON161%20EFM%20Datasheet%20WH.pdf
[159] See http://business.bt.com/broadband-and-internet/leased-lines/efm/
[160] See http://www.spitfire.co.uk/EFM-Ethernet/?gclid=CNW4irbrycACFVNutAodlgkArw

allowing us both to support distances beyond 7km and speeds in excess of 40mb"[161]

A6.53 We also referred to the fact that EFM was typically marketed as serving speeds up to 30 to 40Mbit/s, but we said that in the near future it may address some higher bandwidths.

Pricing of EFM

A6.54 We considered the available evidence on relative prices of EFM-based services and leased lines. In summary, in our price analysis we found:

- a smaller price gap between leased lines and EFM on average than between asymmetric broadband services and leased lines offering similar headline bandwidth rates.
- demand for an Ethernet service could be met at lower prices using EFM at bandwidths of up to about 30Mbit/s – 40Mbit/s, at which point customers are likely to consider a 100Mbit/s Ethernet circuit if they want additional bandwidth.
- the lower annualised price, compared to an equivalent leased line, may also partly reflect the lower costs and lead times of installing EFM.
- evidence of past pricing behaviour appeared to be consistent with greater competitive interaction between EFM and Ethernet than seen for asymmetric broadband.

A6.55 We recognised, however, the pricing evidence was open to some interpretation and we therefore stated that we relied on a range of evidence to inform our views on EFM and leased lines.

Market questionnaire[162]

A6.56 We referred to the results of our market questionnaire, which asked users for their views about EFM as a potential substitute for leased lines. In summary, those respondents that provided a view generally saw EFM as a product more similar to leased lines than NGA.

A6.57 [✂] noted that it positioned EFM more towards 10Mbit/s connections to larger SMEs and corporates, but as an 'Ethernet lite' service, reflecting inferior service levels and lack of bandwidth upgrade capability. [✂] noted that it adopts a similar approach when marketing access into VPNs.

A6.58 [✂] noted, in terms of SDH leased lines customers, that most of its users had moved to EFM a few years ago, but those remaining typically move onto Ethernet

[161] http://www.updata.net/products/updata-efm

[162] We did not report consumer survey results for EFM, as survey length limitations, and the small base of EFM users we were not able to test this part of the market.

leased lines.[163] [✂] saw a similar migration picture for Ethernet users with some going to EFM and some upgrading bandwidth.

A6.59 [✂] made a similar comment to that made by [✂].[164] [✂] further mentioned that it uses EFM as an access option alongside Ethernet leased lines in its [✂] product targeted at the larger SME and corporate market.

A6.60 BT referred to some migration analysis it had conducted where a customer ceased a circuit and BT was able to detect a new service.[165] This suggested that a relatively large proportion of Ethernet users were migrating from legacy WES to newer EAD, but with only a small proportion moving to EFM. For TI, it noted the vast majority apparently migrating to Ethernet and with a smaller proportion moving to EFM. Of its wholesale Ethernet customers, [✂] apparently migrated from one Ethernet product to another EAD product often at higher bandwidths. It noted that a small proportion ([✂] of all EAD ceases) moved to EFM with a small but increasing proportion apparently moving to other access options such as NGA and ADSL (equivalent to [✂] of EAD ceases by summer 2014). In a similar internal exercise carried out in 2012 for a sample of ceased PPCs, where BT could determine a follow-on activity, the majority of circuits migrated to EAD with [✂] going to EFM, and a proportion (approximately [✂]) moving to NGA.[166] We considered that BT's migration evidence was therefore generally consistent with EFM being a closer substitute for leased lines than NGA.

Conclusions on demand-side substitutability for EFM

A6.61 Our comparison of EFM and Ethernet leased lines showed that:

- The service characteristics are largely similar
- The price differences between them depend on the bandwidth required, with EFM cheaper for speeds up to around 30/40Mbit/s
- EFM seems to be marketed as a low-cost, low-bandwidth Ethernet service
- CPs appear to regard them as close substitutes

A6.62 Therefore we considered that EFM services and leased lines are likely to be linked by a chain of substitution on the demand-side.

[163] [✂] noted that the willingness to switch was driven by customer's needs with those looking for reliable service moving to Ethernet over fibre and those looking for more bandwidth at lower cost moving to NGA or EFM services.
[164] [✂] stated that in their experience, *"enterprises that have connections based on low speed 10Mbps Ethernet may often replace it with EFM when their contract is renewed, or otherwise upgrade the Ethernet bandwidth dependent on whether the requirements to reduce expenditure or cater for growing bandwidth needs".*
[165] Annex 3 of BT letter to Ofcom, "BCMR – some further evidence relevant to Ofcom's market analysis", 30 January 2015
[166] Source: BT response to Ofcom's market questionnaire.

Barriers to switching

A6.63 We considered possible issues that end-users might face when switching from leased lines to asymmetric broadband or EFM. We explained that they are likely to face some of the same issues as end-users considering moving from TI to CI leased lines (as discussed in Section 5). We identified these as:

- the potential for service disruption;
- parallel operation whilst the new service is tested; and
- changes required to customer premises equipment as end-users with SDH/PDH interfaces switching to Ethernet. Examples include changes to PBX equipment used to provide private circuit switched voice services.

A6.64 Alongside these, we argued that there may be particular issues which arise if they were to migrate a leased line to asymmetric broadband. These include:

- technological challenges, which may include adjusting existing systems in anticipation of different levels of contention, latency and lack of synchronisation;
- security considerations of using contended capacity rather than dedicated capacity offered by leased lines;
- service level agreements for asymmetric broadband, which can vary by package, but are usually inferior to those of leased lines.

A6.65 We stated that, as in the case of migration from TI to CI services, the impact of switching costs were likely to vary by type of end-user. We explained that switching may involve significant costs for end-users with large legacy networks or with specialised applications, because of the need to upgrade customer premises equipment and applications.

A6.66 We considered that barriers to switching added weight to our provisional finding that asymmetric broadband was not a close demand-side substitute for a leased line. We considered that the barriers to switching between an EFM service and a CI leased line (i.e. with an Ethernet interface) seem likely to be less significant as the factors listed in paragraph A6.64 will not apply.

Supply-side substitution

A6.67 Finally we considered whether to broaden the market to include asymmetric broadband in the CISBO market on supply-side substitution grounds.

A6.68 We explained that supply-side substitution appeared to be technically possible, in that an LLU operator which is not already providing EFM-based Ethernet services (which we include in the CISBO market on demand-side substitution grounds) could begin to do so relatively quickly and easily. However, we stated that we would only broaden the market in this way if supply-side substitution represented a genuine additional constraint on leased lines services that we had not already taken into account. In other words, a CP that is already active in the supply of leased lines cannot also be included based on supply-side substitution.

A6.69 BT, Sky, TalkTalk and Vodafone are among the main players in broadband markets with extensive presence at BT exchanges.

A6.70 However, we considered that supply-side substitution from Vodafone would not be relevant as it is already 'present' in the market by virtue of the fact that it already supplies leased lines and EFM services. Similarly, we found that TalkTalk was among the main suppliers of EFM-based services and, as we included EFM within the same market as Ethernet leased lines, then we already take into account the competitive constraint from TalkTalk. Our view was that as Vodafone and TalkTalk have already entered the market for leased lines they are not potential supply-side substituters.

A6.71 [✂]

A6.72 We excluded supply-side substitution by LLU-players as a relevant constraint. We considered that the SMP analysis is the most appropriate place to reflect any scope for greater competition in the EFM segment to emerge in future.

Ofcom's proposed conclusions

A6.73 In light of the available evidence, we considered that (asymmetric) broadband services do not fall in the same market as any leased line services. We considered that EFM services are part of the same market as other Ethernet leased lines.

Stakeholders' responses

A6.74 BT supported the inclusion of EFM in the same (retail) market as CI services at lower bandwidths.[167] It noted that, while there can be significant price differences between the two (mainly depending on distances), they are widely regarded as alternatives both by customers and by CPs. However, BT considered that we have underestimated the price constraints asymmetric broadband services impose on lower bandwidth services. BT referred, for example, to the reduction in TI volumes as evidence that EFM and ADSL are among the substitutes for TI leased lines.

A6.75 BT argued that broadband services including NGA act as a direct substitute in some circumstances for sites where bandwidth requirements are comparatively low and are mainly for access to VPN services which, in BT's view, make up the primary relevant downstream market.

A6.76 BT argued that while there are normally significant differences in SLAs associated with broadband, this may not remove the price constraining effects as not all customers require higher SLAs. Further, it submitted that it is possible to reduce the effect of SLAs by adding multiple broadband/NGA access circuits.

A6.77 BT also observed, in the context of our analysis of TI markets that the price comparisons relied on incorrect estimates of BT Wholesale's EFM charges. Specifically, it did not recognise our estimates of its EFM prices and suggested alternative higher prices which BT considered were broadly similar to other CPs' EFM prices.[168]

[167] BT referred specifically to direct fibre services at 10/100 Mbit/s.
[168] BT referred to our estimate of £614 used in the context of our product market assessment for TI services. BT's view was that the price for a service would be about £1900.

A6.78 Vodafone considered that competitive conditions in the provision of EFM-based services had not been adequately explored. Vodafone noted that its own broadband roll-out plans were based on fibre in order to supply NGA broadband services. Hence, Vodafone did not consider its broadband footprint would be used to support copper-based services such as EFM. It considered that EFM was at risk of being monopolised by BT and that, although it was a substitute for low bandwidth Ethernet, it was a poor one that "*falls in a gap between two markets*". Vodafone suggested that EFM volumes should be treated as part of BT's Ethernet volumes and that EFM supply was not "*competitively supported by LLU/MPF*".

A6.79 Six Degrees questioned the inclusion of EFM-based services in the CISBO market.[169] It suggested that EFM-based services were more like NGA services than Ethernet leased lines in that the use of the copper access network meant that speed and quality were variable. It saw some scope for increased competition between NGA and fibre-based Ethernet in future, as technologies such as G.Fast are rolled out, though it considered that NGA might be used for back-up services rather than to replace a fibre-based primary circuit.

A6.80 BT and KCOM asked whether the SMP regulation proposed for the wholesale CISBO market would apply to EFM-based services.

Ofcom's views

A6.81 We first comment on BT's argument that NGA services should also be included within the market. We consider its arguments in support of this view, namely: observed declines in lower bandwidth leased lines (TI) volumes; the use of NGA for access to VPNs; and BT's view that not all users require higher SLAs associated with leased lines.

A6.82 We consider that, even if some customer migration from leased lines to NGA has occurred in the past, this does not necessarily imply that NGA should be included in leased line markets. The available evidence, including previous evidence submitted by BT, does not suggest that past migration has been material.[170] Moreover, for substitution to NGA to impose a sufficient constraint on leased line prices for definition of a single market to be justified, it would be necessary for a sufficient number of *current* leased lines users to be willing to substitute to NGA in response to a SSNIP.

A6.83 We observe large price differences between leased lines and NGA and the services seem to be marketed to different groups of customers with different needs. Given the already existing price differences between NGA and leased lines, we consider that there is likely to be limited further switching to NGA from leased lines in response to a small price increase in leased lines. Users do not appear to regard them as close substitutes and neither do CPs. This is reflected in most

[169] As noted elsewhere, Six Degrees generally agreed with our definition of the CISBO market. It considered that the differences between WDM and single-service Ethernet were less important than those between EFM and fibre-based Ethernet services.
[170] See for example paragraph A6.60 above.

stakeholders' responses and replies to the market questionnaires and in CPs' marketing of NGA.[171]

A6.84 A number of CPs, in their responses to our market questionnaire and CFI, argued that most low-bandwidth leased lines users were looking to upgrade their bandwidth and would continue to use leased lines. This does not suggest that NGA is likely to be an effective constraint on prices of leased lines services. If a significant proportion of users of low bandwidth CI services are looking to upgrade their bandwidth, then they will not consider NGA, which is currently limited to, at best, 20Mbit/s upload speed, especially where most stakeholders now view 100Mbit/s as an entry-level speed.[172]

A6.85 We recognise that some users of leased lines, such as TI services at 2Mbit/s or below, could potentially achieve an increase in speed if they moved to NGA. However, responses to our market questionnaire suggested that most observed migration was from SDH to Ethernet leased lines (A6.40 to A6.41 above). This may be partly explained by end-users wishing to achieve a significant upgrade in speed as part of a major IT replacement programme, or reflect qualitative concerns associated with NGA services (as discussed in Table A6.2 and our consumer survey results in paragraphs A6.24 to A6.35 above).

A6.86 BT argued that, even if asymmetric broadband services often cannot guarantee specified performance levels, this may not matter to some users of leased lines, who may therefore still substitute to NGA. BT observed that many business users purchase connectivity as part of a VPN solution. It considered that this implies that NGA can be used as a substitute. However, if an end-user is willing to pay a premium for a leased line (even where that access connection forms part of a VPN-based solution) this is likely to be driven by a requirement for superior SLAs/SLGs. As discussed in Annex 4, VPNs accessed via Internet links are unlikely to be close substitutes for point-to-point leased line networks or VPNs which use a leased line for access as they are not able to offer the same service features (for the reasons set out in our qualitative assessment in paragraphs A6.7 to A6.15 above).

A6.87 Therefore we consider that asymmetric broadband services and leased lines are not currently sufficiently close demand-side substitutes to be considered part of the same market.

A6.88 Six Degrees noted that improvements in NGA technology in future may increase substitution between these services and leased lines. We note that BT has conducted 'real world' trials of asymmetric broadband technologies such as G.Fast and Fibre on Demand with peak download speeds of up to 1Gbit/s and significantly increased upload speeds of up to 50 and 100Mbit/s respectively.[173] However, these services are yet to be deployed commercially and the full specification and their positioning relative to leased lines is uncertain. Moreover, Six Degrees still saw

[171] As noted in paragraph A6.15, Virgin markets and prices managed internet services over Ethernet connections quite differently to a standard business broadband.
[172] For end-users with CI services, the lowest available speed is currently 10Mbit/s, but the entry level speed for CI services is increasingly recognised as 100Mbit/s. This is supported by evidence from a series of meetings with CPs on their approach to pricing and marketing of leased lines services.
[173] http://www.btplc.com/sinet/SINs/pdf/STIN518v1p0.pdf

substitution as mainly likely to affect demand for back-up connections used for resilience purposes, even with these developments. We consider that NGA services and leased lines are likely to remain separate markets over the current review period.

Stakeholders' comments on the inclusion of EFM

A6.89 SixDegrees' response suggested that both EFM and NGA should fall outside leased line markets. We recognise in our qualitative assessment above that EFM is not a close alternative to a fibre-based leased line in all respects. For example, CPs are reluctant to market retail EFM-based services as capable of supporting high speeds reliably. Nevertheless, in most cases, EFM can deliver access speeds of up to 40Mbit/s while retaining other service characteristics. Reflecting this, EFM is marketed as an 'Ethernet-lite' and often appears on CPs' websites alongside leased lines. We contrast this with NGA, which is rarely positioned as a direct leased lines substitute. Our analysis of price and migration is also supportive of EFM as a closer substitute to CISBO services.

A6.90 Vodafone commented that its current footprint does not support EFM services and it argued that we should specifically assess competition in the EFM segment. However, in our SMP assessment for CISBO services, we have not assumed that Vodafone provides EFM-based services and have only taken into account the competitive constraint from EFM providers in the market currently and over the market review period. For example, our service share analysis only includes the main operators that sell EFM services such as BT, TalkTalk and Updata. The competitive constraint that arises from these EFM-based operators is most likely to be felt in lower-bandwidth CISBO services.

A6.91 We have not conducted a separate competition analysis for retail services supplied using EFM. We consider such services to be part of the retail CI market. The upstream wholesale inputs used to supply the access segment of EFM services rely on remedies imposed as a result of our Wholesale Fixed Access market review. The review of these inputs falls outside the scope of the BCMR. However, we do not believe that there are significant obstacles to the use of MPF to supply an EFM service.[174]

A6.92 BT and KCOM questioned whether the application of SMP regulation to CISBO services included wholesale EFM services. For the avoidance of doubt, we do not, as part of this review, conclude that EFM-based services should be subject to SMP regulation even though we consider that these services should form part of the CISBO market. We explained this in our clarifications and corrections document to the May 2015 BCMR Consultation.[175]

[174] As noted in paragraph A6.68 above, supply-side substitution appears technically possible, in that an LLU operator which is not currently providing EFM-based Ethernet services could begin to do so relatively quickly and easily.

[175] http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/Clarifications_and_corrections.pdf. See also Annex 4 and Section 6 of this statement.

A6.93 We take account of EFM in the CISBO product market by considering the indirect constraint it imposes rather than as a direct constraint.[176] We consider EFM to be an effective substitute for low-bandwidth CI services at the retail level (as discussed above in our qualitative assessment and our analysis of EFM prices and marketing relative to leased lines). Indeed, evidence we have seen in some of BT's internal documents further supports this view. [✂].[177]

A6.94 We consider that the existing requirement on BT to provide MPF lines in the Wholesale Local Access market, together with continued availability of regulated products suitable for LLU backhaul, would allow CPs to compete using EFM.

Updated price analysis for EFM versus "equivalent" leased lines

A6.95 BT also questioned the estimate of EFM prices we presented in the May 2015 BCMR Consultation. We have therefore updated our price analysis to reflect BT's comments and account for any other price changes since then. We understand that the difference between our May 2015 figures and those submitted by BT is explained by our exclusion of certain of BT's charging elements. However, even if we accept BT's suggested changes we find they do not significantly alter our findings.

A6.96 Our estimates for wholesale EFM charges were based on BT Wholesale's online price quotation tool. In our analysis, we only included connections and access-related rental charges, known as 'Etherway'. We understand that BT's estimates for EFM service charges also include 'Etherflow' charging elements, which relate to rental charges for backhaul/core bandwidth capacity.[178] We obtain a similar charge to BT for wholesale EFM service when including both the rental charges types.[179]

A6.97 We do not consider that the inclusion of Etherflow in our price analysis for EFM would fundamentally alter our conclusions. Our analysis is set out in Figure A6.1 below, which updates the comparison of EFM versus the most affordable leased lines alternative at the given bandwidth[180] (Figure A9.4 in the May 2015 BCMR Consultation).[181]

[176] This is because the wholesale inputs to EFM cannot be used to support Ethernet leased lines (or vice versa).
[177] [✂].
[178] "Etherflow" charges relate to the assumed bandwidth capacity consumed by the EFM service over BT Wholesale's 21CN (i.e. its backhaul/core network).
[179] For example, if we were to include both 'Etherway' and 'Etherflow' charges, a 2-10 Mbit/s EFM would be around £1900 per annum. This compares to our estimate of £614 for a comparable service (based on 'Etherway' rentals only).
[180] BT's EAD 10Mbit/s service is priced higher than its 100Mbit/s EAD service. We have shown this in the Figure, but in principle, a CP wanting a new connection would always purchase a 100Mbit/s service given the lower price.
[181] We have updated this analysis for BT Wholesale's EFM prices and we have also updated for any changes to BT's leased lines charges and any changes to the retail prices we presented in the May 2015 BCMR Consultation for EFM.

A6.98 In Figure A6.1 we plot annualised prices of EFM against the advertised bandwidth in Mbit/s.[182] We calculated annualised prices from publicly available data from six CPs' websites across 13 individual EFM packages.

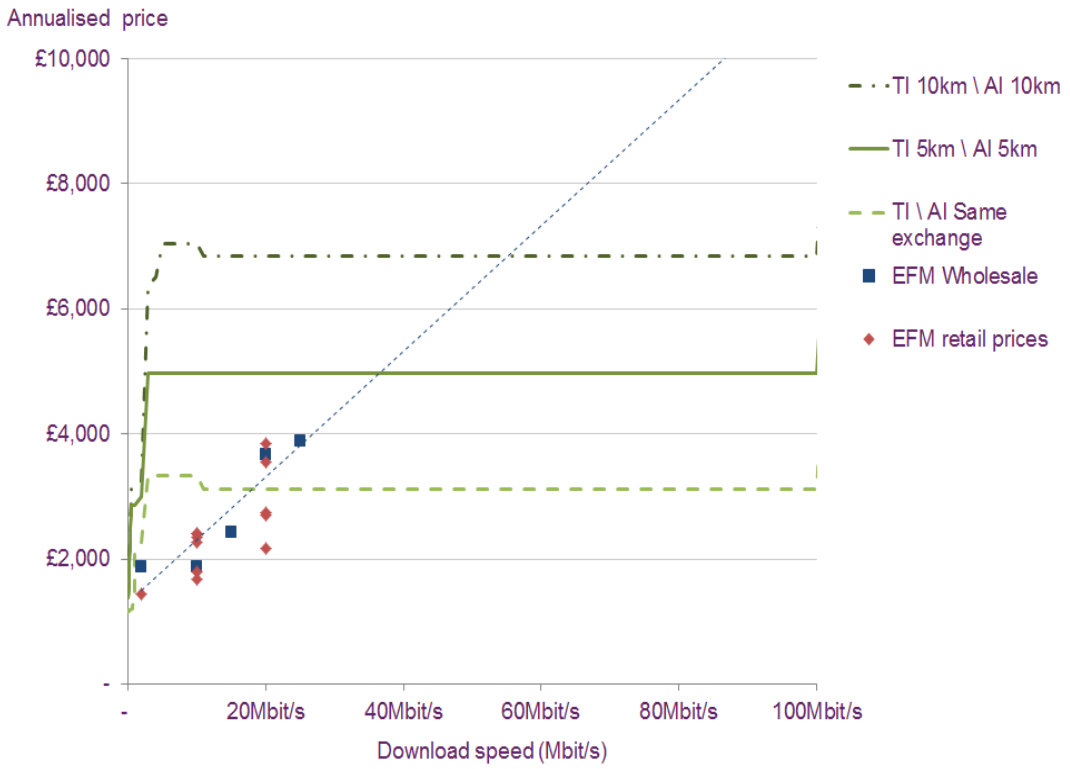
A6.99 For comparison purposes, we need to identify leased lines and EFM services that are as far as possible equivalent. We have taken the retail EFM prices as indicative of a connection to one customer site.[183] For 'equivalent leased lines' we show the price of a 5km leased line (just below the average length of a terminating segment) and sensitivities around this based on 10km circuit lengths and for a terminating segment handed over at the nearest exchange. [184]

A6.100 We have also included BT Wholesale's price of EFM at the equivalent bandwidth.[185] We project the price of wholesale EFM services for various bandwidths based on the observed data points we identified.[186] But we note that it is not possible to compare directly BT's wholesale EFM price to retail prices, as:

- retail prices are 'headline' rates (i.e. advertised as 'prices starting from…');
- the retail charges may be based on alternative wholesale EFM providers such as TalkTalk; and
- a retail EFM package price would also vary depending on the need to include other network and management costs and any retail margins.

[182] The annualised price includes charges such as connection fees and line rental, where applicable. When unspecified, we assumed a 36 month contract is required. Our sample of EFM prices is limited because the majority of CPs do not provide pricing information publicly and instead offer 'price on application' terms. Although unpublished prices could be significantly higher or lower than the ones collected in our research, we have no reason to believe there is in fact a systematic bias in the data we have.
[183] According to CPs' websites most retail EFM services are sold to provide access to the Internet or as part of site-to-site connectivity, but there is no evidence on operators' website that they vary the price of EFM for different usage scenarios.
[184] Data retrieved in January 2016.
[185] Data was retrieved in January 2016 using BT Wholesale's EFM pricing tool, available at https://bt.pricingtool.net/Modules/Pricing/WholesaleEthernet/WholesaleEthernetInput.aspx. We have gathered evidence for various postcodes and their distance to the local exchange, although there is no variation by distance within BT's EFM Access charge.
[186] We make the simplifying assumption that EFM charges would increase linearly with bandwidth reflecting the underlying cost of renting additional copper pairs to deliver higher speeds.

Figure A6.1: Comparison of EFM (retail and wholesale prices) and 'equivalent' leased lines



Source: Ofcom analysis January 2016, based on prices on CPs' websites (retail) and BT price lists (wholesale)

A6.101 On average, across the retail packages surveyed, a 2Mbit/s EFM service is priced at £1,440 per year, a 10Mbit/s service is £2,400 per year and a 20Mbit/s service is £3,064 per year. This compares to a typical price of £5,000 per year for a 5km CISBO segment.

A6.102 We note that across the packages surveyed there is also some variation in EFM prices, which seems to reflect different service wraps. For example, at a given bandwidth, higher priced offers include enhanced features such as higher level service guarantees and priority customer support relative to lower priced alternatives.

A6.103 The analysis presented in Figure A6.1 shows prices increasing with bandwidth at a more-or-less uniform rate for EFM. Except at the very lowest bandwidth, (2Mbit/s and below), the cheapest leased line alternative to EFM is a 100Mbit/s circuit giving much greater capacity. Competition from Ethernet leased lines may explain why EFM services are only offered commercially over a limited bandwidth range. For example, in Figure A6.1 we use prices of EFM at lower bandwidths to 'project' the

prices for higher speed EFM services. We estimate that at bandwidths above 40Mbit/s, an Ethernet leased line would be cheaper than an EFM service.[187]

A6.104 Although we cannot rely on our analysis in Figure A6.1 to predict definitively where EFM would be most attractive, it broadly agrees with the analysis of EFM marketing (discussed above), in which the cut-off point is typically around the 30-40Mbit/s mark. At bandwidths above 40Mbit/s most users would find a 100Mbit/s Ethernet leased line more attractive. However, at bandwidths below 40Mbit/s, savings may be available by switching to EFM from a fibre-based Ethernet leased line.

A6.105 Another driver of demand for EFM may be the lower costs (and time) associated with connecting these services relative to fibre-based leased lines. Connecting a new EFM customer would usually cost CPs less, as many premises are already connected to a copper network, while fibre may require additional construction costs. This is especially the case when the nearest fibre network node is further away from the customer premises. In such cases, Excess Construction Charges (ECC) might be imposed on new customers for leased lines which require new fibre connections to their premises. Because EFM uses existing copper infrastructure, and no additional construction is usually required, typical lead times can be as low as half those for leased lines.[188]

A6.106 However, even with EFM, the level of upfront costs and speed of installation may depend on the bandwidth required. For instance, a customer asking for higher speed EFM services would require multiple bonded copper lines. The cost of leasing many copper lines might erode or even eliminate the potential saving relative to Ethernet over fibre. Furthermore, higher speed EFM services would require additional copper lines to be installed and in some cases additional construction. Nevertheless, over the bandwidths at which EFM is typically supplied, lower connection price and shorter lead times are used in marketing EFM to emphasise its benefits over leased lines to certain types of customers.

A6.107 Overall, our updated analysis does not alter our view of EFM as a substitute for leased lines. There is a smaller price gap between leased lines and EFM on average than between asymmetric broadband services and leased lines offering similar headline bandwidth rates. Prices of EFM services appear to overlap somewhat with those of leased lines at some bandwidths. At some bandwidths there is a price gap, but EFM prices in general are much closer to leased lines than seen in our price comparison of NGA and leased lines. As EFM also offers similar service characteristics to a fibre-based Ethernet leased line (though with some possible quality differences), we consider that the evidence is consistent with a chain of substitution including EFM-based services and other Ethernet leased lines. It is likely that demand for an Ethernet service would be met using EFM at bandwidths of up to about 30Mbit/s – 40Mbit/s, at which point customers are likely to consider a 100Mbit/s Ethernet circuit if they want additional bandwidth.

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[187] We base this comparison of EFM and leased lines on the cost of the cheapest available wholesale leased line terminating segment for a 5km link against projected prices of EFM above 20Mbit/s.

[188] For instance, Zen states that while their "EFM service is typically installed in less than 30 working days, Ethernet leased lines have a standard lead time target of 65 working days but this can increase if civil engineering works are required to install the physical fibre into the building". See http://www.zen.co.uk/business/leased-lines-and-ipvpn/leased-lines/leased-line-faqs.aspx

A6.108 We also note the past pricing behaviour also suggests greater competitive interaction between EFM and Ethernet than between asymmetric broadband and Ethernet. For example, in 2013, BT reduced the rental charges of its main wholesale Ethernet service at 100Mbit/s (EAD100) such that the total cost of ownership of an EAD 100 was below that of the lower bandwidth EAD10 service.[189] The reduction in the price of BT's Ethernet services at 100Mbit/s may have been in response to competition from EFM at the low end of the market. With competition in the low bandwidth segment, it may be that BT has encouraged existing Ethernet leased lines to upgrade to 100Mbit/s. Indeed, from our discussions with some stakeholders, they view 10Mbit/s Ethernet leased lines as largely redundant, which may, in part, reflect the emergence of EFM as an alternative.[190]

A6.109 However, as discussed in the May 2015 BCMR Consultation, the pricing evidence is open to some interpretation, and we therefore rely on a range of evidence to inform our views.

Ofcom's conclusions about broadband and EFM substitution

EFM

A6.110 On the basis of our analysis we propose to include EFM in the CI market for the following reasons:

- the qualitative assessment generally shows that there are not significant qualitative differences between EFM and other Ethernet leased lines. The main differences between the two relate to reductions in the speed of EFM services as the distance of the end-user's site from the exchange increases and the fact that only low bandwidths and somewhat lower quality SLAs can be supported by EFM. However, customers with bandwidth requirements up to no higher than 30-40Mbit/s, for which EFM is a feasible option, are likely to consider EFM as a substitute for an Ethernet service;

- evidence also suggests that CPs position EFM as a lower-cost type of leased line service, suitable for those customers that do not require high bandwidths. This is evidenced by the way CPs market EFM to consumers on their websites, along with responses to our questionnaire which supported the information we have on marketing;

- consideration of barriers to switching highlights that end-users with Ethernet-ready infrastructure in place might not face significant barriers to switching;

- relative price comparisons are consistent with a chain of substitution including EFM-based services and Ethernet leased lines. We further note that reductions in

[189] Figure 4.1 (Section 4) presents a time series of BT's fibre-based Ethernet leased lines services since 2007. In May 2013, BT reduced its EAD 100 rental charges from £3,628 to £2,400 per annum whereas EAD 10 rental charges dropped from £3,352 to £3000. The connection charge for an EAD 100 (£712) remained marginally higher than the EAD10 (£570). However, given the large reduction in rental charges, the total cost of ownership of an EAD100 would be £500 less over a 1 year term with greater savings available if the service was used for longer periods.

[190] This is further supported by the evidence from [✂] discussed in paragraph A6.93 above.

the price of BT's Ethernet services at 100Mbit/s may have been in response to competition from EFM at the low end of the market. The view that 10Mbit/s is a 'largely redundant' speed for standard Ethernet may in part reflect the emergence of EFM as an alternative; and

- there has been a significant increase in EFM volumes since our 2013 Review. We do not hold enough data to determine whether this significant increase might be a migration from leased lines, SDSL or asymmetric broadband. However, when considered in light of broader evidence, the increase in EFM take-up may seem like a reasonable consequence of the identified incentives for consumers to migrate to EFM as a lower-cost substitute for low-bandwidth CISBO services.

A6.111 Our analysis suggests that EFM would be a good substitute for some leased lines customers, especially those currently using or considering migration to low-bandwidth Ethernet services.

Asymmetric Broadband

A6.112 On the basis of our analysis we propose that asymmetric broadband is outside relevant leased lines markets because:

- our assessment of the qualitative differences between broadband services and leased lines highlights that there remain a number of key differences in technical and service features;

- the growing availability of NGA has increased the speeds available with asymmetric broadband, but the available migration data suggests that there has not been an obvious change in leased lines growth overall and BT reports very few cases in which customers ceased BT's Ethernet or TI services due and migrated to NGA migration;

- evidence from the May 2015 BDRC consumer survey suggests that a minority of users might consider switching to NGA as an alternative to a leased line, but does not suggest that NGA and leased lines are close enough substitutes to be placed in a single market;

- evidence also suggests that most CPs do not market asymmetric broadband as a substitute for leased lines, because of the key differences indicated above. This evidence includes CPs' marketing of broadband to consumers on their websites, as well as the vast majority of CPs' responses to our questionnaire and CFI about substitutability between the two; and

- consideration of barriers to switching highlights that end-users with large legacy networks and/or those who use specialised applications in particular are likely to face higher switching costs in moving to broadband than higher quality leased lines services in the short term.

A6.113 In addition to the above factors, we note that price comparisons show that there is a considerable difference between the prices of broadband and leased lines services. The size of the price differentials, together with evidence on volume trends and migration appears consistent with the broadband and leased line markets being separate.

A6.114 Overall our analysis suggests that substitutability is insufficiently strong to include leased lines and asymmetric broadband in the same market, and that this will

remain so over the course of the three- year review period. Nevertheless, we take into account the ‘external constraint’ that might arise from leased lines users switching to broadband in our SMP assessments.

Annex 7

Wholesale product market definition: mobile backhaul

Introduction

A7.1 In Section 4 we summarise our decision to include mobile backhaul services within the markets for other wholesale leased lines (used for business connectivity purposes). This annex explains why MNO backhaul is included in the CISBO and TISBO product markets we define. The issues raised as part of this discussion are also relevant to our assessment of SMP in the CISBO market. We also consider what, if any, implications MNOs' purchases of managed backhaul services (notably BT's MEAS product) have for market definition at the CISBO level and explain why we do not consider competition in the supply of downstream managed backhaul services in detail.

A7.2 Our analysis is largely in line with the approach we proposed in Annex 11 of the May 2015 BCMR Consultation. However, we have revised some of our analysis to take account of comments from stakeholders and recent market developments including the publication of the Competition and Market Authority's decision on BT's takeover of EE.[191]

A7.3 We consider below whether there are:

- particular demand-side or supply-side issues for mobile backhaul that would justify identifying separate wholesale product markets for these services; or
- significant differences in competitive conditions for the supply of mobile backhaul services that warrant identifying a separate market (or at least considering competition for these segments separately).

A7.4 We find that:

- RBS backhaul and the technically equivalent TISBO services are in principle substitutable;
- As Ethernet services also increasingly support the synchronisation needed for MNO backhaul as standard, Ethernet MNO backhaul and the technically equivalent CISBO services are also in principle substitutable;
- Ethernet and WDM-based MNO backhaul services of similar capacity are substitutable;

[191] Competition and Markets Authority, press release, 15 January 2016 at https://www.gov.uk/government/news/cma-clears-btee-merger

- We do not include microwave links in the market as they are unlikely to be a substitute for fibre backhaul except in very specific circumstances;

A7.5 There was disagreement among respondents to the May 2015 BCMR Consultation about competitive conditions in the provision of MNO backhaul:

- BT says MNO backhaul is competitive everywhere due to a combination of competition from OCPs in a bidding market and self-supply using microwave;

- MNOs say MNO backhaul is not competitive anywhere due to the ubiquity of BT's network, the MNOs' need for national coverage and their more-or-less necessary reliance on a single supplier.

A7.6 We believe competitive conditions in MNO backhaul are in fact sufficiently homogeneous with other leased lines for them to be included in the same markets as the corresponding CISBO or TISBO services. Outside the CLA, in areas where there is insufficient OCP infrastructure, MNOs are largely reliant on BT for backhaul. However, there is no technical need for reliance on a single supplier and MNOs can and do use alternative suppliers for some of their needs. The size of the CLA and the number of potential suppliers there, particularly at higher bandwidths, should mean MNOs have both the option of choosing an alternative supplier to BT and a strong incentive to do so if BT sought to raise prices for MNO backhaul.

A7.7 Therefore, we do not identify a separate mobile backhaul market and we have considered competition in the provision of MNO backhaul as part of our wider assessment of SMP in leased lines.

Background

A7.8 Mobile network operators connect most of their radio base stations to their switching centres using leased lines from other CPs. Previously, MNOs mainly used TI legacy services and, in some locations, microwave links to connect base stations to their core networks. However, as mobile consumers' mobile data requirements have increased, the trend is now towards the use of Ethernet to replace TI services on the main mobile backhaul links.

A7.9 Since the last BCMR, mobile operators have been rolling-out their 4G networks, with EE, the leading 4G operator, reporting that it has now rolled out its 4G coverage to 93% of the population.[192] The take-up of 4G services has been high with EE also stating that "4G customers now represent more than 52% of the total EE mobile customer base".[193] This is equivalent to some 12.6 million subscribers with a target of 14 million by the end of the year.[194] The take-up of 4G services has resulted in significant increases in data usage.

A7.10 Even prior to the launch of 4G services, data usage was growing rapidly with the take-up of smartphones. This growth is expected to increase further as consumers

[192] EE results for the Third Quarter to 30 September 2015, at http://ee.co.uk/our-company/financials/2015/10/21/EE-results-for-the-third-quarter-to-30-September-2015
[193] Ibid.
[194] Ibid.

with 4G subscriptions tend to use more data than 3G users. In response to this growth in data demand, MNOs have been in the process of installing higher capacity fibre-based backhaul links.

A7.11 With the increase in bandwidth requirements for mobile backhaul (1Gbit/s or more) and the trend to packet-based networks,[195] Ethernet has become the more attractive technology, not least due to the lower cost per Mbit/s relative to TI services.[196] According to stakeholders (EE, MBNL, Three), major urban sites are currently served by [✂] connections which are likely to be upgraded to [✂] within [✂]. MBNL indicated that it expected to move remaining [✂] mobile sites currently on [✂] to [✂] speeds over [✂].

A7.12 Some operators have indicated their plans to retire most or all of their TI services by the end of the review period. For example, [✂], indicated that most of its TI circuits will be decommissioned by the end of 2017 in the core, and by the end of 2018 in the backhaul segment.[197] [✂], and EE/MBNL's roll-out of fibre [✂], also means that it has [✂] TI circuits remaining.

Summary of the consultation

A7.13 In the May 2015 BCMR Consultation, we proposed to include mobile backhaul within the TISBO and CISBO markets, depending on the interface of the circuit. This was based on the following provisional findings:

- We considered that MNO backhaul was technically equivalent to standard TISBO and CISBO services. We considered that mobile operators' need to synchronise timing at cell sites could be met by all TI services, and by Ethernet services that included synchronisation as a service feature. We found that synchronisation was now a standard feature of available Ethernet equipment and operators, such as Virgin, had successfully deployed these Ethernet solutions for mobile backhaul applications in the UK;

- In the light of this technical equivalence, we found that MNO backhaul and standard services (with the same interface) were in principle demand-side substitutes. We also considered that supply-side substitution was technically possible where the CP had the necessary infrastructure;

- We found that, notwithstanding some differences in service share, competitive conditions in the provision of MNO backhaul were not materially different to those in the provision of other technically equivalent wholesale leased lines.

A7.14 We proposed to exclude microwave links from the TISBO and CISBO markets as we did not consider that microwave could be substituted for fibre-based MNO backhaul except in some limited circumstances.

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[195] Unlike previous generation networks such as 2G or 3G, 4G networks are packet-switched only. Therefore, the fact that Ethernet is packet-based is another reason why it is suitable for 4G applications, in addition to its lower cost per Mbit/s.
[196] Microwave continues to be used for mobile backhaul, but as we discuss below, it tends to be restricted to particular use cases.
[197] [✂] response to market questionnaire.

A7.15 We noted that a significant proportion of mobile purchases from BT made use of 'downstream' MEAS solutions. However, we considered that this did not suggest there was a fundamental difference in competitive conditions at the upstream level or a need to define a separate MNO backhaul market.

Our assessment

Technical assessment

A7.16 In the BCMR 2013, we noted that a key technical requirement for mobile networks was very accurate time synchronisation to set their operating frequency[198] and to provide seamless handover as mobile users move between cells. TI services have historically provided synchronisation as standard, so MNOs have always been able to use an RBS service for mobile backhaul that was technically equivalent to a standard TISBO service. The same was not true of Ethernet services however, as standard Ethernet services did not feature synchronisation, and an MNO would not have been able to use a standard Ethernet service without adding a timing source. As we discuss below, developments in Ethernet technology mean that these differences are now less important than in the past.

A7.17 The lower cost per Mbit/s of Ethernet and the move to 4G networks mean that Ethernet will become the more attractive technology for mobile backhaul going forward, assuming it is able to provide the required technical characteristics. Accurate timing information is not an inherent feature of Ethernet technologies, as Ethernet packet-based networks do not need synchronised timing information to transport data, unlike SDH. However, Ethernet solutions have now been developed to support synchronisation.

A7.18 In some cases, where MNOs have rolled out Ethernet links, they initially retained a TI circuit to the base station to continue to provide timing or relied on 'circuit emulation'.[199] However, this was seen as a short term solution pending the deployment of the more efficient synchronisation standards. The two main Ethernet synchronisation solutions deployed in the UK are known as IEEE1588v2 and Synchronous Ethernet (SyncE). Virgin has successfully deployed SyncE in its provision of mobile backhaul to MBNL and Openreach offers SyncE as an option in its EAD product range.

A7.19 Since TISBO services support synchronisation as an inherent feature of the technology, and since the service sold to MNOs known as RBS backhaul is technically identical to other TISBO services (such as BT's PPCs), we consider that there is no technical barrier to substitutability between TISBO and RBS services.

[198] Accurate operating frequencies allow narrower guard bands between cell frequencies and thus more efficient use of the radio spectrum.

[199] In the AI/TI context, "emulation" would refer to the provision of a service imitating, as far as possible, TI characteristics and behaviour, delivered to the user using suitably adapted AI technology and service platforms. For example, BT deployed an interim solution in its MEAS product which used 'Pseudowire' technology to enable 2Mbit/s TDM circuits to be emulated over Ethernet connections in order to deliver synchronisation.

A7.20 In the case of Ethernet leased line services, technological developments mean that standard Ethernet services also increasingly support synchronisation, so any technical barrier to switching between standard Ethernet and "MNO" versions will become less important over time.

Demand-side substitution

A7.21 In the light of the technical assessment set out above, we now consider the potential for demand- and supply-side substitution

- between TISBO and RBS backhaul; and
- between CISBO and Ethernet mobile backhaul.

A7.22 Finally, we consider whether distinctions between Ethernet and WDM-based services are relevant to mobile backhaul.

RBS backhaul and TISBO services

A7.23 As noted above, RBS backhaul and TISBO rely on the same underlying inputs and therefore the cost of providing these services should be the same. As there is no technological distinction between SDH/PDH mobile backhaul and other forms of TISBO services, it should be possible, technically, to use a TISBO service to deliver RBS backhaul (or vice versa). Therefore, an MNO would find an RBS service and a TISBO service of the same bandwidth and delivered to the same locations to be good substitutes (or vice versa). In practice however it may be possible for a supplier to set prices which discriminate between MNOs and other users.[200]

Standard Ethernet versus Ethernet mobile backhaul

Demand-side arguments

A7.24 On the demand-side, the nature of mobile backhaul provision suggested a strong requirement for synchronised Ethernet. To provide mobile backhaul, BT essentially relies on the same wholesale inputs (e.g. EAD services) which it uses to provide Ethernet leased lines and LLU backhaul. However, a standard Ethernet service would not be in itself a direct substitute for a synchronous Ethernet service because it would need:

- equipment capable of supporting synchronisation, which is not necessarily the case in some pre-existing Ethernet services using older technologies; and
- to deliver the synchronisation capability, for which the service would need to be enabled and a necessary clock source supplied.

[200] The CP may know the identity and location of the customer, including whether it is an MNO. Given the technical similarity of RBS backhaul and TISBO, if a CP offered TISBO and RBS to MNOs at different prices, the MNO would always take the cheaper one. However, there are two (equivalent) ways in which (unregulated) the CP might be able to price-discriminate: to offer only "RBS" to MNOs (at a different price to TISBO, offered only to non-MNOs); or to sell TISBO to MNOs but at a different price to that charged to other customers.

A7.25 In relation to the first point, we note that modern equipment now supports synchronisation features as standard.[201] This suggests that Ethernet mobile backhaul could be supplied using similar Ethernet equipment to that used to supply enterprise customers.

A7.26 Furthermore, as new Ethernet equipment is deployed, these synchronisation features are therefore likely to increasingly become part of the standard Ethernet product. As this new equipment is deployed, it is then likely to become increasingly difficult to draw a distinction between synchronous Ethernet and ordinary carrier Ethernet (i.e. a similar situation to TI where there is essentially no difference between PPCs and RBS circuits). This would be consistent with demand-side substitution between mobile Ethernet and standard Ethernet services.

A7.27 We therefore consider that demand-side substitution between TISBO and RBS backhaul, and between mobile and standard Ethernet services, is intrinsically strong because these products are technically interchangeable. However, there may be constraints on customers' ability to switch in practice. In particular, if only one operator is connected to a site, the technical substitutability of these services would not constrain the prices that that supplier could charge. In these circumstances, the supplier could practise price discrimination between MNOs and other customers, as we discuss below.

Supply-side substitution

A7.28 For supply-side substitution to occur, it would be necessary for a CP to be able to take a standard TI or Ethernet circuit and add the necessary equipment or services to supply mobile operators with synchronous Ethernet services quickly and at low cost.[202] In this section, we focus on the question of whether such substitution is technically possible. Even if this condition was met (as it appears to be), it does not mean that supply-side substitution would occur in response to a SSNIP in any particular case. Unless operators can easily enter using existing physical infrastructure, then supply-side substitution in response to a 5% to 10% increase in the price of MNO backhaul is unlikely to be a strong constraint on MNO backhaul prices. This is because the costs of providing network (especially digging and ducting) include significant sunk costs and there would also likely be a time delay in responding to the price increase. In most cases, these sunk costs mean that operators will not be willing to extend their networks by more than a short distance in response to a SSNIP.[203]

A7.29 As explained above, a CP could use a standard TISBO circuit to deliver mobile backhaul.[204] To use Ethernet to provide mobile backhaul, the CP would need to

[201] In Figure A11.1 of the May 2015 BCMR Consultation, we reproduced an extract from ADVA sales literature which stated that its Ethernet equipment supported synchronisation as a built-in feature of that equipment, "unlocking new revenue opportunities such as value-added mobile backhaul services".

[202] However, we would normally only broaden a market on the basis of supply-side substitution if there were additional suppliers that would enter the market rapidly and at low cost in response to a small price change, and which were not already operating in the (narrowly-defined) market.

[203] See Annex 13

[204] Mobile operators have to keep their mobile base stations synchronised to a reference clock source. Telecoms networks rely on a hierarchical structure to deliver accurate timings. The hierarchy

access a clock-source to provide synchronisation (as well as a version of Ethernet that allows synchronisation between the base station and the reference clock-source). This however is not a significant hurdle. For example, a CP currently providing TDM-based circuits would have its own access to a clock source, and providers such as Virgin are also successfully supplying a synchronous Ethernet product, suggesting that there are no major technical hurdles to providing synchronous services.

A7.30 While synchronisation functions may add an additional cost to Ethernet services, this is unlikely to be a significant proportion of the cost of deployment (relative to the costs of installing fibre and Ethernet equipment).[205]

A7.31 We conclude that supply-side substitution is possible in the sense that a CP which was supplying or offering to supply a given site with a TISBO or CISBO service could supply the same site with a technically equivalent MNO backhaul service quickly and at low cost.[206]

Ethernet versus WDM-based solutions

A7.32 In Section 4, we conclude that there is likely to be a chain of substitution linking Ethernet and WDM-based services, in general. Here we consider this in the specific case of MNO backhaul. As discussed above, MNOs' backhaul capacity requirements are at a point where 1Gbit/s and 10Gbit/s circuits have been deployed and MNOs are looking to upgrade many circuits from 100Mbit/s to 1Gbit/s or 1Gbit/s to 10Gbit/s.

A7.33 For fibre-based cell sites supporting 4G technologies, MNOs will typically require an Ethernet interface. As both standard Ethernet services and WDM-based services can be provided with Ethernet interfaces, this is consistent with demand-side substitutability between them.

A7.34 The main driver of technology choice is therefore likely to be the total cost of ownership of the alternative services given current and foreseen bandwidth requirements. In this respect, we note that both WDM-based services and Ethernet

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comprises a master or Primary Reference Clock (PRC) and the timing information from the PRC is distributed to Slave Clocks that reside at relevant points in the network. These master and slave clocks provide timing outputs for the rest of the network equipment to use. TDM and SDH-based systems, such as the RBS backhaul product, are designed in such way to natively propagate the clock signal from the PRC to all the network nodes.

[205] If there were a significant premium associated with synchronous Ethernet then it may be that CPs would seek to avoid the equipment costs of this feature for end-users that do not generally need it. We do not have detailed information on the likely underlying costs, but from informal discussions with vendors, we do not consider that the costs of SyncE would be sufficiently large. Moreover, Openreach connection charges for 1Gbit/s SyncE service are sold at only a small premium (£750) relative to a standard EAD. In relation to BT's recent EAD 10Gbit/s launch in its internal documents it stated [✂]

[206] As we note in Section 4, the task is to identify the nature and strength of competitive constraints and the labelling of a particular constraint as supply-side substitution or, *inter alia*, potential entry should not matter for our conclusions on SMP. The key question in this context is whether a sufficient number of CPs have network close enough to MNO cell sites to connect to them rapidly and at low cost. In other words, the strength of the constraint is primarily a matter of geography rather than whether the customer is an MNO or a business enterprise.

have been used to deliver mobile backhaul with a given bandwidth. In particular, the detailed circuit information we obtained (using S135 requests) from CPs on their sales to mobile operators, and from MNOs on their purchases of backhaul, shows that MNOs have used a range of solutions capable of providing 1Gbit/s services. These include Ethernet on BT Wholesale's 21C network; direct inputs from Openreach; and Virgin's mobile backhaul solution (a variant of its WDM-based High Capacity Services). As we note elsewhere, [✂] has supplied a 1Gbit/s WDM-based service apparently at prices comparable to BT's single-service Ethernet service at 1Gbit/s.

A7.35 Therefore, consistent with the finding that Ethernet and WDM services (used by enterprise customers) are part of the same CISBO market, we do not segment mobile backhaul services on the basis of whether an Ethernet service or one using WDM-based technologies is supplied as we consider MNOs would substitute between the two technologies in response to a small but significant relative price change.

Summary of demand and supply-side assessment

A7.36 We consider that the potential for demand- and supply-side substitution suggests that CISBO and TISBO products used by enterprise customers could also be used to meet mobile backhaul requirements. Given their technical equivalence and our understanding that the main driver of MNO purchase decisions is the likely total cost given bandwidth needs, we consider that MNOs would be likely to switch to CISBO and TISBO products used by enterprise customers in response to a small but significant increase in the price of mobile backhaul products, if that option were available. In addition, OCPs currently providing CISBO and TISBO products for enterprise customers would be equally capable of providing mobile backhaul in areas where they have their own network.

A7.37 This potential for substitution is consistent with the inclusion of MNO backhaul in the same market as the technically equivalent TISBO and CISBO services used by enterprise customers. We have also considered whether there may still be some non-technical features of mobile backhaul demand which could be an obstacle to demand-side substitution and enable a provider to discriminate between MNOs and enterprise users of leased lines in order to exploit any differences in competitive conditions. We note in particular that mobile backhaul customers are a large (in terms of demand for circuits) and identifiable group of customers. In addition, in the absence of regulation there may be an incentive to discriminate where competitive conditions vary. Therefore, below, we consider whether there are any differences in competitive conditions for mobile backhaul such as would justify a separate market definition.[207]

[207] In effect, this approach is equivalent to making a separate assessment of competition in the provision of MNO backhaul alone before considering whether our findings indicate sufficient homogeneity for MNO backhaul to be included in the same market as other TISBO or CISBO services.

Differences in competitive conditions

A7.38 Because wholesale leased lines for enterprise customers and mobile backhaul are technically equivalent and can be provided over a single network, we would expect competitive conditions to be broadly homogeneous between MNO backhaul and other wholesale leased line services in any given area. However, mobile backhaul circuits differ from the general supply of leased lines to enterprise customers due to the geographic spread of mobile backhaul purchases. This may reduce OCPs' ability to compete for mobile backhaul services compared to enterprise connectivity even where they have network, if MNOs require a single national supplier. On the other hand, BT has also suggested that mobile backhaul markets are more competitive (citing competitive entry by OCPs and MNOs' ability to self-supply or make use of microwave links). We discuss these points in turn below.

Why mobile backhaul demand might face limited competition

A7.39 Mobile operators need to purchase access circuits across a very wide geographic footprint in order to provide national coverage, including in some areas where OCPs have little rival infrastructure. This could make it difficult for operators with a more limited geographic reach to compete for a national contract because to do so would require them to provide a high proportion of services off-net. This difficulty would be the greater if MNOs had a strong preference for a single national supplier at the most upstream level.[208]

A7.40 The geographically distributed nature of mobile base stations, including in remote rural locations, has meant that, over the years, the mobile industry has purchased access circuits from BT in areas outside the geographic footprint where the majority of enterprise customers are located. In a number of cases, mobile operators have had to bear the costs of BT's excess construction charges associated with extending its network to cell sites.

A7.41 MNOs have previously argued that this offers BT a first mover advantage as it is often already present at relevant locations (for example having previously supplied RBS backhaul). This means that BT has already incurred the main costs of provision (digging and ducting), which are largely sunk, giving it an advantage over CPs without an existing connection. BT would also not face costs associated with obtaining way-leaves and land-owner permissions to connect to those sites. This may explain why competitive provision by BT's rivals has been the exception rather than the rule.

A7.42 Figure A7.2 shows, for example, data on fibre connected cell sites associated with one of MBNL's core switches in South Wales.

[208] See Annex 16 paragraph A16.27 for a discussion of the implications of off-net versus on-net provision. In paragraphs A16.28 – A16.36 there is a discussion of the implications of multi-site demand for local and national competition in the context of geographic market definition.

Figure A7.2: Geographical distribution of fibre connected cell sites

[✂]

Source: Ofcom 2015

A7.43 Figure A7.2 shows how the fibre connected cell sites can be in fairly remote locations, which clearly advantages BT because of the greater reach of its network.

A7.44 MNOs have also argued that the hierarchical structure of mobile networks creates important differences between BT and other CPs in their ability to exploit economies of scale and scope in mobile backhaul.

A7.45 Mobile networks are typically configured in a hierarchy with a relatively small number of core network switches each serving a number of main fibre-connected cell sites. The fibre-connected sites also act as hubs for small sites which may be connected by fibre or microwave links. For example, according to MBNL, the network consists of around [✂] core nodes, which serve approximately [✂] mobile cell sites made up of [✂] served by fibre and the remaining [✂]% served by microwave. Those microwave links are often (but not always) from cell sites back to fibre-connected sites [✂].[209]

A7.46 Mobile network operators prefer not to procure alternative mobile services on an individual site-by-site or route-by-route basis. It is more likely that they will contract with a single supplier for backhaul connectivity for a region of their network, whereby a large number of cell sites are connected into the core network node or switch. In these circumstances, which effectively mean that an MNO requires its provider to have coverage to each of its cell sites associated with a core node, the ubiquity of BT's network clearly provides a competitive advantage. For a rival CP to BT to be able to competitively serve all of an MNO's cell sites in a particular region would require the rival CP to have network in sufficient proximity to all of the cell sites to be able to serve them at a low enough cost to compete with BT. But this is unlikely and still may not be sufficient to overcome BT's incumbency advantages.

A7.47 Another source of advantage for BT is that there are economies of scale from aggregating traffic from multiple cell sites and backhauling it to the core network over a single backhaul link. In addition, BT has the potential to aggregate traffic lower down in its network hierarchy onto high capacity backhaul links. With a larger overall share of wholesale circuits used to support other retail markets (LLU/broadband, enterprise etc.) this potentially provides it with greater economies of scope in backhaul. OCPs may not be able to replicate these as easily (particularly outside of urban areas).

BT's view that backhaul is competitive

A7.48 In response to the April 2014 CFI, BT argued that: "mobile network operators have a number of competing options available to them including use of microwave

[209] Information provided in response to S.135 request and at a meeting on 25th June 2014

backhaul infrastructure. BT provided detailed views as part of the last BCMR on the extent to which this was a viable option in many scenarios. In the relevant UK markets, the existing wide range of wholesale products, competing provision from existing networks and the self-build options (including microwave access) provide sufficient competing options. We do not consider there is evidence that mobile operators have not been able to use existing products to acquire sufficient, competitively priced, backhaul capacity to meet their expanding needs, given the current and projected state of 4G roll out and usage in the UK." [210]

A7.49 We discuss competition from (self-supplied) microwave below, concluding that it would not act as a significant constraint on BT's prices. In many situations where BT circuits are used, for example for backhaul of traffic from MNOs' main hub sites to their core networks, microwave would not be a viable alternative due to the scale of expected bandwidth requirements on these routes.

A7.50 In relation to competition from existing networks, as set out in our discussion above, the limited geographic coverage of many OCPs' networks is a barrier to competition in mobile backhaul in at least some areas since MNOs demand backhaul in areas outside of the geographic footprint of many OCPs' networks. These barriers to competition are reflected in our service share data below, which does not suggest that operators such as Virgin have yet gained a significant share of the circuits sold to MNOs on a national basis. However, in areas where competing networks exist, OCPs including Virgin may be more successful in future. We discuss below how far local competition in MNO backhaul can develop in the same way as in other leased lines, and how far national purchasing from a single supplier is likely to be a barrier to competition even in the areas where OCP networks exist.

Evidence of differences in competitive conditions

A7.51 Our analysis suggests that BT currently has a very high share of Ethernet and TI circuits sold to MNOs ([✂] in 2014). These shares are clearly consistent with an SMP finding in most of the UK, the same finding as we make for CISBO services sold to enterprise customers outside the CLA. In the May 2015 BCMR Consultation, we suggested that other CPs may make larger inroads into BT's share in future. For example, Virgin accounts for approximately [✂]% of EE/Three/MBNL's mobile backhaul purchases (excluding microwave and legacy TI links). Telefónica has also estimated that on a forward-looking basis it expected to purchase around [✂]% of its mobile backhaul requirements from [✂] within the three year timeframe of this review. In the May 2015 BCMR Consultation, we said that for both of these MNOs we expected BT's shares to remain very high.

A7.52 CityFibre now has a contract with MBNL, EE and Three to deliver backhaul using dark fibre and the first phase of the investment has been completed in Hull. CityFibre's network could also be used to supply enterprise customers (provided they are located sufficiently close by) and indeed CityFibre also plans to address business connectivity users more generally. Hence, and although the MNO is the "anchor contract", we do not consider CityFibre's entry initially to supply MNO backhaul to imply a necessary difference in competitive conditions between MNO

[210] BT response to Ofcom CFI, paragraph 69.

backhaul and other CISBO services in Hull.[211] [✂].[212] We do not consider that CityFibre's plans affect our market definition or SMP findings therefore.

A7.53 A key development in the market review period is BT's acquisition of EE. The CMA has considered the implications of the merger for competition in mobile backhaul. The CMA has concluded that, "the merged entity would have the incentive to cease purchasing mobile backhaul from third parties".[213] The merger does not change our view that BT's share of mobile backhaul is therefore likely to remain very high.

A7.54 BT's service shares are higher than seen in most leased lines markets. In addition there is limited variation in BT's service share in the CLA or LP relative to the Rest of the UK.[214] Nevertheless, our network reach analysis suggests that the infrastructure of many competitors in the CLA could be used to supply MNOs' backhaul in this area as well as leased lines for enterprise users. For example, our analysis of OCPs' networks' reach shows that network reach at mobile sites is nearly identical to that at large business sites for any given area.[215]

A7.55 As with CISBO generally, we consider that the main determinant of competitive conditions is the number of competing networks present. Hence, outside the CLA, we would find BT to have SMP in the provision of MNO backhaul and of other CISBO services even if we treated MNO backhaul as a separate market. In the CLA there is considerable potential for competitors to supply MNOs' backhaul just as there is for other CISBO services. Indeed, the size and density of the CLA in terms of demand sets it apart from other areas of the UK.[216] The size of the CLA and the number of potential suppliers there, particularly at higher bandwidths, should mean MNOs would have both the option of using an alternative supplier to BT and a

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[211] The scale of CityFibre's investment and its implications for the market in the Hull area are discussed in Section 6.

[212] Response to 12th S135 19 August 2015

[213] Competition and Markets Authority, Final Report, 15 January 2016, paragraph 56 at https://assets.digital.cabinet-office.gov.uk/media/56992242ed915d4747000026/BT_EE_final_report.pdf

[214] We estimate BT's service share in the CLA at [✂]% (excluding TI and microwave), [✂]% in the London Periphery and [✂]% in the Rest of the UK.

[215] Average network reach of nearly 8 for MNO cell sites in the CLA (200m buffer distance assumption). In addition, 35% of MNO cell sites located in the CLA are within 200m of 9 OCPs and 27% of sites are located within 200 metres of 8 OCPs. Network reach for the CLA contrasts with the Rest of the UK where, on average, network reach at mobile cell sites is 1.01. Network reach for MNO cell sites in a given area is similar to that for business sites and enterprise customer sites in that area (see Annex 10, Tables A10.27 and A10.41).

[216] We note for example that some of the MNOs that have network sharing agreements (e.g. Vodafone and Telefonica) have different arrangements in the London area. For most of the UK, under the network sharing arrangements, the UK is divided into two geographic zones outside London (east and west). Within each territory, one operator is the 'host', owning and operating the single RAN used by both companies. London is treated as a special case to be split only for 4G, with each MNO retaining control of its existing mobile sites. The arrangements also establish a joint transmission network, consolidating traffic over a reduced number of sites to achieve economies of scale in backhaul capacity. These arrangements are described in more detail in the OECD's 2015 report on Wireless Market Structures and Network Sharing: http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=DSTI/ICCP/CISP(2014)2/FINAL&docLanguage=En

strong incentive to do so if BT sought to raise prices, overcoming concerns about multi-sourcing. MNOs could then combine services bought from an OCP or OCPs in the CLA with Openreach services in (all or part of) the LP and RoUK. We know that [✂] already self-supplies some backhaul services and sources others direct from Openreach, and the availability of regulated dark fibre from Openreach will facilitate this in future. The fact that this has not so far been translated into service shares does not necessarily indicate a difference in competitive conditions at the CISBO market level therefore.

Microwave links

A7.56 In this part, we explain our reasons for excluding microwave links from the market based on:

- technical features: we discuss the technical capabilities and some issues associated with the use of microwave links; and
- demand-side substitution: we consider whether a hypothetical monopolist would be constrained in its ability to increase the price of mobile backhaul by the threat of MNOs switching to microwave links.

Technical assessment

A7.57 In the BCMR 2013, we asked MNOs to provide details of the technologies they used in different parts of their networks. The information submitted by MNOs in response to our information request showed that microwave was used at various levels within the network including between cell sites and for links back to operators' core networks. However, we found that microwave was most typically used at the edge of the network or to 'daisy chain' cell site traffic back to another cell site that acts as collector hub. From this location, traffic from other cell sites (provided over microwave) might then be backhauled to the core network (using fibre). In some cases, these cell site to cell site links were self-provided and predominantly carried 2Mbit/s SDH transmission. Some microwave links also carried Ethernet transmission.

A7.58 In current network deployments, some MNOs make use of microwave to a significant extent while others had only very limited deployments. For example, Telefónica (formerly BT Cellnet) has historically relied far less on microwave.

A7.59 In most cases, MNOs self-supply microwave links as shown in Annex 10 of this Statement, Table A10.11.

A7.60 Although microwave links are used for some mobile backhaul needs, they can only meet MNOs' backhaul requirements in certain specific circumstances. In others, especially once an MNO is already committed to a particular network design, microwave could not act as a substitute for fibre-based mobile backhaul products. We have previously identified a number of issues with microwave backhaul:

- ability to support only lower capacity links compared to fibre-based backhaul;[217]
- requirement for line of sight connectivity;
- significantly lower transmission range than fibre-based backhaul links;
- deployed microwave antennae are exposed and have higher risk of failure.

A7.61 In response to the CFI, Vodafone submitted a report by Analysys Mason suggesting that microwave faced significant challenges to its ability to meet capacity requirements going forward.[218] Analysys Mason also indicated issues related to available spectrum suited to microwave backhaul uses.

A7.62 Given that 4G / LTE network deployments and continuing growth in data demand are driving significant increases in required backhaul capacity, the limitations of microwave technology set out above make fibre the preferred and potentially the only viable technology choice for many backhaul applications. MNOs have told us that, in response to this, they planned to reduce the extent of microwave usage for backhaul applications and to rely increasingly on fibre deployments which can be more easily scaled to meet increasing bandwidth requirements. In other circumstances, however, fibre might not be feasible and therefore microwave links might be the only option. However, the use of microwave is often limited to the edge of the network rather than the major backhaul links to MNOs' core switches. Our discussions with MNOs support our view that, as backhaul bandwidth capacity requirements increase, fibre will be preferred in most circumstances over microwave.

Demand-side substitution

A7.63 Overall, mobile networks use both fibre and microwave, depending on the conditions. As noted above fibre might be preferred for most use cases and may be the only viable solution in others. There may be instances however, at the margin, where some, albeit limited substitution could be possible. The question in these circumstances would be whether switching to microwave links would impose a sufficient competitive constraint on a hypothetical monopolist to make a SSNIP on fibre-based backhaul solutions unprofitable.

A7.64 An MNO that already had in place a fibre-based link would also incur various costs in switching from fibre to microwave, even if switching were feasible. Given the extent of fibre connections to mobile sites already in place, it is unlikely that an

[217] Although next generation microwave might support high bandwidths, it is not clear whether cost effective microwave backhaul supporting more than 1Gbit/s would become available during the period covered by this review. In addition, the same technical considerations are still likely to apply, such as overall performance guarantees and length of transmission ranges of microwave backhaul links.
[218] http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity-market-review/responses/Vodafone_Annex_3.pdf. We also note that the CMA, in its final report on the BT/EE merger, took the view that microwave is not suited to general backhaul applications and therefore not part of the same market as fibre-based MNO backhaul: see paragraphs 15.41 – 15.42 at https://assets.digital.cabinet-office.gov.uk/media/56992242ed915d4747000026/BT_EE_final_report.pdf

MNO would switch to microwave provision in response to a SSNIP applied to Ethernet mobile backhaul. The costs of doing so are likely to be prohibitive (and it might not be a technically feasible solution). It is therefore unlikely that a SSNIP would prompt sufficient switching from fibre/copper links to wireless to impose a competitive constraint. On this basis, we have excluded microwave links from both the CISBO and TISBO product market definitions.

Managed backhaul services for MNOs

A7.65 The primary focus of our work in this review is to examine the state of competition in the upstream provision of terminating segments of leased lines. This reflects our general approach across regulated markets of focusing regulatory intervention on any upstream bottlenecks and promoting competition at the deepest level where it will be effective and sustainable. We consider that promoting competition at the upstream level should have the effect of safeguarding users' interests in the markets for downstream services.

A7.66 However, MNOs have typically purchased backhaul in the form of integrated managed service solutions which aggregate connections to large numbers of cell sites, rather than making discrete purchases of large numbers of links to connect each cell site individually. As noted above, each MNO must connect the thousands of cell sites of its network with its core switches, which are located in a small number of sites. Mobile networks are also connected in a hierarchy of sites. Core switch sites are connected by fibre to a primary sub-set of cell sites. Each of the latter acts as a collector node for a number of smaller cell sites, which may be connected either by fibre or by microwave links.

A7.67 BT Wholesale provides a high proportion of these managed services for MNOs' backhaul, in the form of its Managed Ethernet Access Service (MEAS) product. We consider below whether MNOs' use of managed backhaul services (notably BT's MEAS product) results in differences in competitive conditions between MNO backhaul and other CISBO services.

A7.68 Indeed, MNOs have raised concerns about lack of competition in the managed services they purchase in the context of our work in this review. In response to the CFI, MBNL expressed concerns over its reliance on MEAS for around [✂] and proposed "a change in the regulatory model to one focused on deeper infrastructure competition". Our circuit information from Vodafone also suggests that MEAS represents more than [✂] of its purchases of Ethernet circuits from BT. [✂].

A7.69 We have therefore considered, at a high level, whether there may be enduring competition issues in the provision of managed backhaul services in light of the MNOs' concerns and of the remedies we are imposing at the upstream level.

A7.70 We note that BT Wholesale assembles the infrastructure for MEAS using a combination of Openreach's regulated Ethernet leased line services, together with standard electronic equipment (e.g. service routers and cell-site gateways) and unregulated transmission links in BT's national core network. We currently require Openreach to provide a variety of fibre Ethernet leased line terminating segments on regulated terms. We have decided in this review to require Openreach to provide passive access (in the form of a dark fibre product).

A7.71 Notwithstanding BT Wholesale's high shares of managed services, we consider that in principle, a rival would be able to use Openreach's regulated Ethernet leased line services (or dark fibre), together with standard electronic equipment and

unregulated transmission links available from BT or its competitors, to supply managed services to MNOs in competition with BT Wholesale (or indeed for the MNOs to self-supply managed services using the same inputs).

A7.72 BT Wholesale has established extensive presence of its own Ethernet equipment at BT exchanges.[219] Hence, in the May 2015 BCMR Consultation, we thought this could place BT Wholesale in a better position than its rivals to use Openreach's regulated Ethernet leased line terminating segments to connect cost-effectively to MNOs' cell sites across the country. In particular, we thought that BT Wholesale was better placed to consume EADLA products that are priced cheaper than other Ethernet variants. However, we now understand that other CPs such as TalkTalk or Vodafone, while still reliant on Openreach upstream inputs, have also established presence (or have plans to) in BT exchanges to access EADLA products and therefore this is no longer an advantage for BT Wholesale.[220]

A7.73 We recognise however that BT Wholesale might still have some advantages over other potential providers of managed services. This is because BT Wholesale is a major supplier of other managed services, such as fixed wholesale broadband access, and hence may be in a better position than its rivals to exploit economies of scale and scope in providing managed services to MNOs, by aggregating MNOs' traffic with other traffic (as discussed earlier at paragraph A7.47).

A7.74 We also understand that the MNOs are typically tied into long-term managed services contracts (including circuit-volume commitments) with BT Wholesale, and so may have limited ability to switch to alternative suppliers (and/or self-supply) in the short term.

A7.75 Notwithstanding these factors, we would expect BT Wholesale's prices for MEAS to be constrained (albeit not necessarily to the level of BT's own costs) by the prospect of alternative supply using the regulated inputs, and we would therefore not expect it to have SMP at the level of managed services. This also reflects CPs' complaints, which have largely been focused on the Openreach products and pricing (not MEAS).[221] MNOs' ability to use upstream services purchased from Openreach is also consistent with our view, set out above, that MNO backhaul is (potentially) competitively provided in the CLA. It means an MNO could combine Openreach services in some areas with an OCP's services in others (like the CLA). As noted above, [✂] already self-supplies some backhaul services and sources others direct from Openreach, and the availability of regulated dark fibre from Openreach will facilitate this in future. Hence, given the findings of a single CISBO

[219] According to BT internal documents, as at June 2015 BT Wholesale had coverage to over [✂] Ethernet nodes. BT estimated that it allowed it to supply approximately [✂]% of cell sites using Openreach's EADLA inputs.

[220] Indeed, according to BT's internal document, it estimated that TalkTalk could cover around [✂]% of cell sites using Openreach's EADLA inputs.

[221] http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity-market-review/responses/Combined_response.pdf. As noted above, MBNL argued for a "change in the regulatory model to one focused on deeper infrastructure competition" which would feature encouragement for deeper interconnection with Openreach, better quality of service and faster innovation from Openreach and the imposition of passive remedies. Where justified, all these concerns are addressed by the remedies we are imposing in this review.

market in which BT has SMP outside the CLA but not inside it, there is no need to define a separate product market for MNO backhaul.

A7.76 In the May 2015 BCMR Consultation, we also noted that BT's acquisition of EE could give the combined firm an incentive to discriminate in the provision of MEAS in favour of EE over other MNOs. We noted that this might be considered further as part of the CMA's assessment of the merger.

A7.77 The CMA has now published its final report on the merger. It considered whether BT would be likely to foreclose rival MNOs' access to managed backhaul services at contract renewal or under the current contracts, but found that it was unlikely that it would have the incentive or (under current contracts) the ability to do so. It also found that MNOs would have the ability to protect themselves against most material risks through commercial negotiations. This is consistent with our views set out above. [222]

Comments in responses

A7.78 We received comments on the approach to mobile backhaul set out in Annex 11 of the May 2015 BCMR Consultation from BT and KCOM as the main regulated suppliers and from the MNOs as customers. The main issues were:

- the role of large national contracts in purchasing mobile backhaul;
- backhaul as a "bidding market" and the existence of countervailing buyer power;
- the usability of microwave as a substitute for fibre backhaul; and
- other differences between MNO backhaul and other CISBO services.

A7.79 Below we set out our response to comments we have received on the approach to mobile backhaul set out in Annex 11 of the May 2015 BCMR Consultation. We address comments on the above issues in turn.

BT's Comments on the role of large national contracts

A7.80 BT described the purchase of backhaul in the form of "large turn-key managed solutions" as the most important feature of the market.[223] It said that this should be considered first as it "should provide the context for all the other aspects of the analysis". We understand BT to be arguing that the scale of these large contracts means the winner inevitably has a high market share, but that this should not be seen as evidence of market power because this share was won through competition in a bidding market (which we discuss below).

[222] Competition and Markets Authority, Final Report, 15 January 2016, paragraphs 41 – 52 at https://assets.digital.cabinet-office.gov.uk/media/56992242ed915d4747000026/BT_EE_final_report.pdf

[223] By its use of the term "turn-key" we understand BT to mean that provision of the backhaul network and service is managed by the supplier and requires no or minimal input from the purchaser.

A7.81 BT also said that the high share of the market it had won with MEAS reflected historic success in winning two contracts. It noted that, since then, [✂] It also noted that MEAS is based on Openreach EoI inputs which are available to any CP and said that, as MEAS contracts were freely entered into, the term length could not be considered a barrier to switching.

A7.82 BT contrasted the MEAS contract with "switching link by link", saying that switching costs (between TI and AI services) were absorbed in the MEAS contracts, and that this effectively removed barriers to switching between TI and AI services. It said Ofcom was wrong to consider demand-side substitution on a link-by-link basis rather than on a turn-key contract basis.

A7.83 BT set out a number of options (listed in Section 4, paragraph 4.607) which it thought would be available to MNOs in a greenfield scenario. It argued that, as it had had to build out to reach MNO sites, it had not benefited from having sunk costs in an existing network. It also said that economies of scope and scale are not relevant to the options available in a modified greenfield scenario.

Our response on these points

A7.84 In relation to the provision of MEAS, we regard large managed solutions, of which BT's MEAS is the most important example, as downstream of the TISBO and CISBO markets we define in this review. Even if the market at the MEAS level were as competitive as BT argues, bidding at this level could not make the upstream market (at the TISBO or CISBO level) competitive. Rather, competition or, in its absence, regulation at the upstream level would be a pre-requisite for competition at the downstream MEAS level. This is because MNOs (as noted earlier) need backhaul in all areas of the UK, and BT is the only CP with a ubiquitous network. Moreover, if MNOs required all their backhaul to be supplied by the same CP at the most upstream level as well as at the downstream (MEAS) level, BT's SMP would be entrenched even in areas where there are potential alternative suppliers. Competition at the MEAS level and local competition at the upstream level are possible, but only by combining MNO backhaul over an OCPs' network where it has coverage with regulated access to BT's network where it does not. [224] We also would not agree that long-term contracts must be disregarded as a potential barrier to switching simply because they were agreed commercially. The point is that they make switching away from BT less likely.[225]

[224] BT also claimed that the order of analysis in Annex 11 was incorrect and had led to erroneous conclusions. To be clear, our conclusions are not dependent on the order of analysis. We also do not consider that use of turn-key contracts means there is a single product market for all MNO backhaul services. In any case, we find that BT has SMP in the provision of both SDH backhaul (in the TISBO market) and Ethernet backhaul (in the CISBO market outside the CLA). We also note that the CMA, in its final report on the BT/EE merger, took the view that SDH backhaul was not part of the same market as Ethernet MNO backhaul: see paragraph 15.41 at https://assets.digital.cabinet-office.gov.uk/media/56992242ed915d4747000026/BT_EE_final_report.pdf.

[225] For example, the CMA guidelines "assessment of market power" (OFT 415) say at para 5.31, "The nature of the market may also limit the times at which entry may occur. For example, where customers award long-term contracts, a potential entrant may have to wait until these contracts are renewed before it has an opportunity to enter the market. It may also be important to assess whether enough contracts would come up for renewal to allow the entrant to attain a viable scale."

A7.85 We do not agree that BT derives no benefit from the ubiquity of its existing network. Even where it has had to extend this network to reach a particular MNO site or sites, it is highly likely that it will have had to do so less often and by a shorter distance than an OCP with a smaller network. Going forward, it now has the advantage of having sunk costs in the additional connections to sites it has built, plus the economies of scope and scale identified above in paragraph A7.47. BT does not explain why, in its view, these latter are not relevant in a modified greenfield scenario and we believe they would be.

OCPs' comments on the role of large national contracts and our response

A7.86 Several other stakeholders commented on the implications of large national contracts for MNOs' backhaul. The MNOs, in particular, disagreed strongly with BT's view that the market is competitive.

A7.87 Sky said that BT's market power in MNOs' backhaul is entrenched due to the ubiquity of BT's network and the demand for single national solutions.

A7.88 [✂].

A7.89 Vodafone also commented that "mobile backhaul has the particular characteristic of requiring services to unserved premises on a national basis, a high volume of circuits provided on a longer term basis and requiring specific technical characteristics such as synchronisation. There is no doubt that BT has little if any competition in mobile backhaul."

A7.90 Vodafone also said "Ofcom does not take account [of] the potential for leverage from uncompetitive geographies into the CLA. We consider that this leverage is in evidence for mobile backhaul within the CLA. Even though there is evidence of greater alternative network in CLA, BT has a market share of 89% for mobile backhaul."

A7.91 In relation to the provision of upstream (CISBO) services, these comments are broadly consistent with our analysis of BT's SMP in mobile backhaul outside the CLA, where we and the MNOs agree that BT has SMP. As we explain in Section 4 of this Statement, we find that there is a single CISBO product market including circuits at all bandwidths in which BT has SMP outside the CLA. Given that we find BT to have SMP both in the provision of MNO backhaul and the provision of other CISBO services, there is no need to define a separate market for MNO backhaul outside the CLA, and it can be included in the same market as other CISBO services.

A7.92 Regarding the risk of leverage into the CLA, we consider that the extent of competing infrastructure in the CLA (noted above in paragraph A7.54) combined with regulation of Openreach outside the CLA is sufficient to prevent such leverage. This is because, as we noted above, the size of the CLA and the number of potential suppliers there, particularly at higher bandwidths, should mean MNOs would have both the option of using an alternative supplier to BT and a strong incentive to do so if BT sought to raise prices. An MNO could then combine Openreach services in some areas with an OCP's services in the CLA. The availability, outside the CLA, of regulated dark fibre from Openreach will facilitate this in future. As noted above, [✂] already self-supplies some backhaul services and sources others direct from Openreach.

A7.93 [✂].

A7.94 In relation to the provision of MEAS, we consider that, although BT has a high market share at the MEAS level, it is still constrained by upstream regulation. As we noted above, Vodafone's (actual or planned) presence in all BT's Access Serving Nodes (ASNs) would enable it to self-supply a national network, in conjunction with Openreach inputs, if it wished. This is because Openreach's leased line access products can reach almost all points in the UK from the ASNs. Other CPs are also either connected or could connect at the ASNs to a similar extent. TalkTalk, for example, has an extensive network connected to BT at a large number of sites and could provide an MNO backhaul service, even if it does not currently perceive an incentive to do so. We therefore believe that an MNO should be able to assemble a product with national coverage through self-supply or sourcing from multiple providers who in turn use Openreach products to supply off-net. Although this may be somewhat more expensive than buying from BTW, as BT's costs may be lower due to economies of scope and scale, we consider that BT's ability to increase prices is limited (albeit they may not be constrained to the level of BT's own costs). As noted above, [✂] already self-supplies some backhaul services and sources others direct from Openreach. In addition, the dark fibre which we are requiring BT to provide on regulated terms will improve MNOs' ability to self-supply MNO backhaul. Whilst it is possible that the length of MEAS contracts may limit the ability of MNOs to switch away from BT rapidly, we consider these are not a barrier to switching in the long-term.[226]

Comments on backhaul as a "bidding market" and the existence of countervailing buyer power and our response

A7.95 BT said that MNO backhaul is a "bidding market". It said that the EC Guidelines say that market shares in a bidding market should be approximated by the share of bids won[227] and that Ofcom had not followed these guidelines by calculating BT's share of circuits. BT said that Ofcom should not put weight on these market shares.

A7.96 In relation to the provision of upstream (CISBO) services, we are not persuaded that a share calculated from bids won and lost would be a more reliable indicator of competitive conditions even if the data were available. As BT itself says, the number of bids for MNO backhaul won in any period is so small that it may be statistically insignificant. In any case, the wording of the Commission guidelines does not suggest that only shares of bids can be relevant, rather the main point is "not to rely only on market shares as they in themselves may not be representative of the undertaking's actual position".[228] Hence, and consistent with the EC Guidelines, we consider all relevant indicators including entry barriers, sunk costs and control of relevant infrastructure. Given these, BT's very high share of mobile backhaul provision and the persistence of this very high share over time are clearly consistent with a position of SMP.

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[226] In its final report on the BT/EE merger, the CMA considers BT's ability and incentive to raise MEAS prices or employ other anti-competitive strategies in the provision of MNO backhaul after the merger. Our conclusions are consistent with those of the CMA. See CMA Final Report, https://assets.digital.cabinet-office.gov.uk/media/56992242ed915d4747000026/BT_EE_final_report.pdf

[227] The Commission's SMP Guidelines, paragraph 76 at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52002XC0711(02)&qid=1399986405910&from=EN

[228] Commission Guidelines, note 81.

A7.97 We consider that the use of competitive tender is not in itself a guarantee of effective competition.[229] For example, the structural features of the market such as BT's ubiquity and first mover advantages in the supply of mobile backhaul remain relevant even in a bidding market.[230]

A7.98 In general, we do not consider MNOs to have sufficient countervailing buyer power to offset BT's SMP. In order to exercise countervailing buyer power, MNOs must have a credible alternative to BT. We note that our network reach analysis shows that MNOs are unlikely to be able to switch to alternative providers in much of the country outside the CLA.[231]

Comments on the usability of microwave and our response

A7.99 BT said that exclusion of microwave from the market is incorrect on technical and demand-side substitution grounds. It cited the service shares shown in Table A15.11 of the May 2015 BCMR Consultation in support of this view. It also said that there is a strong correlation between the ability to use microwave and the absence of fibre infrastructure, competitive or otherwise. We consider BT to be arguing that it faces some competition in all or most locations, from either fibre supplied by OCPs or from self-supply of microwave.

A7.100 We consider that the service shares referred to by BT are not compelling evidence of substitutability at the margin, which is the relevant question for market definition. For the reasons set out above in paragraphs A7.56 – A7.64 and below, we consider that such substitutability is unlikely.

A7.101 We consider that, where it is feasible to use microwave, it is likely to be already in use. The widespread use of fibre is likely to reflect the fact that microwave links only provide an effective alternative to fibre/copper-based solutions where it is technically feasible to use it. In addition, unless a network is designed to use microwave from the start, it is difficult to switch to microwave at a later date. We consider that the costs of switching to microwave are likely to prevent microwave links being an effective substitute in the provision of low bandwidth links. Moreover, the expected significant increases in backhaul capacity requirements discussed in paragraphs A7.8 to A7.12 will make microwave less usable for mobile backhaul from a greater number of cell sites in future.[232] Therefore there is likely to be little opportunity for switching at the margin.[233]

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[229] Various papers to UK competition authorities have considered the implications for competition policy of markets characterised by auctions or bidding processes. See "Bidding Markets", June 2005, Report prepared for the CC; Paul Klemperer, and "Markets with bidding processes: Economic discussion paper", May 2007, Report prepared for the OFT by DotEcon Ltd.

[230] The CMA guidelines on "assessment of market power" (OFT 415) note that, for bidding markets to be competitive, it is important that "suppliers are not differentiated (so that for any particular bid, all suppliers are equally placed to win the contract)", paragraph 4.4.

[231] We discuss the use of wireless links to self-supply backhaul further below.

[232] These comments are supported in the report submitted by Vodafone to the CFI, "Analysys Mason Mobile Backhaul Market Report - Phase 1 – FINAL". It concluded that "it is clear that if the operator dimensions its backhaul network according to the peak throughput and uses traditional microwave spectrum bands, 14 MHz and 28MHz point to point systems will provide insufficient capacity to backhaul to urban macro and a significant fraction of rural sites beyond 2016. Also, if the operator

Comments on other differences between MNO backhaul and other CISBO services and our response

A7.102 BT said that MNO backhaul differs from business access in a number of aspects, in addition to the use of national turn-key contracts. It said that Ofcom should not presume that MNOs would use the same inputs as leased lines in a modified greenfield scenario. It also said that VM's use of WDM to supply 1Gbit/s MNO backhaul circuits is not evidence of a chain of substitution in CISBO generally (the evidence for which is considered in Section 4) as the MNO backhaul market is very different to the business access market (a point relating to the homogeneity of competitive conditions between the two).

A7.103 BT agreed that technical differences between mobile backhaul and other TISBO and CISBO services now appear much less important than formerly, for reasons set out above (paragraphs A7.24 – A7.30). Given the technical similarity, we do not consider there to be any conflict with the Modified Greenfield scenario.

A7.104 In relation to the provision of upstream (CISBO) services, we include MNO backhaul and other technically equivalent wholesale leased line services in the same market only after first assessing competitive conditions separately and confirming that competitive conditions (assessed separately) are sufficiently homogeneous. In particular, we find that BT has SMP everywhere outside the CLA and the Hull area in a single CISBO market. Our understanding is that the Virgin WDM products referred to by BT are not confined to MNO backhaul but are available to enterprise customers as well and so do not imply any necessary difference in competitive conditions.

A7.105 BT said that the EC's Explanatory note places MNO and LLU backhaul outside fixed access markets and says that they are not subject to "generalised market failure". Although BT does not provide a reference, the extracts it quotes appear to be from Page 51 of the Explanatory Note.[234] It is also stated there that "NRAs may however consider and analyse whether the provision of wholesale leased lines or equivalent inputs in the wholesale high-quality market is able to provide, for instance in remote areas, a connection to mobile stations and between the co-located equipment and the accessing operator's core network". We consider that this is consistent with our approach.

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dimensions its backhaul network according to the peak throughput, sub-6GHz systems (20MHz or 40 MHz) provide insufficient capacity to backhaul small cell sites today. The situation is further exacerbated by the increasing use of site sharing, which can put significant additional strain on the capacity required for the backhaul. […]These points will make access to leased lines increasingly important for mobile operators…"

[233] MLL, a major provider of microwave, told us during the 2013 BCMR that it saw microwave as a complement to, rather than a substitute for, fibre-based solutions (paragraph 4.338, BCMR 2013 Statement).

[234] The EC Explanatory Note on relevant markets of 9 October 2014, http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=7056

KCOM's comment on competition in Hull

A7.106 KCOM argues that it now faces additional competition for MNO backhaul from CityFibre which it did not at the time of the BCMR 2013. KCOM argues that mobile backhaul services should be looked at separately in light of competition from CityFibre in Hull and radio backhaul services by MNOs in the Hull area.

A7.107 We agree that, if competitive conditions in the Hull area differed between TISBO and CISBO on the one hand, and MNO backhaul on the other, it could be appropriate to define a separate MNO backhaul market in Hull, even if they remain part of the same markets outside Hull.

A7.108 As KCOM notes, it had argued for a separate MNO backhaul market in Hull in its response to the 2013 BCMR consultation, on the grounds that use of microwave for backhaul was more widespread in Hull than in the rest of the UK. We rejected this argument on the grounds that:

- data obtained from MNOs using S135 requests showed that MNOs were reliant on KCOM for mobile backhaul;
- as in other parts of the UK, limitations on microwave usage meant there was no strong price constraint at the margin between microwave-based and fibre backhaul links.

A7.109 In Section 6 of this Statement, we set out details of how MNOs now meet their needs for backhaul in the Hull area, including the extent of microwave usage and supply (on a forward-looking basis over the market review period) by CityFibre. In the light of this we also set out our conclusions on market definition and SMP in Hull.

Summary of our views on responses to the May 2015 BCMR Consultation

A7.110 Above we said that we understood BT to be arguing that the provision of MNO backhaul was competitive despite its high share, because this had been won as a result of a small number of successful bids in a competitive bidding market for national turn-key contracts. Having considered the various arguments advanced by BT and others, we consider that BT's high share of MNO backhaul is, to a significant extent, a reflection of its underlying advantages arising from the control of a ubiquitous network which is characterised by significant sunk costs and economies of scope and scale. As a result, and despite the use of competitive tender for large contracts, BT has SMP at the upstream (CISBO and TISBO level). Indeed, in the absence of effective regulation upstream, a requirement on the part of MNOs for large national contracts from a single supplier would tend to entrench BT's SMP even in areas where there are potential alternative suppliers.

Conclusions

A7.111 We have decided to include mobile backhaul in the TISBO and CISBO markets as appropriate based on the following:

- **Technical assessment:** MNO backhaul is technically equivalent to standard leased lines. Whilst mobile operators have a need to synchronise timing at cell sites, this technical requirement can be supported natively by TI services, and Ethernet now includes synchronisation as a service feature (the main standard is referred to as SyncE). We find that SyncE is now a standard feature of available

Ethernet equipment and operators such as Virgin have successfully deployed Ethernet equipment using SyncE for mobile backhaul applications in the UK.

- **Demand and supply-side substitution:** in the light of specific technical requirements for MNO backhaul, we consider whether any demand or supply-side substitution opportunities exist between, on the one hand CISBO and TISBO services, and on the other, mobile backhaul services. In our view RBS backhaul services are identical to standard TI services and synchronisation is increasingly a standard feature of Ethernet and so in principle MNO backhaul and standard services are substitutable. The key question therefore is whether opportunities for demand-side or supply-side substitution actually exist, and this depends on the extent of competition in the provision of mobile backhaul; and

- **Competitive conditions:** It might be appropriate to define mobile backhaul as a separate market if the competitive conditions differ significantly from other leased lines services. However, we have concluded that our SMP findings would be the same even if we defined a separate market for mobile backhaul. Respondents to the May 2015 BCMR Consultation who commented on MNO backhaul focused on competitive conditions. We summarise the different viewpoints as follows:

  - BT says MNO backhaul is competitive everywhere due to a combination of competition from OCPs in a bidding market and self-supply using microwave;

  - MNOs say MNO backhaul is not competitive anywhere due to the ubiquity of BT's network, the MNOs' need for national coverage and their more-or-less necessary reliance on a single supplier;

  - We believe competitive conditions in MNO backhaul are in fact sufficiently homogeneous with other leased lines for them to be included in the same markets as the corresponding CISBO or TISBO services. Outside the CLA, in areas where there is insufficient OCP infrastructure, MNOs are largely reliant on BT for backhaul. However, there is no technical need for reliance on a single supplier and MNOs can and do use alternative suppliers for some of their needs. The size of the CLA and the number of potential suppliers there, particularly at higher bandwidths, should mean MNOs have both the option of choosing an alternative supplier to BT and a strong incentive to do so if BT sought to raise prices for MNO backhaul.

A7.112 We note that a significant proportion of purchases of MNO backhaul from BT make use of ‘downstream’ MEAS solutions. However, this does not suggest a fundamental difference in competitive conditions at the upstream level or a need to define a separate MNO backhaul market.

A7.113 Therefore, we do not identify a separate mobile backhaul market and we have considered competition in the provision of MNO backhaul as part of our wider assessment of SMP in leased lines.

Annex 8

Wholesale product market definition: LLU backhaul

Introduction

A8.1 In Section 4 we summarise our decision to include LLU backhaul services within the markets for other wholesale leased lines (used for business connectivity purposes). The analysis we conducted which led to this decision is set out in more detail in this Annex.

A8.2 Our analysis is largely in line with the approach we proposed in Annex 12 of the May 2015 BCMR Consultation. However, we have revised some of our analysis to take account of comments from stakeholders.

A8.3 Local Loop Unbundling ("LLU") operators rely on leased lines to backhaul broadband traffic from BT's exchanges (where they have co-location equipment to aggregate unbundled local loops) to their core networks. We consider in this Annex whether there are:

- particular demand-side or supply-side issues for these LLU backhaul services that would justify identifying a separate wholesale product market for these services; and
- significant differences in competitive conditions between the supply of LLU backhaul services and the supply of other CISBO services.[235]

A8.4 We find that LLU backhaul and the technically equivalent CISBO backhaul services are in principle substitutable.

A8.5 Respondents to the May 2015 BCMR Consultation had different views on competitive conditions in the provision of LLU backhaul:

- BT says LLU backhaul is competitive everywhere due to competition from OCPs in a bidding market;
- LLUOs say LLU backhaul is not competitive anywhere due to the ubiquity of BT's network, the LLUOs' need for national coverage and their preference for a single national supplier;

A8.6 We believe competitive conditions in LLU backhaul are in fact sufficiently homogeneous with other CISBO services for them to be included in a single market. Outside the CLA (where both access and backhaul are competitive) and apart from at those exchanges designated as "New Competitive Exchanges" (where backhaul

[235] We do not compare LLU backhaul and TISBO services, because the primary technology used for LLU backhaul is Ethernet.

is treated as part of competitive core conveyance), BT has SMP in LLU backhaul.[236] However, there is no technical need for reliance on a single supplier and LLUOs can and do use alternative suppliers for some of their needs. In the CLA, there is evidence of both actual competition (BT's share of LLU backhaul is lower here than in other areas) and potential competition. At the NCEs, as described in Annex 15, a sufficient number of OCPs are present for the supply of conveyance from these exchanges to be competitive.

A8.7 Therefore, we do not identify a separate LLU backhaul market and we have considered competition in the provision of LLU backhaul as part of our wider assessment of SMP in the CISBO market.

Background

A8.8 In the last review, we included LLU backhaul services within the relevant AISBO and MISBO markets. In this Annex we consider our approach to market definition for LLU backhaul for the period until 2019.

A8.9 LLU backhaul circuits provide links between OCPs' LLU co-location facilities and their core network nodes.[237] Currently, LLU backhaul providers mainly rely on Ethernet circuits.

Proposals in the May 2015 BCMR Consultation

A8.10 In the May 2015 BCMR Consultation, we proposed to include LLU backhaul as part of the CISBO product market and gave the following reasons:

- First, LLU backhaul and other leased lines services make use of the same products from BT. BT's Ethernet services do not differentiate between circuits used for backhaul of LLU or of leased lines, and this reflects the technical similarities in the requirements for Ethernet connectivity used to support LLU backhaul and other leased lines services. This was consistent with LLU backhaul and other Ethernet backhaul services being close substitutes;

- Second, in a given geographic area, competitive conditions in the provision of LLU backhaul and other CISBO services are similar. We noted that in the CLA, BT has only a slightly higher share of LLU backhaul than that of the rest of the CISBO market and, as these are technically equivalent services provided using a common infrastructure, we considered competitive conditions to be broadly homogeneous. We noted that there are rival networks present at CLA exchanges able to supply LLU backhaul in competition with BT, in line with the effect of the presence of competing networks in the CLA generally.

[236] In Annex 15 we identify 34 New Competitive Exchanges (NCEs) to be treated as CI core nodes. Conveyance between the NCEs or between the NCEs and the 56 currently-designated Trunk Aggregation Nodes (TANs) will, as a result of this review, be treated as part of the (competitive) core conveyance market rather than as backhaul (in the CISBO market).

[237] LLU backhaul connects a CP's co-location facility to its relevant point of handover. Currently most CPs have their co-location equipment at BT local exchanges. However, our LLU backhaul definition would include co-location at a point closer to the end-user, including at the street cabinet level. Similarly, the definition could include co-location at a point more distant from the end-user.

- Third, although Sky and TalkTalk have expressed a preference to use a limited number of suppliers of backhaul, we noted that they do use suppliers other than BT.

Our assessment

A8.11 We proceed by first reviewing the substitutability between products used for LLU backhaul and those used for the provision of services to enterprise customers. We go on to discuss whether competitive conditions in the supply of LLU backhaul services and CISBO services are broadly homogenous.[238]

Demand-side substitution

A8.12 The CISBO market is a market for wholesale "terminating segments" of leased lines. A terminating segment can be further divided into an access segment (from the customer site to a local exchange) and a backhaul segment (from the local exchange either to another exchange on the same CP's network or to an OCP's point of connection (POC)).

A8.13 An LLU backhaul circuit is technically equivalent to the backhaul segment of a CISBO service used to provide a leased line to an enterprise customer. In principle, therefore, we would expect LLU backhaul between two sites to be a close demand-side substitute for a standard CISBO backhaul circuit between the same two locations. In practice, substitution possibilities will depend on the particular location of the two sites (the circuit ends) and in the case of an LLU backhaul circuit these are quite specific, as we explain below. LLU backhaul circuits by definition start at an LLU operator's co-location point at the (unbundled) BT local exchange. In this they differ from leased lines circuits provided to enterprise customers, which always need an access circuit starting at the end-user's premises. An LLUO which needed a backhaul circuit would be unlikely to switch to a CISBO circuit which included both backhaul and a redundant (in this case) access segment as it would not be willing to pay the costs of the access segment it did not need. However, Ethernet backhaul segments used to provide services to enterprise customers and LLU backhaul services both use identical fixed point-to-point Ethernet connectivity. Indeed, BT's EAD and EBD services (which are wholesale Ethernet point-to-point services typically used to provide leased lines) are not limited to particular uses. Thus, EAD is not restricted only to enterprise applications but can also be used for LLU backhaul, whilst EBD can be used to backhaul traffic from enterprise or LLU customers, or both, over a common Ethernet link. This is consistent with demand-side substitutability between backhaul circuits with (nominally) different applications provided at the same locations.[239]

[238] It may sometimes be appropriate to include two services which are neither demand- nor supply-side substitutes in the same market provided competitive conditions in the supply of the two services are sufficiently homogeneous.

[239] http://www.openreach.co.uk/orpg/home/products/ethernetservices/ethernetaccessdirect/ead/downloads/eadfactsheet.pdf

Supply-side substitution

A8.14 For supply-side substitution to occur, it would be necessary for a CP to be able to take capacity used to supply Ethernet backhaul for enterprise customers and begin using it to supply LLU operators with Ethernet backhaul services quickly and at low cost.[240] This is technically possible, as the services are technically similar. However, this does not mean that supply-side substitution would occur in response to a SSNIP in any particular case. Unless operators can easily enter using existing physical infrastructure then supply-side substitution in response to a 5% to 10% increase in the price of LLU backhaul is unlikely to be a strong constraint on LLU backhaul prices. This is because the costs of establishing a new point of connection at a BT exchange in order to supply backhaul include significant sunk costs and there would also be likely to be a time delay in responding to the price increase.

A8.15 We conclude that supply-side substitution is possible in the sense that a CP which was supplying or offering to supply Ethernet backhaul between two points could supply a technically equivalent LLU backhaul service between the same two points quickly and at low cost.[241]

Summary of demand and supply-side assessment

A8.16 We note that BT does not attempt to distinguish between Ethernet backhaul services offered to LLUOs and those supplied for other purposes. There appears to be flexibility for these products to be used to provide backhaul for both asymmetric (e.g. residential and business broadband) and symmetric broadband services (e.g. leased lines). Thus an Ethernet leased line sold for general enterprise applications could be used for LLU backhaul (and vice versa). We therefore consider that LLUOs would be likely to switch to an Ethernet backhaul product used by enterprise customers in response to a small but significant increase in the price of LLU backhaul products, if that option were available. In addition, OCPs currently providing Ethernet backhaul products for enterprise customers would be equally capable of providing LLU backhaul where they have existing network.

A8.17 This potential for substitution is consistent with the inclusion of LLU backhaul in the same market as the technically equivalent Ethernet backhaul services used by enterprise customers. We have also considered whether, absent regulation, there are features of LLU backhaul demand which could be an obstacle to demand-side substitution and create scope for price discrimination. For example, discrimination might be possible because the main LLU backhaul users (Sky and TalkTalk) are large and easily identifiable customers. Indeed, Sky and TalkTalk have expressed concern that the nature of LLU backhaul purchases places them at a relative disadvantage when seeking competitive supply. We therefore consider below

[240] However, we would normally only broaden a market on the basis of supply-side substitution if there were additional suppliers that would enter the market rapidly and at low cost in response to a small price change, and which were not already operating in the (narrowly-defined) market.

[241] As we note in Section 4, the task is to identify the nature and strength of competitive constraints and the labelling of a particular constraint as supply-side substitution or, *inter alia*, potential entry should not matter for our conclusions on SMP. The key question in this context is whether a sufficient number of CPs have network close enough to unbundled BT exchange sites to connect to them rapidly and at low cost. In other words, the strength of the constraint is primarily a matter of geography rather than whether the customer is an LLUO or a business enterprise.

whether there are differences in competitive conditions between LLU backhaul and other leased lines services such as would justify a separate market definition. In effect, this approach is equivalent to making a separate assessment of competition in the provision of LLU backhaul alone before considering whether our findings indicate sufficient homogeneity for LLU backhaul to be included in the same market as other CISBO services.

Variations in competitive conditions

A8.18 In our Market Questionnaire, we asked LLU operators to tell us about their main suppliers and about competition in the supply of LLU backhaul. There was a significant degree of consistency between the replies of the two main LLU operators, TalkTalk and Sky. Both said that:

- their main supplier of LLU backhaul was BT;
- Virgin was also a key supplier;
- there had been little market entry outside the major urban areas and, in some areas, BT was the only available supplier;
- [✂].

A8.19 Because Ethernet backhaul used to provide services for enterprise customers and LLU backhaul are technically equivalent and can be provided over a single network, we would expect competitive conditions to be broadly homogeneous between LLU backhaul and other wholesale Ethernet services in any given area. However, the geographic spread of LLU backhaul demand is potentially wider than that for enterprise segments (i.e. some unbundled exchanges are outside the main urban areas where most of the leased lines demand from business customers is located).[242] In its response to our market questionnaire, Sky described this wide geographic spread as offering BT a significant advantage in the supply of LLU backhaul now and over the market review period as:

- BT is the only provider that can offer products nationwide while only using its own network. Sky argued that it is often more efficient for Sky to purchase products from a single provider at a national scale than to purchase from multiple providers, because the latter option introduces additional overheads; and
- new demand for LLU backhaul would be likely to be concentrated away from areas of high business density (where OCPs had built networks primarily to meet demand for enterprise leased lines) and even away from those areas that currently have some limited competitive supply of LLU backhaul. The scope for

[242] We identified in the WBAMR three geographic areas: Market A – where no more than two significant operators known as Principal Operators are present or forecast to be present, which accounting for 9.5% of UK premises; Market B – in which there is effective competition, accounting for 89.8% of premises; and the Hull area – 0.7% of UK premises, where KCOM is the only significant provider. Market A tends to be in the most rural and remote parts of the country. http://stakeholders.ofcom.org.uk/binaries/consultations/review-wba-markets/statement/WBA-draft-statement.pdf

entry is lower in areas with a lower density of potential customers and lower scope to supply a range of customers (i.e. where there are fewer businesses and lower demand from LLU operators).

A8.20 TalkTalk made similar comments in its Market Questionnaire response:

"[✂]"

A8.21 As in mobile backhaul, BT has a strong position in the provision of LLU backhaul. The evidence from data provided in response to our formal information request suggested that [✂] of their total LLU backhaul requirements (i.e. they only self-supplied or procured backhaul from third parties for less than [✂]). This compares to BT's share of the CISBO market of around 57% in the Rest of the UK.

A8.22 The figures show that BT's shares of LLU backhaul (to Sky and TalkTalk) and of other CISBO services are both in excess of the threshold for a presumption of dominance of 50%. This suggests that if we were to assess market power for LLU backhaul and other CISBO services separately, we would be likely to conclude that BT was dominant or had SMP in the supply of both services in most parts of the UK.

A8.23 We have considered whether geographic variations in competitive conditions in LLU backhaul are similar to those found in CISBO generally. To assess whether competitive conditions were similar for CISBO services and LLU backhaul, we have looked specifically at the CLA and the LP.[243]

A8.24 For the CLA, our analysis suggests that BT's share of LLU backhaul is much lower [✂] on average than in the RoUK, with shares for each of the main LLUOs of [✂]. The lower shares in the CLA than elsewhere reflect the scope for competitive provision of backhaul from the local exchanges in the CLA. In particular, we observe an average network reach of more than eight OCPs at BT local exchanges within the CLA. All CLA exchanges have at least two OCPs with network within 100 metres and 96% of CLA exchanges have at least four alternative operators within 100 metres. For the LP, BT's share is higher ([✂]) and more similar to its nationwide share of LLU backhaul. In addition, the number of OCPs with network within reach of exchanges in the London Periphery is lower than in the CLA (e.g. in the LP the average network reach at BT local exchanges is 3 OCPs compared to more than eight in the CLA). BT's very high share of LLU backhaul outside of London is also consistent with the relative lack of competing infrastructure in the rest of the UK, which itself is reflected in BT's dominant position there in the CISBO market generally.

A8.25 Both TalkTalk and Sky told us that they generally prefer to purchase services from a single provider although, as noted above, both Sky and TalkTalk also make some

[243] Here we consider competition in the CISBO market which, as noted earlier, is a market for terminating segments consisting of both access and backhaul. In Annex 15 we identify 34 New Competitive Exchanges (NCEs) to be treated as CI core nodes from which backhaul (only) is competitive (see footnote 236 above). In Annex 15 we include a detailed assessment of the ability of the main LLU operators to obtain backhaul competitively, as they are among the most significant purchasers of backhaul from BT. As we explain earlier in this Annex, neither BT nor we distinguish between LLU backhaul and other Ethernet backhaul from a given location.

use of alternative providers to BT. Hence, we consider that Sky's and TalkTalk's preference for purchase from a single supplier ought not to be a significant barrier to competition, and that competitive conditions in LLU backhaul within a given geographic area should therefore be broadly similar to competitive conditions in the rest of the CISBO market. In other words, as with CISBO generally, we regard the number of competing networks present to be the main determinant of competitive conditions. In the CLA, the many competing networks are, in principle, able to supply LLU backhaul as well as other leased line services. This seems to be reflected in the significantly lower BT share of LLU backhaul provision in the CLA.

A8.26 Therefore, we consider that competitive conditions are not sufficiently distinct between LLU backhaul and CISBO services more generally to identify a separate product market for LLU backhaul. Even if we were to identify a separate market for LLU backhaul, it would not impact our SMP findings.

Stakeholders' responses

A8.27 We received relatively few comments on the approach to LLU backhaul set out in Annex 12 of the May 2015 BCMR Consultation. Those who commented tended to bracket LLU backhaul with MNO backhaul, arguing that competitive conditions were similar in both cases although not necessarily similar to those in other CISBO services.[244] Below we summarise, and set out our response to, comments we have received.

A8.28 BT questioned the inclusion of LLU backhaul in the wider CISBO market. BT noted that in our product market assessment we said that its Ethernet services could be used for LLU backhaul and for enterprise applications. BT explained that this was because Ofcom had placed LLU backhaul in the same market and made it subject to the same regulation as other CISBO services. Hence, BT stated that we could not rely on this to support identification of a single market in an unregulated (modified greenfield) setting.

A8.29 It said that LLU backhaul is purchased as part of network solutions by CPs who have countervailing buyer power in a bidding market and argued that this meant that its high market shares do not indicate market power. It also said that LLU backhaul is provided using similar services to other CISBO leased lines because LLU backhaul is subject to identical regulation.

A8.30 BT made similar comments in its response on MNO backhaul (though at rather greater length). We respond to these in Annex 7.[245] In short, we consider that the use of competitive tender does not in itself guarantee effective competition since, for example, the structural features of the market such as BT's ubiquity and first mover advantages in the supply of LLU backhaul remain relevant even in a bidding market. We also do not consider that LLU operators have sufficient countervailing buyer power to offset BT's SMP outside the CLA. In order to exercise countervailing buyer power, LLU operators must have a credible alternative to BT but, in many locations, there may be no such alternative. BT's ubiquity – it is already present at

[244] In Annex 7, we find that competitive conditions in MNO backhaul and CISBO services used by enterprise customers are broadly homogeneous.
[245] See paragraphs A7.84 and A7.95 – A7.98

all its exchange sites – and its greater scale and scope give BT advantages in the supply of LLU backhaul that would remain relevant even in a bidding market.

A8.31 As with MNO backhaul, the technical similarity between LLU backhaul and other CISBO services seems to be a reflection of their similar functions and required service characteristics. The backhaul elements of both a standard CISBO circuit and an LLU backhaul circuit are used for the same purpose: to provide fixed connectivity using Ethernet technology between a local exchange and a point of interconnection.[246] Indeed it is possible for a single wholesale "converged backhaul" product to carry a number of different types of traffic including voice, leased lines and asymmetric broadband. Given the functional similarity, there does not seem to be any conflict with the Modified Greenfield scenario in our approach. In the absence of regulation, LLU backhaul and other backhaul products would still be similar.

A8.32 Sky and Vodafone saw BT's market power in LLU backhaul, as in MNO backhaul, as entrenched due to the ubiquity of BT's network and a preference for suppliers who can offer connectivity across a wide geographic area. This is broadly consistent with our own views although, again as with MNO backhaul, we do not believe there is a risk of leverage of market power into the CLA.[247] As noted in paragraph A8.24 above, BT's share of LLU backhaul is much lower in the CLA than in other areas.

Conclusion

A8.33 We find that:

- LLU backhaul and the technically equivalent CISBO backhaul services are in principle substitutable;

A8.34 The main issue for respondents to the May 2015 BCMR Consultation concerns competitive conditions in the provision of LLU backhaul:

- BT says LLU backhaul is competitive everywhere due to competition from OCPs in a bidding market;
- LLUOs say LLU backhaul is not competitive anywhere due to the ubiquity of BT's network, the LLUOs' need for national coverage and their preference for a single national supplier;
- We believe competitive conditions in LLU backhaul are in fact sufficiently homogeneous with other CISBO services for them to be included in a single market. Outside the CLA, (where both access and backhaul are competitive) and apart from at those exchanges designated as "New Competitive Exchanges" (where backhaul is treated as part of competitive core conveyance), BT has SMP in LLU backhaul. However, there is no technical need for reliance on a single supplier and LLUOs can and do use alternative suppliers for some of their needs.

[246] Indeed competitors to BT rely on Ethernet to provide LLU backhaul and for backhaul elements for leased lines sold to enterprise customers.
[247] See the discussion in Annex 7, paragraphs A7.91 – A7.92.

In the CLA, there is evidence of both actual competition (BT's share of LLU backhaul is lower here than in other areas) and potential competition. At the NCEs, as described in Annex 15, a sufficient number of OCPs are present for the supply of conveyance from these exchanges to be competitive.

A8.35 Therefore, we do not identify a separate LLU backhaul market and we have considered competition in the provision of LLU backhaul as part of our wider assessment of SMP in the CISBO market.

Annex 9

Approach to SMP Assessment

Introduction

A9.1 This Annex presents the approach to SMP assessment that we follow in our assessment of the relevant markets for wholesale and retail leased lines defined in Sections 4, 5 and 6 of this consultation. The approach is largely that set out in Annex 13 of the May 2015 BCMR Consultation and we have therefore summarised in places for the sake of brevity. We also summarise comments received on that Annex, and include our replies to those comments.

A9.2 In this annex, we:

- describe the relevant regulatory framework;
- explain that this framework sets out the criteria to be considered in an SMP assessment;
- identify the criteria which are most relevant to the assessment of SMP in wholesale leased line markets;
- explain, in general terms, how we apply the SMP criteria set out in this framework to the markets covered in this review;
- discuss OCPs' investment plans in our forward-look at the prospects for competition.

The Regulatory framework

A9.3 Significant market power (SMP) is defined in the Act as being equivalent to the competition law concept of dominance. A CP shall be taken to have SMP if, either individually or jointly with others, it enjoys a position equivalent to dominance, that is to say a position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers.[248]

A9.4 We have taken particular account of the SMP Guidelines[249] and, where relevant, of the ERG Revised SMP Paper.[250] The SMP Guidelines set out a non-exhaustive list

[248] See section 78 of the Act and Article 14 of the Framework Directive.
[249] Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services, 2002/C 165/03. In accordance with section 4A of the Act we have taken due account of all applicable guidelines and recommendations which have been issued by the European Commission under Article 19(1) of the Framework Directive, and which relate to analysis or the determination of what constitutes significant market power. In doing so, pursuant to Article 3(3) of Regulation (EC) No 1211/2009, we have also taken utmost of any relevant opinion, recommendation, guidelines, advice or regulatory practice adopted by BEREC.

of criteria to be considered in an SMP assessment, and state that a dominant position may derive from a combination of these criteria, which taken separately may not necessarily be determinative.[251] Evidence on the most relevant SMP criteria should be considered in the round, and findings should not be based on assessment of a single criterion.

A9.5 Whilst we consider all the criteria listed in the SMP Guidelines, we regard the following criteria as particularly relevant to assessment of SMP in wholesale leased lines markets:

- market shares and market share trends;
- control of infrastructure not being easily duplicated;
- economies of scale and scope;
- barriers to entry and expansion;
- external constraints[252];
- countervailing buyer power;
- profitability, and;
- prospects for competition.

A9.6 Given that we are required to determine whether a CP will enjoy a dominant position in any of the relevant markets over the course of the review period, it is important to bear in mind that a degree of uncertainty may be present in the SMP assessment as a whole. This is expressly recognised, and provided for, in the SMP Guidelines.

A9.7 We recognise that *ex ante* regulatory reviews should be forward-looking. Our aim is to assess whether markets can be prospectively competitive and thus whether any lack of competition is durable by taking expected or foreseeable market developments over the review period into account.[253]

A9.8 We adopt the *modified Greenfield* approach when assessing competition in wholesale and retail markets.

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[250] Revised ERG Working Paper on the SMP concept for the new regulatory framework, September 2005.
http://berec.europa.eu/doc/publications/public_hearing_concept_smp/erg_03_09rev3_smp_common_concept.pdf

[251] Paragraph 79 of the SMP Guidelines.

[252] External constraints are not explicitly mentioned in the SMP Guidelines. We consider that their inclusion here is consistent with the approach in the Guidelines to chains of substitution. Some products *potentially* in a chain of substitution, but which are found to be outside the market, may still exert some influence on products within it, even if this is relatively weak. See also the discussion of chains of substitution in Annex 4 at paragraph A4.40.

[253] See Recital 27 of the Framework Directive and paragraph 20 of the SMP Guidelines. The forward-looking period of this review is three years.

- In wholesale markets we assume that no *ex ante* regulation arising from a finding of SMP applies to any CP within the relevant market in question.[254]

- In retail markets we take the presence of *ex ante* regulation in wholesale markets into account (where relevant). That is, we assume that while no *ex ante* SMP regulation applies to any CP in the retail market in question, CPs have access to regulated wholesale leased line products.

A9.9 We note that the EU Civil Infrastructure Directive (CID) is due to come into effect in UK law by summer 2016 and that it would be consistent with the *modified Greenfield* approach for it to be taken into account in our forward looking assessment of market power. We note that it will not come into effect until after we conclude the 2016 BCMR and that the detail of the transposition into UK law is currently the subject of a government consultation. After its implementation, it will be necessary to establish how it will be used and to resolve issues about, in particular, the scope and pricing of access. CPs will then have a clearer understanding of whether they wish to seek access to infrastructure under CID. As such, there is still some uncertainty as to the extent to which CID will be used, and over what time period such use will materialise. Consequently, for the purpose of this review, we do not consider that its existence materially changes our assessment of market power in any relevant markets. However, we would expect this to be a more significant factor in future reviews.

Comments in responses and our conclusions

A9.10 In its response to the May 2015 BCMR Consultation, BT said that there was overlap between the SMP criteria of control of infrastructure, economies of scale/scope and barriers to entry.

A9.11 We note that these are separate criteria in the EC's SMP guidelines. There is some interaction between them, but we do not agree that this means we have "double counted" their impact or overstated BT's market power.[255] We have attempted to draw out the distinction in this Annex.

General assessment of SMP criteria in the relevant wholesale markets

A9.12 Below we explain in general terms how each of the SMP criteria identified as relevant in paragraph A9.5 above applies to the wholesale markets for leased lines identified in this review.

Market shares and market share developments

A9.13 The SMP Guidelines note that "market shares are often used as a proxy of market power".[256] Market shares – and trends in market shares – are a measure of the

[254] We note that *ex ante* regulation in adjacent markets (which can be relevant when assessing external constraints) is taken into account as part of our assessment.
[255] BT advanced the same argument during the 2012/13 BCMR consultation: see para 7.79 of the 2013 Statement and our response in para 7.83.
[256] See paragraph 75 of SMP Guidelines.

outcome of competition, and as such, can provide an indication of how competitive a market has been in the past, and is now. Where an undertaking has a persistently large market share this usually points to impediments to effective competition being present, and where impediments, as in many cases, do not change over time, market shares can be a good indicator of competitive conditions in the future.

A9.14 In this respect, we continue to regard the following from the SMP Guidelines as of particular relevance:

- single dominance concerns normally arise where market shares exceed 40%;
- concerns can also arise at lower shares depending on the difference between the market shares of the undertaking in question and that of its competitors;
- very large market shares in excess of 50% are in themselves evidence of a dominant position, save in exceptional circumstances; and
- undertakings with market shares of no more than 25% are not likely to enjoy a (single) dominant position on the market concerned.[257]

A9.15 While market share is an important criterion, we recognise that a large market share alone is not sufficient to find SMP. The SMP Guidelines note in this regard that "the existence of a dominant position cannot be established on the sole basis of large market shares". Barriers to entry are particularly important in this respect. An undertaking with a high market share may not have market power when entry barriers are low as the threat of other undertakings entering the market within a reasonable amount of time and at low costs, could be enough to prevent an undertaking raising prices above the competitive level.

A9.16 Market shares do not always provide a reliable indicator of future competitive conditions. Underlying competitive conditions can and often do change over time. Changes in market shares can be informative about an undertaking's position in markets. More particularly, a decrease in the share of an undertaking may point to that undertaking having limited or declining market power. We note in this regard that:

- Where an undertaking maintains a high share over time, this may provide further evidence that impediments to effective competition are present, but by itself does not imply that that undertaking has SMP.
- While the gradual erosion of an undertaking's very high share may indicate that a market is becoming more competitive over time, such a development does, in itself, not preclude a finding of SMP.[258]

A9.17 In addition, the market shares that we are able to observe will often reflect the effects of existing regulation. In some circumstances, regulation might allow rivals to an incumbent to build up significant market shares, but if the underlying competitive conditions are such that the incumbent still has SMP, these market shares might

[257] See the SMP Guidelines.
[258] See paragraph 75 of the SMP Guidelines.

not be sustained if regulation were removed. In other situations, regulation may have the reverse effect of reducing incentives for entry, allowing the incumbent to maintain a higher market share than it otherwise would.[259]

A9.18 In Annex 13 of the May 2015 BCMR Consultation, we listed a number of practical issues which we considered were relevant to an understanding of our market share estimates:

- Our primary measure of market shares is based on the volume of leased line sales by each CP;
- It is also useful to consider value based shares, reflecting shares of revenues, especially where products are differentiated.[260] Within a broad market (such as the markets for CISBO services identified in Section 4), we have estimated value-based shares (for each relevant geographic market) by weighting CP volumes in each bandwidth segment by the standard prices for BT wholesale products in these segments;
- Our market shares are estimates, and so subject to uncertainty. In Annex 10 we describe the steps we have taken in this review to ensure that these shares are as accurate they can be. We also present the results of some analysis of the sensitivity of our estimates to changes in the underlying data.

A9.19 In the May 2015 BCMR Consultation, we also described a number of limitations which we considered applied to estimates of CPs' shares of the very high bandwidth segment. We said that we placed less weight on service shares for very high bandwidth CISBO on a stand-alone basis and would take due note of service shares in CISBO at bandwidths up to and including 1Gbit/s (and the adjacent high CISBO segment in particular) and of developments with a particular relevance to very high bandwidth CISBO (including growth, migration, CP pricing and product positioning).[261]

Comments in responses and our conclusions

A9.20 In its response to the May 2015 BCMR Consultation, BT said that Ofcom had not provided plausible ranges for service shares and that our estimates were biased. BT had already made similar points in its response to the October 2014 Data Analysis Consultation and our response is set out in Annex 15 of the May 2015 BCMR Consultation.[262]

A9.21 BT also argued that we should present trends in market shares over time. Towerhouse, in a submission for the PAG, also said that we had not taken account of trends in BT's market share. It said that a low but stable share combined with high profits may indicate that the firm has SMP, for example if customers are locked

[259] This may not be detrimental if the entry which is discouraged would have been inefficient.
[260] See for example paragraph 77 of the SMP Guidelines at http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52002XC0711(02)&qid=1399986405910&from=EN
[261] The limitations we identified and our assessment of market developments affecting the VHB CISBO segment are set out in Annex 5 of this statement.
[262] See also further analysis in paragraph A10.119 – A10.128 of this statement.

in by switching costs. Towerhouse presented figures from the 2015, 2013 and 2008 BCMRs to argue that BT's AISBO share had been stable in the WECLA at about 47%. It said that, as there has been little recent new infrastructure investment, we should not expect this share to fall in future, and so it "demands explanation".

A9.22 We do not present an analysis of trends because we do not have directly comparable data over time.[263] However, we note that BT's shares of the TISBO and CISBO markets remain at levels consistent with SMP and that a significant decline since the last review in 2013 seems unlikely to have occurred. We also do not expect significant declines in the markets where BT or KCOM has SMP over the market review period. Fuller details are set out in Sections 4, 5 and 6.

A9.23 We consider that, as a matter of principle, a low market share is unlikely to indicate market power, provided the market is correctly defined.[264] Whilst no practical approach to definition is likely to result in geographic markets which are completely homogeneous, the boundary tests used to define the CLA minimise the risk that a site in the CLA will not receive an adequate number of competing offers. We also recognise that, by itself, a market share of 40% or more may not indicate that the firm has SMP, as in the case of BT's share of the CISBO market in the CLA. The finding of no-SMP reflects our consideration of all the indicators, on balance (see Section 4 of this Statement). However, a slightly more general version of the Towerhouse point that low market shares may conceal pockets of market power may be relevant to the LP. Here, some sites appear competitive, but the patchy infrastructure in the area, with much lower network reach than the CLA on average, makes it more likely that some customers will have little effective choice.

A9.24 We consider that, even if market shares have been broadly stable, there is other evidence that the market is not as static as Towerhouse suggests, but is changing over time. For example, BT has cut prices over time (as it is required to do, but in the CLA it has done so by more than required by the safeguard cap on AISBO charges without apparently increasing its share), the boundary between the former AI and MI markets has gone, and there is a trend for customers to migrate to higher bandwidths. As Towerhouse notes, EFM services provided by LLU operators are also growing in importance. All these are signs of changes in the market, which we take into account in our forward-looking analysis.

A9.25 BT did not agree that more weight should be put on shares of the broad CISBO market as it thought the Very High Bandwidth (VHB) segment should be a separate market.[265]

A9.26 For the reasons set out in Section 4 we do not define a separate market for VHB CISBO services. Nonetheless, we recognise that BT has a lower share of the VHB segment than it has in other bandwidths and take this into account in our assessment of remedies in each geographic market. In Section 4 and Annex 5, we

[263] One reason why shares may not be comparable over time is that we have made significant improvements to our data collection and analysis process with each BCMR. Thus, in relation to its own comparison of shares from previous BCMRs, Towerhouse states "There are many caveats to be made about these comparisons since each data point was produced using different sets of assumptions."
[264] This view is consistent with Paragraph 75 of the SMP Guidelines
[265] The VHB segment includes Ethernet services at >1Gbit/s and WDM services at all bandwidths

set out in detail our reasoning as to why we consider anticipated migration trends are likely to strengthen BT's position in the VHB segment in the RoUK (and the LP) in the course of this review period. We expect these trends to bring BT's share closer to its share of the CISBO market as a whole as the VHB segment expands and VHB customers are increasingly those migrating upwards from lower bandwidths. We also explain why we do not include dark fibre sold to end users in our service share calculations and provide an illustrative example of how BT's share of VHB could change very quickly as anticipated migration trends play out in Section 4 and Annex 5.

A9.27 We agree with BT that the location of the most attractive business sites is unlikely to be affected by migration trends. However, we consider that, if anything, this feature of the market makes it more (rather than less) likely that BT's share of VHB will increase in the RoUK and LP during this review period. This is because investment in infrastructure by OCPs tends to focus on high value sites only (as these sites are more likely to support the high sunk and fixed costs associated with multiple competing networks). Historically, these higher value sites have tended to correspond quite closely to the location of VHB users, with the result that customers of VHB services in some parts of the UK have benefitted from access to rival infrastructure.

A9.28 However, as migration trends play out, VHB customers will increasingly be users who have recently migrated from lower bandwidth services. The sites where these customers are located are unlikely to become significantly more valuable as a result of this migration because the fundamental drivers of site value (e.g. concentration of businesses on a site and individual contract value) are unlikely to be affected to any material extent by migration to VHB. As a result, we consider it unlikely that OCPs will find it attractive to invest in material new deployments of infrastructure to serve these customers as they upgrade, making it more likely the competitive conditions these customers face are similar to conditions faced by lower bandwidth CISBO customers in the same area. As our network reach analysis shows, these competitive conditions vary by geography depending on the extent and depth of rival infrastructure already in place, but in both the RoUK and LP we find these customers would have limited alternatives to BT.

A9.29 We have considered the costs of upgrading to a VHB service in assessing the likely impact of migration trends on BT's SMP and disagree with BT that these costs mean customers are more likely to review their choice of supplier when they upgrade. Our discussions with CPs suggest that the costs of migration to VHB services are higher in absolute terms but similar, as a proportion of revenues, to those at lower bandwidths. Hence they are unlikely to have markedly greater significance for the migration decision. Evidence from the January 2016 BDRC survey also suggests that obstacles to migration may be more significant at lower bandwidths.[266] Moreover, the incumbent supplier will start with an advantage in any customer's review of its connectivity arrangements.

[266] Of those able to recall a product migration, 41% indicated that they had experienced an obstacle during the migration, and this ranged from 45% for those with an Ethernet leased line at ≤100Mbit/s and 46% for those with an Ethernet leased line at ≤1Gbit/s, to 27% for those with WDM or >1Gbit/s connections

A9.30 We do not include dark fibre sold to end users in the market shares as to do so would be inconsistent with our finding that the most appropriate treatment of retail usage of dark fibre is as an "external constraint" outside the CISBO market. We set out our reasons for this in detail in Section 4, where we conclude that dark fibre sold to end users is used by a niche customer segment only and as such we do not expect it to have a material impact on competition for retail customers in general. Hence we take retail usage of dark fibre into account as an "external constraint" in our SMP assessment, and do not include it in the market for the purpose of calculating market shares.[267]

Control of infrastructure not easily duplicated

A9.31 In order to provide leased lines to a site, a CP requires a physical connection to that site. Where a CP does not have an existing connection to a site, it needs to extend its network to establish a connection in order to provide leased lines to that site. The costs of network extension represent a significant proportion of the total costs of providing leased lines, are largely sunk, are common to fixed telecommunications services, and increase with the distance of network extension required.

A9.32 BT, as the former monopolist, has a very extensive trench and duct network extending to most (business) sites in the UK outside the Hull area. BT's infrastructure enables it to supply leased lines to almost any site in the UK outside the Hull area at low incremental costs and within a relatively short period of time (due to its close proximity to customers meaning only limited network extension may be required). BT benefits both from its large number of existing fibre connections and, even where it does not have a fibre connection, from existing ducts which reduce the frequency with which it has to dig to connect new customers compared to other CPs (installing fibre in existing duct being cheaper than digging from scratch). Moreover, on the occasions it does dig, BT usually only has to dig a relatively short distance.[268] BT benefits from this competitive advantage even where other CPs have access network infrastructure.

A9.33 Rival infrastructure is considerably more limited in amount and coverage. Commonly, OCPs will not have an existing connection to a site, in which case they will need to extend their networks to establish the connection. The greater the distance between a site and their infrastructure, the greater the costs of network extension.

A9.34 In the May 2015 BCMR Consultation, we listed a number of other reasons why BT benefits from its more extensive network:

- BT, because of its ubiquitous network, does not need to rely on third party CPs for connectivity. This reduces the possibility of interoperability issues occurring, contributes to a greater level of control over network equipment, can improve network security, and removes the need to negotiate wholesale supply

[267] Where dark fibre is bought by one CP from another in the wholesale market, its use by the purchasing CP to supply a retail leased line would be captured by the data we have gathered from the purchasing CP about its provision of leased lines.
[268] See Annex 13, Figure A13.2

arrangements with third party suppliers which may be complex and potentially influenced by whether the third party supplier is also a downstream competitor;

- BT's extensive network infrastructure may create technical advantages in terms of its ability to offer and build diverse physical routes. Physically separate routes are required to provide a service which is resilient to faults in network infrastructure. Some users seeking high availability may value such routes. We consider it easier for BT to connect a customer site to two separate access points and to find diverse routes from access points to destination; and

- BT may have advantages in serving multi-site contracts if customers place value on knowing that a single provider supplies the physical infrastructure for the whole contract or a large part of it. [269]

Comments in responses and our conclusions

A9.35 BT argued that we were wrong to regard its network as ubiquitous, pointing out that only 65% of businesses are within 200m of a flexibility point on its network. It claimed that Virgin can replicate BT's services for the vast majority of sites. It also argued that we had understated the extent of network competition by not taking account of EFM operators in the network reach analysis.

A9.36 BT said it disagreed with all the arguments set out in paragraph A9.34 above. In particular, it considered that the existence of a merchant market was evidence that reliance on third parties would not put smaller competitors at a disadvantage, and it disputed the relevance of a requirement for resilience. BT argued that the BDRC research carried out for Ofcom and published alongside the May 2015 BCMR Consultation showed that businesses that use a single supplier do not regard this as barrier to switching, which it considered implied that it does not have an advantage in supplying multi-site contracts.

A9.37 Below, we present evidence that Virgin's footprint is significantly smaller than BT's, and it is likely to have fewer connections within this footprint.[270] Virgin's market share is significantly lower than BT's despite apparently pricing at a significant discount to BT.

A9.38 The analysis of CPs' digging data, presented in Annex 18 of the May 2015 BCMR Consultation and Annex 13 of this Statement, provides evidence corroborating our view that BT derives an advantage from its network. The analysis shows that:

- BT requires network extension for a lower proportion of new customers (indicating that BT's network extends to a greater number of sites); and

[269] Purchasing from a single supplier does appear to be a widespread practice. The BDRC survey published in May 2015 found that 69% of respondents use a single supplier for all their business connectivity services. Of these, 80% said that having all their services with a single supplier was not a barrier to switching (at the retail level). However, OCPs' belief that they are not competitive for contracts which would require them to serve a large proportion of the customer's requirements off-net may mean that choice for some multi-site customers is limited. References to BDRC in this annex are to the May 2015 BDRC Consumer Survey rather than the February 2016 BDRC CI consumer survey unless indicated otherwise.

[270] See paragraph A9.78.

- BT, on average, digs shorter distances in cases where network extension is needed (indicating that BT's existing network, on average, tends to be closer to sites).

A9.39 One reason may be that distance to flexibility points is of less significance for BT than to other CPs as it will in most cases already have a connection to a customer's site. If an existing fibre connection or access duct is in place, it will not be necessary to dig in order to connect fibre from a customer site at a flexibility point. As the costs of digging are the most important distance-related component of costs, the importance of the distance between the site and the flexibility point are then much reduced. In practice, a high proportion of BT's digs are less than 25m in length and this suggests that the distance of customer sites from BT flexibility points has little bearing on BT's ability to compete.[271] This asymmetry between BT (with connections already typically in place) and OCPs (generally without such connections) would remain even in the hypothetical (modified greenfield) deregulated market in which BT considers it might dig beyond 200m. This is because, even if all CISBO regulation were removed, and prices allowed to increase, where BT has a material cost advantage in connecting a customer, other rivals located further away (or otherwise incurring higher connection costs) would provide a limited constraint on its prices.

A9.40 We consider that we should take account of the competitive constraint provided by EFM operators in our market analysis. We have done so by including EFM operators in our CISBO market share calculations and taking them into account in our qualitative assessment of SMP, but not by directly including such operators in the network reach analysis. This is because EFM can only be used to supply bandwidths of up to about 40Mbit/s, and so the competitive constraint provided by an EFM operator is not equivalent to that of an operator with its own fibre infrastructure able to supply all bandwidths. As a result, we do not consider it appropriate to treat infrastructure used to provide EFM circuits as equivalent to infrastructure used to provide CISBO circuits: which is what we would effectively be doing if we were to include EFM directly in our network reach calculations. Instead, when considering whether the rival infrastructure identified in our network reach analysis is sufficient for effective competition in each of the geographic markets defined, we take into account whether EFM services would be available in that area and the constraint they would provide in doing so. As EFM operators do not need their own networks near to customer sites, an assessment of network reach is not needed to identify areas where they are able to supply customers. Instead, we identify the presence of EFM in an area based on BT exchanges that LLU operators have unbundled (i.e. co-located at that exchange).[272]

A9.41 We have taken account of competition from EFM operators in our qualitative assessment of SMP in the following way. At the lowest bandwidths (relevant for CISBO services of up to 30 - 40Mbit/s), LLU operators are able to supply EFM services to any site in the exchange area where they are present. Most (but not all) of the CLA is part of exchange areas that were identified as competitive in the 2014 WBA Market Review Statement. Hence, we can expect most businesses in the CLA

[271] See Annex 13, Figure A13.2 and Table A13.5.
[272] By way of an aside, we also note that only a small proportion of leased lines are supplied using EFM, and the biggest user is in fact BT itself.

to have access to EFM services at competitive terms.[273] Thus, in the CLA, EFM competition is an adjunct to the primary source of competition to BT (the OCPs with their own fibre infrastructure) that reassures us that low bandwidth users will be able to obtain a competitive offer even if some other CPs are unwilling to dig to connect a customer site. In the LP and other areas, the primary source of competition (alternative fibre infrastructure) is weaker or absent across all the CISBO bandwidths, including the higher bandwidths where EFM is not viable.[274] Moreover, even at the lower bandwidths, Virgin rather than EFM appears to be the main competitor to BT in these areas.

A9.42 The fact that there is a merchant market does not mean that all costs of connection with third parties, or resulting disadvantages, are eliminated. Whilst some trades may still be worthwhile, the costs of establishing points of connection mean that interconnection with multiple operators may often not be an efficient proposition from a technical, operational or cost perspective.

A9.43 There may also be other advantages to using a small number of suppliers. One CP that uses third-party suppliers told us that [✂].[275] It seems likely that using additional suppliers in a bespoke or ad-hoc way would add to transactions costs therefore [✂].

A9.44 We also do not agree that resilience is irrelevant. In the May 2015 BDRC survey, it was found that "25% of businesses use more than one supplier for BCS…For one in ten [of these], using multiple suppliers offers a safety cushion of sorts (i.e. resilience). If one supplier lets the business down, the others can step into the breach and avoid a disruption to their connectivity that might occur following the failure of a single supplier's services."[276] Resilience is also said to be among the most important features of a service: "The most important features for businesses when making decisions about BCS are availability (a measure of reliability), resilience (an option for a second data path to provide higher availability) and bandwidth – both download and upload speed. Availability has by far the greatest importance for businesses, with nearly twice the level of importance than next most important service element, resilience…56% of large businesses and 53% of medium businesses think resilience will become more important vs. 34% of small businesses".[277]

A9.45 We do not agree with BT's interpretation of the BDRC results. According to the BDRC research, 69% use a single supplier; 42% say it is easier to manage and 25% say it is for QoS reasons. This suggests that a CP that can supply all a user's sites will have an advantage over one that cannot.

[273] In practice an LLU operator may not supply EFM services from all the exchanges it has unbundled. However, we have confirmed that, at all exchanges in the CLA, at least one operator is supplying EFM-based services. The average number of such operators at exchanges in the CLA is 2.33.
[274] It is also interesting to note that the average number of EFM operators per exchange is highest in the CLA, somewhat lower in the LP and somewhat lower still in the CBDs.
[275] [✂]
[276] BDRC, page 52
[277] BDRC, pages 4 and 33

Barriers to entry and expansion

A9.46 We consider that *sunk costs* and *switching costs* are likely to give rise to barriers to entry and expansion in wholesale leased lines markets. Where present, barriers to entry and expansion can raise significant impediments to competition, protecting the position of incumbent CPs – KCOM in the Hull area and BT in the rest of the UK – and making it more difficult for OCPs to compete for the supply of wholesale leased lines.

Sunk costs

A9.47 An extension of network infrastructure commonly requires a significant investment, and the costs associated with such investment are, to a large degree, sunk. We define a sunk cost as one which has been paid in the past, is not recoverable on market exit, and does not need to be paid again in order to remain in the market over the period under consideration.

A9.48 The OFT's guidelines on the assessment of market power (OFT 415) explain that:

> "sunk costs might give an incumbent a strategic advantage over potential entrants. Suppose an incumbent has already made sunk investments necessary to produce in a market while an otherwise identical new entrant has not. In this case, even if the incumbent charges a price at which entry would be profitable (if the price remained the same following entry), entry may not occur. This would be the case if the entrant does not expect the post-entry price to be high enough to justify incurring the sunk costs of entry".[278]

A9.49 The costs of extending network infrastructure to connect to sites are largely sunk as the physical network built cannot be transferred to another location if it is no longer required at the original site.

A9.50 BT and KCOM have extensive network infrastructure in the UK outside Hull and in Hull respectively. The asymmetry between incumbent CPs which have already incurred sunk costs in creating these networks, and potential entrants which have not, gives rise to barriers to entry.

Comments in responses and our conclusions

A9.51 In its response, BT complained that Ofcom has incorrectly represented BT's network as sunk and costless to maintain.

A9.52 We consider that BT's local access duct is a sunk asset (that is, one which does not need to be replaced for BT to stay in the market).[279] The forward-looking costs of sunk assets tend to be low (relative to the sunk costs of creating the asset) meaning that, in the absence of regulation, they would constitute a barrier to entry (as the forward-looking costs of a potential entrant which has not yet incurred sunk costs

[278] Paragraph 5.10 of the OFT Guidelines.
[279] Moreover, this has been established on appeal – see the CC determination of BT's appeal of the 2012 LLU charge control.

may be higher).[280] However, we do not assume that BT's forward-looking costs are zero.

Switching costs

A9.53 Existing customers may incur – or anticipate incurring – costs when switching to another supplier which they would not incur when continuing to purchase from their current supplier. Such costs, known as switching costs, can be of a financial or non-financial nature – cost of replacing equipment are an example of the former, and risk of temporary service disruption and being tied to existing contracts are examples of the latter.[281]

A9.54 Customers are considerably less likely to switch when tied to a contract with a current supplier. The presence of longer-term contracts – 77% of businesses have a contract lasting more than one year, 40% of more than two years - means that only a proportion of existing customers may be contestable at any given time, making it more difficult for OCPs to attract customers.

A9.55 Incompatibility of technology, most likely to arise in relation to IT systems and customer equipment, can also be a significant barrier to switching supplier.

- Wholesale customers may develop IT systems to help automate and manage transactions with their supplier. Customers will typically have a system in place for dealing with BT, and might have to develop a second set of systems when purchasing from another CP

- Compatibility relating to customer equipment is not guaranteed, and is likely to make customers more reluctant to switch supplier.

A9.56 Evidence from the May 2015 BDRC survey suggests that leased line users place a high value on avoiding service downtime and disruption. Service availability (a measure of reliability i.e. uptime without disruption) had by far the greatest importance for businesses, with nearly twice the level of importance of the next most important service element, resilience. Some 14% of respondents mentioned the risk of service disruption as a barrier to switching.

A9.57 The direct effect of switching costs is that customers will be reluctant to switch to another supplier even if that supplier offers terms and quality that are at least as good as those offered by the current supplier. OCPs may then anticipate that attracting new customers will require prices significantly below those offered by the current supplier and this may make OCPs less likely to invest in network extension and customer acquisition.

[280] Note that when setting regulated charge controls, we value BT's assets on a replacement cost basis (with the exception of pre-1997 access duct which is valued on an indexed historical cost basis), meaning that the sunk nature of BT's network does not deter efficient entry.
[281] See Section 8 of the BDRC end-user survey, http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

A9.58 While switching costs affect all suppliers, in practice we consider the impact will be greater for suppliers with no, or only a small, existing customer base. Such suppliers, OCPs, need to increase their customer base in order to compete more successfully and gain a greater foothold in leased lines markets. Switching costs may be of less significance if new CPs entering the market do not need to rely only on winning existing customers from an incumbent CP. As a result, we consider that barriers to entry and expansion tend to be less of an impediment to competition in markets with rapidly growing volumes.[282]

Comments in responses and our conclusions

A9.59 In its response, BT argued that the May 2015 BDRC survey shows that switching costs are minor and easily manageable:

- 50% of contracts are for up to 3 years allowing rapid change of supplier within a market review period;
- Most businesses review their service every 2-3 years and nearly 60% go to tender in the same period;
- 87% of firms are satisfied with their service;
- Reliability or resilience is relatively unimportant as a reason for using more than one supplier.

A9.60 BT also argued that incompatibility of technology is not a material source of market power.

A9.61 We consider that evidence from the two BDRC surveys we commissioned suggests that switching costs or difficulties are experienced by a material proportion of customers when changing supplier, and that these costs can be significant. The first BDRC end-user survey shows that businesses indicated the hassle of switching, the potential for service disruption, the risk of the new service not working well, and internal costs of switching are barriers to switching supplier of business connectivity services.[283] For example, BDRC say: “Figure 8.6 shows that price of services and hassle are the main barriers to switching (mentioned by 31% and 29% respectively).” The potential for service disruption was mentioned by up to 15%. This is consistent with the view that switching costs are “present to a material degree”.[284]

[282] This applies where growth is due to new demand from customers who do not already have a leased line. In the case of the growth expected in the higher bandwidth segments of the CISBO market, most new customers are expected to be migrations from lower bandwidth leased lines. In these circumstances, any costs of switching supplier are likely to confer an advantage on BT in retaining its high share of lower bandwidth customers as they upgrade to higher bandwidths.
[283] See Section 8 of the BDRC end-user survey, http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf.
[284] We are here concerned with the costs of changing supplier. Other costs may be incurred when changing service (for example from a TI service to an Ethernet service) or when migrating from a

A9.62 We consider that this view is also consistent with the results of the January 2016 BDRC survey:

- Of those surveyed who claimed to have switched suppliers in the past five years, some 14% rated the process as "not very easy" and a further 10% as "not at all easy";
- whilst 31% of those who had switched suppliers indicated that there had been no associated cost (internal or external), the average for those that had incurred a cost was £3,500, whilst the highest figure was £25,000;
- Of those that had not switched supplier, 13% said that they would need to 'break a contract or incur costs as a result of exiting early' in order to switch supplier;
- Where BT is considered to be the 'main supplier', 14% indicated it is 'too difficult/ too much hassle to change' compared to 3% where the main supplier is not BT;
- When asked how they would react if their existing supplier increased price by 10%, only 13% indicated that they would 'switch suppliers' and the great majority (86%) of respondents said that they would seek to negotiate with their existing supplier.

Taking all these results together suggests that switching costs can be significant, even if they are not always so.

A9.63 The prevalence of long-term contracts reduces the share of customers which are contestable at any one time, making it harder to attract new customers. In addition, CPs have told us that it is hard to attract customers unless they are out of contract. We do not consider that the possibility that 50% of contracts might be of shorter duration than the three year market review period means that long-term contracts cannot be a barrier to entry. The implication seems to be that up to 50% of contracts may be of longer duration than the period covered by the market review, suggesting that a significant proportion of contracts may be reviewed at most once in the three year period, and may then be contestable only in a relatively brief "window".[285] We consider that this is consistent with long-term contracts acting as an impediment to entry.

A9.64 The level of satisfaction reflects the impact of regulation of the markets in which BT has SMP, as well as competition (which may itself depend on access to regulated inputs).

A9.65 We comment above on the importance of resilience. Technological barriers may not be major where equipment conforms to manufacturers' standards and is widely

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lower bandwidth service to a higher bandwidth one of the same interface type. Migration of this latter kind is likely to be relatively low-cost.

[285] For example, paragraph 5.31 of the CMA guidelines "Assessment of market power" (OFT 415) states that "where customers award long-term contracts, a potential entrant may have to wait until these contracts are renewed before it has an opportunity to enter the market. It may also be important to assess whether enough contracts would come up for renewal to allow the entrant to attain a viable scale."

available but anything that increases switching costs is likely to benefit an incumbent. This can include customer systems (for example, if these have been developed for dealing with BT) more generally. The May 2015 BDRC survey found that "existing relationships also play a role…with a fifth citing good contacts at their existing supplier (20%) or that their current supplier understands their business (19%) is a barrier to switching."

Economies of scale and scope

A9.66 Markets for wholesale leased lines products – or fixed telecommunications services more broadly – are characterised by economies of scale and scope, with economies of scope typically being more material. We define *economies of scale* (or increasing returns to scale) as circumstances in which the unit cost falls as volumes of the same service increase, and *economies of scope* as circumstances where the unit cost falls as volumes of a different service increase.

A9.67 The presence of fixed costs can give rise to economies of scale because average fixed costs necessarily fall as volumes of a service increase. The presence of common costs – costs that need to be incurred in order to provide any of a group of services, but which then do not need to be incurred again in order to supply any other service in the group – can give rise to economies of scope with the average fixed cost decreasing in the total volumes of services in the group supplied.

A9.68 The costs of developing network infrastructure – which form a major proportion of total costs of providing leased lines – are both fixed in the short-term and to a large extent common. The materiality of economies of scale and scope in any particular case depends on the extent to which network infrastructure can be used to supply additional volumes in the same market (*economies of scale*) or in different markets (*economies of scope*).

A9.69 We note that common costs relating to development of physical infrastructure are particularly significant in fixed telecommunications markets as CPs can use the same infrastructure to supply a range of fixed telecommunications services, including leased lines. In relation to the supply of leased lines, we consider that the more significant reductions in unit costs that can be achieved are driven by the ability of a CP to spread the common costs of network infrastructure over a wider range of fixed telecommunications services. This explains why in our view, economies of scope are more likely to be material in wholesale leased lines markets.

A9.70 The incumbent CPs – BT (in the UK outside the Hull area) and KCOM (in the Hull area) – because of the scope and scale of their fixed telecommunications operations, are likely to benefit to a greater extent from economies of scale and scope than OCPs.

Economies of scale

A9.71 A large proportion of costs associated with providing leased lines are incurred in developing (and maintaining) the part of the infrastructure that connects to sites, i.e. the dedicated access links. This part of physical infrastructure is, to a large degree, incremental to sites, and the cost of developing these links depends greatly on the length of links. We consider that the costs of access links only give rise to economies of scale insofar as the number of services provided to a site increases and do not depend on the total number of leased lines supplied or customers served by a CP.

A9.72 We recognise that there may be economies of scale arising from costs that are not related to access links.

- CPs providing greater volumes of wholesale leased lines purchase more equipment, and they may be able to negotiate a lower equipment price per unit than CPs supplying lower volumes.

- BT may be able to exploit economies of scale in backhaul more effectively than smaller CPs. This is because the lowest unit costs are usually obtainable by purchasing the highest capacity circuit and then filling it, but only BT may have sufficient traffic to do this on some routes. As one circuit can be used to backhaul the traffic of multiple services and/or of multiple customers, the greater the number of services using a backhaul circuit, the lower is the unit cost of that circuit. While this holds true for any CP (and BT's backhaul products are provided on an EoI basis), we note that the ability of a CP to use the highest capacity backhaul products will depend on that CP's sales of downstream products. Thus BT may be better able to utilise the capacity of its backhaul product (as it will more commonly be able to increase the number of customers that make use of the same backhaul product), allowing it to achieve greater economies of scale overall, with respect to these services than OCPs offering similar products.

A9.73 As part of the financial modelling undertaken to inform the charge control remedy we propose to impose, we use cost volume elasticities (CVEs) and asset volume elasticities (AVEs) for the cost components relevant to provision of leased line services. CVEs and AVEs reflect how operating costs and capital costs, respectively, vary with changes in volumes of cost components. CVE and AVE values below one provide an indication of the unit operating and the unit capital cost, respectively, decreasing in volumes. We interpret such values as an indicator of economies of scale.

A9.74 In Annex 32 of this Statement we set out the base year component CVEs and AVEs used in setting the LLCC. These elasticities are derived from BT's LRIC model outputs. The values are below one, some significantly so. We interpret this as evidence of BT achieving economies of scale in its provision of leased lines. We expect OCPs, while they are able to achieve economies of scale as well, to be constrained in the economies they can achieve due to the smaller scale of their operations.

Economies of scope

A9.75 As explained above, it is the presence of common costs in the provision of leased lines that gives rise to economies of scope, and given the significance of common costs in provision of leased lines, we consider that economies of scope are likely to be material.

A9.76 It can be instructive to distinguish between costs common to the provision of fixed telecommunications services, to the provision of leased lines, and to leased lines provided using a particular technology:

- A large proportion of costs incurred in supplying leased lines are common to the provision of fixed telecommunications services. Thus, CPs selling a wider range of fixed telecommunications services have greater opportunities to benefit from economies of scope.

- There are also costs that are incremental to supplying leased lines, yet common to all types of leased lines. If such costs are significant, this allows CPs providing a range of leased lines to reduce unit costs.

- There can be costs which are common to leased lines provided using a particular technology. CPs selling a greater number of lines using a given technology may benefit from lower unit costs in providing services using this technology.

Comments in responses and our conclusions

A9.77 In its response, BT argued that other CPs can achieve similar economies of density and stated that rival infrastructure includes NGA and EFM services as well as Virgin.

A9.78 We consider that the scale and scope of BT's operations in the UK outside the Hull area are greater than those of OCPs – across markets for fixed telecommunications and leased lines services. Virgin, BT's closest competitor in terms of scale and scope of its telecoms services, has a significantly less extensive network and a considerably smaller installed customer base across these markets.[286] Therefore, we consider that BT benefits from a greater ability to spread the costs of its network infrastructure across a wider range and greater number of fixed telecommunication services than OCPs. We recognise that the materiality of the advantage BT derives from its scale and scope will be smaller in areas with a greater amount of rival infrastructure, but there is little such infrastructure in most areas outside Central London. In the Hull area, KCOM is the CP with by far the greatest scale and scope of fixed telecommunications operations, and as such is likely able to benefit to a greater extent from economies of scale and scope.

A9.79 At the network level, most NGA and EFM competitors (e.g. TalkTalk) are likely to use a BT service (LLU or VULA plus CISBO for backhaul) and so might even contribute to BT's ability to benefit from economies of scale/scope in its network (certainly if the alternative supplier was a full infrastructure CP like Virgin).

Countervailing buyer power

A9.80 A market in which one supplier has a high share and barriers to entry are present may not lead to harmful outcomes for consumers if buyers have sufficient countervailing buyer power.

A9.81 In general, purchasers in wholesale leased lines markets may have a degree of buyer power where they purchase large volumes and have a credible threat to switch supplier or to meet requirements through self-supply. In order for the threat to be effective, the volumes that are or can credibly be met from another source of supply need to have a material impact on the supplier's profitability. Practically, this

[286] The difference between BT and Virgin in terms of coverage of network infrastructure and scale remains significant. The total number of leased lines supplied by BT is more than four times the number supplied by Virgin, and BT supplies twice as many CISBO services. Moreover, the coverage of BT's network is considerably greater than that of Virgin. BT has network infrastructure in the proximity of most businesses. [✂].

requires volumes to be significant and to represent a material proportion of a supplier's total volumes.

A9.82 In practice, our assessment of countervailing buyer power considers the availability of another source of supply (another supplier or self-supply), and the materiality of purchasers' volumes as the two requirements that need to be cumulatively met for purchasers to have material countervailing buyer power.

A9.83 The first requirement concerns the availability of another source of supply. In leased lines markets, the availability of another source of supply depends on the presence of rival infrastructure in the proximity of a site. Only where one or more OCPs have network near its site can a purchaser make a credible threat to switch volumes from the incumbent CP to an OCP. Where a purchaser knows that more than one CP has network in the proximity of his site, and can thus provide leased lines at not too great incremental costs, he can try to play CPs off against each other asking for better terms.

A9.84 As a general rule, the greater the presence of rival infrastructure in an area is, then the more likely it is that one or more OCPs have some infrastructure in the proximity of a site and thus some ability to supply leased lines to that site. The network reach analysis that we carried out (presented in Section 4) estimates the presence of rival infrastructure in geographic areas. In areas where the presence of rival infrastructure is low (as evidenced by their low network reach), most businesses will have no or limited choice when it comes to suppliers as few OCPs have infrastructure in the proximity of their site.[287]

A9.85 The second requirement concerns purchasers' volumes. As stated in the ERG SMP Paper, "the higher the amount of purchase of services by customers or the higher the proportion of the producer's total output that is bought by a certain customer, the stronger the countervailing power might be".[288]

A9.86 In principle, countervailing power could be exercised at the wholesale level and at the retail level. However, retail users are likely to purchase too few volumes to have any material countervailing power. If we turn to wholesale markets, we can observe that in each of the relevant wholesale markets identified in the BCMR 2013, BT/Openreach's largest customer is its downstream retail division.[289] Table A9.1 below presents internal and external volumes (as reported in BT's Regulatory Financial Statements 2015), and the ratio of internal/total volumes for the markets in which BT was found to have SMP in the previous market review. The ratio of internal/total volumes varies between 56% and 76% and exceeds 60% in five out of the six markets and market segments shown in Table A9.1.

[287] Low bandwidth (up to around 40Mbit/s) CISBO users are likely to be able to obtain an EFM-based service in areas of the UK outside those covered by alternative fibre networks. LLU operators are able to supply EFM services by purchasing access to BT's copper local loops on regulated terms.
[288] See paragraph 11 of the 'Revised ERG Working Paper on the SMP Concept for the New Regulatory Framework', 2005.
http://berec.europa.eu/doc/publications/public_hearing_concept_smp/erg_03_09rev3_smp_common_concept.pdf
[289] The same is true for KCOM in relation to wholesale business connectivity services markets in the Hull area.

Table A9.1 BT sales of wholesale leased lines: internal vs external

Product market	Internal volumes (circuits)	External volumes (circuits)	Ratio of internal to total volumes
Low bandwidth TISBO (<=8Mbit/s)	35,090	19,189	65%
Higher bandwidth TISBO (>8Mbit/s)	746	239	76%
Low bandwidth AISBO (<=10Mbit/s)	22,261	12,296	64%
Medium bandwidth AISBO (>10Mbit/s, <1Gbit/s)	52,225	31,909	62%
High bandwidth AISBO (1Gbit/s)	22,133	10,383	68%
MISBO* (WDM at all bandwidths and AI services >1Gbit/s)	2,629	2,049	56%

* Includes only non-WECLA MISBO volumes. Excludes EBD/ONBS MISBO rentals

Source: Ofcom analysis based on BT's Regulatory Financial Statements 2015

A9.87 Apart from BT's downstream retail divisions – and possibly MNOs and LLUOs – we do not consider there are customers whose volumes are large enough for them to potentially exert buyer power.[290]

A9.88 BT's involvement upstream and downstream, if anything, reduces its incentives to offer (selective) discounts to competitors of its downstream divisions. Offering discounts would only intensify downstream competition, possibly reducing margins earned and volumes sold by BT's downstream division.

[290] We note that even where a customer purchases significant volumes, this does not necessarily imply that this customer has material countervailing buyer power. For example, if a significant proportion of a customer's volumes can only be purchased from one supplier (as only that supplier has network in that area) this would weaken the customer's, and strengthen the supplier's bargaining position.

A9.89 Even if some purchasers were able to exercise buyer power effectively, this is unlikely to benefit customers without buyer power. Where BT is able to offer selective discounts to purchasers with buyer power, those without buyer power would not benefit, and in fact, would likely face higher prices. Where BT is not able to offer lower prices only to purchasers with (potential) buyer power, it will be less inclined to decrease prices in response to the threat of a single purchaser.

A9.90 We discuss specific issues relating to competition for mobile and LLU backhaul, including countervailing buyer power, in Annexes 7 and 8, respectively.

Comments in responses and our conclusions

A9.91 In its response, BT said that Ofcom had understated the extent of countervailing buyer power by relying on the high internal share of BT sales, as BT's external share is depressed by the effect of regulation which prevents it offering various discounts, including those based on total spend.

A9.92 BT has been regulated in the past in respect of most wholesale products, with regulation placing limits on BT's ability and incentives to respond in a targeted way to offers made by OCPs. In practice BT has generally adopted broadly uniform pricing, with little variation by area.[291] In the absence of regulation, BT would have greater flexibility to respond to instances where it did face competition by offering selective discounts. This would raise the level of risk associated with OCPs' investments in network extension as BT, provided it could identify the customers most willing and able to switch to its rivals, could compete aggressively for customers of OCPs without having to forgo revenue on customers less likely to switch away from BT. It may also translate into BT winning a larger share of sales, though we note that the absence of regulation would also allow BT to set higher prices on average, which may give OCPs some increased ability to win business if BT was not able to target these price increases effectively.

A9.93 We therefore consider that regulation which prevents BT offering selective discounts is unlikely to reduce countervailing power. Whilst allowing BT to discount aggressively in circumstances where it had SMP might increase its external sales at the expense of OCPs, in doing so it would be likely to result in its customers having less choice – and hence less countervailing power – than at present. In any case, our market analysis is carried out on the basis of the modified Greenfield assumption, in the absence of regulation.

A9.94 Overall, we consider that buyer power in relevant wholesale markets would not materially constrain the incumbent CPs – BT and KCOM – in potentially exercising market power in these markets.

External constraints

A9.95 Our market power determinations aim to take all relevant competitive constraints, whether inside or outside markets defined, into account. We consider external

[291] We note that BT offered discounted connection charges on EAD 1Gbit/s product in the WECLA in the period March 2013 to May 2014, and tends to price its MISBO services in the WECLA more flexibly. [✂]

constraints – out-of-market products which some customers might regard as substitutes to in-the-market products – and their individual and joint impact on competition for in-the-market products as part of our SMP assessment. External constraints by their nature tend to be relatively weak, but they can, either when taken together and/or in combination with competition within the market, constrain a CP's ability to exercise market power, as some customers may switch to out-of-market products in response to a relative price increase of the in-the-market product.

A9.96 Customer requirements offer a natural starting point for identifying external constraints. Out-of-market products can only potentially constrain CP market power if some (potential) users regard these products as substitutes to in-the-market products. Practically, this requires out-of-market products to be able to meet broadly similar needs and to be of acceptable quality for at least some users.[292]

A9.97 In the markets under consideration in this Review, the relevant out-of-market products typically concern fixed telecommunications services that can be provided over the same network as the in-the-market products. As BT supplies most fixed telecommunications services, the directional impact of out-of-market products can be ambiguous. They can constrain BT's market power when BT faces intense competition in the markets for out-of-market products, but they can, on the other hand, strengthen BT's market power when BT maintains a strong position in these markets.

A9.98 We identify other leased lines products and asymmetric broadband (NGA) as potentially relevant external constraints. As noted above, we also take account of the ability of a small minority of end-users to use dark fibre as an external constraint. Generally, we do not consider the external constraints arising from these out-of-market products to materially constrain BT's market power for in-the-market products because the sources of external constraints will, by definition, not be very close substitutes for the products in the market.

Profitability

A9.99 The SMP Guidelines refer to the importance, when assessing market power, of considering the ability of a CP to raise prices without incurring a significant loss of sales or revenue as part of a market power assessment.[293]

A9.100 An unregulated CP with SMP has, by definition, the ability and incentives to increase profits by raising prices above the competitive level. CPs that do not have market power will, constrained by competition, not be able to raise prices above the competitive level, and thus cannot sustain profitability that materially exceeds the cost of capital (the competitive benchmark).

A9.101 We note that profitability temporarily exceeding the cost of capital, for example because of successful innovation, can be consistent with competitive markets, and can in fact ensure that markets remain competitive by providing incentives for entry

[292] Secondly, price differences between in-the-market and out-of-market products matter too.
[293] See paragraph 73 of SMP Guidelines.

and expansion. It is the ability of a CP to sustain high profitability (i.e. substantially above the cost of capital) over a longer period of time that points to market power.

A9.102 We do not consider the reverse to be true, particularly where a CP is already subject to a charge control. That is, we do not regard profitability at or below the cost of capital as evidence of a CP not having market power since the objective of a charge control is normally to reduce prices to the competitive level, eliminating excess profits. In addition, firms with SMP, whether or not they are subject to a charge control, are often able to operate inefficiently, in the absence of competitive pressure to reduce costs and this can then be reflected in low reported profits. Low profitability can therefore be the result of CP inefficiencies and/or price regulation, both of which factors arise where a CP has SMP.

A9.103 We assessed the profitability of the two incumbent CPs (BT and KCOM) by benchmarking the return on capital employed (ROCE) against the weighted average cost of capital (WACC).[294] Both BT and KCOM are obliged to publish the financial data required for carrying out profitability analysis (returns, operating costs, mean capital employed) in their regulatory financial statements for each of the markets in which they were found to have SMP in the previous review.

A9.104 We note that analysis of BT's and KCOM's leased lines operations is subject to measurement and interpretation limitations.

- First, the treatment of holding gains/losses as costs in BT's accounts has an impact on ROCEs observed, and in particular, introduces a volatility reflecting changes in asset values.

- Second, the high proportion of common costs in leased lines markets has an important consequence for accounting measures of profitability which necessarily reflect a particular common cost allocation which may not be uniquely correct. We note that BT has some discretion in the way it recovers common costs.

- Third, financial data might apply to groups of services which do not correspond to our proposed market definitions.

- Finally, the economic lives of some assets may exceed their accounting lives. This means that the assets used to provide some services (more likely for low bandwidth TISBO than for CISBO services) may be heavily depreciated, tending to reduce the accounting value of capital employed and raise measured ROCEs without necessarily indicating the exploitation of market power.

A9.105 Taking the above into account, we interpret profitability as follows:

- We do not make inferences about competitive conditions in markets where we find low levels of profitability and price regulation applies; and

- We do place weight on a high level of profitability as an indicator of market power.

[294] The WACC is the minimum expected return required by investors given the level of risk they bear.

A9.106 As discussed above, our proposals regarding market power determinations never rely on one indicator alone. Although the existence of profitability persistently and significantly above the competitive level often indicates that a CP has SMP, we note that this is not a necessary condition for finding SMP.[295] Neither is it a sufficient condition. For example, where we have strong evidence on rival infrastructure being significant enough to sustain effective competition, this can overcome evidence on high profitability as a potential indicator of SMP. In these circumstances, high current profits should act as a signal to encourage rivals to compete actively for customers.

A9.107 Annex 17 presents the profitability analysis of BT's and KCOM's operations in leased lines markets we have carried out. The main findings are:

- ROCEs relating to BT's provision of low bandwidth TISBO services have consistently and significantly exceeded BT's cost of capital and have been rising over time. This is consistent with a finding of SMP, although we do not put much weight on the precise figure as the relevant assets are heavily depreciated;
- The high ROCE indicators relating to the provision of AISBO services outside of WECLA are consistent with BT having market power in the supply of CISBO services in this area.
- ROCEs relating to the provision of AISBO services in WECLA have been consistently and significantly above BT's cost of capital, which by itself is consistent with BT having market power in the supply of CISBO services in this area.
- There is no variation in KCOM's ROCEs across product markets and over time. This strongly suggests that the ROCEs reported by KCOM do not reflect its true profitability. Hence we consider that the ROCEs reported by KCOM do not provide a reliable basis for making inferences as to any market power KCOM may have.

Comments in responses and our conclusions

A9.108 In its response, BT said that it noted Ofcom's comments on the limitations of profitability figures (as set out in paragraph A9.104 above) and argued that they are particularly relevant for VHB services as these are a "growing market" with unpredictable equipment lives.

A9.109 We consider that high profits in CISBO as a whole suggest that at least some of BT's prices are above the competitive level. In this context, BT's high profitability on VHB services despite its loss of share in the VHB segment, and its policy of discounting in more competitive areas, suggests that its VHB prices may not be at the competitive level. See also Annex 17 for comments on CISBO profitability.

[295] This is consistent with the ERG Revised SMP Paper (see section 3, paragraph 20).

Prospects for competition

A9.110 In applying cumulatively all the relevant SMP criteria, we also reflect the requirement under the terms of Article 16 of the Framework Directive for our market analysis to involve a forward-looking, structural evaluation of the relevant market, based on existing market conditions. We need to determine whether, in the absence of *ex ante* regulation, the market is prospectively competitive, and thus whether any lack of effective competition is durable, by taking into account expected or foreseeable market developments over the course of a reasonable period[296].

A9.111 We assess the prospects for competition by reviewing evidence on expected and foreseeable market developments that may lead to effective and sustainable competition in a market. Competition is more likely to increase in intensity where either there have been actual announcements of plans to enter and/or expand by rivals, and/or prospects for profitable entry appear to exist or are expected to improve. Relevant factors include any announcements of investment plans by rival CPs as well as the value of services, the level of and trends in demand and any expected technological changes which could affect costs or entry conditions.

A9.112 We note that costs of providing services do not vary greatly over the bandwidth range, whereas prices do. BT's prices for its CISBO products increase with the bandwidth of the circuit, whilst the incremental costs of network extension – which forms the majority of costs of providing services – generally do not vary with the bandwidth of the circuit. This combination of prices which rise with bandwidth and costs which vary to a much lesser degree has tended to encourage greater entry by OCPs in higher bandwidth CISBO segments.

A9.113 As explained in Section 4, we interpret service shares in the supply of very high CISBO services in light of this pricing structure. OCPs, in particular Virgin, have been successful in winning a materially greater share of supply due to BT setting higher prices for these services and hence making it more attractive and feasible for OCPs to gain a foothold.

A9.114 At low bandwidths (up to about 30Mbit/s), entry can also occur using EFM technology and wholesale unbundled local loops purchased from BT on regulated terms. An LLU operator can provide EFM services at low incremental costs to each site located in exchange areas where the LLU operator is co-located at the local BT exchange. While TalkTalk currently offers EFM services in many areas, [✂]

CPs' investment plans

A9.115 We asked CPs to tell us about their future investment plans in the Market Questionnaire and in a formal information request sent as part of our data gathering process.[297] In both cases, the replies we obtained indicated that few CPs have firm plans for material expansion of their networks. Whilst some indicated a desire to

[296] See Recital 27 of the Framework Directive and paragraph 20 of the SMP Guidelines. The forward-looking period of this review is three years.
[297] 1st Notice requiring the provision of specified information under Section 135 of the Communications Act 2003, 7 March 2014

expand in future, this was often conditional on future sales success, and likely to be relatively small-scale. At least one suggested that it would invest more if BT were required to make passive access available. In other cases, plans were for expansion in locations which were already competitive in Central London or at large datacentres.

A9.116 Two CPs, Virgin and CityFibre, have more significant plans to expand their networks in this market review period. Virgin has announced plans to invest a further £3bn in network expansion.[298] It estimates that this investment should increase the number of households and businesses to which it can offer services by one third over the next five years. CityFibre has plans to deploy fibre-based networks in a number of what it calls 'second-tier' UK towns and cities.[299]

A9.117 However, even with these developments, most CPs' networks will remain far more limited in extent than BT's, with fewer physical connections to business users. In addition, the locations of the investment planned by CityFibre and Virgin are in areas where the CISBO market is unlikely to become effectively competitive even with these investments.[300]

Demand developments

A9.118 Trends in demand are important for a number of reasons. First, economies of scale mean that average costs fall as volume grows. Growth in demand can make entry more attractive by reducing average costs. Second, switching costs may be of less significance in a growing market, also making entry easier.

A9.119 We analysed the development of volumes over time, and going forward. Actual and forecast volumes for TISBO services were obtained from IDC. Volumes for CISBO services, both actual and forecast, were provided by IDC and Ovum.[301] Tables A9.2 and A9.3 present the expected compound annual growth rates for TISBO and CISBO services at various bandwidths for the periods 2013-15, 2015-18 and 2018-19 or 2018-20 based on data provided by IDC and Ovum respectively.[302]

[298] http://about.virginmedia.com/press-release/9467/virgin-media-and-liberty-global-announce-largest-investment-in-uks-internet-infrastructure-for-more-than-a-decade

[299] City Fibre estimates it currently has at least some fibre presence to 50 UK towns and cities: http://static1.squarespace.com/static/50a0c308e4b081ffff792a0b/t/5565f691e4b0da31db61bfa9/1432745617126/CityFibre+Infrastructure+Holdings+Plc+Annual+Review+2014.pdf and plans for further investment within these areas and across the UK: http://www.cityfibre.com/gigabit-cities/

[300] CityFibre has recently acquired KCOM's network outside of the Hull area. However, this represents a transfer of ownership of existing infrastructure rather than new entry.

[301] These concern total volumes of services at the retail level. We consider this an appropriate approximation of total volumes at the wholesale level as wholesale demand is derived from retail demand. We also note that IDC's data are based on end-to-end Ethernet services whereas Ovum's data are based on local ends. Volume figures for 2013 and 2014 are actual data, those for 2015 are estimates.

[302] These forecasts are for the growth of the entire market. Elsewhere in this Statement we present the forecasts we consider appropriate for BTW and Openreach's sales.

Table A9.2 Development of volumes across interface types and bandwidth segments (IDC)

		Expected compound annual growth rate		
Interface	**Bandwidth**	**2013-15**	**2015-18**	**2018-19**
TISBO	Low bandwidth (<=2Mbit/s)	-24%	-30%	-36%
	Higher bandwidth (>2Mbit/s)	-26%	-32%	-41%
CISBO	<=10Mbit/s	0%	-3%	-6%
	>10Mbit/s & <=100Mbit/s	14%	9%	6%
	>100Mbit/s & <=1Gbit/s	27%	18%	17%
	>1Gbit/s	44%	29%	26%

Source: Ofcom analysis based on IDC data.

Table A9.3 Development of volumes across interface types and bandwidth segments (OVUM)

		Expected compound annual growth rate		
Interface	**Bandwidth**	**2013-15**	**2015-18**	**2018-20**
CISBO	<=10Mbit/s	-2%	-7%	-20%
	>10Mbit/s & <=100Mbit/s	13%	9%	8%
	>100Mbit/s & <=1Gbit/s	20%	20%	18%
	>1Gbit/s	55%	43%	29%

Source: Ofcom analysis based on Ovum data

A9.120 The development of volumes varies considerably across service types, with TISBO volumes declining and volumes of CISBO services, especially at 1Gbit/s and above, on the rise. This development is forecast to continue over the review period. That is, TISBO volumes are forecast to decline significantly, and volumes of 1Gbit/s and above CISBO services are forecast to grow strongly over the period reflecting greater demand from existing users, users of lower bandwidth CISBO services

upgrading, users of TISBO services migrating, and emerging demand from new users of leased lines.

Prospects for competition - overall

A9.121 Having considered two drivers of revenue opportunities – value per service and demand prospects – we find that, in the absence of *ex ante* regulation, the prospects for competition are potentially more favourable for CISBO services. These services are currently sold at significantly higher prices, and have better demand prospects. Prospects for competition are poor for low bandwidth TISBO services. The combination of low value per service supplied and unfavourable demand prospects means that OCPs are unlikely to be willing to invest in network extension for providing these services.

A9.122 However, as we explain in Section 4, competition for CISBO services is driven primarily by the presence and extent of rival infrastructure, so for competition in CISBO services to increase, we would need to consider it likely that there would be material investment in rival infrastructure in the course of this review period on a sufficient scale so as to allow effective competition to emerge. Our analysis of rival infrastructure indicates that OCP investment in network infrastructure has been limited. Few CPs have firm plans for material expansion of their networks, whilst it appears that the two that do – Virgin and CityFibre – plan to invest in areas which we consider unlikely to become effectively competitive in any event. The limited investment in network infrastructure by OCPs suggests that caution is warranted when placing weight on the prospects for competition in market power determinations.

A9.123 Overall, we expect barriers to entry arising from the presence of sunk costs and asymmetries between BT and KCOM on the one hand and OCPs on the other hand, to remain significant. We do not expect any fundamental changes to technology or costs which would undermine these. In addition, BT will retain the only ubiquitous UK network capable of supplying leased lines (at the wholesale level) nationwide. We therefore consider that, in most of the UK, there is unlikely to be any material change in competitive conditions over the review period. Moreover, any prospects for greater competition (in the absence of regulation) are likely to be confined to those areas where conditions are already relatively favourable.

Comments in responses and our conclusions

A9.124 In its response, BT said that Ofcom had not taken sufficient account of the effect of its dark fibre remedy on the prospects for competition.

A9.125 As our proposals for dark fibre are a remedy for SMP in the CISBO market and our market analysis is conducted on a modified Greenfield basis, we do not take account of the effect of regulated provision of dark fibre in our SMP assessment. We take account of the effect of various combinations of passive and active remedies in our impact assessment which informs our decision about which remedies to impose.

A9.126 CityFibre and the IIG considered that we should put more weight on prospective competition. CityFibre expressed “deep concern” at what it considered was a lack of a forward-looking analysis in the May 2015 BCMR Consultation and noted that the word “prospective” only appears twice. This was related to its broader concern about the impact of our proposed dark fibre remedy on its own business case.

A9.127 We do adopt a prospective view of competition when assessing both market definition and market power, and consider the implications of CityFibre and Virgin's plans for both in detail in Section 4.

Annex 10

Data Analysis

Introduction

A10.1 As part of our market review process we have drawn on a wide range of evidence. This annex provides details of the data we have requested from network operators and how we have gone about processing and analysing that information.

A10.2 We have collected the following data:

- leased line data, including the locations of circuit end-points, bandwidth and interface and indicating whether the circuit is provided on- or off-net;
- data on CPs' networks' flexibility points;
- data on fibre-connected buildings; and
- data on network sites and network architecture.

A10.3 After cleaning and processing this information, we used it for:

- estimating service shares; and
- undertaking our network reach analysis.

A10.4 It is not a trivial exercise to gather relevant, accurate and consistent data for markets as complex as the ones reviewed in this statement. We have collected leased line data from 18 CPs, and the initial dataset contained around 850,000 observations. While we cannot guarantee that we have obtained completely error-free data, we are confident that we have received as accurate a picture of leased line services in the UK as we practically could, given the complexity of the task and the data gathering difficulties we faced.

A10.5 This Annex is structured as follows. First, we explain our evidence gathering process and data processing methodology, and present a set of summary statistics that illustrate the updates we have made since the May 2015 BCMR Consultation. When explaining our methodology we summarise any substantive consultation responses that we received as well as our comments on these responses.

A10.6 In the final section we present a series of sensitivity analyses that have been used in our assessment of market definition and SMP. The analyses show the effects of changes in the criteria we use to define geographic markets, including the CLA, and the implications of the most significant plans for OCP network expansion.

A10.7 In summary, we consider that:

- the data gathering, cleaning and processing methodologies described in this Annex result in sets of data which are sufficiently robust to support the analysis presented in this statement; and
- The results of the sensitivity analyses support our conclusion that the market definition and SMP findings set out in Section 4 are robust.

Evidence Gathering and 2014 Data Consultation

A10.8 The datasets we construct for the BCMR are unavoidably large and complex because we require detailed and granular information from a number of CPs. Stakeholders had divergent views on our approach to processing and analysing the data in the BCMR 2013, which required a significant investment of resource by both Ofcom and CPs.[303]

A10.9 Before starting this BCMR, we held a series of meetings with the CPs that had provided the majority of data[304] for the BCMR 2013 in order to discuss the type and quality of data we would require from them for conducting this BCMR. These meetings also allowed us to understand in more detail what data each CP holds and how such data are recorded.

A10.10 In spring 2014, we issued information requests to 17 fixed network operators, four local loop unbundler (LLU) operators and four mobile network operators (MNOs).[305] We discuss our choice of CPs later in this Annex.

A10.11 Differences in CPs' information systems meant that the data we received in response to our requests were not provided in a consistent format. We therefore needed to apply a large number of cleaning rules and some assumptions (particularly with regards to the circuit data) in order to allow us to use the data for economic analysis.

A10.12 In October 2014, we published a consultation on data analysis for the BCMR (October 2014 BCMR Consultation), which focused on our network reach analysis and service share analysis.[306] The network reach analysis assesses the extent to which BT's competitors have laid their own networks in different parts of the UK, whilst the service share analysis looks at the shares of different types of leased lines that BT and its competitors supply.

A10.13 We received several responses to the October 2014 BCMR Consultation as well as comments from some CPs on the clean data we provided to them.[307] Where necessary, we held further discussions with operators to discuss their data. Where appropriate, we have incorporated the feedback we received into our analysis[308]. For brevity, in this statement we do not reproduce the comments we received if they were addressed in Annex 15 of the May 2015 BCMR Consultation.

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[303] A detailed description of the data analysis was provided in Annex 5 of the March 2013 BCMR Statement, whilst the network reach and service share analyses are described in Sections 5 and 7 respectively.
[304] This included BT, Virgin, Vodafone (following the purchase of Cable & Wireless Worldwide), KCOM, Level 3, COLT and Verizon.
[305] These notices were requests for information made using our formal information gathering powers under section 135 of the Communications Act 2003.
[306] Ofcom, *Business Connectivity Market Review Consultation on Data Analysis*, 8 October 2014. http://stakeholders.ofcom.org.uk/consultations/bcmr-data-analysis/
[307] Non-confidential versions of the responses we received can be found on the Ofcom website. http://stakeholders.ofcom.org.uk/consultations/bcmr-data-analysis/?showResponses=true
[308] Detailed comments and our responses can be found in tables A15.12 and A15.13 in Annex 15 of the May 2015 BCMR Consultation.

A10.14 Following the October 2014 BCMR Consultation, we also commissioned an external auditor to review the network reach and service share models, as well as the calculations carried out for the market definition and SMP analysis, to ensure that our methodologies had been correctly implemented. We published the findings of the audit alongside the May 2015 BCMR Consultation.[309]

A10.15 The May 2015 BCMR Consultation gave stakeholders another opportunity to comment on our methodology and analysis. The comments we received and our responses are summarised in the relevant sections of this Annex below.

A10.16 In light of the work that has been undertaken since the last BCMR, we believe that we have sufficiently robust sets of data to support the analysis presented in this statement. Where certain assumptions or judgements are required and where there are limitations within the data, we take these into account when the data is interpreted for economic analysis and give appropriate weight to other sources of evidence.

Scope and Coverage of the Data

A10.17 As explained in the October 2014 BCMR Consultation, our information requests were informed by the scope and coverage of the data we used in the BCMR 2013. Specifically, we requested data on 'leased lines' as defined in the BCMR 2013 – i.e. a symmetric service of dedicated (uncontended) capacity between two fixed locations.[310] These are used for a variety of communications (including voice, video and data communications) and they are also used as building blocks for other connectivity services, such as virtual private networks (VPNs)[311] and IP transit.

A10.18 Although we allowed CPs to provide data on other types of connectivity (for example ADSL broadband, Next Generation Access (NGA) and ISDN), this was not a mandatory requirement and the majority of CPs did not provide us with data on other forms of business connectivity. As set out in Annex 6, we do not consider connectivity such as ADSL broadband or NGA to be part of the relevant market for leased lines. We have therefore not obtained additional information from CPs on these services.

A10.19 In terms of the data we have requested on leased lines, our information requests (and this Annex) often refer to three distinct parts of a telecommunications network: core, backhaul and access. These are illustrated in Figure A10.1 below. By 'core', (also referred to as 'trunk' or 'backbone') we are referring to connections between core network nodes. These are nodes where CPs provide switching or routing of traffic and where voice, data, internet and storage services are accessed.

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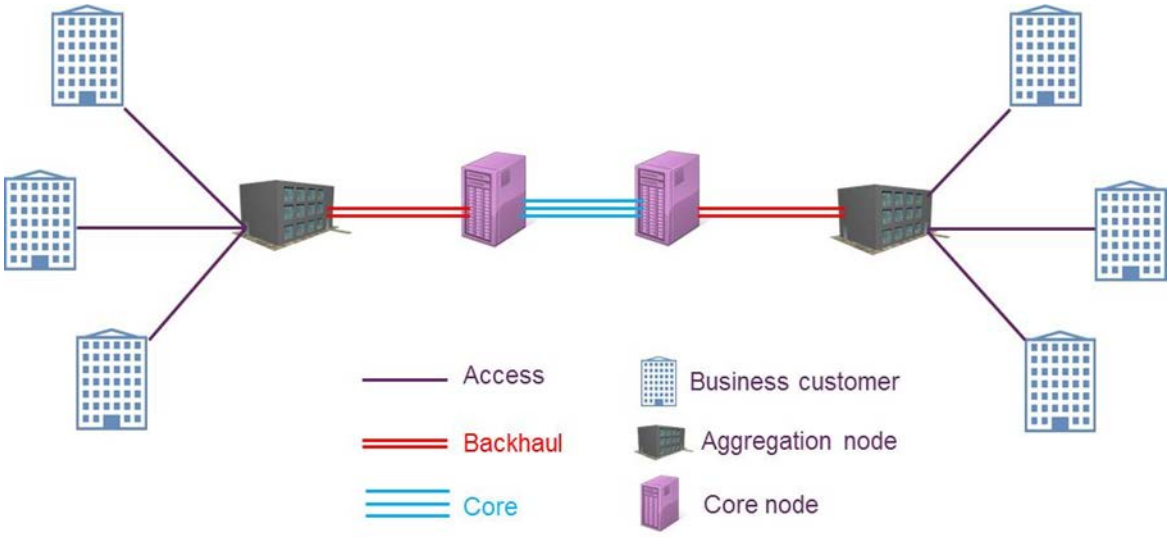
[309] Cartesian, 'Business Connectivity Market Review Model Audit' (April 2015)
[310] See also Section 4.2.2.3., 2nd paragraph, of the European Commission's (EC) draft Explanatory Note accompanying the EC's draft Recommendation on relevant product and service markets within the electronic communications sector susceptible to *ex ante* regulation in accordance with Directive 2002/21/EC of the European Parliament and of the Council on a common regulatory framework for electronic communications networks and services.
[311] A VPN allows users to connect multiple sites over a public telecommunications network that is software partitioned to emulate the service offered by a physically distinct private network.

A10.20 'Backhaul' connections are typically the 'intermediate' links on the network between local network nodes close to the customer and the core network or, in other cases, between local nodes. Backhaul connections typically aggregate together different traffic streams (e.g. residential broadband traffic from different customers) but economies of scale and scope in backhaul are typically less significant than in the core network.

A10.21 By 'access' we refer to connections between end-users, particularly business customers, and a local node where network equipment to backhaul traffic is located (such as a local exchange). In this market review our primary focus is on leased line 'terminating segments', which generally refer to leased lines in the access network (though they may also include leased lines in the backhaul part of the network).

A10.22 The figure below provides a stylised example of this network topology. Although each CP will construct its network in a specific manner, the majority can be broadly split into the three segments above.

Figure A10.1: Stylised network example[312]



A10.23 The task of obtaining relevant, accurate and consistent data for the BCMR is not a trivial one and we cannot guarantee that we have obtained data that is completely error-free. However, we spent considerable time working with CPs to ensure they understood what we required and we then spent further time checking submissions to our formal data request to ensure we had the data we expected. We are therefore confident that we have received as accurate a picture of leased line services in the UK as can be practically obtained, given the complexity of the task and the data gathering difficulties we face. Furthermore, as set out in Sections 4-6 of this statement, when analysing market definition and SMP we take into account a range of evidence, consistent with the relevant guidelines, and check the

[312] For simplicity, only two aggregation nodes are shown. In practice, more traffic is aggregated in the core links than shown here as a result of the connection of additional aggregation nodes.

robustness of our results using sensitivity analysis to ensure that any decisions we take are well-founded.

Data from fixed network operators

A10.24 We requested leased line and flexibility point data from all the network operators that own or lease access infrastructure and are large enough to have a material effect on our network reach and service share analysis. Ownership of access infrastructure is important because in the BCMR we are mainly concerned with wholesale leased line services that are provided 'on-net' by CPs in the access network.

A10.25 By 'on-net' we mean leased lines which the CP builds by connecting its electronic equipment to physical links that it either owns and operates or leases from another company (for example LLU and dark fibre). Owning or leasing access infrastructure is a prerequisite for providing wholesale leased lines because to do so requires a physical link between two or more premises (the physical link can be a copper wire, coaxial cable or optical fibre). We do not include information from leased line resellers in our wholesale assessment because this would constitute double counting.

A10.26 We have not sought to capture data from every operator in the UK, but only from those which we consider could have a material impact on our network reach and service share analyses. In the light of Ofcom's industry knowledge, our experience from the BCMR 2013 and following comments received in response to the October 2014 BCMR Consultation, we identified 18 operators[313] which own or lease fixed access infrastructure and which also supply leased lines (and/or infrastructure) in material quantities. We therefore requested data from these 18 fixed network operators as the main suppliers of on-net terminating segments of leased line services in the UK.[314] As an additional cross-check, we also issued four information requests to large CPs which we understood not to own or lease any access infrastructure.

A10.27 The following sub-sections set out the five broad requirements of the information requests which we sent to fixed operators.[315]

Sales and purchase of leased lines

A10.28 We requested inventories of live leased line sales and purchases.[316] For each leased line, we requested information on:

[313] Data requests were issued to 17 operators in March/April 2014. Following October 2014 BCMR Consultation, we requested data from one additional operator.
[314] In the 2013 BCMR, we researched over 100 small CPs that had code powers (and can therefore build fixed network infrastructure) to test whether our analysis could be affected by not requesting data from all UK CPs. We found that the CPs to whom we did not issue an s135 request did not supply a material number of leased line circuits and, as such, it would have been disproportionate to obtain detailed information in terms of the impact on our analysis. See March 2013 BCMR Statement, Section 7, paragraph 7.62 (footnote 742)
[315] In Annex 6 of the October 2014 BCMR Consultation we presented the s135 that was issued to fixed network operators.

- the interface used, or a product name which would allow us to infer the interface;
- whether the service uses WDM technology at the customer's premises;
- the bearer bandwidth;[317]
- the bandwidth sold to the customer;
- the location of each circuit-end (either postcode or Eastings and Northings);
- whether each end is on-net or off-net;
- the annual rental price;
- the connection price; and,
- the name of the wholesale supplier for leased line purchases.

A10.29 We also requested an inventory of sales and purchases of dark fibre and duct, with information on the location of each end and the supplier (for purchases).

A10.30 As discussed above, we also allowed CPs to provide data on other business connectivity services (for example broadband and ISDN) if it was easier for them to extract data for all services from their information systems rather than a subset, though we note that the majority did not do so.

Network flexibility points

A10.31 We asked CPs to provide the Easting and Northing location details of all their flexibility points.[318] These are points where existing physical links can be accessed to connect an end-user premise and from which CPs would consider extending their network in order 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. We also asked CPs to provide digital maps of their networks.

[316] By 'live' we mean circuits that were active and in use at the time of the data request, i.e. March-April 2014.
[317] The 'bearer' refers to a transmission link that carries one or more multiplexed smaller-capacity leased line services. For example, if a system using wave-division multiplex technology is used to carry several 1Gbit/s leased line services over a single fibre connection, we would consider the wave-division multiplex system as the bearer. Similarly, if, for example, a 155Mbit/s SDH transmission link is used to carry 60 2Mbit/s leased line services then we would consider the 155Mbit/s transmission link as the bearer.
[318] Eastings and Northings provide the coordinates of any given location in the UK in metres East and North of an origin just to the South West of the Isles of Scilly.

Fibre-connected buildings

A10.32 We asked CPs to provide a list of fibre-connected buildings (including both end-user/customer sites and network sites), with information on the full postal address of each building.

A10.33 Furthermore, for the buildings that were newly connected in the 2013 calendar year, we also asked CPs to provide the following information:

- the actual distance dug in order to connect the building (indicating whether this was the radial distance[319] or the route distance[320]);
- the distance between the connected building and the nearest flexibility point;
- the service the CP delivered to the newly connected building (where one was provided);
- the total cost of connecting to the building (including the cost of digging trenches, duct construction, cable installation and installing transmission equipment).

A10.34 Our analysis of dig distances and the costs of new connections is presented in Annex 13.

Network sites

A10.35 We requested from each CP a list of its network sites, which we defined as locations in the CP's network where it had installed transmission equipment that is used for leased lines and which is capable of serving more than one business customer. Network sites are distinct from flexibility points in that the latter are physical locations from which a CP can extend its copper, fibre or coax network. Network sites are buildings where a CP has telecom equipment that allows for the transmission, switching, routing and/or aggregation of traffic. Therefore, although a network site can serve as a flexibility point, the reverse is normally not true.

A10.36 For each network site, we requested address details, a description of the site and whether it is coincident with a customer site. We also asked CPs to provide details of their interconnect points with BT (in our s135 to BT we requested details of its interconnect points with other CPs).

Network architecture

A10.37 Lastly, we requested that each CP provide a description of the architecture of their network, the way in which it provides business connectivity services and whether it has plans for network expansion in the next 5 years.

[319] This is the straight line or 'as the crow flies' distance between two points.
[320] This is the actual length of the physical connection between two points.

Mobile network and LLU operators

A10.38 In addition to providing connectivity for business customers, we know that a significant proportion of demand for leased lines comes from MNOs and LLU operators buying access and backhaul circuits to connect radio cell sites (and BT exchanges for LLU operators) to their core networks. These are illustrated in the figures below. Figure A10.2 shows mobile cell sites connected to each other (sometimes via a microwave link) and/or a network or aggregation node. We refer to these access circuits as ‘mobile backhaul’ in this annex. Figure A10.3 shows a group of unbundled BT exchanges (in green) which are connected to an LLU operator’s network node. We refer to these circuits as ‘LLU backhaul’ in this Annex.

Figure A10.2: MNO network example

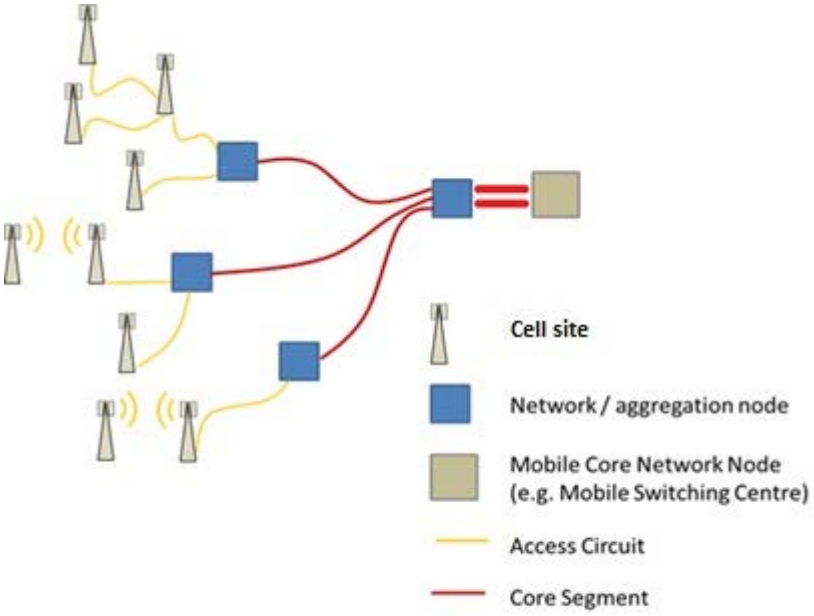
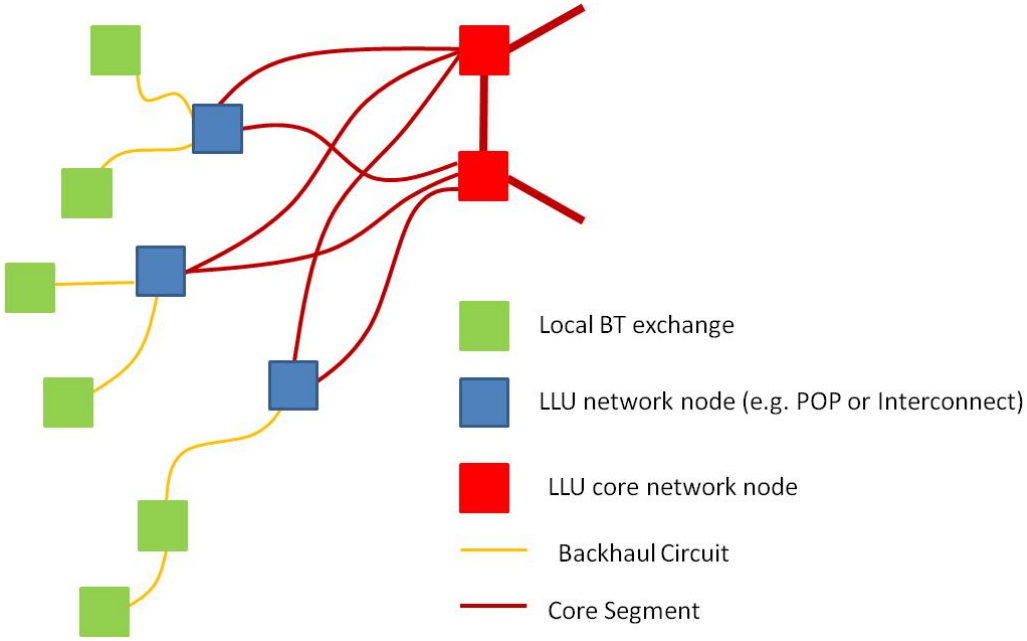


Figure A10.3: LLU network example



A10.39 Although the diagrams above are not representative of how all mobile and LLU operators construct their networks, they illustrate what we mean by mobile and LLU backhaul in the context of leased lines.

A10.40 In order to better understand how competitive conditions for mobile and LLU backhaul compare to those for other leased lines, we requested an inventory of

leased line self-supply and purchases from the largest MNOs and LLU operators in the UK. For each leased line, we requested information on:

- the transmission medium (i.e. copper, fibre or microwave) for MNOs;
- the interface used;
- whether the service uses WDM technology;
- the bearer bandwidth;
- the bandwidth that is used;
- the location of each circuit-end (either postcode or Eastings and Northings);
- the name of the supplier;
- the annual rental price; and,
- the connection price.

A10.41 We also requested an inventory of purchases of dark fibre and duct, with information on location of each end and the supplier.

A10.42 In the case of predominantly LLU operators (Updata, Zen, TalkTalk and Sky), we also requested an inventory of Ethernet First Mile (EFM) sales as EFM can be used to provide a leased line.[321] As with our request to fixed operators, we asked that for each EFM sale the CP provides the bandwidth, location of each circuit end and the annual rental and connection price.

Business locations and postcode data

A10.43 In order to carry out our network reach analysis, we require data on UK business locations and postcodes. For the March 2013 BCMR Statement we used Experian as our source of UK business information. From the full Experian business database of 2011 we extracted the locations of all offices for businesses which employed 250 or more employees. For this BCMR we reviewed business database suppliers and, based on the specific requirements of the BCMR, chose Market Location as our source of UK business information.

A10.44 For the March 2013 BCMR Statement, geographic market areas were built up by aggregating individual postcode sectors. In 2011 we used Dotted Eyes[322] for an up-to-date set of postcodes, postcode sectors and their associated polygons.[323] For this BCMR we evaluated a number of options for a postcode database and decided to use Dotted Eyes again.

[321] The other main providers of EFM that use LLU as a wholesale input were included in our list of fixed network operators (e.g. Vodafone and Virgin).
[322] Dotted Eyes is a company specialising in digital mapping and geographic information systems.
[323] For mapping purposes, the polygons for each postcode and postcode sector represent the geographic coverage of the postcode or postcode sector.

A10.45 The postcode database is also used to identify locations of businesses and network sites for our network reach analysis. Furthermore, we constructed a database of old postcodes from the Ordnance Survey so that, where CPs had provided an out-of-date postcode, we were able to identify the most up to date postcode.

A10.46 As discussed in the October 2014 BCMR Consultation, we checked whether our choice of Market Location rather than Experian as a source of data on UK business locations could materially affect the results of the network reach analysis by, for example, undermining our ability to compare results with those arrived at in the BCMR 2013. We did not find this to be the case.[324]

Physical network and flexibility point data

A10.47 Business customers require a physical network (most commonly using copper wire, optical fibre, radio or coaxial cable) to be able to receive connectivity services. For a business to be competitively served at the wholesale level it must have a choice from among a number of alternative networks.

A10.48 In order to determine how many networks are close enough to businesses to be able to supply them competitively, we need to know the location of businesses and the location of networks. We obtained the former from Market Location and gathered network location information from CPs who own or have access to physical network infrastructure (including dark fibre and LLU). From the business and network location information we were able to build a map showing where independent networks exist that can serve the needs of business consumers.

A10.49 For the 18 CPs we identified as owning fixed network access infrastructure we requested digital maps of their network, the locations of their flexibility points and network nodes.

A10.50 During our discussions with CPs about the BCMR data requirements (in advance of issuing the final s135 notices), two issues were raised about our definition of flexibility points. The first was that certain CPs stated that they are not constrained by flexibility points when looking to extend their network, i.e. they will consider extending from any point on their duct network. In order to take account of this, we requested digital maps of CPs' duct networks to extract a set of points representative of their infrastructure. In areas where concentrations of businesses are relatively high, flexibility points tend to be relatively close to each other and there is little difference between the results of the network reach analysis when based on flexibility points and when based on duct.

A10.51 The other issue some CPs noted is that not all manholes and footway boxes could be considered as flexibility points based on Ofcom's definition, as in some cases the CP would not consider extending its network from certain points (for example a manhole providing the CP with access to a long distance link). Furthermore, it may not be possible to extend the network from some flexibility points for other reasons, for example where there is no space in the duct.

[324] Ofcom, *Business Connectivity Market Review Consultation on Data Analysis*, 8 October 2014, paragraph 2.32. http://stakeholders.ofcom.org.uk/consultations/bcmr-data-analysis/

A10.52 On this point, we note that although access to a physical network can be constrained by lack of capacity, physical obstacles or specific planning rules, no CP was able to consistently identify flexibility points that were unavailable. In addition, capacity constraints and similar obstacles are often likely to be temporary. Given that all CPs may suffer from such limitations to their physical network access, we have treated all flexibility points as equally available.

Processing and cleaning

A10.53 In many cases flexibility point data was provided as Eastings and Northings. Where data was provided as Latitude and Longitude we used MapInfo to convert to Eastings and Northings. Where locations were provided as postcodes we used our postcode database to convert to Eastings and Northings. We have also performed a number of checks of the data to ensure its consistency and reliability.

A10.54 It is important to understand the accuracy of the location data we gathered and the physical nature of business sites. In particular:

- The accuracy of CP-supplied flexibility point data varies, with some data given in 1 metre Eastings and Northings and other data in 10 metre Eastings and Northings.

- The accuracy of postcode-derived locations (which are relevant to our data on UK businesses) depends on the size of the area covered by the postcode. In using the postcode of a business to identify its location, we assume that the business is positioned at the centroid of the postcode (this is the mean grid reference of all addresses in that postcode). The maximum number of delivery points covered by one postcode is 100 and the average is 15.[325] Typically, the area covered by a postcode is small in densely populated and business regions and large in rural regions. In Table A10.1 below we present the cumulative distribution of postcode radii (assuming postcodes are perfect circles[326]) in different areas of the UK.

- Business sites cover an appreciable area and a single point location cannot describe it completely. For example, if we were able to identify the precise Easting and Northing of a business it may be located in the centre of the building, whereas the fibre-entry point may be towards the front of the building. This could be tens of metres away.

Table A10.1 Distribution of postcode radii

Radius (m)	CLA	LP	CBDs	All UK
<=10	62%	12%	8%	8%
<=50	98%	75%	66%	46%

[325] http://data.ordnancesurvey.co.uk/ontology/postcode/PostcodeUnit
[326] This assumption is inevitably a simplification but it is made to provide an illustration of the differences in postcode sizes.

<=100	100%	97%	96%	78%
<=150	100%	98%	98%	82%
<=200	100%	99%	99%	85%

Source: Ofcom's analysis of postcode areas based on Dotted Eyes dataset

A10.55 Therefore, any interpretations of our network reach analysis should take into account the degree of accuracy we are able to achieve in locating flexibility points and businesses.

Leased line data

A10.56 In this sub-section, we explain our method for cleaning the leased line (or circuit) data. In order to understand the data that we have obtained on leased lines, it is important to understand the context in which leased lines are sold and purchased in the UK.

A10.57 Leased lines provide dedicated transmission capacity between fixed locations. They are part of a complex value chain and both CPs and end-user organisations use them in a variety of ways, for example to access the internet or private voice and data networks, backup and disaster recovery, remote monitoring and telemetry applications. Furthermore, many end-user organisations do not purchase leased lines as distinct services but instead do so as part of a bundle also including other services (for example a business with multiple offices may purchase an ICT package from a systems integrator, which uses leased lines to connect the offices together).[327]

A10.58 In the BCMR, there are two broad categories of leased line use for which we require data:

i) The most straightforward way in which leased lines are used is to provide point-to-point connectivity between two sites. So in Figure A10.1 above a business customer might purchase a leased line to connect two of its sites.

ii) In more complicated scenarios leased lines are used as inputs into another connectivity service, for example a virtual private network (VPN), or form part of a wider suite of ICT services (which might include, for example, managed IT services, cloud storage or application hosting). In this case, neither the CP nor the customer may refer explicitly to the leased line in their commercial agreement as it is simply one of many inputs into the service being purchased.

A10.59 This has important implications for the collection of data on leased lines because CPs generally have better information on the first category. In the case of the second category, some CPs cannot directly source leased line data from sales databases because these will only record the service provided (for example an IPVPN) with no information on the underlying technical inputs.

[327] See Section 3 of this statement.

A10.60 As a result, our request for leased line data often requires CPs to draw on a number of internal databases and information systems. For example, some might source data from a customer billing database as well as a network inventory or engineering database. A further complication is that circuit data on sales and purchases are often recorded on separate systems and may not always match. For example, if a CP purchased an EAD circuit from BT Openreach and this was used to provide a VPN, this could be identified as a leased line purchase in the CP's billing records but it may not appear as a leased line sale in a sales database if the latter only records the VPN.

A10.61 Another issue affecting the provision of leased line data is that some CPs that have merged with other operators in recent years have not yet finished amalgamating records from different sources, meaning that data has to be gathered from different IT systems. These may not always be consistent.

A10.62 The main consequence of these issues is that the majority of CPs are unable to provide all the information we seek for each circuit. In particular, there is often insufficient information to determine the geographic location and bandwidth of a circuit. As discussed below, we deal with this by using uplift allocations.

Processing and cleaning

A10.63 Following the March 2013 BCMR Statement, we decided that all data cleaning and processing should be done by Ofcom rather than by CPs to ensure consistency. We therefore asked CPs to provide unprocessed data from their own databases, where possible, so that we could apply a set of cleaning rules in a consistent manner (rather than sending a template that requires CPs to carry out their own processing). Therefore, the first step in the data cleaning process was to compile a list of leased line circuits (both sales and purchases) into one large dataset with raw data.

A10.64 We did this by creating several fields to manage the data. These are listed in Table A10.2 below. We then mapped the data submitted to us by CPs to the relevant data fields.[328]

Table A10.2: Raw data fields

Field	Description
ID	A unique Ofcom generated ID for each circuit
File	Name of the file containing source data (in order to check against raw data provided by CPs)
Worksheet	Worksheet that the source data is contained in

[328] For example, two CPs may provide information on interface but in the original files they provided one will use a field called 'Interface' and another will use a field called 'Technology'. Then we will map data from the 'Interface' column into the 'CircuitType' column in our dataset. For the second CP, we would map data from the 'Technology' column into the 'CircuitType' column.

CP	Name of CP providing the data
Category	'W' to indicate a sale and 'P' to indicate a purchase
CircuitID	Any circuit ID information provided by the CP
CircuitType	Information provided by the CP on technology or interface or method of delivery
CircuitType_2	An additional field for CPs that provide further information on technology/interface/delivery
Product	Product name used by CP
Product_2	An additional field for CPs that provide further product information
Bandwidth	Bandwidth that is being sold (or purchased)
Bandwidth_bearer	Information on bearer bandwidth where provided
Customer	Information on customer where provided
Supplier	Information on circuit supplier where provided
A_address	There are three fields for the A-end address (for example some CPs have one column for street address, another for city and another for country)
A_postcode	The postcode of the A-end of the circuit
A_easting	The easting of the A-end where provided
A_northing	The northing of the A-end where provided
B_address	There are three fields for the B-end address (for example some CPs have one column for street address, another for city and another for country)
B_postcode	The postcode of the B-end of the circuit
B_easting	The easting of the B-end where provided
B_northing	The northing of the B-end where provided
WDM	Information on whether the circuit uses WDM equipment at the customer's premise (where provided)
OnnetA	Information on whether the A-end is on-net or off-net
OnnetB	Information on whether the B-end is on-net or off-net
Price_period	The time period for which the rental price is given (monthly, quarterly or annually)
Rental_price	The rental price of the circuit (where provided). Usually given on an annual basis but sometimes it is given by month.
Connection_price	The connection price of the circuit (where provided)

Currency	Currency of the price information (e.g. pounds sterling, euros etc)
Status	Status of the circuit (e.g. live, cancelled)

A10.65 Having finished this part of the process, we then used the compiled raw dataset to start the data cleaning. At this point, we had information on 888,948 circuits (though not all of these are leased lines as some CPs provided information on other types of connectivity and services).[329]

A10.66 In order to make the data useful for economic analysis, we need to produce a set of circuit records which has the following information recorded in a consistent manner:

i) interface;

ii) bandwidth;

iii) postcode for each end;

iv) whether each end is a network site or a customer site; and

v) whether each end is on-net or off-net.

A10.67 We explain how we identify these categories below.

Identify interface

A10.68 A CP that supplies an electronic communications service needs to provide an interface to the customer that complies with a technical standard which the customer requires, for example Ethernet, SDH or PDH.

A10.69 For the purposes of our analysis of circuits by interface type, we classify circuits into the following four categories:

- services that directly fall inside the scope of relevant BCMR markets and which operators often refer to in their responses (for example analogue, EFM, Ethernet, Fibre Channel, FICON, SDH and PDH);
- services that are outside of the scope of the market (for example ADSL, NGA, CCTV and Broadcast Access);
- delivery mechanisms that are relevant to the market review (for example radio/microwave and WDM); and,
- circuits that can be grouped into broader categories (for example ATM, Frame Relay and X.25 can all be considered as services likely to be delivered over TDM-based technologies).

[329] This is less than the 918,730 circuits reported in the October 2014 BCMR Consultation due to the removal of duplicate and inactive circuits.

A10.70 Although not all of our categorisations would be considered as 'interfaces' from a technical or networking perspective, we use the term 'interface' to describe how we categorise the circuit, based on the considerations listed above.

A10.71 In order to identify the interface of each circuit in our database, we follow a sequential approach. First, we use information in the two 'CircuitType' and two 'Product' fields by creating a set of translation tables that identify the interface of each circuit type and/or product.[330] Where it is possible to infer two or more different interfaces from these fields, we have sought to clarify with CPs the correct interface.[331]

A10.72 Table A10.3 below lists the relevant interfaces in our clean dataset, which are based on our analysis of the different circuit type and product combinations. From this list we can remove circuits that do not fit our definition of leased lines.

Table A10.3: List of circuit interfaces used in cleaning process

ADSL
Analogue
ATM
Broadcast Access
CCTV
Dark fibre
EFM
Ethernet
Fibre Channel
FICON
Frame Relay
NGA
PSTN/ISDN
Radio/Microwave
SDH and PDH

[330] For example, we would create a rule whereby BT Openreach EAD products would be classified as Ethernet and KCOM's Kiloline products would be classified as PDH/SDH.
[331] For example if the circuit type is given as SDH but the product name contains the word 'Ethernet'.

SDSL
WDM (bearer)
WDM (wavelength)
xDSL
X25
Other (not leased line)
Unknown

A10.73 On this basis, we have been able to classify 93% of circuits in the dataset. For the remaining circuits, there was either no information on circuit type or product or the information was not sufficient to infer an interface (for example “Internet Access”). Where direct information on the interface was missing, our next step was to determine the interface indirectly, using information on the bandwidth of the circuit, as certain bandwidths are typically associated with specific interfaces (for example 155Mbit/s is associated with an STM-1 carrier, which is delivered using SDH). In doing so, we made the assumptions shown in Table A10.4 below. This step allowed us to classify the interface of an additional 6% of the circuits in the dataset, or more than 99% overall (just less than 7,000 circuits could not be classified, only around 3,000 of which were entries related to sales of leased lines and not purchases).

Table A10.4: Bandwidth and circuit category assumptions

Bandwidth	Circuit Category Assumption
Up to 9Mbit/s	SDH/PDH
34, 45, 144, 155 and 622 Mbit/s	SDH/PDH
Multiples of 10Mbit/s or 100Mbit/s (up to and including 1Gbit/s)	Ethernet
Above 1Gbit/s	WDM
Different download and upload speeds	ADSL (up to 30Mbit/s download) / NGA (above 30Mbit/s download)

A10.74 During the October 2014 BCMR Consultation, we sent each operator a cleaned version of the data it had provided as well as the relevant parts of our interface translation tables. The majority of operators said that our classifications were correct and that no changes were required. Where operators did identify a mistake, we have amended our cleaning rules in order to correctly classify these circuits.

A10.75 After this step we have information on 605,969 leased line entries (on-net, off-net, and with an unknown on/off-net status).[332] The other circuits are either purchases or not leased lines. We have also excluded around 3,000 circuits where we do not have any information from which to infer an interface, and for which the operators have been unable to provide further information.

Identify bandwidth

A10.76 We requested information on both the circuit bearer bandwidth and on the bandwidth sold. The reason for doing so is that mixing the two can lead to inconsistent and biased analysis when the data are aggregated. For example, suppose two CPs each provide five 100Mbit/s services in a particular postcode using a 1Gbit/s bearer. One CP could report five sales whereas the other may just report the bearer. In this case, both CPs are providing the same services in the same quantity but the data would suggest that the first CP is selling more connections.

A10.77 We would ideally classify bandwidths using one option (bearer or service sold) but the data we have received consists of a mix of the two (with some CPs only able to provide one type of bandwidth). We have received significantly more information on the bandwidth that is sold (or purchased), and we therefore use this measure in the clean bandwidth data.[333] This is also our preferred metric because it reflects the services that customers are receiving and paying for.

A10.78 Our processing of bandwidth information was carried out in two steps. The first step was to consider circuits where the only bandwidth information we had was a single number. The measurement unit was mostly consistent within each CP's dataset but not always. We therefore applied the following cleaning rules[334]:

- if the bandwidth number was less than or equal to 10,000 we kept the number on the basis that it was given in Mbit/s; and,
- if the number was greater than 64,000 we divided it by one million on the basis that it was given in bits.

A10.79 In cases where we had some non-numeric information on bandwidth (for example where a unit was given, such as '100M' or when the bandwidth could be inferred from a certain standard, such as STM-1), we used a process similar to the one used for cleaning interfaces. We created translation tables for different combinations of bandwidth, circuit type and product fields (as bandwidth information is sometimes contained in the circuit type or product fields) and identified the appropriate bandwidth for each combination. This allows us to convert bandwidths into a

[332] The actual number of leased lines is slightly higher (just over 607,000) because some operators have reported multiple circuits in one entry.
[333] Though in many cases, the bandwidth that is sold is the total circuit capacity, especially for Ethernet services.
[334] After the publication of the May 2015 BCMR Consultation we have identified several cases when application of this rule led to errors, for example when numerical entries 64, 128, 192, 256, 512, 1024 and 2048 were assumed to be in Mbit/s but were more likely to be in kbit/s. This concerned a very low number of circuits (less than 0.1%), and has been corrected in preparation for this statement.

consistent unit (Mbit/s). Where the entry was not a leased line (for example ADSL, co-location services etc.) the bandwidth field was given as null.

A10.80 We also have an additional step where we identify the bandwidth based on other information that has been provided by CPs. For example, where the bandwidth is missing and the interface is EFM, the bandwidth is likely to be less than 30Mbit/s - 40Mbit/s and so we identify it as such. Furthermore, if operators tell us that circuits with missing bandwidth information are likely to be in a particular range (for example below 100Mbit/s, above 1Gbit/s etc.) then we can incorporate that information here, before the uplift process.

A10.81 Following the October 2014 BCMR Consultation, operators either told us that we had correctly identified the bandwidth of most of their circuits (where it was given) or raised no objections. The main exception was that our clean data did not include the bandwidth of Ethernet circuits greater than 1Gbit/s. This has now been corrected.[335]

A10.82 Having cleaned the data using the methodology described above, 93% of leased line circuit-end sales in our dataset have an identifiable bandwidth. Where we do not have bandwidth information, we use the uplift process described below.

Identify postcodes

A10.83 In order to carry out a geographic analysis of leased line circuits, we need to establish the postcode of each circuit end. Using the postcode information that operators provided, we validated each one against a database of old and new postcodes[336]. This allows us to filter out erroneous postcodes and update postcodes that are no longer in use.

A10.84 During its external review of service share and network reach models, the external auditor noted that our postcode database contained a number of postcodes with multiple locations (i.e. the same postcode would appear more than once with a different Easting and Northing). This is driven by the Ordnance Survey data and is partly due to the fact that postcode boundaries shift over time. In our model, we use the most recent location of a postcode when identifying a circuit's location (this is the same approach used in the BCMR 2013), as we do not know when each circuit was recorded in a CP's database. Given that our analysis ultimately aggregates circuits at a postcode sector level (and our geographic markets are further aggregated to broad areas) we do not believe that this issue has a material impact on our analysis. In its review, Cartesian also came to this conclusion.[337] However, it does highlight a difficulty that would arise if we carried out our analysis at the more granular level of full postcodes.

[335] A further issue related to this was that Ethernet circuits with bandwidths greater than 1Gbit/s were erroneously excluded from our 2014 service share estimates for the MISBO markets in Table 8 of the October 2014 BCMR Consultation. This was due to an error in the identification of relevant markets in the service share model and it has now been corrected.
[336] The old postcodes are sourced from the Ordnance survey and the 2014 postcodes are sourced from Dotted Eyes.
[337] Cartesian, 'Business Connectivity Market Review Model Audit' (April 2015)

A10.85 In addition, when reviewing the Ordnance Survey data we found that it included a large number of Post Office (PO) Boxes, which usually have their own postcode. A circuit end that is reported to terminate in a PO Box is unlikely to be an accurate indicator of the circuit location (e.g. it is more likely to represent a billing address). We found that less than 0.5% of circuit-ends were reported with a PO Box postcode. Given the relatively small proportion, we do not believe this will have a material impact on our analysis. For the purposes of our model, we have removed these PO boxes from our postcode list and so these circuits are allocated as part of our uplift process.

A10.86 Once this geographic cleaning has been carried out, we have 'clean' postcode data for 81% of circuit-ends. A significant proportion of the missing postcodes for leased line sales (around 55%) are relevant to the data provided by two CPs about their B-ends. Both stated that most of their B-ends are network sites. Where the B-end for these CPs is a customer site, the information is given in a separate field and a postcode is provided. We sought further information from these CPs where postcodes were not provided for the B-end and obtained some additional postcode data following the October 2014 BCMR Consultation.[338] The additional postcodes we received appeared in the list of network sites provided by the operators, providing us with assurance that the B-ends with missing postcode information for these CPs are network ends. Given that we are primarily interested in customer sites (as discussed below), the fact that our data about these B-ends are missing postcodes should not present a material issue for our service share analysis of terminating segments. The table below shows the distribution of postcode information for leased line circuit-ends.

Table A10.5: Postcode and circuit-end information

Category	Proportion of circuit-ends
Postcode is known	81.3%
End is not in the UK	0.4%
Classify end based on product information (e.g. EFM and SDSL)	1.7%
Classify end as 'network' based on CP information	10.3%
End is assumed to be a customer (no other information)	6.3%

[338] The issue was described in paragraph A7.32 of the October 2014 Consultation

A10.87 Where we do not have postcode information for non-network sites, any aggregated analysis of the data will need the application of uplifts, which are discussed below.

Identify on-net and off-net circuits

A10.88 In the BCMR 2013, we noted that CPs do not generally explicitly record whether their sales of leased lines use infrastructure that they own or lease or instead use a wholesale leased line service that they have purchased from another CP.[339] We therefore requested leased line data from CPs split into three categories:

- retail sales (i.e. to end users other than CPs);
- wholesale sales (i.e. sales to other CPs); and
- wholesale purchases (i.e. purchasers from other CPs).

A10.89 Given that retail sales include instances where a CP resells a leased line that it has purchased from another operator, we calculated wholesale service shares by inferring wholesale supply using the following calculation;

$$(1)\ Wholesale\ Supply = \begin{pmatrix} Wholesale\ circuit\ ends\ sold \\ + \\ Retail\ circuit\ ends\ sold \end{pmatrix} - \begin{pmatrix} Wholesale\ circuit \\ ends\ bought \end{pmatrix}$$

A10.90 We could potentially use this formula if we could obtain consistent data for each of its components. For example, if a CP uses only circuits purchased from another CP to reach customer sites in a certain postcode, its supply volume will net off to zero once we have subtracted its wholesale purchases.

A10.91 In practice, however, there were two main reasons why this approach did not always give an accurate estimate of wholesale supply. The first is that, based on our discussions with CPs following the end of the BCMR 2013, we found that a number of CPs had difficulty distinguishing between what Ofcom defined as 'wholesale' and 'retail' sales of leased lines. This distinction is not generally made by CPs, especially when they source data from engineering databases, and so asking CPs to extract it can lead to errors.[340]

A10.92 The second issue is that, as discussed above, CPs often use different databases to record sales and purchases. These are not always consistent and the sales databases are often missing more address/postcode information than the purchase databases. One consequence of this for the BCMR 2013 was that there were instances where the above equation resulted in negative wholesale supply for some

[339] Paragraph A5.11 in Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/annexes1-7.pdf.

[340] Although such errors should not affect the overall estimate of wholesale supply using the above formula, they could lead to errors in estimating the size of the merchant market (i.e. sales between OCPs).

CPs in certain postcode sectors (i.e. they recorded greater (net) wholesale purchases than their overall retail sales implied they would need).[341]

A10.93 Having discussed this issue with CPs after the BCMR 2013, we found that the majority were able to identify leased line sales that used infrastructure that they own and/or lease. Such sales are generally referred to as 'on-net'. A leased line that is provided using a third-party purchase is referred to as 'off-net'. The benefit of having on-net and off-net information is that it allows us to estimate wholesale supply of leased lines directly (by only counting on-net sales) rather than inferring it from the equation (1) above. It also avoids relying on CP data that might be sourced from two or more inconsistent databases (e.g. sales and billing).

A10.94 In terms of processing the on/off net information, for each circuit sale, operators indicated whether each circuit end was on-net, off-net or unknown (or left blank).

A10.95 If the on/off net status of a circuit was unknown, we identified it using additional information. For example, if operators tell us that circuits of a certain interface are generally on- or off-net then we identify those here. Having carried out this processing, the majority of respondents were able to provide information for most of their leased line circuit sales (around 90 per cent in total).[342]

A10.96 For operators where we were missing on-net information for a significant proportion of their circuit sales (we set a threshold of more than 10%), we use the information they provided on postcodes and mapped this against the operator's nearest flexibility point. If the circuit-end is within 200 metres of the flexibility point, we have classified the circuit as on-net, otherwise it is off-net (if the postcode is not known then we leave the on-net classification as unknown).[343] For the remaining ends where we do not have on-net or postcode information, which account for less than 2% of leased line ends in our database, we have applied a set of uplift allocations (discussed below).

A10.97 In order to ensure that the above methodology is sensible, we have compared the number of off-net sales for the relevant CPs (after we have used postcode information to fill any on-net information gaps) with the number of purchases they report and have not found them to be significantly different.[344]

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[341] Paragraphs A5.132 and A5.141-A5.145 in Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/annexes1-7.pdf.

[342] The on-net/off-net distinction is not relevant to leased line purchases as these are by definition all off-net.

[343] We note that this assumption is used to classify circuit-ends *which we know the CP supplies* and is therefore distinct from the buffer assumptions that are used in our geographic market analysis (where we are assessing the area within which we think a CP is likely to be an active competitor across the CISBO market, but where the CP may not *actually* have customers).

[344] We would not expect the figures to reconcile completely due to the data inconsistencies mentioned above. For comparison of the two approaches, see Table A15.10 in the May 2015 BCMR Consultation, which shows that our service share results in high volume segments are not significantly different depending on whether we use the 'on-net' approach or the 'sales minus purchases' approach.

Identify circuit-end types

A10.98 In our service share analysis we need to determine whether leased lines terminate at a customer site (by "customer" we mean an end-user that is not a fixed-network operator[345]) or at a network site. As discussed above, some CPs have sourced their data from sales or billing databases, where circuits are more likely to be recorded on an 'end-to-end' basis (i.e. the two ends will represent customer locations). In cases where CPs have sourced data from network or engineering databases, the circuits are more likely to be recorded from a network perspective, meaning that one end is often a network end. Therefore, any analysis that aggregates the circuits assuming that each entry is a complete 'end-to-end' circuit is likely to result in errors because the units are not consistent. To illustrate this point, consider the following generic example of a circuit between two points, A and B. These could be the location of two business sites (e.g. different branches of a bank).

Figure A10.4: Generic circuit diagram

A10.99 In this diagram, the leased line passes through two network sites at locations N^1 and N^2. Where a CP has recorded sales on an end-to-end basis, it would record one entry for this sale, with the A and B ends represented accordingly. However, if the data are sourced from a network inventory, the CP would record three entries, one for the A end (which it would show as connected to N^1), one for the B end (which it would show as connected to N^2) and one for the link between N^1 and N^2. If we were not to distinguish between customer and network sites, we would assume that the first CP sold one circuit and the second sold three, even though they are providing the same service.

A10.100 We did not ask CPs to classify whether circuit ends were network or customer sites in their s135 responses because our experience from the BCMR 2013 was that CPs do not usually know when a circuit terminates at another CP's network site (i.e. they only know the locations of their own network buildings).[346] Requesting this information again would therefore have been inappropriate as we would not have considered it reliable.

A10.101 Therefore, in order to identify network ends, we have built a list of postcodes of network sites that is drawn from CPs' responses on their network site locations.

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[345] We include mobile network operators in our definition of end-users as MNOs purchase leased lines for backhaul.

[346] Paragraph A5.57 in Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/annexes1-7.pdf.

Based on this data, we have a list of around 9,000 unique postcodes where there is at least one network site located (including BT exchanges). We then carry out a matching exercise of these postcodes against the postcodes for each circuit-end in our database. If a match is found, we categorise that circuit end as a network site and if no match is found, we assume it is a customer site. Where there is no postcode, we do one of the following, as applicable:

- check whether the circuit end is located outside of the UK using the address information that CPs have provided – if this is the case then we define the end as 'Non-UK' and it is not included in our service share calculations (Non-UK ends account for approximately 0.5% of leased line circuit ends);

- categorise it using information given to us by CPs (for example, as discussed above, in some CP datasets the B-end is generally a network site), which allows us to classify 10% of leased line ends;

- for certain products (specifically EFM and xDSL), one end is always a network site (usually a BT exchange) and so if there is missing postcode information for one end and the other end is a customer site, we assume the former is a network site (this allows us to classify around 2% of leased line ends); or

- we otherwise assume it is a customer site.

A10.102 The last assumption affects 6% of leased line circuit-ends. We have run our service share model assuming that unknown ends are network ends and the service shares in each market by operator do not significantly change so this assumption does not impact our interpretation of the results.

A10.103 We had adopted the same approach in the BCMR 2013.[347] The benefit of the approach we have taken is that all CPs are treated alike and so any errors in the circuit allocations will be unbiased across CPs. There are, however, two important caveats to bear in mind with our approach. The first is that postcodes cover a number of buildings and so a circuit which terminates at a customer building in close proximity to a network site could be mistakenly classified as a network end in our methodology. In some cases, a customer site may even be in the same building as a network node and so the same mistake would be made. As discussed below, we have mitigated this by obtaining data from CPs on whether any of their network nodes are coincident with a customer's premises (this includes some data centres). This allows us to exclude these postcodes when identifying network sites.

A10.104 Customer sites that are close to (but not coincident with) network sites would be excluded from our analysis by the above approach, but we expect that such omissions are unlikely to have material effect. This is because we assess service shares at the postcode sector level and, on average, there are 160 postcodes per postcode sector, meaning that customer sites and network sites will in most cases have different postcodes and so are unlikely to be confused. The main exception to this could be data centres, many of which are likely to host a significant number of

[347] Paragraphs A5.57-A5.66 in Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/annexes1-7.pdf.

customer connections and network nodes. However, as discussed in Annex 15 we have defined the largest data centres as core nodes within the CISBO market and therefore links between these are considered competitive. We do not therefore need to include customer ends at these data centre sites in our analysis of service shares for terminating segments.

A10.105 Our service share analysis is based on customer ends only and excludes leased line sales to the fixed-network operators from which we have requested data. So, for example, if Vodafone purchased a leased line from Virgin to connect two of its network sites, we would not count this in the service share analysis because in this case, Vodafone is the end-customer. As discussed above, the focus of our analysis is on the access network, although we have also calculated shares for MNO and LLU backhaul.

Joint customer-network sites

A10.106 Following our discussions with CPs after the BCMR 2013, we requested additional information as to whether each CP network site was coincident with a customer site (we refer to these hereafter as joint 'customer-network sites'). This was primarily for two reasons:

i) some CPs locate network sites at their customers' premises; and

ii) many customers require connections to data centres, which serve as network sites for a number of CPs.

A10.107 In the October 2014 BCMR Consultation, we presented indicative service share estimates based on two scenarios: one where we treated all customer-network sites as network sites and another where we treated them as customer sites. This approach led to some significant variations in service share estimates, notably for AISBO in the WECLA but also for MISBO.[348] We noted that actual service shares would likely fall within the range we presented because in one scenario we are likely to include some circuit ends that do not terminate at a location requested by a customer (and so are network ends) whilst in the other scenario, we would likely exclude some customer ends from our analysis.

A10.108 Following further analysis carried out after the consultation, we found that one of the main reasons why service shares varied depending on the inclusion or exclusion of customer-network sites was that they included a number of data centres. Some of these, particularly large data centres such as Telehouse, have several thousand connections. As discussed in Annex 15, we consider it appropriate to treat certain data centres as core nodes and we are deregulating connections between them. We have therefore treated these as unambiguous network sites for our service share analysis.

A10.109 After this step, as shown in Table A15.10 in the May 2015 BCMR Consultation, the inclusion or exclusion of customer-network sites in our analysis no longer has a

[348] See Table 8 of the October 2014 BCMR Consultation. The consultation presented service share analysis based on the market definitions used in the 2013 BCMR and so we refer to those definitions here.

significant impact on our results, once data centres are excluded. In this statement we only use our base case approach described below, as we have satisfied ourselves that the results are not highly sensitive to the choice of a particular scenario.

A10.110 In terms of forming our best estimate of service shares (or 'base case'), having removed data centre connections, we have adjusted our estimates such that if an operator has identified a postcode as a joint customer-network site, we only count circuit-ends in that postcode as customer ends for that specific operator. The following example illustrates this:

- Suppose we have a list of three network sites (or network postcodes) – A, B and C
- CP1 identifies A as a joint customer-network site
- CP2 identifies B as a joint customer-network site
- CP3 identifies no customer-network sites
- All of CP1's circuit-ends in postcode A are counted as customer-ends and all those in postcodes B and C are counted as network ends.
- All of CP2's circuit-ends in postcode B are counted as customer-ends and all those in postcodes A and C are counted as network ends.
- All of CP3's circuit ends in postcodes A, B and C are counted as network ends.

A10.111 This method ensures that we do not understate the competitive position of operators that build networks in a way that combines network nodes with customer sites and it also ensures that we do not overstate the position of operators that do not utilise customer sites as network nodes.

Uplift process

A10.112 As discussed above, a number of CPs have supplied incomplete data for some of their circuits. For example, in some cases the bandwidth is unknown or no valid postcode has been supplied. However, we want to include these circuits in our service share calculation and this means that we need to make an appropriate assumption to complete the dataset for each such circuit. We therefore allocate a bandwidth or postcode sector to each of the circuits with missing data in the same proportions as the various bandwidths and postcode sectors that are found in the circuits for which we have complete data for a given CP. We then apply appropriate pro rata uplifts to the number of circuits for which we have data.

A10.113 As discussed in the October 2014 BCMR Consultation, this method works well when the number of unknown variables is small, but becomes increasingly complex as the number increases. In general, with x variables unknown, we would have to consider 2^x scenarios and implement 2^x -1 separate uplifts. In the service share calculations, we are interested in five variables: interface; bandwidth; postcode sector; whether each end is a customer or network end; and whether each end is on-net or off-net. However, we have not been able to obtain complete information. Indeed, for all five of the variables of interest, there is at least one circuit for which we do not know the value of that variable. In other words, we do not know the interface of every circuit: nor do we know the bandwidth of every circuit, nor the

postcode sector and in some cases we do not know whether a circuit end is a customer or network end or whether it is on- or off-net. Therefore, in principle we would have to calculate 2^5-1 = 31 separate uplifts to complete our dataset.

A10.114 We consider that calculating and applying 31 separate uplifts would be overly complex. In addition, the proportion of circuits with an unknown interface and end-type is relatively small, at less than 1% and 6% respectively (and we have established that our share estimates do not materially change if we treat unidentifiable circuit-ends as network ends). Therefore, we have estimated allocations for 3 unknown variables: bandwidth; postcode sector; and whether the circuit is on-net or off-net. This is a change to our methodology from the October 2014 BCMR Consultation, in which our model was only designed to uplift two unknown variables (bandwidth and postcode sector) which meant that we had to assume that if the majority (i.e. more than 50%) of a CP's sales are on-net (off-net) then we assumed that circuits with missing information are also on-net (off-net). We made this simplifying assumption because we had not developed a three-variable uplift process at the time of the consultation.

A10.115 In order to illustrate how the three-variable uplift process works, a numerical (and hypothetical) example of a CP's data is provided in Table A10.6.

Table A10.6: Hypothetical three-variable uplift example

Column/row		*a*	*b*	*c*	*d*	*e*	*f*	*g*	*h*	*i*
		<=1G			**>1G**			**Unknown bandwidth**		
		On	**Off**	**Unk**	**On**	**Off**	**Unk**	**On**	**Off**	**Unk**
j	**Postcode Sector 1**	2	4	2	1	3	1	2	1	1
k	**Postcode Sector 2**	3	2	2	4	2	1	2	3	1
l	**Unknown Postcode**	2	1	1	1	2	1	1	1	2

Note: 'On' refers to on-net. 'Off' refers to off-net. 'Unk' refers to unknown.

A10.116 In this example, the CP has 49 circuit-ends in the market and we have complete information on 21 of them (identified in cells [a,j], [a,k], [b,j], [b,k], [d,j], [d,k], [e,j] and [e,k]). The allocations then work as follows:

- For circuits with one missing variable, for example on/off-net: the uplift is based on postcode and bandwidth information. So the 2 "<=1G" ends in postcode sector 1 with no on/off net information (cell [c,j]) are allocated in proportion to the six other "<=1G" circuit-ends in that postcode sector (in cells [a,j] and [b,j]. This

means that 4/6 would be allocated as off-net and 2/6 would be allocated as on-net.[349]

- For circuits with two missing variables, for example on/off-net and bandwidth: the uplift is based on postcode information. So for the 1 circuit end in cell [i,j], this would be allocated in proportion to the 10 circuits with complete information in postcode 1 (in cells [a,j] , [b,j] , [d,j] and [e,j]). This means that 2/10 would be allocated as on-net "<=1G", 4/10 would be allocated as off-net "<=1G", 1/10 would be allocated as on-net ">1G" and 3/10 would be allocated as off-net ">1G".[350]

- For circuits with three missing variables: the uplift is based on circuits with complete information. So the 2 circuit-ends with no information in cell [i,l] would be distributed in proportion to the 21 circuits with information on all variables.

A10.117 An important point to note, as illustrated by the above example, is that if a circuit is missing information for one or two variables the uplift process does not drop the information that is known. For example, if we know the bandwidth and postcode of a circuit but we do not know whether or not it is on-net or off-net, the uplift process ensures that this circuit remains in the given postcode sector and within the given product market – the only variable that is inferred using the uplift process for this circuit is whether or not it is on-net or off-net.

A10.118 Table A10.7 below presents the distribution of leased line circuit ends (at customer sites only) based on the information that is known and unknown. The table refers to TI, WDM, and other CISBO. Our service share model maintains the distinction between WDM and "other CISBO", as the former are generally likely to be high bandwidth circuits and so we want to avoid a significant proportion of WDM circuits being allocated to low bandwidths.

[349] In a small number of cases, this 'primary' uplift does not work because there is not enough information. In the example given, this would occur if cells [a,j] and [b,j] were both zero. In this case, we apply a 'secondary' uplift where the two circuit-ends in cell [c,j] are kept in the same market ("<=1G") and postcode sector (sector 1) but they are allocated as on/off net based on the proportion of the CP's on/off net circuits across the entire market. In our service share analysis, this secondary uplift is applied to around 7,500 circuit-ends.

[350] If there are no other known circuits in postcode 1, i.e. if cells [a,j], [b,j], [d,j] and [e,j] are all zero then there is not enough information to allocate the circuit-end and so it is dropped. Our uplift process drops around 500 circuit-ends so we do not believe this has a material impact on our results.

Table A10.7: Distribution of circuit information (% of circuit ends in the dataset).

Bandwidth	Postcode	On/off-net	All leased line ends	TI ends	CISBO ends (excl. WDM)	WDM ends*
Known	Known	Known	82%	82%	83%	62%*
Known	Known	Unknown	0%	0%	0%	0%
Known	Unknown	Known	10%	16%	6%	8%
Unknown	Known	Known	6%	1%	9%	20%
Unknown	Unknown	Known	0%	0%	0%	4%
Unknown	Known	Unknown	0%	0%	0%	1%
Known	Unknown	Unknown	0%	0%	0%	0%
Unknown	Unknown	Unknown	1%	0%	1%	5%

* Although the proportion of WDM circuits with complete information is less than the others, in practice it is not essential to know the bandwidth because we assume they are likely to be high bandwidth (i.e. 1Gbit/s or higher). If we ignore bandwidth, we have complete information on 82% of WDM circuits.

A10.119 In its response to the October 2014 BCMR Consultation, BT argued that circuits with missing information may not be distributed evenly for each CP and that this assumption can have a significant impact on our market share estimates. For example, the missing data could all be associated with high bandwidth, low volume circuits. BT therefore suggested that Ofcom should present sensitivity analyses based on different assumptions in our uplift process and that we should also present the cumulative effect on the possible range of service shares calculated.[351]

A10.120 In the May 2015 BCMR Consultation, we said that we did not consider it appropriate to present service share estimates based on different assumptions in the uplift process. This was because there would have been an untenable number of permutations to consider and, furthermore, presenting a large number of combinations of hypothetical assumptions around bandwidth, geographic area and on/off net, when these were not supported by evidence, would have resulted in a range of estimates that would not have been informative for the purposes of market definition and SMP.

[351] BT response to the October 2014 BCMR Consultation, paragraphs 73-82.

A10.121 We also explained that our service share model was designed to address non-random distributions before the uplift process where practical. For example, where a CP had indicated that a specific rule was applicable (such as assuming that all EFM circuits are on-net), we had implemented this when categorising circuit-ends as on-net or off-net. Similarly, if we knew a circuit was delivered using EFM , we took this into account before the uplift process to ensure that EFM circuits were identified as low bandwidth, even if the actual bandwidth of the circuit was not known.

A10.122 We considered that, having dealt with potential non-random distributions early in the process to the extent possible, it was reasonable to assume that the remaining circuits with missing information could be allocated proportionately to circuits with known information. We therefore did not present ranges for our service share estimates based on different uplift assumptions.

A10.123 Since the May 2015 BCMR Consultation, we have considered the issue of sensitivity analysis around the uplift assumptions further. We recognise that, given the data limitations, the various different bandwidths, locations etc., may not be distributed among circuits for which these data are missing in the same proportions as they are distributed among the circuits for which we do have these data. We therefore consider that it might be helpful to stakeholders if we provided some indication of the effect that changes in the uplift assumptions could in principle have on the results of our analysis.

A10.124 We have considered the two most common cases of missing information: circuits with unknown postcode (but known bandwidth and on-net status), and circuits with unknown bandwidth (but known postcode and on-net status). Other cases were not frequent enough to have a material impact. For the case of missing postcodes, we looked at the effect on BT's share (by geographic market area and CISBO segment) of varying the number of circuits allocated by the uplift process by +/-20%. We established that the impact on BT shares would be between +1.1 to -1.0 percentage points.

A10.125 Regarding the circuits with missing bandwidth information, we considered only the impact on the VHB (very high bandwidth, >1Gbit/s) CISBO segment (as likely to be of most interest to stakeholders). The total number of VHB circuits consists of:

a) WDM circuits with known bandwidth,

b) WDM circuits with unknown bandwidth (these were assumed to be VHB and hence the uplift process had no impact),

c) Ethernet circuits with known bandwidth above 1Gbit/s, and

d) Ethernet circuits with unknown bandwidth that were allocated to the VHB segment by the uplift process.

A10.126 We checked the underlying data and established that only one CP [✂], had circuits in category d). The number of "uplifted" circuits was negligible compared to the total number of VHB CISBO circuits in the UK (less than 1%), hence removing these uplifted circuits would not have any material impact on BT's share.

A10.127 We also considered the effect of allocating a higher than proportionate number of the circuits for which bandwidth was unknown to the VHB segment. To do this we examined how many more circuit ends (out of the ones with unknown bandwidth)

we would need to add to the VHB volumes in each area (CLA, LP, RoUK) in order for BT's share to change by two percentage points. In the CLA it would require us to allocate all the CISBO circuit ends with unknown bandwidth to the VHB segment, which we do not consider reasonable. In the LP it would require us to add around 100 circuit ends (compared to only two that were actually allocated by the standard uplift process) to the VHB segment. In the rest of the UK it would require us to add around 500 circuit ends (compared to 88 actually allocated by the standard uplift process).

A10.128 We conclude that for the case of unknown postcodes, small to moderate changes in the uplift assumptions result in a negligible impact on BT's share. For the cases of unknown bandwidth we conclude that it would require an unreasonably large re-allocation of circuits across different bandwidth bands for BT's shares to change even by a relatively insignificant two percentage points. We consider that the results of these sensitivity checks support our conclusion that the uplift process is sufficiently robust for the purposes of this statement.

Data from MNOs and LLU operators

A10.129 The circuit cleaning process described above was applied to all sales and purchases of active leased lines by the 18 CPs with fixed access infrastructure. We created two additional databases for MNOs' purchases and LLU operators' purchases. A similar mapping and cleaning process was used for these datasets as was used for the main leased lines dataset described above, and when calculating service shares we used the same uplift process (though for MNOs and LLU operators we had complete information on suppliers so we only needed to uplift two variables, bandwidth and postcode).

A10.130 For the MNO data, the 'customer' ends that are counted in the service share estimates are the cell sites from which backhaul is being supplied or purchased. We do not count connections to aggregation or switch sites (which are assumed to be 'network' ends for these purposes).

A10.131 For LLU data, the unbundled exchanges from which backhaul is being supplied (or purchased) are the 'customer' ends and the 'network' end is where the LLU operator aggregates traffic onto its own network (this could be its own site or it could be an Openreach Handover Point).

Dark fibre and duct leases

A10.132 As discussed above, we also requested data from operators which provide dark fibre and duct leasing. CPs' records of these are not generally as complete as they are for leased lines so it is possible that we have not received full inventories. However, for the data we have received, we have applied the above cleaning steps. Furthermore, when estimating shares of dark fibre/duct leasing there is only one variable that requires uplifting (postcode sector) because there is no bandwidth and the 'interface' is either dark fibre or duct. All duct and dark fibre leases are also on-net from the perspective of the company that owns the infrastructure.

A10.133 The classification of end types for dark fibre and duct leases uses the same network site list that is used for our leased line data. However, although this allows us to count dark fibre ends at customer sites in a consistent manner, it cannot be assumed that these all represent additional leased line services that are provided by operators with no fixed access network or services that are self-built by end-users. This is because if a fixed operator uses leased dark fibre to provide a leased

line then this will already be captured in our estimates of active service shares. For example, suppose operator 1 leased dark fibre to a retail bank, which then installed its own equipment to connect two sites. This would not be captured in our estimates of wholesale leased lines. However, if the operator leased dark fibre to another fixed operator (say Colt or EU Networks) which then used it to provide a leased line to a media company, then this would already be captured in our leased line data. In order to distinguish between these two scenarios, we therefore requested customer details from the largest dark fibre providers.

Network site data

A10.134 The main purpose of obtaining information on network sites was to allow us to distinguish between leased lines circuits that terminate at a business site and those that terminate at a network node. Each CP provided location details of its network sites, either in Eastings and Northings or with an address. We were therefore able to extract the information to create a list of postcodes where each CP has a network node (as discussed above we have around 9,000 unique network site postcodes).

A10.135 We also asked CPs to indicate which network nodes were coincident with a customer site, for the reasons discussed above. Some CPs were unable to provide this information but we have used it where it is available.

Data on fibre-connected buildings

A10.136 We asked CPs to provide a list of fibre-connected buildings, with information on the full postal address of each building.[352] Some CPs provided data on eastings and northings, and in that case we converted these coordinates into postcodes using MapInfo.

A10.137 As an initial check we compared the postcodes from the dataset of fibre-connected buildings with the postcodes in the leased lines dataset. Our expectation was that the customer circuit ends (excluding EFM circuits and those low-bandwidth TISBO circuits and which are provided via copper) from the leased lines dataset will form a sub-set of the fibre-connected buildings dataset, because in order to provide a customer with a leased line in a specific location, that location would need to be connected to a CP's network using a fibre connection. However, we discovered that the two datasets do not seem to be comparable.

A10.138 We started our checks with the two largest providers, and for both BT and Virgin we saw that there were numerous instances of postcodes where:

a) fibre-connected buildings were present but no leased line circuit ends were reported, or

b) leased line circuit ends were present but no fibre-connected buildings were reported.

[352] This was to inform our market analysis, as a CP with a large number of existing connections would be likely to be able to acquire leased line customers at lower cost than a CP without such connections, by utilising its existing fibre connections.

A10.139 For Virgin, for example, out of all postcodes where it had leased line circuit ends, [✂] did not report the presence of a fibre connection, and such postcodes accounted for [✂] of its leased line sales. For BT, out of all postcodes where it had leased line circuit ends, [✂] did not report the presence of a fibre connection, and such postcodes accounted for [✂] of its leased line sales.

A10.140 At the same time, Virgin's data suggested there were around [✂] postcodes with fibre connections but no corresponding leased line circuit ends. BT's data suggested that there were about [✂] postcodes where it had a fibre connection but did not apparently supply a leased line.

A10.141 We sought clarification from both providers to understand the source of this discrepancy. BT suggested there were a number of explanations for inconsistency of type (b) described above (leased line but no fibre), the most important of which are issues related to poor location data for fibre-connected buildings[353], as well as issues with mapping of eastings and northings into postcodes. Moreover, BT explained that many postcodes where a leased line was present but no fibre connection was reported are very small business postcodes allocated to a single building, or cases when one building had multiple postcodes, and often these buildings indeed have a fibre connection in a close proximity but a direct match had not been found in the location during our postcode conversion process.

A10.142 Regarding the inconsistency of type (a) (fibre but no leased line), BT explained that in addition to issues with location data for fibre connections explained above, in some cases fibre connections are used for products other than leased lines. In some cases the fibre connection dataset also includes the locations where BT has installed fibre, but the customer has subsequently ceased the service, due to migration to another non-fibre based product, or ceasing a BT service, or moving to another location. Also, a number of such locations will be the leased lines network sites which we removed from leased line dataset.

A10.143 Virgin explained to us that it does not hold a definitive list of fibre-connected buildings, and therefore sought to provide data based on information held in other relevant databases [✂] Therefore, the list of leased line circuits and list of fibre-served premises were derived from completely different datasets, and are not easily reconciled.

A10.144 Taking these explanations into consideration, we concluded that it would not be practical to make further attempts at cleaning and improving the data on fibre-connected buildings, given its limitations. However, we note that the explanations offered by BT for inconsistency type (a) in particular suggest it could benefit from having existing connections to sites where it does not currently supply a leased line. This may also be true for Virgin. Unfortunately the limitations of the data do not allow us to compare the two operators.

[353] BT said that, in many cases, the textual address field (number and street name) in the fibre location records is more accurate than the reported eastings and northings which we used to derive corresponding postcodes.

Data outputs

Comparisons with the May 2015 BCMR Consultation

A10.145 In this sub-section, we present an updated analysis of the network reach and service share outputs that were included in the May 2015 BCMR Consultation. Following the publication of the May 2015 BCMR Consultation we have discovered a small number of errors in the data cleaning process and corrected them. We have also received a number of stakeholders' comments and conducted additional analyses, which we report below.

Network reach analysis

A10.146 The underlying data for the network reach analysis has not changed since the May 2015 BCMR Consultation. Table A10.8 shows the current network reach analysis, with 'high network reach' (HNR) postcode sectors defined as in the BCMR 2013 (i.e. there are on average two or more operators, in addition to BT, with flexibility points within 200m of business sites).

Table A10.8: Network Reach Descriptive Statistics

	Region	
	UK excl. the CLA and the LP[354]	The CLA and the LP
No. of large business sites	155,404	7,617
No. of postcode sectors	9,628	421
No. of HNR postcode sectors	780 (8%)	396 (94%)
No. of business sites in HNR sectors	24,908 (16%)	7,506 (99%)
No. of businesses with HNR (all sectors)	46,004 (30%)	7,306 (96%)

[354] The CLA and the LP together cover the same area as the WECLA geographic market defined in the 2013 BCMR Statement. We present data for the CLA and the LP combined for ease of comparison with the May 2015 BCMR Consultation and the October 2014 BCMR Consultation where data for the WECLA and the UK excluding the WECLA were presented, so that stakeholders can see the impact of changes in methodology.

A10.147 The next section presents our updated analysis based on this dataset.

Service share analysis

A10.148 The following table shows which product market each circuit category falls in for the purposes of the service share analysis presented in this section. In addition, similar to the analysis in the May 2015 BCMR Consultation, the shares for the VHB CISBO (formerly MISBO) segment include all circuits with bandwidth greater than 1Gbit/s irrespective of the underlying technology.

Table A10.9: Market Definitions used for Service Shares

Circuit Category	Relevant market
ADSL	Other
Analogue	TI
ATM	TI
Broadcast Access	Other
CCTV	Other
Dark fibre	Other
EFM	CISBO
Ethernet	CISBO
Fibre Channel	CISBO
FICON	CISBO
Frame Relay	TI
NGA	Other
PSTN/ISDN	Other
Radio/Microwave[355]	Other
SDH and PDH	TI
SDSL	TI
WDM (bearer)	Other
WDM (wavelength)	CISBO
xDSL	Other
X25	TI
Other (not leased line)	Other

A10.149 In Table A10.10 below we present the updated results of the service share analysis[356]. As mentioned in the introduction to this Annex, during the previous

[355] Although radio is a physical medium used to transmit a communications signal (rather than an interface), we include it as a separate category because it was not included in any of the relevant markets in the BCMR 2013.

stages of data collection, cleaning and production of intermediate results, we ran several scenarios in order to test the sensitivity of our results to different underlying assumptions. The October 2014 BCMR Consultation and Annex 15 of the May 2015 BCMR Consultation contain detailed descriptions of these scenarios. For brevity, in the current Annex we only present our base case scenario[357], which we have described in the relevant sections of this Annex above.

A10.150 The service share analysis in Annex 15 of the May 2015 BCMR Consultation was mostly based on the markets defined in the BCMR 2013. This was so that stakeholders could easily compare the results of the updated analysis with the equivalent results which had been presented in the October 2014 BCMR Consultation (in which we had adopted the 2013 definitions for illustrative purposes). In this Annex we follow the decisions on market definition contained in this statement. Other relevant service shares using the market definitions can be found in Section 4.[358]

A10.151 The numbers presented in table A10.10 differ slightly from those presented in table A15.10 in the May 2015 BCMR Consultation. This is primarily driven by the following changes in the data cleaning process:

- We corrected some minor errors during postcode identification, which we discovered after the publication;
- We updated the list of data centres used when identifying customer or network sites to be consistent with the updated analysis in Annex 15;
- We corrected data for some circuits with bandwidths that we understood to have been measured in Mbit/s whereas it was in fact kbit/s;
- For the data on passives – we extracted postcode data from the data submitted by one CP, which we had been unable to do before the May 2015 BCMR Consultation.

A10.152 BT criticised our treatment of MNO and LLU backhaul in calculating service shares as inconsistent.[359] BT attempted to combine data from table A15.10 and from Section 4 of the May 2015 BCMR Consultation to calculate service shares for the very high CISBO segment in a scenario in which MNO backhaul is included but LLU backhaul is excluded, when these numbers were in fact published in table A15.10. In the May 2015 BCMR Consultation we estimated BT's share in the very high CISBO segment in the Rest of UK as 29% when we include MNO backhaul but exclude LLU backhaul (see table A15.10 in the consultation); 30% if we exclude both MNO and LLU backhaul and 32% if we include both MNO and LLU backhaul

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[356] We have also presented our volume and service share estimates of passive infrastructure leasing (i.e. dark fibre and duct) based on the information provided to us by operators.
[357] The main difference between scenarios is in the treatment of joint customer-network sites. In the base case scenario, circuit-ends at a joint customer-network site postcode are only counted as customer-ends for those CPs that have identified the postcode as having a joint site; see paragraph A10.110.
[358] Also, to be consistent with our analysis in Section 5, we have also combined TI segments above 8Mbit/s in one row.
[359] Paragraphs 12.70-12.80 of BT response to the May 2015 BCMR Consultation.

(Tables 4.4 and 4.5 of the consultation). The main reason for presenting the service share estimates in the very high CISBO as a range between scenarios was to test the sensitivity of the estimates to inclusion or exclusion of MNO and LLU backhaul.

A10.153 At the same time, we recognise the need for clarity of presentation and consistency of our numbers throughout the statement. Therefore, in this statement, in order to be consistent with our market definition, we present the service share estimates and underlying number of circuits that include both MNO and LLU backhaul.

A10.154 In order for operators to compare the updated results with those presented in the May 2015 BCMR Consultation, and to separate the effect of adding LLU backhaul circuits from the effect of correcting errors in the data, we present three sets of numbers in the table A10.10[360]:

- numbers as they were presented in the May 2015 BCMR Consultation (i.e. including MNO backhaul but excluding LLU backhaul);
- the same set of numbers after correcting minor data errors described above (on the same basis, i.e. including MNO backhaul but excluding LLU backhaul);
- The updated set of numbers, after correcting the errors, and adding LLU backhaul circuits.

[360] For a comparison between estimates presented in the October 2014 BCMR Consultation and the May 2015 BCMR Consultation, see table A15.10 of the latter.

Table A10.10: Updated Service shares estimates

Product	Bandwidth (Mbit/s)	Geographic Market	Volumes (customer ends only; including MNO backhaul)			Service shares		
			May 2015 Base Case (excluding LLU backhaul)	Current Base Case (excluding LLU backhaul)	Current Base Case (including LLU backhaul)	May 2015 Base Case (excluding LLU backhaul)	Current Base Case (excluding LLU backhaul)	Current Base Case (including LLU backhaul)
TI	<=8	UK less Hull	249,976	250,786	250,786	BT: 89%	BT: 89%	BT: 89%
		Hull	1,893	1,893	1,893	KCOM: 86%	KCOM: 86%	KCOM: 86%
	>8, <=1000*	UK less WECLA less Hull	3,447	3,543	3,543	BT: 74%	BT: 72%	BT: 72%
		WECLA	1,637	1,725	1,725	COLT: 40%	COLT: 39%	COLT: 39%
Low, Medium and High CISBO**	<=1000	UK less WECLA less Hull	251,518	250,475	256,165	BT: 57% Virgin: 30%	BT: 57% Virgin: 31%	BT: 58% Virgin: 30%
		WECLA	42,264	42,232	42,302	BT: 47% COLT: 20% Virgin: 13%	BT: 47% COLT: 20% Virgin: 13%	BT: 48% COLT: 20% Virgin: 13%
		Hull	938	974	985	KCOM: 97%	KCOM: 97%	KCOM: 96%
Very High CISBO**	>1000 and WDM*	UK less WECLA less Hull	7,814	7,609	8,578	Virgin: 55% BT: 29%	Virgin: 54% BT: 30%	Virgin: 53% BT: 32%
		WECLA	2,938	2,681	2,728	COLT: 33% Virgin: 23% Zayo: 14%	COLT: 36% Virgin: 18% Zayo: 15%	COLT: 35% Virgin: 18% Zayo: 16%
Passive	N/A*	UK less WECLA less Hull	3,793	3,838		Cityfibre: 32% Zayo: 20% Surf: 18%	Cityfibre: 32% Zayo: 20% Surf: 18%	
		WECLA	1,658	2,091		Zayo: 70% Interoute: 20%	Zayo: 55% COLT: 21% Interoute: 16%	

* Volumes in Hull are not material, and numbers are not therefore presented.
** In Annex 15 of the May 2015 BCMR Consultation we referred to “Very High CISBO” segment as “MI”, and “Low, Medium and High CISBO” as “AI”.

A10.155 In Table A10.11, we present our service share estimates of MNO backhaul (analysis of LLU backhaul is presented in Annex 8), based on the data provided by MNOs. We present two separate estimates for MNO backhaul, one including microwave links and one excluding them. The table suggests that the number of microwave links used for MNO backhaul is significantly higher than the number of copper and fibre links. In fact, the number of unique cell sites that use microwave links for MNO backhaul is smaller than the number of those that use fibre or copper (microwave accounts for just less than one third of links to unique cell sites). However, a significant proportion of microwave links are used to deliver multiple 64kbit/s or 2Mbit/s services. We have counted each of these services separately, so for example where microwave is used to deliver 16 distinct 2Mbit/s services (i.e. the bandwidth is reported as '16x2Mbit/s') then we have counted this as 16 circuit-ends (all at 2Mbit/s).

A10.156 It should also be noted that MNOs were generally unable to indicate whether the leased lines in their inventories were delivered using WDM technology. In Table A10.11 we have therefore not included separate estimates for the market previously defined as 'MISBO'. Instead, any WDM circuits, as well as any circuits with bandwidth above 1Gbit/s, are reported in the combined CISBO segment[361] for completeness and to avoid confusion.

A10.157 In contrast, table A15.11 in the May 2015 BCMR Consultation excluded AI and TI circuits with bandwidth above 1Gbit/s, and reported any WDM circuits in the AI segment. Some stakeholders misunderstood Table A15.11 in the May 2015 BCMR Consultation and erroneously inferred from it that the number of circuits previously defined as "MI" (including WDM circuits and any circuits with bandwidth above 1Gbit/s) was zero.

[361] The service shares reported in Table A10.10 will include WDM mobile backhaul in the Very High CISBO segment because fixed operators were generally able to indicate whether a circuit was delivered using WDM technology.

Table A10.11: Service share estimates for MNO backhaul

Product	Bandwidth (Mbit/s)	Geographic Market	Volumes				Service shares			
			Excluding microwave		Including microwave		Excluding microwave		Including microwave	
			2015 Consultation	Updated figures	2015 Consultation	Updated figures	2015 Consultation	Updated figures	2015 Consultation	Updated figures
TI	<=8	UK less Hull	38,361	38,361	189,619	189,619	BT: 96%	BT: 96%	Self-supply: 76% BT: 23%	Self-supply: 76% BT: 23%
		Hull	367	367	1,341	1,341	KCOM: 70%	KCOM: 70%	Self-supply: 64% KCOM: 19%	Self-supply: 64% KCOM: 19%
	>8, <=1000*	UK less WECLA less Hull	39	40	2,958	2,960	Not material	Not material	Self-supply: 98%	Self-supply: 99%
		WECLA	4	4	120	120	Not material	Not material	Self-supply: 100%	Self-supply: 100%
CISBO	<=1000, >1000 and WDM**	UK less WECLA less Hull	20,707**	20,745	26,356**	26,393	BT: 93%	BT: 93%	BT: 73% Self-supply: 23%	BT: 73% Self-supply: 23%
		WECLA	1,785**	1,787	1,933**	1,935	BT: 89%	BT: 89%	BT: 83%	BT: 83%
		Hull	2	2	63	63	Not material	Not material	Self-supply: 97%	Self-supply: 97%

* Volumes in Hull are not material so analysis has not been presented

** MNOs were generally not able to indicate whether a circuit was delivered by WDM. Other circuits greater than 1Gbit/s were small in number (less than 50), with the vast majority purchased from Virgin. Table A15.11 in the May 2015 BCMR Consultation excluded these circuits, whereas the current table includes them in CISBO category.

Data Analyses

A10.158 In this section of the Annex, we present a series of analyses[362] that have been used in our assessment of market definition and SMP set out in Section 4. These relate to the following:

- Definition of the Central London Area;
- Analysis of CBDs;
- CityFibre's roll-out plans;
- Ethernet in the first mile (EFM) geographic analysis;
- Virgin's network investment plans;
- Data analysis issues raised in stakeholder responses to Annex 15 of the May 2015 BCMR Consultation;
- Detailed postcode sector analysis;
- Identification of areas of leased line supply in the UK using customer locations;
- Additional analyses of CPs' network coverage;
- Mobile backhaul network reach;
- LLU network reach;
- CLA boundary sensitivity analysis;
- Calculating CISBO service shares based on revenues; and
- Additional material on CBDs and London postcode sectors.

Definition of the Central London Area

A10.159 In the May 2015 BCMR Consultation we proposed to define the Central London Area (CLA) as an area in which, primarily because of the presence of a large number of rival networks, competition in the CISBO market was already likely to be effective.[363] The CLA was one of several areas where competitive conditions appeared to have some potential to differ, to a greater or lesser degree, from the

[362] In paragraphs A15.183-188 of the May 2015 BCMR Consultation we also presented a discussion of calculating service shares of WDM services using bearers as opposed to wavelengths, and specified the reasons why we believe that counting wavelengths is more appropriate than counting bearers because the former gives a better proxy for the value of the service.
[363] Annex 15 of the May 2015 BCMR Consultation, paragraphs A15.155 to A15.181.

RoUK. [364] In each case, the process of deriving the boundary of the area involved applying a set of boundary test conditions, and identifying a geographic boundary composed of postcode sectors which pass these boundary tests.[365]

A10.160 The boundary of the CLA geographic market was formed by postcode sectors which fulfilled at least one of the conditions of the boundary test[366]:

- Condition 1: Network Reach[367] equal to or higher than 5 (i.e. number of OCPs >= 5); and

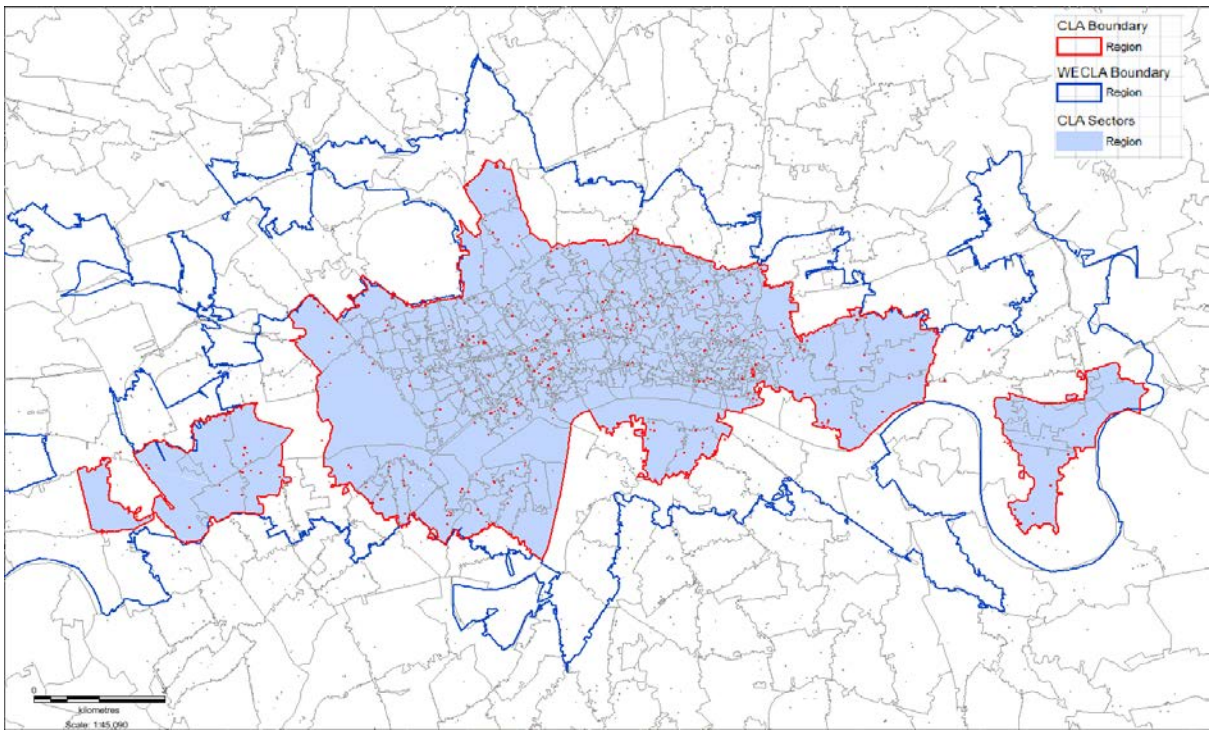
- Condition 2: Network Reach equal to or higher than 4 and, in addition, at least 90% of businesses within the given postcode sector are no further than 100 metres[368] from a flexibility point of at least 2 OCPs.

A10.161 As the newly identified CLA was a subset of the previously defined WECLA, we proposed that the remainder of the postcode sectors in the WECLA which were not classified as being in the CLA were defined as the London Periphery (LP).[369]

A10.162 The defined CLA boundary, as shown in Figure A10.12, is an area composed of one large and two smaller contiguous blocks each separated from the main block by a single postcode sector. We considered that the economic linkages between these three contiguous blocks are likely to be strong, and consistent with our approach in the March 2013 BCMR Statement we thought it reasonable to include these three blocks in the CLA market.

[364] These geographic areas were the CLA and the LP (which together form the WECLA as defined in the March 2013 BCMR Statement) and central business districts of five cities (known as the CBDs): Birmingham, Bristol, Glasgow, Leeds and Manchester.
[365] The CLA also includes eleven postcode sectors which came close to passing and which are within the boundary, as detailed in Annex 15 of the May 2015 BCMR Consultation.
[366] Annex 15 of the May 2015 BCMR Consultation, paragraph A15.162.
[367] "Network reach" is here defined as the average number of OCPs with a flexibility point within 100m of the large business sites in a postcode sector.
[368] More information on Ofcom's approach to determining appropriate buffer distances can be found in Annex 13.
[369] Annex 15 of the May 2015 BCMR Consultation, paragraph A15.171.

Figure A10.12 – Central London Area (CLA)



CLA Boundary shown in red; CLA postcode sectors shown in pale blue; WECLA boundary shown in dark blue; and UK postcode sector borders shown in grey.

A10.163 We tested the robustness of the boundary test conditions used for the definition of the CLA in the May 2015 BCMR Consultation with sensitivity analyses. These involved two sets of alternative boundary tests, with the first being a less strict version[370] and the second being a stricter version[371] of the boundary test conditions. The results of these two alternative boundary tests showed that the definition of the CLA would not change significantly as a result of small changes to the conditions of the boundary test conditions. This sensitivity analysis provided us with assurance that competitive conditions in the CLA are sufficiently homogeneous and appreciably different from the conditions in the neighbouring areas.

Analysis of CBDs

A10.164 In the May 2015 BCMR Consultation we looked at the Central Business Districts (CBDs) of five cities and applied the same boundary test conditions applied in deriving the CLA. This showed that there were only a few sectors in each of the cities that passed either one of the conditions of the boundary test.

A10.165 Table A10.13 shows the number of postcode sectors with high network reach in each selected city area as well as for all five CBDs combined. In addition to this, the

[370] Condition 1: Network Reach equal to or higher than 4 OCPs; Condition 2: Network Reach equal to or higher than 3 if at least 90% of businesses within the given postcode sector are no further than 100 metres from a flexibility point of at least 2 OCPs.
[371] Condition 1: Network Reach equal to or higher than 5; Condition 2: Network Reach equal to or higher than 4 if at least 90% of businesses within the given postcode sector are no further than 100 metres from at least 3 OCPs.

number of postcode sectors passing the conditions of the CLA boundary test is shown, as well as the number of business sites, average network reach, and number of CISBO and VHB circuits in those postcode sectors which pass the conditions of the CLA boundary test. This shows that a small proportion of postcode sectors in each city pass the conditions of the CLA boundary test, with a combined proportion of less than 20%. The average network reach values for these postcode sectors are between four and five. This is in contrast to the CLA, where the average network reach is more than six. The difference indicates that the second of the two conditions of the boundary test (which requires only 4 OCPs to be present) is of relatively greater importance in the CBDs.[372]

Table A10.13 Statistics for CBDs

	Birmingham	Bristol	Glasgow	Leeds	Manchester	Combined
No. of Postcode Sectors with 2 OCPs within 200m	28	15	43	23	49	158
No. of Postcode Sectors passing CLA Boundary Tests	4	3	5	5	11	28
No. of Businesses in Postcode Sectors passing CLA Boundary Tests	139	98	218	145	244	844
Avg. 100m Network Reach in Postcode Sectors passing CLA Boundary Tests	4.4	4.6	5.0	4.8	4.5	4.6
No. of CISBO circuits in Postcode Sectors passing CLA Boundary Tests	597	353	609	541	668	2768
No. of VHB CISBO circuits in Postcode Sectors passing CLA Boundary Tests	10	2	6	1	5	24

CityFibre roll-out plans

A10.166 CityFibre plans to expand its network to a series of towns and cities[373] which are located in the RoUK or LP. We recognise that this planned network expansion will

[372] This is also apparent from a comparison of Figure A15.17 and Figures A15.24 – A15.28 of the May 2015 BCMR Consultation.

[373] These cities include Aberdeen, Ayr, Bath, Bournemouth, Coventry, Dewsbury/Batley, Dundee, Edinburgh, Exeter, Huddersfield, Hull, Leeds/Bradford, Leicester, Milton Keynes, Newcastle, Newport, Nottingham, Peterborough, Plymouth, Reading, Sheffield, Slough, and York. Please note that this list is not intended to be exhaustive as there is some uncertainty around the cities where CityFibre plans to invest, particularly as its own plans appear to change over time. However, we are confident that the cities we have considered are representative of the areas where CityFibre is interested in

increase levels of competition in the affected towns and cities. As we explain in Section 4, competition for CISBO services is driven primarily by the presence and extent of rival infrastructure in an area. Thus, for the purposes of the analysis below, we have assumed that CityFibre uses its infrastructure to supply a wholesale CISBO service. This could be either as part of a retail service which CityFibre itself sells to an end user (if it chose to do so), as a wholesale active service sold to another CP, or in the form of dark fibre sold to another CP which then uses that fibre to supply an active wholesale and/or retail CI leased line.

A10.167 A sensitivity analysis was performed on this series of cities, calculating the network reach values based on the assumption that CityFibre, as an OCP, will always be present.[374] To emulate the approach taken to defining the CBDs, we identify the postcode sectors in each city which either are HNR[375] or would be HNR if CityFibre were present in addition to the existing operators. We then calculate the NR values for each postcode sector as if CityFibre were present, in effect increasing the NR value by one. We do not know the eventual extent of CityFibre's actual roll-out in each city, and it could be less than that assumed here. Table A10.14 shows the results of this sensitivity analysis.

Table A10.14 Sensitivity analysis NR values in City HNR postcode sectors, based on CityFibre roll-out

City	100m NR	200m NR	No. of HNR Postcode Sectors	No. of CISBO Circuits	No. of VHB Circuits
Aberdeen	1.99	2.53	17	1548	14
Ayr[376]	-	-	0	0	0
Bath	2.00	2.18	15	610	11
Bournemouth	2.00	2.23	50	1523	119
Coventry	2.02	2.44	48	2211	41
Dewsbury/Batley	2.06	2.50	36	1692	19
Dundee	2.37	2.82	23	460	39
Edinburgh	2.71	3.30	73	3664	40
Exeter	2.37	3.09	21	1226	241
Huddersfield	2.07	2.41	23	1103	8
Hull	1.71	2.23	17	515	0
Leeds/Bradford	2.49	3.18	159	7251	58
Leicester	2.36	2.95	63	2312	16
Milton Keynes	2.01	2.64	32	1632	43
Newcastle	2.22	2.59	89	4488	71

investing and so do not consider an exhaustive analysis based on the most recent plans to be necessary.

[374] For example, when calculating 100m NR it is assumed that CityFibre is within 100m of every business site in a postcode.

[375] Postcode sector has a 200m NR greater than or equal to two.

[376] The sensitivity analysis showed that Ayr contained no postcode sectors that were of HNR. The average 200m NR when considering all postcode sectors in Ayr was 1.45 OCPs.

Newport	2.04	2.35	18	614	15
Nottingham	2.26	2.69	91	4201	267
Peterborough	2.11	2.59	27	1299	17
Plymouth	2.23	2.75	31	1195	40
Reading	2.48	3.61	77	4537	101
Sheffield	2.16	2.72	81	2802	36
Slough	2.61	3.64	41	2436	126
York	2.45	3.09	21	507	8

A10.168 The potential 200m NR values for these cities are in the range of 2.1 – 3.7 OCPs including CityFibre (1.7 – 2.8 OCPs at 100m including CityFibre). The potential 200m NR values for these cities are below that of the LP (which is 4.10). Over two-thirds of cities in which CityFibre plans to invest would have network reach of below 3 even after its investment.[377]

Ethernet in the First Mile (EFM) geographic analysis

A10.169 Analysis was performed to gauge the geographic distribution of EFM exchange services throughout the UK. Data was obtained from the main EFM operators, [✂][378], on the exchanges in which they have EFM presence.

A10.170 Based on the coordinate location of these exchanges they were then classified by geographic area. We recognised that exchanges in proximity to areas such as the CLA or LP can provide services to customers within these areas without being located in these areas themselves. To account for this, we have classified exchanges which are within 1km of the CLA as being able to serve the CLA, exchanges which are within 1km of the LP as being able to serve the LP, and exchanges which are within 1km of the CBDs as being able to serve the CBDs. Exchanges which are further than 1km away from the CLA, LP and CBDs are considered to serve the RoUK.

A10.171 Table A10.15 presents the average number of OCPs providing EFM services at EFM exchanges by geographic area. This shows that the highest average number of OCPs providing EFM services is in the CLA, with the lowest being the RoUK (including CBDs).

Table A10.15 Average number of OCPs providing services at EFM exchanges, by geographic area

Area	Average No. of OCPs Present

[377] CityFibre has purchased KCOM's infrastructure assets outside Hull. However our understanding is that KCOM remains able to supply services over these assets. We have therefore treated KCOM and CityFibre as independent operators for the purposes of the network reach analysis and note that this also adds to the robustness of our findings. See KCom's press release at: http://www.kcomplc.com/business-insight/news-media/proposed-sale-of-uk-network-infrastructure/

[378] Our circuit data indicates that [✂] also sell some EFM circuits, but their response to the May 2015 BCMR Consultation did not suggest they use their exchange footprint to supply these on-net, so they have been excluded from the analysis.

CLA	2.33
LP	2.02
CBDs	1.70
RoUK (inc. CBDs)	0.70

A10.172 Table A10.16 presents the distribution of the number of OCPs providing EFM services at EFM exchanges by geographic area. This shows that the CLA and LP most frequently have two OCPs providing EFM services, the CBDs most frequently has one OCP providing EFM services, and the RoUK (including CBDs) most frequently has zero OCPs.

Table A10.16 Distribution of OCP service provision at EFM exchanges, by geographic area

	No. of Exchanges			
No. of OCPs Present	CLA	LP	CBDs	RoUK (inc. CBDs)
0	1	1	0	2492
1	3	12	31	2233
2	19	16	10	699
3	16	13	9	67
4	1	1	3	4

A10.173 Table A10.17 presents the sales of EFM circuits by CP throughout the whole of the UK. This shows that [✂] has the highest number of EFM circuit sales followed by [✂], [✂] and [✂]. [✂] and [✂] have low EFM circuit sale numbers and, as recognised above, [✂] were excluded from the geographic classification of EFM exchange services.

Table A10.17 EFM circuit sales by CP

CP	Circuit Quantity
[✂]	[✂]
[✂]	[✂]
[✂]	[✂]
[✂]	[✂]
[✂]	[✂]
[✂]	[✂]

A10.174 The CLA has, on average, the highest number of OCPs providing EFM services, followed by the LP and CBDs, with the RoUK having the lowest number of OCPs providing EFM services. This is consistent with our network reach analysis where the highest levels of competition were present in the CLA and lowest in the RoUK. The LP appears to benefit from its geographic proximity to the CLA with EFM

services with around 70% of exchanges having two or more OCPs provide EFM services. This is not as high as the CLA where around 90% of exchanges have two or more OCPs provide EFM services, but is much larger than the CBDs (around 42%).

Virgin's network investment plans

A10.175 Virgin has announced plans to invest a further £3bn in network expansion. It estimates that this should increase the number of households and businesses to which it can offer services by one third over the next five years.[379]

A10.176 Virgin provided us with further details of the location and timing of committed and planned build for over [✂], and also included details on whether the investments were upgrades to existing sites, 'infills' to its existing network or entirely new build.

A10.177 Virgin's data showed only [✂] premises as committed build with a known date. Virgin classified 55% of this committed build as either infill or upgrades at existing sites with the remainder classified as new build.

A10.178 By geographic area, Virgin's committed build is almost all within the RoUK [✂], with [✂] in the LP, [✂] in the CLA and [✂] within CBDs.[380] We further note that the majority of the committed build activity within the LP relates to [✂]. Virgin only plans [✂] to just over [✂]. Virgin's 'planned' build appears even more heavily focussed on the RoUK.

A10.179 We consider that this committed and planned build will not make any difference to our assessment of the competitiveness of these areas according to the network reach criteria due to the majority of the build being located in the RoUK.

Data analysis issues raised in Stakeholders' responses to Annex 15 of the May 2015 BCMR Consultation

A10.180 In this section we consider and respond to stakeholders' responses to the May 2015 BCMR Consultation relating to geographic market definition data analysis. Stakeholders' comments and our responses are summarised below in Table A10.18. Where further analysis has been undertaken in light of these comments, the results and our conclusions are set out under separate headings in subsequent sections.

Table A10.18 Ofcom responses to stakeholders' comments on May 2015 BCMR Consultation[381]

Comment Reference	Respondent	Comment	Ofcom Response
A10.181	BT	"Ofcom's choice of business sites includes many small retail	As a form of sensitivity analysis, the CLA Boundary was constructed using the

[379] http://about.virginmedia.com/press-release/9467/virgin-media-and-liberty-global-announce-largest-investment-in-uks-internet-infrastructure-for-more-than-a-decade

[380] Based on committed build with a known date and where Virgin provided geographic location information.

[381] A number of related stakeholder comments are responded to in Annex 16.

		sites where there is limited demand for business connectivity services and even less demand for the higher value services."[382]	current locations of leased line demand, the results of which can be found below in A10.222 onwards. This sensitivity analysis showed that the CLA Boundary remains reasonably robust, with only a small number of postcode sectors either meeting the conditions of the boundary tests that previously had not done so, or not meeting the conditions of the boundary tests that previously had done so.
A10.182	BT	"We now present a series of postal sectors[383] in WECLA to illustrate these problems." [384] [385]	This series of postcode sectors was analysed in more granular detail with the results, summarised in Table A10.19 below, showing that all but one of these postcode sectors did not have sufficient rival infrastructure to pass the conditions of the boundary test. The one exception refers to a postcode sector with higher levels of competition which was classified as being in the CLA in the May 2015 BCMR Consultation[386], but was omitted from maps of the CLA boundary[387] which is why it may have been unclear to BT whether it was in or out of the CLA. The map of the CLA boundary, in Figure A10.12, includes this postcode sector.
A10.183	BT	The choice of assuming that areas served by postcodes are perfect circles is also distorting the results.[388]	Whilst 100% of postcodes in the CLA have a radius of less than or equal to 100m as can be seen in Table A10.1, 98% of postcodes have a radius of less than or equal to 50m. Due to the small radius of a majority of the postcodes especially in the CLA, the resultant error is minimal when taking into account the actual shape of a postcode since a buffer

[382] BT's response to Ofcom's consultation document "Business Connectivity Market Review: Review of competition in the provision of leased lines" Part B: Economic analysis responding to Ofcom's detailed proposals, paragraph 11.30.
[383] N1C 4, NW10 6, NW10 7, W12 0, W14 0, W2 4 and W6 7.
[384] As found in BT's response to Ofcom's consultation document "Business Connectivity Market Review: Review of competition in the provision of leased lines" Part B: Economic analysis responding to Ofcom's detailed proposals, paragraph 11.30.
[385] BT's response to Ofcom's consultation document "Business Connectivity Market Review: Review of competition in the provision of leased lines" Part B: Economic analysis responding to Ofcom's detailed proposals, paragraph 11.32.
[386] In Schedule 1: List of postal sectors constituting the CLA.
[387] Figures 4.4 and A15.19 of the May 2015 BCMR Consultation.
[388] BT's response to Ofcom's consultation document "Business Connectivity Market Review: Review of competition in the provision of leased lines" Part B: Economic analysis responding to Ofcom's detailed proposals, paragraph 11.40.

			distance of 100m encapsulates the entire postcode in almost all cases. We consider this most significant in the CLA where the size of the postcode sectors is small. We performed a sensitivity analysis, calculating network reach for each of the postcodes within the CLA boundary instead of postcode sectors[389]. The results show that the CLA appears to correspond to the area covered by the "high network reach" postcodes quite closely. However, the map of these postcodes has a "patchy" appearance which is mainly due to many postcodes not containing large business sites.
A10.184	DotEcon (on behalf of BT)	"We note that it is not simply a consideration of granularity and practicality [in the choice of geographic unit], but that the [average network reach] Ofcom will obtain will depend on the size of the regions it uses."[390]	In analysing postcode sectors which met the conditions of the boundary test, there were minimal numbers outside the CLA. There were no areas of material size that did meet the conditions of the boundary test and, therefore, might be regarded as a separate market.
A10.185	DotEcon (on behalf of BT)	"Despite finding many conditions similar to the CLA (in some cases) and the LP (in most cases), Ofcom does not consider the need to define the CBDs as a different market."[391]	Further analysis into the depth of OCP coverage was performed, looking at in particular the percentage of business sites where CPs are available. This can be found below in A10.205 onwards, where we show that the LP has greater depth of competition than the CBDs. Table A10.39 below shows that the LP has a greater proportion of VHB CISBO customer ends within a 100m or 200m buffer distance of four or more OCPs than the CBDs. We outline our full conclusions on the CBDs in Section 4 of this statement.
A10.186	Infrastructure Investors Group	"[The change in the definition of a competitive market since the last BCMR] exacerbates the proposed increase in the average number of OCPs from	In the March 2013 BCMR Statement the WECLA was defined on the basis of a BT plus 2 OCPs test condition, but within the boundary only MISBO circuits were found to be competitive after analysis of

[389] Paragraph A10.224 – A10.225.
[390] Ofcom's Business Connectivity Market Review Consultation: A DotEcon report for BT, section 2.2.1 pages 24 - 25.
[391] Ofcom's Business Connectivity Market Review Consultation: A DotEcon report for BT, section 2.2.1 page 30.

		two to five and increases the proximity requirements."[392]	other competitive indicators. The CLA being found as competitive for all CISBO bandwidths in the May 2015 BCMR Consultation is a deregulatory step.
A10.187	Towerhouse LLP	"The network reach metric could be improved as an estimate of potential supply, and therefore made more robust, by supplementing the large business site location with current locations of leased line demand." [393]	As a form of sensitivity analysis, the CLA Boundary was constructed using the current locations of leased line demand, the results of which can be found below in A10.222 onwards. This sensitivity analysis showed that the CLA Boundary remains reasonably robust, with only a small number of postcode sectors either meeting the conditions of the boundary tests that previously had not done so, or not meeting the conditions of the boundary tests that previously had done so.
A10.188	Towerhouse LLP	"Improve the competition assessment by considering network reach for a set of principal operators." [394]	Whilst we acknowledge that some CPs in the CLA do not necessarily compete across the full range of bandwidths at the moment but concentrate on higher value niches, this is not quite the same as the idea of principal operators taken from the Wholesale Broadband Access Market Review (WBAMR). In the 2008 WBAMR, principal operators were required to have 45% UK coverage as this reflected the nature of the downstream market in that case which is different to the leased lines market. However, the requirement for 4 or 5 OCPs in the conditions of the boundary tests used to derive the CLA boundary allows for the possibility that not all OCPs actually make a competitive offer to a business.
A10.189	Towerhouse LLP	"Analyse network reach at the postcode level for the CLA to determine exactly which areas will be least well served by competing networks rather than relying on postcode sector averages." [395]	As part of a sensitivity analysis, a boundary of the CLA was derived using postcodes instead of postcode sectors. The results of this sensitivity analysis can be found below in A10.224 onwards where the CLA seems to correspond quite closely to the area of "competitive"

[392] Response to the 2015 BCMR and LLCC Consultations by the Infrastructure Investors Group, paragraph 4.5.5.
[393] Geographic market analysis in the BCMR: A Response to the Consultation on Behalf of the Colt, Sky, TalkTalk and Vodafone, paragraph 3.19.
[394] Geographic market analysis in the BCMR: A Response to the Consultation on Behalf of the Colt, Sky, TalkTalk and Vodafone, paragraph 3.42.
[395] Geographic market analysis in the BCMR: A Response to the Consultation on Behalf of the Colt, Sky, TalkTalk and Vodafone, paragraph 3.42.

			postcodes despite the "patchy" appearance of the postcode boundary which is mainly due to many postcodes not containing large business sites.

Detailed postcode sector analysis

A10.190 We conducted a detailed analysis of a series of postcode sectors noted above[396] which were specifically identified by BT in its response to the May 2015 BCMR Consultation.[397] This analysis, summarised in Table A10.19 below, had a particular focus on whether the postcode sector should be included in the CLA (and therefore deregulated).

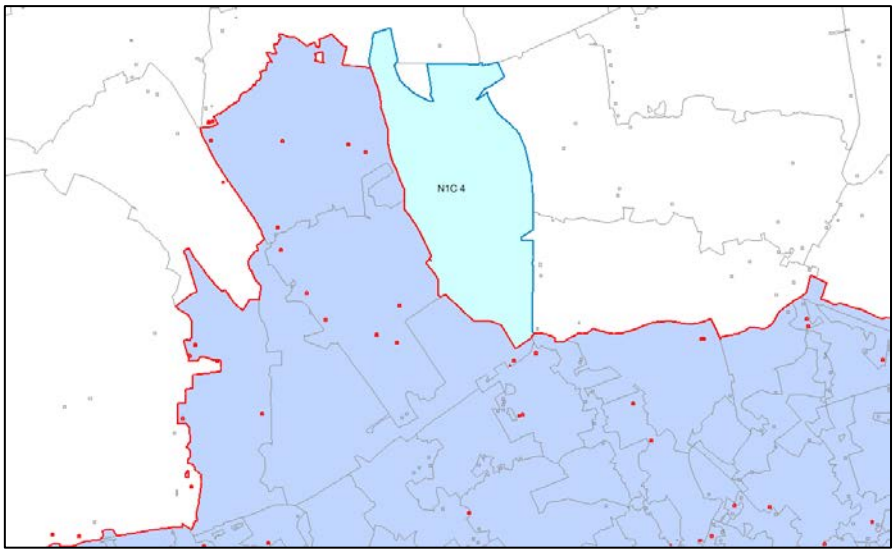
Table A10.19 Detailed analysis of a series of postcode sectors

Comment Reference	Postcode Sector	Discussion
A10.191	N1C 4	This postcode sector is adjacent to the north side of the CLA boundary in the King's Cross area as shown in Figure A10.20. With a network reach below two[398], there appear to be low levels of competition as neither of the conditions of the boundary test is passed. Looking at circuit customer ends in this area by bandwidth and supplier shows that [✂] is in fact the largest supplier in this postcode sector, with over [✂] of all circuits (including TISBO). The presence of TISBO customer ends in the sector, even though they could be supplied on copper cable, indicate that [✂]'s duct network is present and may be well placed to retain these customers if they migrate to CISBO. This postcode sector is classified in the LP.
A10.192	NW10 6	This postcode sector is north-west of the CLA boundary in North-West London as shown in Figure A10.21. There appears to be a moderate amount of competition in this area with a network reach of around four; however neither of the conditions of the boundary test are passed. This postcode sector is classified in the LP.
A10.193	NW10 7	This postcode sector is north-west of the CLA boundary in North-West London as shown in Figure A10.22. There appears to be moderate amounts of competition in this area with a network reach of around three, however neither of the conditions of the boundary test are passed. This postcode sector is classified in the LP.
A10.194	W12 0	This postcode sector is north-west of the CLA boundary in the Wormwood Scrubs area as shown in Figure A10.23. There appears to be moderate amounts of competition in this area with a network reach of around three, however neither of the conditions of the boundary test are passed. This postcode sector is classified in the LP.
A10.195	NW10 6 NW10 7 W12 0	Treating these three postcode sectors, located in North-West London, as a single contiguous block, the network reach figures are closer to the average for the LP than that for the CLA. Coupled with the fact that all three postcode sectors fail to meet the conditions of the boundary test, these postcode sectors

[396] Paragraph A10.182.
[397] BT referred to these in Section 11 of its response to illustrate various comments on our network reach analysis.
[398] I.e. Average number of OCPs is below 2.

		remain classified in the LP.
A10.196	W14 0	This postcode sector is adjacent to the west side of the western block of the CLA boundary in the West Kensington area as shown in Figure A10.24. Despite this postcode sector's adjacency it has a network reach below three, and there appears to be low levels of competition as neither of the conditions of the boundary test is passed. This postcode sector is classified in the LP.
A10.197	W2 4	This postcode sector is the postcode sector connecting the main and western blocks of the CLA boundary in the Kensington Gardens area as shown in Figure A10.25. Despite this postcode sector's location it has a network reach below three, and there appears to be low levels of competition as neither of the conditions of the boundary test is passed. This postcode sector is classified in the LP. It is worth noting that businesses and flexibility points are concentrated in the northern section of this sector which is not contiguous with the main block of the CLA.
A10.198	W6 7	This postcode sector is adjacent to the west side of the western block of the CLA boundary in the Kensington Olympia area as shown in Figure A10.26. With a network reach above five, there appear to be high levels of competition as both of the conditions of the boundary test are passed. This postcode sector was classified in the CLA[399] but was not shown in maps of the CLA boundary.[400]

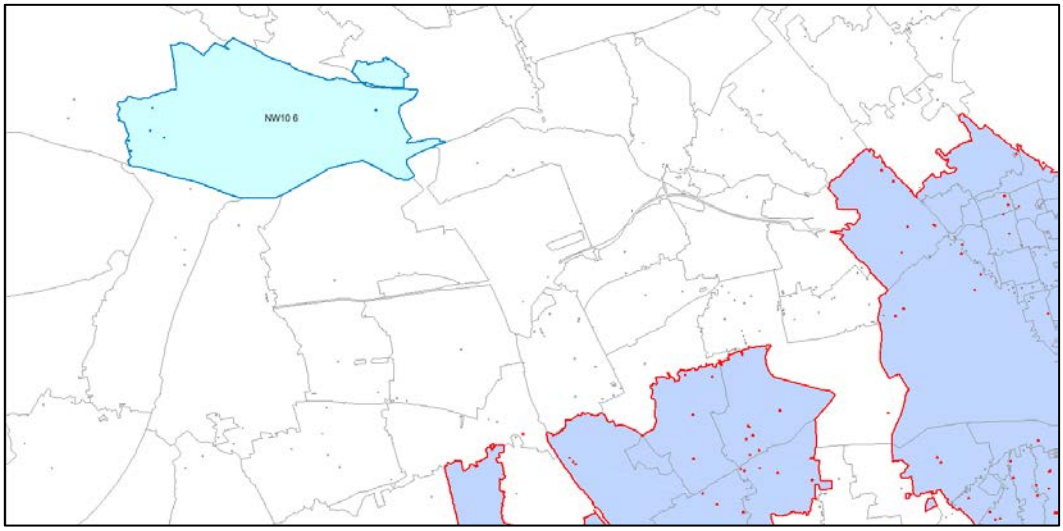
Figure A10.20 Map of Postcode Sector N1C 4



CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'N1C 4' shown in light blue; and UK postcode sector borders shown in grey.

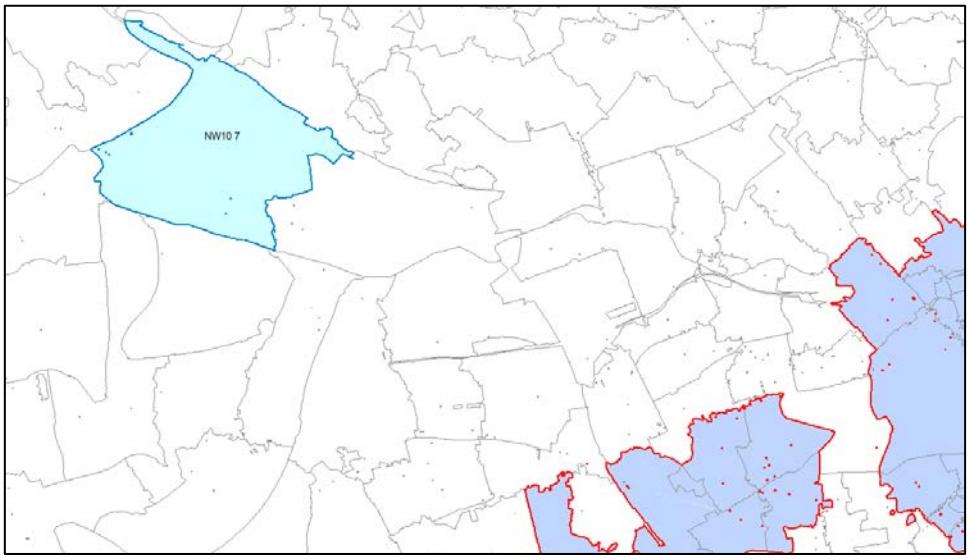
[399] Annex 6 of the May 2015 BCMR Consultation, Schedule 1.
[400] Figures 4.4 and A15.19 of the May 2015 BCMR Consultation.

Figure A10.21 Map of Postcode Sector NW10 6



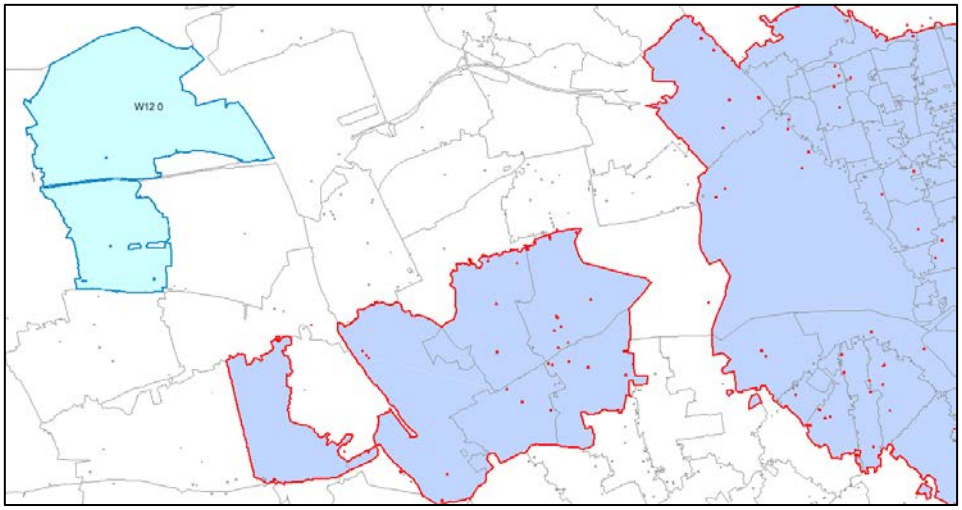
CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'NW10 6 shown in light blue; and UK postcode sector borders shown in grey.

Figure A10.22 Map of Postcode Sector NW10 7



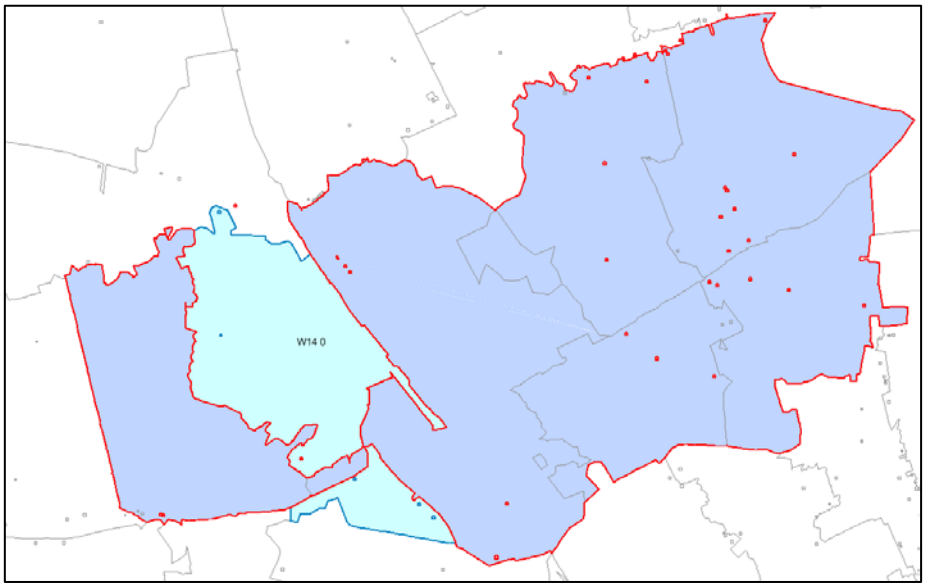
CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'NW10 7' shown in light blue; and UK postcode sector borders shown in grey.

Figure A10.23 Map of Postcode Sector W12 0



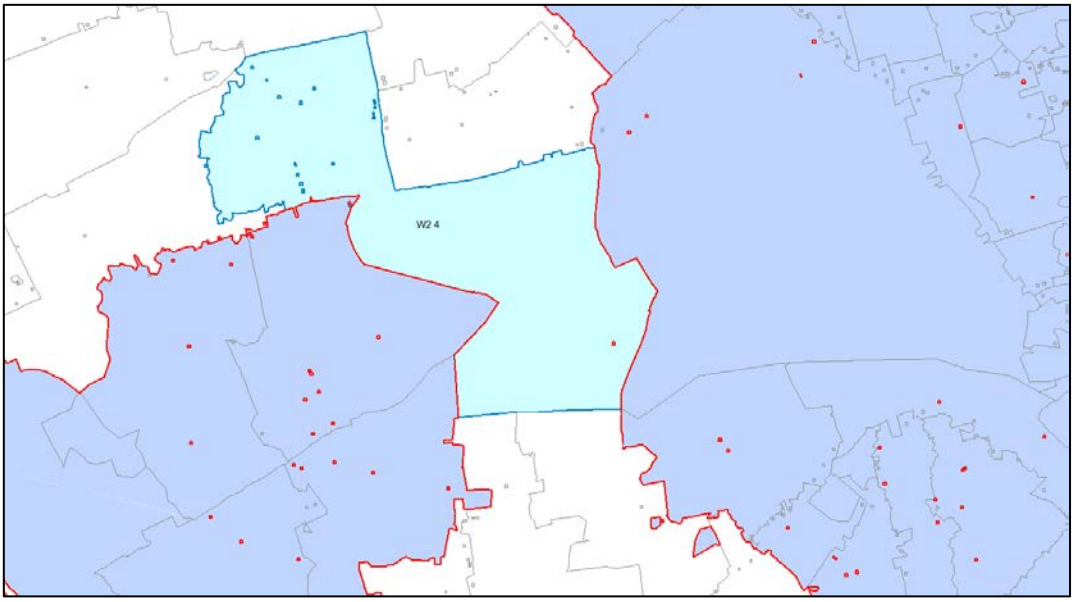
CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'W12 0' shown in light blue; and UK postcode sector borders shown in grey.

Figure A10.24 Map of Postcode Sector W14 0



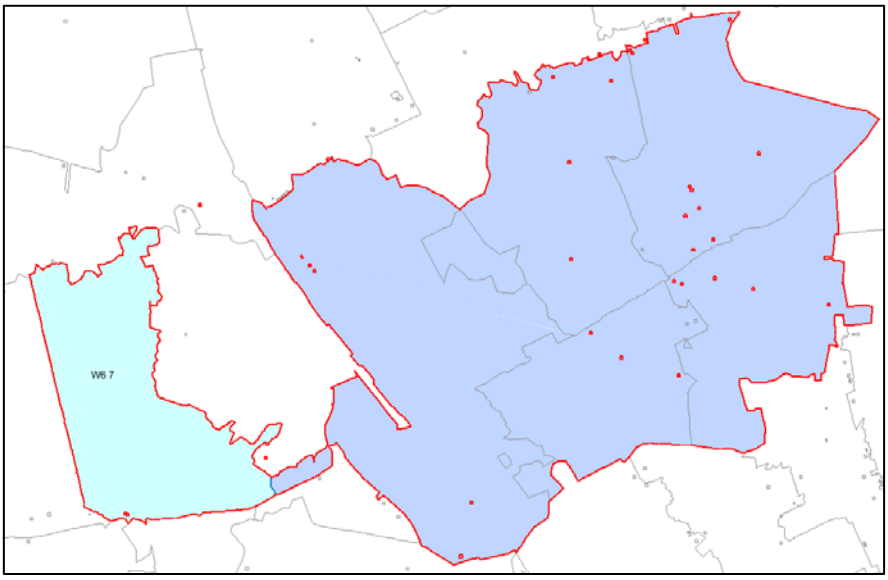
CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'W14 0' shown in light blue; and UK postcode sector borders shown in grey.

Figure A10.25 Map of Postcode Sector W2 4



CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'W2 4' shown in light blue; and UK postcode sector borders shown in grey.

Figure A10.26 Map of Postcode Sector W6 7



CLA Boundary shown in red; CLA postcode sectors shown in pale blue; postcode sector 'W6 7' shown in light blue; and UK postcode sector borders shown in grey.

Identification of areas of leased line supply in the UK using customer locations

A10.199 The leased line customer ends data[401] which is used in the derivation of market shares identifies areas of actual supply of network connectivity in the UK. By

[401] As described in Annex 15 of the May 2015 BCMR Consultation.

substituting this data for business sites, alternate values of network reach can be calculated and compared with existing values.

A10.200 Table A10.27 displays the network reach values for each geographic area using this data on leased line customer ends, as well as the previously calculated values using business sites, at buffer distances of 100m and 200m. As can be seen in Table A10.27, the corresponding values for business sites and customer ends are quite similar, with the main difference being that network reach is higher in the LP than the CBDs for customer ends at 200m.

Table A10.27 Network Reach[402] by geographic area, based on business sites and customer ends

Area	Business Sites		Customer Ends	
	100m	200m	100m	200m
CLA	6.23	8.03	6.06	7.94
LP	2.52	4.10	2.59	4.19
CBDs	2.77	4.26	2.65	4.04
RoUK (inc. CBDs)	0.79	1.13	0.78	1.12

Additional analyses of CPs' network coverage

A10.201 Additional analyses were conducted to measure the network coverage of CPs and the competition present in the recognised geographic areas. This included an analysis of the proportion of business sites within a given distance of each OCP's network (the "depth" of competition provided by each OCP), the distribution of the number of OCPs within a given buffer distance of business sites, the distribution of the number of OCPs within a given buffer distance of customer ends, and the average distance from customer ends to the nearest CP flexibility point.

A10.202 Further analysis investigating the depth of competition from each OCP was conducted. This involved determining the number of business sites within 200m of each OCP's network[403], and converting this to a percentage of the total number of business sites. This was performed in each geographic area.

A10.203 Tables A10.28 and A10.29 show the percentage of business sites within 100m and 200m of each OCP's network respectively for each OCP. On this basis, within 200m the CLA has nine OCPs available to greater than or equal to 40% of business sites. This compares with the LP which has six such OCPs, and the CBDs which have four such OCPs. The RoUK has one OCP available to greater than or equal to 40% of business sites.

[402] The average number of the OCPs with a flexibility point within 100m or 200m of large business sites or customer ends in a postcode.
[403] I.e. The distance between the nearest CP flexibility point and a business site was 200m or less.

Table A10.28 Percentage of Business Sites within 100m of CP flexibility points, by CP and area

[✂]

Table A10.29 Percentage of Business Sites within 200m of CP flexibility points, by CP and area

[✂]

A10.204 We also looked at the distribution of the number of OCPs within a 200m buffer distance of business sites on a per geographic area basis.

A10.205 Tables A10.30 - A10.33 show the percentage distributions of the number of OCPs within 200m of business sites for each geographic area.

Table A10.30 Distribution of number of OCPs within 200m of business sites, CLA

No. of OCPs	% of Business Sites within 200m in the CLA	Cumulative % of Business Sites within 200m in the CLA
0	0.00%	100.00%
1	0.02%	100.00%
2	0.14%	99.98%
3	0.28%	99.83%
4	1.11%	99.55%
5	2.45%	98.44%
6	7.69%	95.99%
7	18.33%	88.30%
8	30.50%	69.97%
9	34.63%	39.47%
10	3.54%	4.84%
11	1.09%	1.30%
12	0.09%	0.21%
13	0.12%	0.12%

Table A10.31 Distribution of number of OCPs within 200m of business sites, LP

No. of OCPs	% of Business Sites within 200m in the LP	Cumulative % of Business Sites within 200m in the LP
0	0.89%	100.00%
1	8.29%	99.11%
2	12.88%	90.82%
3	18.83%	77.95%
4	22.59%	59.12%
5	11.87%	36.53%
6	11.57%	24.66%

7	7.25%	13.08%
8	2.99%	5.83%
9	2.40%	2.84%
10	0.33%	0.44%
11	0.12%	0.12%
12	0.00%	0.00%
13	0.00%	0.00%

Table A10.32 Distribution of number of OCPs within 200m of business sites, CBDs[404]

No. of OCPs	% of Business Sites within 200m in the CBDs	Cumulative % of Business Sites within 200m in the CBDs
0	0.63%	100.00%
1	3.93%	99.37%
2	11.16%	95.44%
3	18.90%	84.28%
4	19.49%	65.38%
5	17.52%	45.89%
6	12.60%	28.36%
7	10.89%	15.76%
8	3.82%	4.88%
9	0.93%	1.06%
10	0.09%	0.14%
11	0.00%	0.05%
12	0.02%	0.05%
13	0.02%	0.02%

Table A10.33 Distribution of number of OCPs within 200m of business sites, RoUK (including CBDs)

No. of OCPs	% of Business Sites within 200m in the RoUK	Cumulative % of Business Sites within 200m in the RoUK
0	28.54%	100.00%
1	41.71%	71.46%
2	17.99%	29.75%

[404] There are slight variations within each of the cities of the CBDs, with Birmingham and Leeds both most frequently having four OCPs within 200m similar to that of the overall CBDs. Bristol also most frequently has four OCPs within 200m, although a high percentage of business sites are also within 200m of six OCPs. Glasgow most frequently has three OCPs within 200m, and Manchester most frequently has 5 OCPs within 200m.

3	6.37%	11.75%
4	2.98%	5.39%
5	1.27%	2.40%
6	0.60%	1.14%
7	0.39%	0.54%
8	0.12%	0.15%
9	0.03%	0.03%
10	0.00%	0.00%
11	0.00%	0.00%
12	0.00%	0.00%
13	0.00%	0.00%

A10.206 As can be seen in the above four tables, business sites in the CLA most frequently have nine OCPs within 200m, whereas business sites in the RoUK most frequently have one OCP within 200m. In both the LP and CBDs business sites most frequently have four OCPs within 200m.

A10.207 This same analysis was also performed on customer ends, resulting in a distribution in number of OCPs within 200m of customer ends by geographic area, as shown in Tables A10.34 through A10.37.

Table A10.34 Distribution of number of OCPs within 200m of customer ends, CLA

No. of OCPs	% of Leased Lines within 200m in the CLA	Cumulative % of Leased Lines within 200m in the CLA
0	0.05%	100.00%
1	0.12%	99.95%
2	0.12%	99.83%
3	0.40%	99.71%
4	1.76%	99.32%
5	1.91%	97.56%
6	12.41%	95.65%
7	14.45%	83.24%
8	25.76%	68.78%
9	38.58%	43.02%
10	2.07%	4.44%
11	1.71%	2.37%
12	0.44%	0.67%
13	0.23%	0.23%

Table A10.35 Distribution of number of OCPs within 200m of customer ends, LP

No. of OCPs	% of Leased Lines within 200m in the LP	Cumulative % of Leased Lines within 200m in the LP
0	1.70%	100.00%

1	6.25%	98.30%
2	8.87%	92.05%
3	13.17%	83.18%
4	14.07%	70.01%
5	13.37%	55.94%
6	14.12%	42.57%
7	10.20%	28.45%
8	7.52%	18.25%
9	9.63%	10.73%
10	0.30%	1.09%
11	0.75%	0.79%
12	0.01%	0.04%
13	0.04%	0.04%

Table A10.36 Distribution of number of OCPs within 200m of customer ends, CBDs[405]

No. of OCPs	% of Leased Lines within 200m in the CBDs	Cumulative % of Leased Lines within 200m in the CBDs
0	0.77%	100.00%
1	4.89%	99.23%
2	12.10%	94.35%
3	16.66%	82.25%
4	18.56%	65.59%
5	16.90%	47.03%
6	15.58%	30.13%
7	9.05%	14.55%
8	4.32%	5.51%
9	0.98%	1.19%
10	0.10%	0.21%
11	0.00%	0.11%
12	0.01%	0.11%
13	0.11%	0.11%

Table A10.37 Distribution of number of OCPs within 200m of customer ends, RoUK (including CBDs)

No. of OCPs	% of Leased Lines within 200m in the RoUK	Cumulative % of Leased Lines within 200m in the RoUK

[405] There are slight variations within each of the cities of the CBDs, with Birmingham, Bristol and Manchester most frequently having four OCPs within 200m similar to that of the overall CBDs. Glasgow most frequently has two OCPs, and Leeds most frequently has five OCPs.

0	26.59%	100.00%
1	39.11%	73.41%
2	18.06%	34.30%
3	7.67%	16.23%
4	4.58%	8.56%
5	2.02%	3.98%
6	1.17%	1.96%
7	0.50%	0.79%
8	0.23%	0.29%
9	0.05%	0.06%
10	0.00%	0.01%
11	0.00%	0.01%
12	0.00%	0.01%
13	0.00%	0.00%

A10.208 As can be seen in the above four tables, customer ends in the CLA most frequently have nine OCPs within 200m, whereas customer ends in the RoUK most frequently have one OCP within 200m. In the LP customer ends most frequently have six OCPs within 200m. In the CBDs customer ends most frequently have four OCPs within 200m. In comparison this is similar to that of business sites, with the exception being in the LP.

A10.209 To investigate differences in competitive conditions between current VHB customer sites and the lower bandwidth CISBO sites which may be representative of the future VHB CISBO customer base, network reach was calculated for VHB CISBO and lower bandwidth (LB) CISBO (up to and including 1Gbit/s) customer ends for each geographic area. This is shown in Table A10.38 where it can be seen that, in general, the network reach for VHB CISBO customer ends is larger than that for LB CISBO customer ends.

Table A10.38 Network reach[406] of VHB CISBO and LB CISBO customer ends, by geographic area

	VHB CISBO		LB CISBO	
Area	**100m**	**200m**	**100m**	**200m**
CLA	6.47	8.08	6.16	8.00
LP	3.03	4.90	2.65	4.30
CBDs	3.06	4.44	2.74	4.17
RoUK (inc. CBDs)	1.17	1.67	0.85	1.23

A10.210 The proportion of VHB CISBO and LB CISBO customer ends within a 100m or 200m buffer distance of four or more OCPs for each geographic area is shown in Table A10.39.

[406] The average number of OCPs with a flexibility point within 100m or 200m of customer ends in a postcode.

Table A10.39 Proportion of VHB CISBO and LB CISBO customer ends within a buffer distance of greater than or equal to four OCPs, per geographic area

	VHB CISBO		LB CISBO	
Area	100m	200m	100m	200m
CLA	97%	100%	93%	99%
LP	55%	85%	39%	67%
CBDs	28%	64%	35%	65%
RoUK (inc. CBDs)	5%	18%	3%	9%

A10.211 The above two tables suggest that:

- Competition is significantly more intense in the CLA than in any other area;
- Overall, the LP appears more competitive than the CBDs; and
- In some areas, most notably the LP, the extent of rival infrastructure near VHB CISBO sites is materially greater than at lower bandwidth sites.

A10.212 The average distance from current customer end locations to the nearest CP flexibility point was a further analysis which was performed on a per geographic area basis.

A10.213 Table A10.40 shows in each geographic area the average distance between leased line customer ends and the closest (1st) CP flexibility point, the next closest (2nd) CP flexibility point, etc.[407] The shorter distances appear in the CLA with the longest distances appearing in RoUK. The LP and CBDs have average distances longer than the CLA but not as long as the RoUK. The CBDs have shorter average distances between the customer end site and the four nearest CPs than the LP. The average distances to the fifth and sixth closest CPs are shorter in the LP than in the CBDs.

Table A10.40 Average customer end to CP distance (m)

Area	1st CP	2nd CP	3rd CP	4th CP	5th CP	6th CP
CLA	16.45	26.36	36.01	45.88	57.67	75.69
LP	38.54	71.85	111.05	154.65	201.54	274.04
CBDs	30.67	59.19	90.00	139.54	219.40	313.81
RoUK (inc. CBDs)	151.98	815.08	2,315.54	4,158.53	8,029.85	11,074.74

Mobile backhaul network reach

A10.214 The network reach results based on the locations of MNO backhaul sites are shown in Table A10.41 for each geographic area. These values are consistent with those for business sites (shown in Table A10.27).

[407] CPs includes BT in this analysis.

Table A10.41 Network Reach per geographic area, based on MNO site locations

Area	100m NR	200m NR
CLA	6.09	7.95
LP	2.42	4.00
CBDs	2.55	3.97
RoUK (inc. CBDs)	0.70	1.01

LLU network reach

A10.215 The network reach results based on the locations of LLU sites are shown in Table A10.42 for each geographic area. These values are consistent with those for business sites (shown in Table A10.27).

Table A10.42 Network Reach per geographic area, based on LLU site locations

Area	100m NR	200m NR
CLA	6.76	8.28
LP	2.94	4.42
CBDs	3.52	4.59
RoUK (inc. CBDs)	0.40	0.52

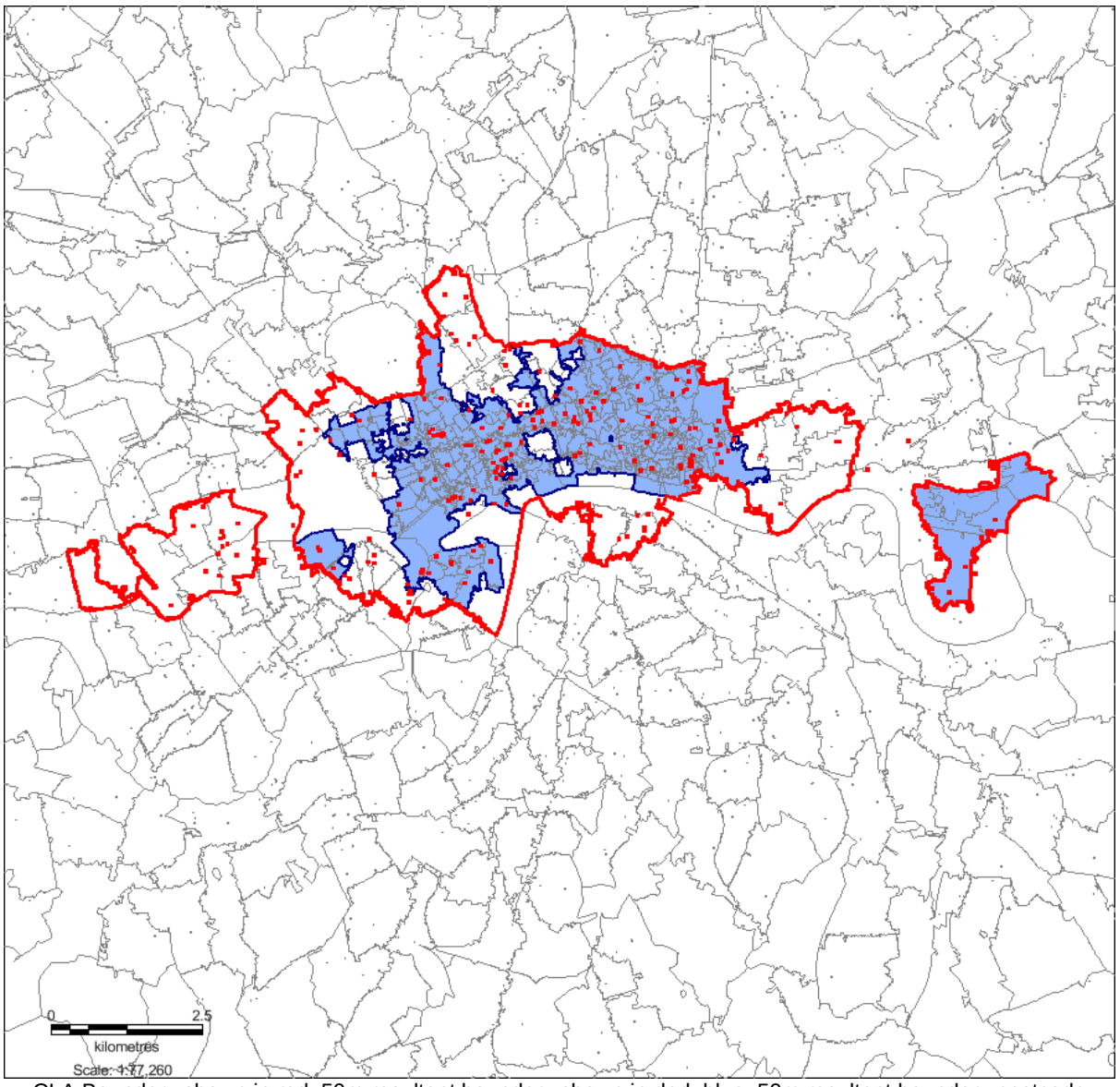
CLA boundary sensitivity analysis

A10.216 As detailed above, the robustness of the CLA boundary was tested with two sets of alternative boundary tests as a sensitivity analysis in the May 2015 BCMR Consultation. Here we perform another sensitivity analysis involving unchanged conditions of the boundary tests, instead we vary the buffer distance (shorter at 50m; longer at 200m), use leased line customer ends instead of business sites, and use postcodes instead of postcode sectors. Based on these variances, alternative CLA boundaries were derived and then compared to the actual CLA boundary.

A10.217 The same process, as summarised above in A10.159 and A10.160, used in deriving the CLA boundary was used in deriving these alternate CLA boundaries with those variances mentioned above.

A10.218 In the first sensitivity, we use a 50m buffer distance rather than the 100m buffer distance used in deriving the CLA boundary. Figure A10.43 shows the resultant boundary (in blue) with the existing CLA boundary overlaid (in red).

Figure A10.43 Map of resultant boundary using 50m buffer distance



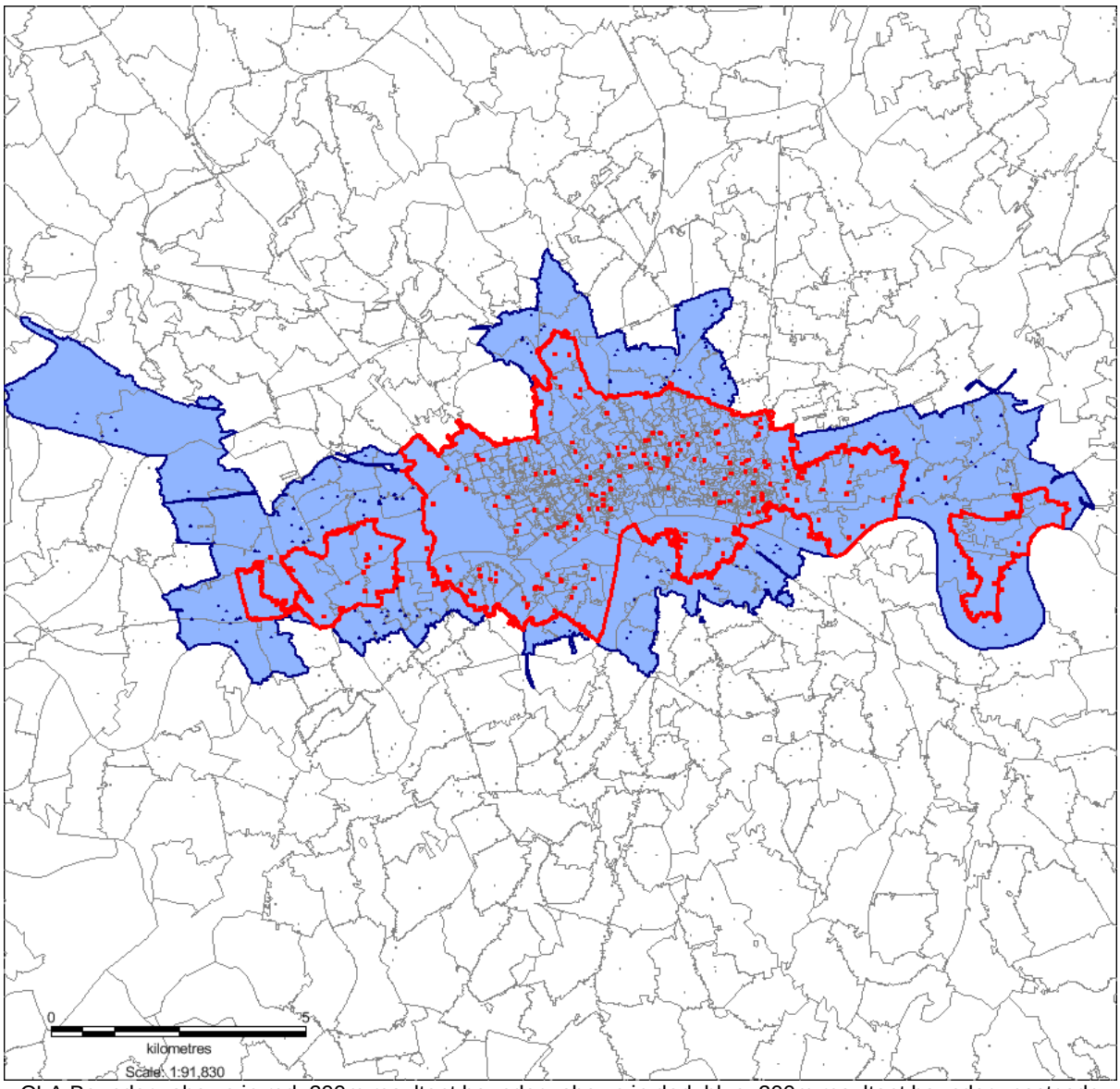
CLA Boundary shown in red; 50m resultant boundary shown in dark blue; 50m resultant boundary postcode sectors shown in pale blue; and UK postcode sector borders shown in grey.

A10.219 This resultant boundary shows that the central core, with a few exceptions, remains defined as "competitive" even when the buffer distance is reduced to 50m. It is also noteworthy that the eastern block of the CLA remains unchanged. Overall, this reduction in buffer distance has not caused a large change to the boundary, so we believe the boundary to be robust to a shorter buffer distance.[408]

A10.220 In the second sensitivity, we use a 200m buffer distance rather than the 100m buffer distance used in deriving the CLA boundary. Figure A10.44 shows the resultant boundary (in blue) with the existing CLA boundary overlaid (in red).

[408] 78% of CLA postcode sectors remain within the boundary defined by the conditions of the "Boundary Test" with a buffer distance halved to 50m.

Figure A10.44 Map of resultant boundary using 200m buffer distance



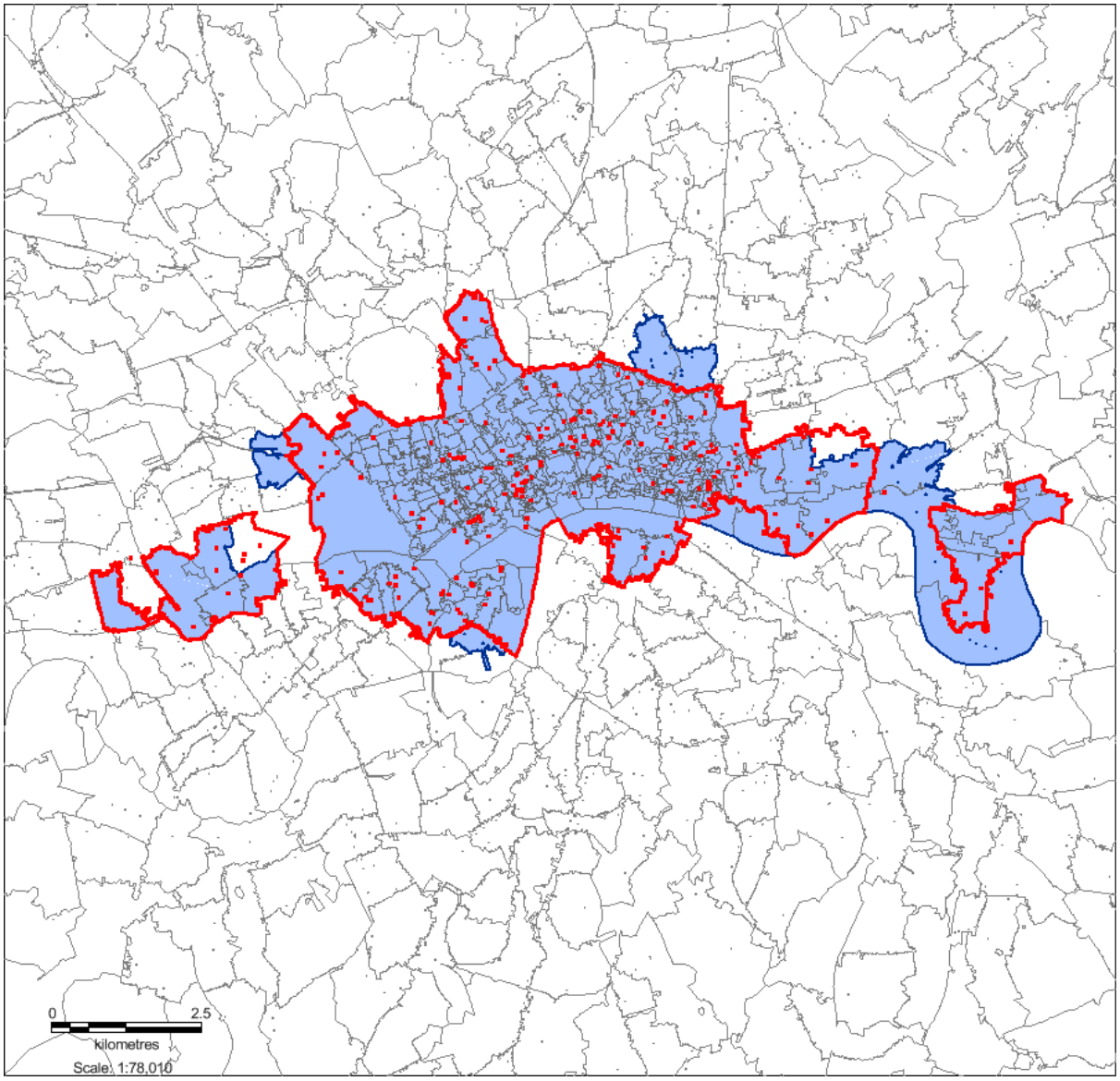
CLA Boundary shown in red; 200m resultant boundary shown in dark blue; 200m resultant boundary postcode sectors shown in pale blue; and UK postcode sector borders shown in grey.

A10.221 This resultant boundary joins the previously separated eastern and western blocks of the CLA boundary with the main block, as well as a number of additional postcode sectors around the existing boundary. Overall though, this increase in buffer distance has not caused a large change to the boundary, so we believe the boundary to be robust to a longer buffer distance.[409]

[409] Doubling the buffer distance to 200m increases by 20% the number of sectors within the boundary defined by the conditions of the "Boundary Test". As can be seen from Figure A10.44, the added sectors tend to be larger than those within the CLA itself.

A10.222 The third variance looks at using leased line customer ends instead of business sites which were used in deriving the CLA boundary. Figure A10.45 shows the resultant boundary (in blue) with the existing CLA boundary overlaid (in red).

Figure A10.45 Map of resultant boundary using leased line customer ends



CLA Boundary shown in red; Leased line resultant boundary shown in dark blue; Leased line resultant boundary postcode sectors shown in pale blue; and UK postcode sector borders shown in grey.

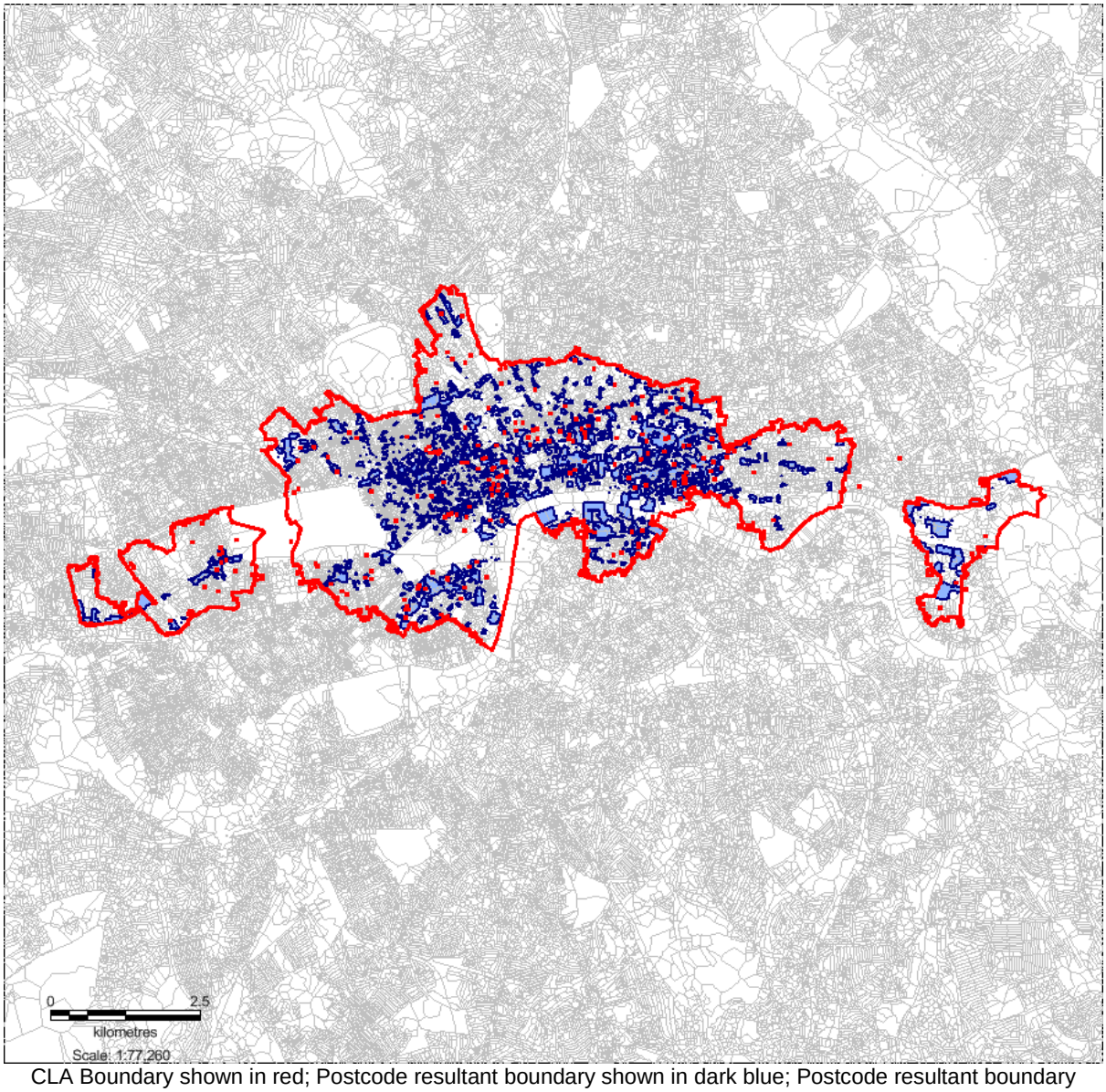
A10.223 This resultant boundary is largely unchanged, so we believe the boundary to be robust to using leased line customer ends.[410] One change that does appear in this sensitivity is the connection of the eastern block to the main block. This connection of the main block with the eastern block is also present in the sensitivity analysis of business sites at a 200m buffer distance above (Figure A10.44). However, given

[410] Using leased line customer ends instead of business sites increases by 2% the number of sectors within the boundary defined by the conditions of the "Boundary Test".

the small number of customer ends in these connecting postcode sectors, we consider large business sites a better reflection of potential demand and are more relevant to competition across the area as a whole. As a result of this, we do not propose to include these postcode sectors in the CLA.

A10.224 In the final sensitivity, we apply the boundary tests to large business sites at a postcode level instead of postcode sector level. Figure A10.46 shows the resultant boundary (in blue) with the existing CLA boundary overlaid (in red).

Figure A10.46 Map of resultant boundary using postcodes



CLA Boundary shown in red; Postcode resultant boundary shown in dark blue; Postcode resultant boundary postcode sectors shown in pale blue; and UK postcode borders shown in grey.

A10.225 This resultant boundary shows differences to that derived using postcode sectors, the CLA boundary. It is evident from this map just how much smaller postcodes are than postcode sectors, even in the CLA where postcode sectors are relatively small compared to other areas. The “patchy” appearance of this resultant boundary is mainly due to many postcodes having no large businesses present, making it seemingly impractical as a basis for market definition. Having said this, however,

93% of those postcodes in the CLA which have business sites present pass the conditions of the boundary test.

A10.226 Overall, this set of sensitivity analysis does not show major differences in their derived boundaries to that of the CLA boundary. As a result, we consider that the CLA boundary is robust as the sensitivity analyses that we have performed do not result in major differences to the boundary.

Calculating shares of CISBO services based on revenue

A10.227 In markets for differentiated products, like leased lines, shares of market value are often informative, in addition to shares of market volume. Our measure of market shares is calculated from the numbers or volume of leased line terminating segments supplied.

A10.228 We are unable to measure market shares based on leased lines revenues because many CPs were unable to present their revenue data at the required level of granularity. However, by using various proxies for leased line prices, we calculate revenue-based shares as a sensitivity test to our main volume-based approach.

A10.229 Our ability to estimate value-based shares is constrained by the limited availability of information on various CPs' prices and their services. As we have no revenue information, and as we do not have information on the prices of the various OCPs, we had to make a number of assumptions.

- First, we calculated BT's prices on an annualised basis, so prices reflect the annual charge including all relevant connection and rental charges over a three year contract term. Where applicable, we assumed a 10km circuit distance (main link). We used these BT's CISBO prices as a proxy for the prices of CISBO products for all CPs

- Second, since prices for CISBO services were not available by geography, we used the same CISBO prices for CLA, LP and RoUK.[411]

A10.230 The following Table A10.47 shows the resulting estimates of CISBO service shares based on revenues for the four largest CPs. For comparison, we also report volume-based service shares. The numbers presented below differ slightly from the ones in table A15.19 of the May 2015 BCMR Consultation due to minor changes in number of customer circuit ends following corrections described above in this Annex. The assumptions about the underlying prices have remained unchanged. For consistency with Section 4 of this statement, we include LLU backhaul in the calculations.

[411] [✂]

Table A10.47 – Revenue-based CISBO shares

		CLA	LP	RoUK
revenue	BT	38%	42%	55%
	Virgin	[✂]	[✂]	[✂]
	Colt	[✂]	[✂]	[✂]
	Vodafone	[✂]	[✂]	[✂]
volume	BT	45%	48%	57%
	Virgin	[✂]	[✂]	[✂]
	Colt	[✂]	[✂]	[✂]
	Vodafone	[✂]	[✂]	[✂]

A10.231 Comparing both sets of results shows that BT's estimated revenue-based shares are slightly lower than its volume-based shares in the CLA and LP whilst in the Rest of the UK the two measures are similar.

Additional material on CBDs and London postcode sectors

A10.232 The following analysis provides additional background on the CBDs and the CLA boundary. This analysis has been extracted from the May 2015 BCMR consultation. We have not updated maps or tables.

A10.233 The "network reach" analysis below shows how the extent of competing infrastructure varies in each of the five cities which contain the CBDs. This was previously set out in Annex 15 of the May 2015 BCMR Consultation at paragraphs A15.159 - A15.161.

A10.234 We identified five cities with the largest density of rival infrastructure outside London – Birmingham, Bristol, Glasgow, Leeds and Manchester. In each of these cities, we identified the contiguous high network reach area, defined as those postcode sectors where the average number of OCPs with a flexibility point within 200m of the large business sites was equal to two or more. In each case, the areas with highest network reach are located in the centre of the city. The next set of maps (Figures A10.48 – A10.52) shows network reach values for the high network reach areas.

Figure A10.48 - Network Reach: Birmingham

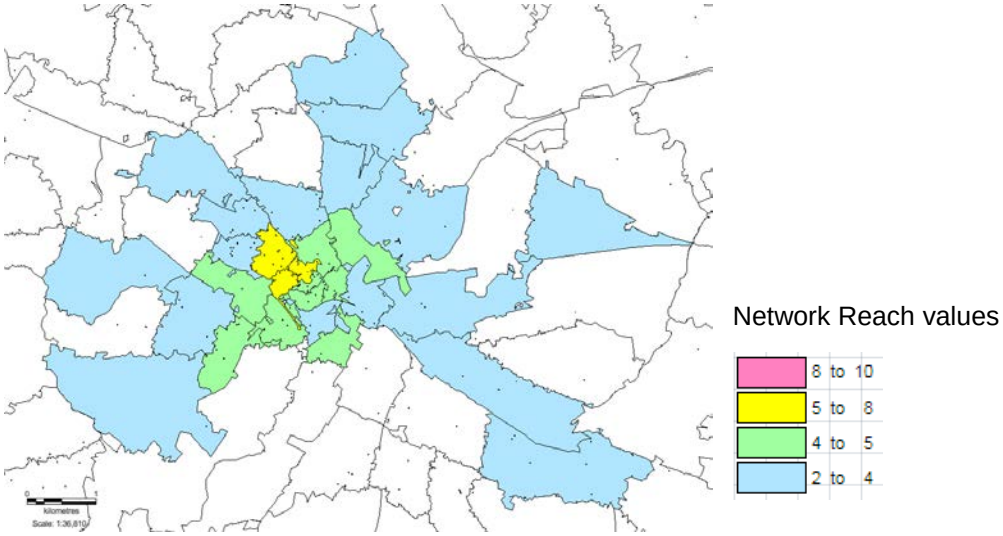


Figure A10.49 - Network Reach: Bristol

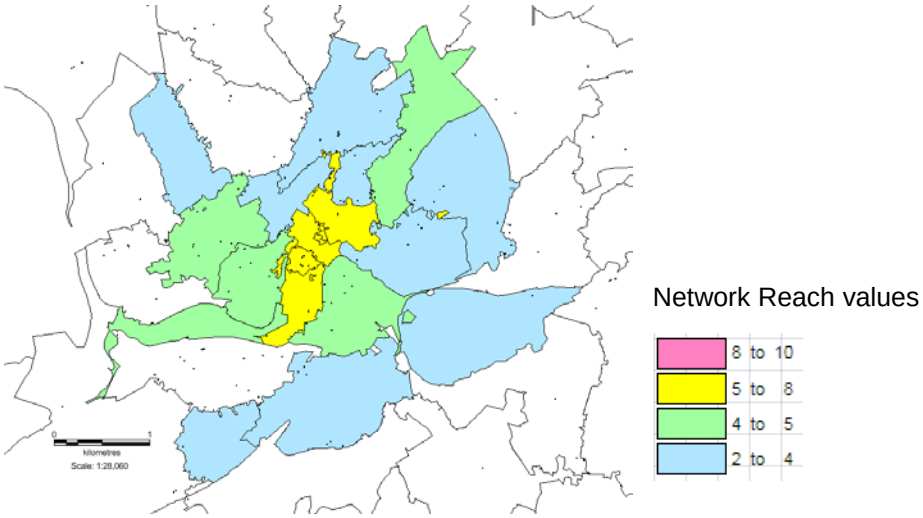


Figure A10.50 - Network Reach: Glasgow

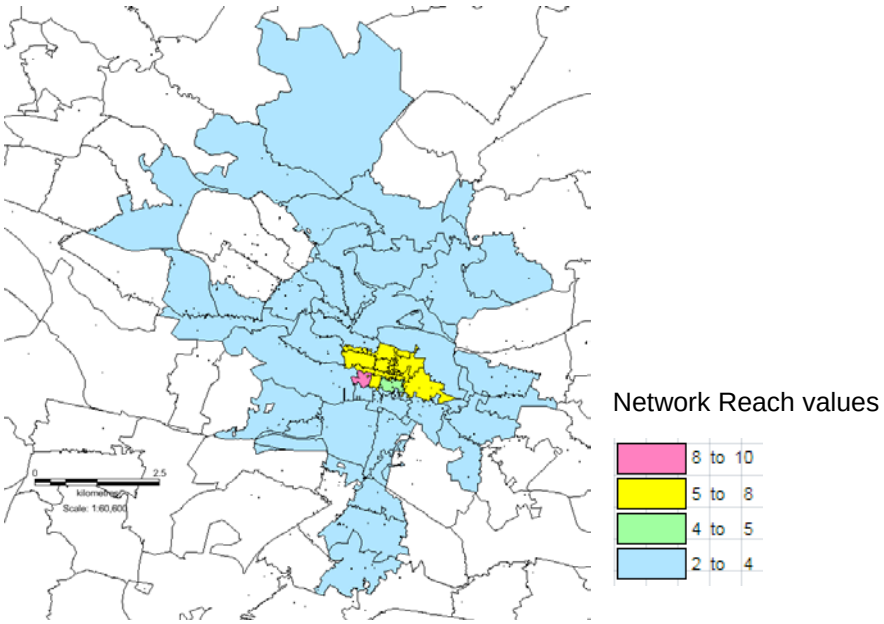


Figure A10.51 - Network Reach: Leeds

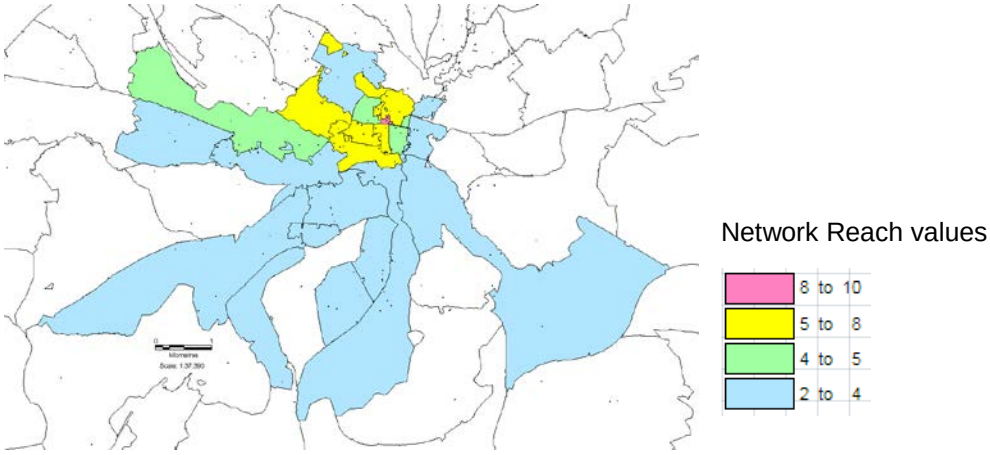
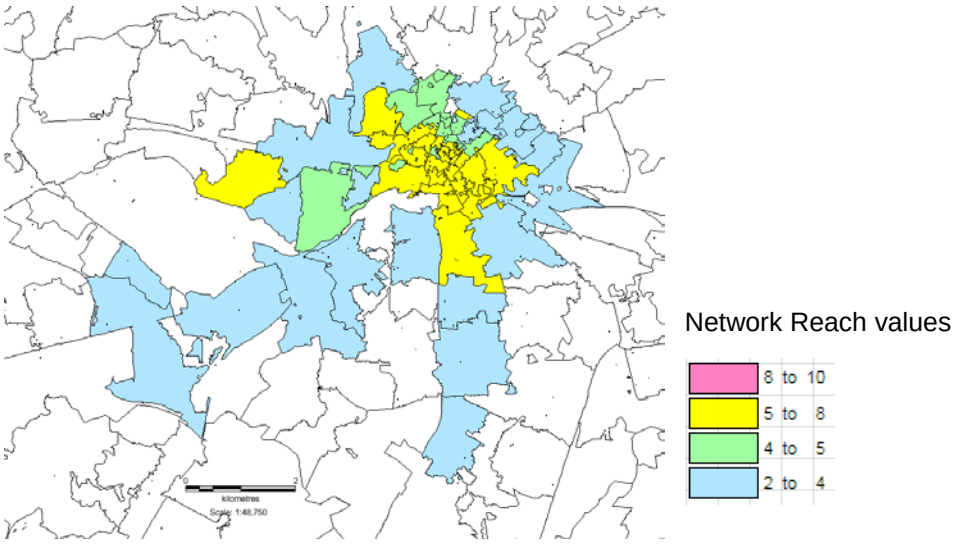


Figure A10.52 – Network Reach: Manchester



A10.235 The maps illustrate that most sectors in the contiguous high network reach areas of city centres have network reach values between 2 and 4 (shown in blue) and very few sectors have network reach equal to or above 4.

A10.236 In the next table (Table A10.53) we present the number of postcode sectors, businesses and leased lines sold in the high network reach areas of each selected city. Additionally we also present average network reach and density of rival infrastructure. The last column of the table shows figures for all five central business districts ("CBDs") combined. The numbers show, for example, that approximately half of the businesses located in the central business districts have at most 4 OCPs' flexibility points within 200m.

Table A10.53 - Statistics for CBDs

	Birmingham	Bristol	Glasgow	Leeds	Manchester	Combined
No. of sectors	28	15	43	23	49	158
No. of business	777	691	1,146	773	1,041	4,428
Avg. network reach	4.1	4.8	4.0	4.7	4.6	4.4
b. within reach of 0 OCPs	0%	0%	0%	2%	1%	1%
b. within reach of 1 OCPs	3%	2%	5%	5%	3%	4%
b. within reach of 2 OCPs	9%	7%	18%	8%	10%	11%
b. within reach of 3 OCPs	23%	17%	27%	14%	12%	19%
b. within reach of 4 OCPs	25%	19%	12%	24%	20%	19%
b. within reach of 5 OCPs	22%	20%	11%	13%	23%	18%
b. within reach of 6 OCPs	16%	10%	12%	11%	15%	13%
b. within reach of 7+ OCPs	2%	24%	15%	23%	16%	15%
TISBO low	1,773	951	2,095	1,405	1,648	7,873
CISBO	2,751	1,558	3,576	2,727	3,246	13,858

A10.237 The analysis below shows results for individual CBDs (Birmingham, Bristol, Glasgow, Leeds and Manchester) when the CLA boundary test is applied. These results were previously set out in Annex 15 of the May 2015 BCMR Consultation at paragraphs A15.181 - A15.182. Figures A10.54 – A10.58 show postcode sectors in each city passing either one of the conditions defined by the CLA boundary test set out above at paragraph A10.160. Sectors passing the first condition are marked in blue, sectors passing the second condition are marked in red. The green line marks the high network reach area, defined as above, of the city centre in each CBD.

Figure A10.54 - Birmingham

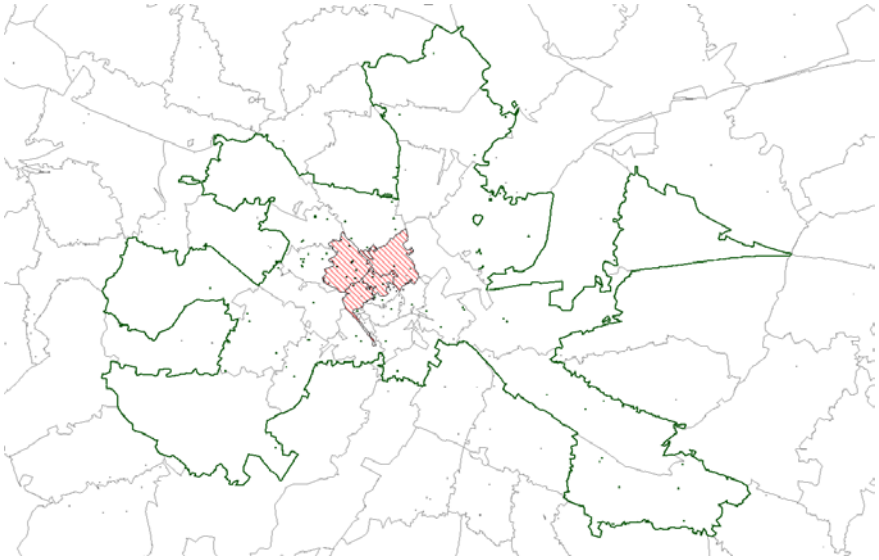


Figure A10.55 - Bristol

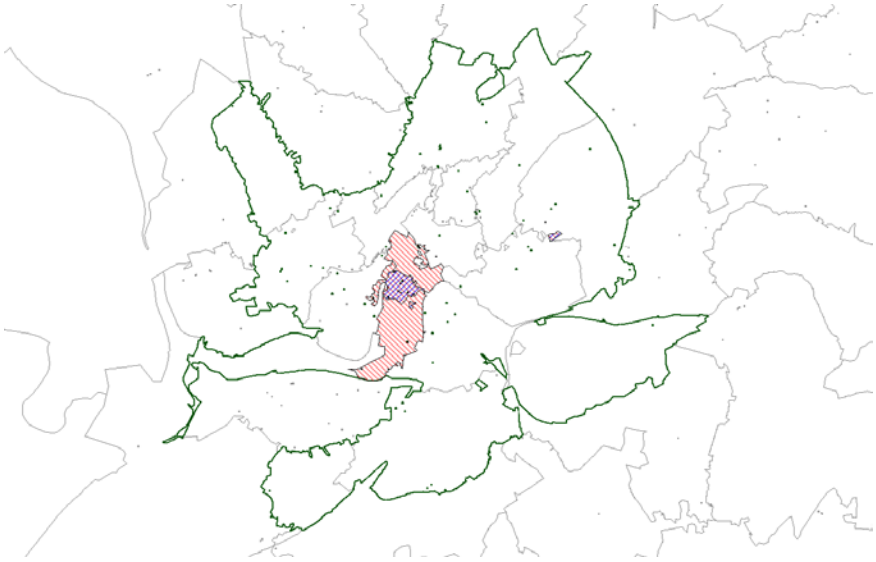


Figure A10.56 - Glasgow

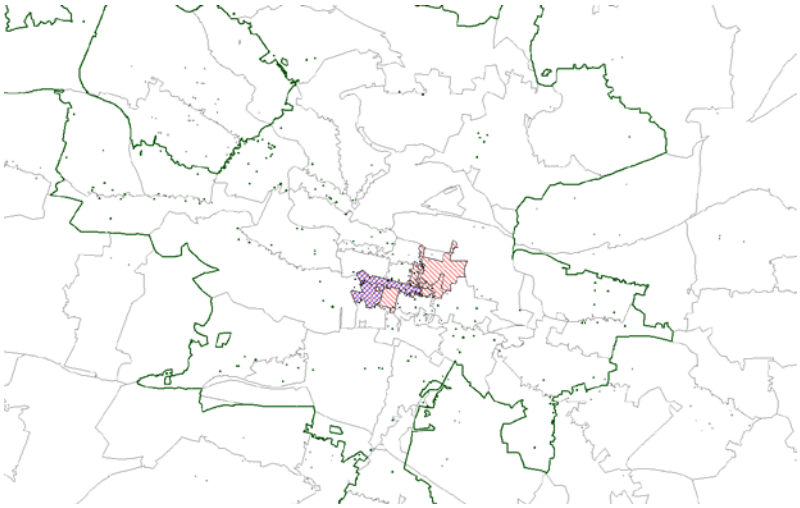


Figure A10.57 - Leeds

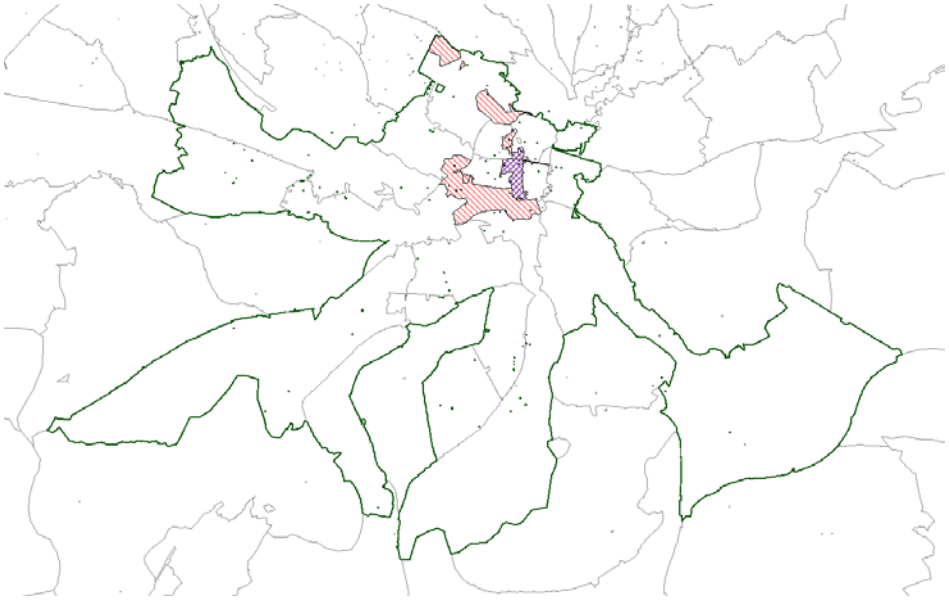
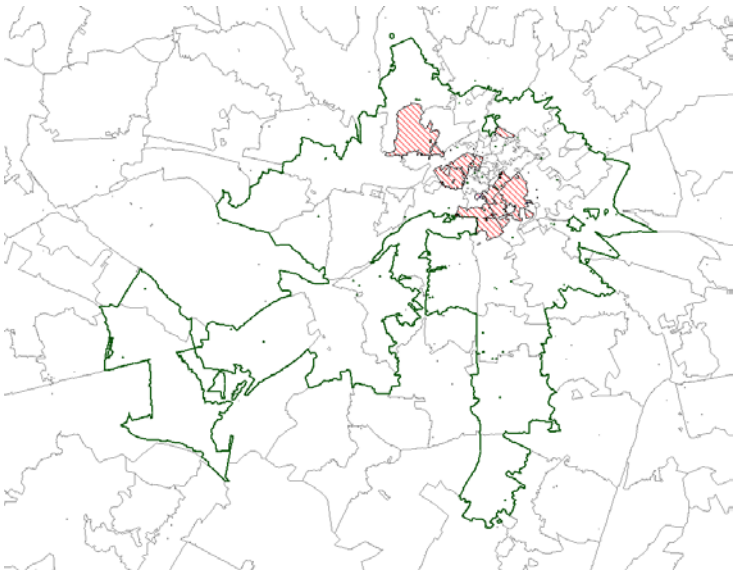


Figure A10.58 - Manchester



A10.238 The maps show that there are only a very few sectors in each city that pass either one of the conditions of the boundary test. The following table (Table A10.59) shows the number of sectors passing the boundary test for each CBD. We also present number of businesses and number of CISBO lines in those sectors. Comparing the values in Table A10.59 with values presented in Table A10.53 indicates that only a small proportion of the high network reach area within each city passes the boundary test.

Table A10.59 – Areas in CBDs passing the boundary test

	Sectors	Businesses	CISBO lines
Birmingham	4	139	650
Bristol	3	98	374
Glasgow	5	218	650
Leeds	5	145	540
Manchester	11	244	713

A10.239 Finally, as detailed in Annex 15 of the May 2015 BCMR Consultation (paragraphs A15.168 – A15. 171), we identified 11 postcode sectors located inside the CLA Boundary but which did not pass either of the conditions of the boundary test. We looked at these postcode sectors in more detail, and we found that all of these sectors came very close to satisfying at least one of the conditions. Even though these sectors do not have exactly the same amount and density of rival infrastructure present, they are contiguous with and indeed almost always entirely surrounded by sectors passing the boundary test. Additionally, 2 sectors of the 11 identified have no network reach value attributed to them as there are no businesses located in those sectors. However there are at least 4 OCPs present in these sectors and able to serve businesses which locate there in future. In the light of this, we consider that conditions in these 11 sectors are sufficiently similar to the conditions in the sectors passing the boundary test for these 11 sectors to be included in our proposed CLA definition.

A10.240 A list of the 11 postcode sectors located inside the CLA Boundary but which did not pass either of the conditions of the boundary test, and their respective number of businesses and leased lines can be found in Table A10.60 below.

Table A10.60 – List of postcode sectors and number of businesses and leased lines contained within each

Sector	Businesses	Leased Lines (local ends)*
E1 2	18	110
EC4Y 7	0	33
EC4Y 9	1	18
NW1 2	60	406
W1G 7	1	62
W1H 7	10	128
WC1H 8	5	28
WC1N 1	34	116
WC1N 3	3	93
WC1R 5	0	26
WC1X 0	3	18

Annex 11

Description of BT's wholesale products

Introduction

A11.1 In this section we describe the products that BT currently offers to satisfy its various SMP obligations across the wholesale leased lines markets. We also describe the associated interconnection services offered by BT.

BT's Ethernet products

A11.2 BT's current wholesale Ethernet products are Ethernet Access Direct (EAD) and Ethernet Backhaul Direct (EBD).

A11.3 EAD and EBD replaced the first-generation products Wholesale Extension Service (WES), Wholesale End-to-End Service (WEES) and Backhaul Ethernet Services (BES), which have been withdrawn from new supply, but are still widely used.

A11.4 BT's Ethernet products are provided by Openreach on an EOI basis and are therefore used by both CPs and BT's downstream divisions.

Wholesale Ethernet access services

A11.5 BT's current wholesale Ethernet access service is Ethernet Access Direct (EAD). It is available in 3 main variants:

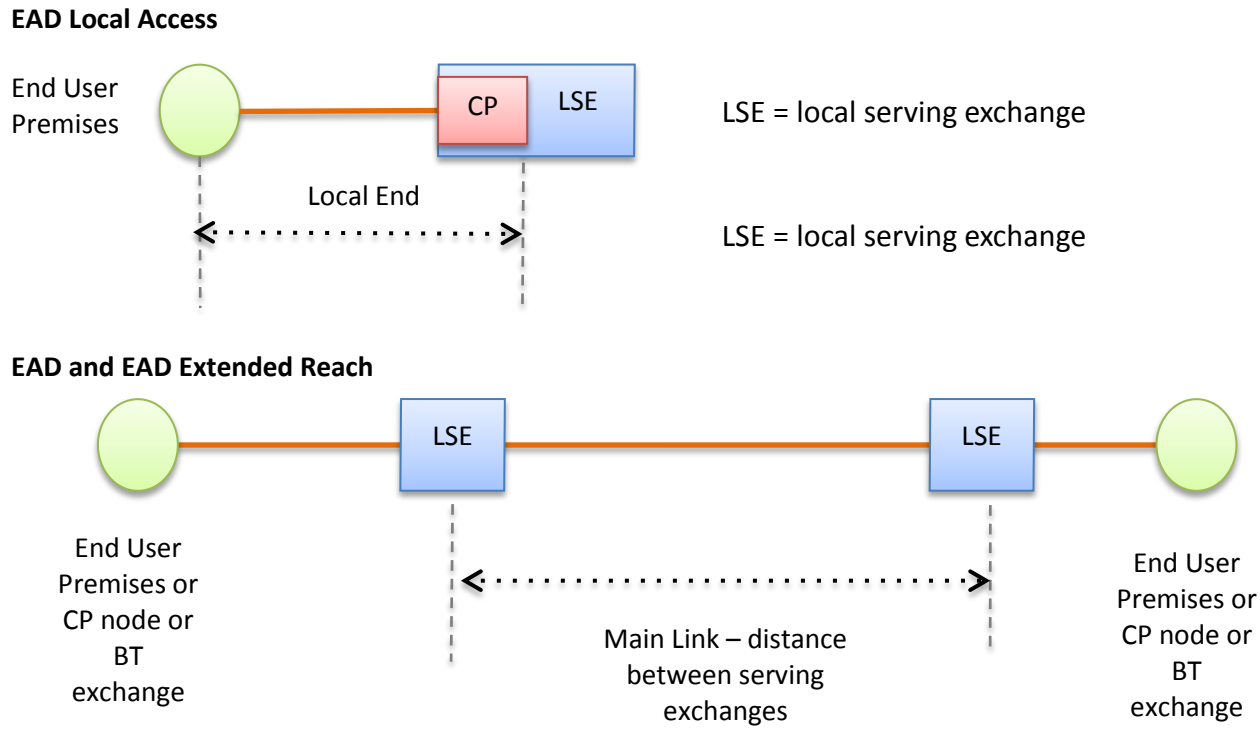
- EAD Local Access – for connections between a customer site and the serving BT exchange;
- EAD – for connections between any two points subject to a radial distance limit of 25km; and
- EAD Extended Reach – for connections between any two points subject to a radial distance limit of 45 km.

A11.6 EAD and EAD Local Access are currently available in bandwidths of 10Mbit/s, 100Mbit/s, 1Gbit/s and 10Gbit/s. EAD Extended Reach is available in bandwidths of 10Mbit/s, 100Mbit/s and 1Gbit/s.

A11.7 EAD and EAD Extended Reach services that serve connections in different BT exchange areas have a 'main link' component for charging purposes. This is measured as the distance between the serving exchanges.

A11.8 Figure A11.1 below illustrates the EAD variants.

Figure A11.1: Wholesale Ethernet access services



A11.9 EAD uses dedicated fibre circuits between the circuit end-points and does not make use of BTs' backhaul transmission systems.

A11.10 Two resilience options are available. Resilience option 1 (RO1) comprises a single bearer diversely routed over two paths. Both paths terminate on the same NTE. If the worker path fails the NTE automatically switches to the protection path. Resilience option 2 (RO2) comprises two separately routed circuits (primary and secondary). The circuits end on separate NTE. There are separate ports for connection to both primary and secondary circuits. If the primary circuit fails, it is the CP's, or its end-customer's, responsibility to switch the traffic between the circuits. CPs are free to use each path as they wish.

Legacy Wholesale Ethernet services

A11.11 Wholesale Extension Service (WES), Backhaul Extension Service (BES) and Wholesale End-to-End Service (WEES) are BT's legacy wholesale Ethernet services, all of which have been withdrawn from new supply but are still widely used by existing customers. Openreach has announced that it will be withdrawing support for most WES, WEES and BES services in 2018.

A11.12 WES provides a link between an end-customer's site and a CP's network site. WEES provides a link between two end-customer sites. BES provides a link between a CP's site and a BT exchange or (in a configuration known as a Daisy Chain) between a BT exchange and another BT exchange.

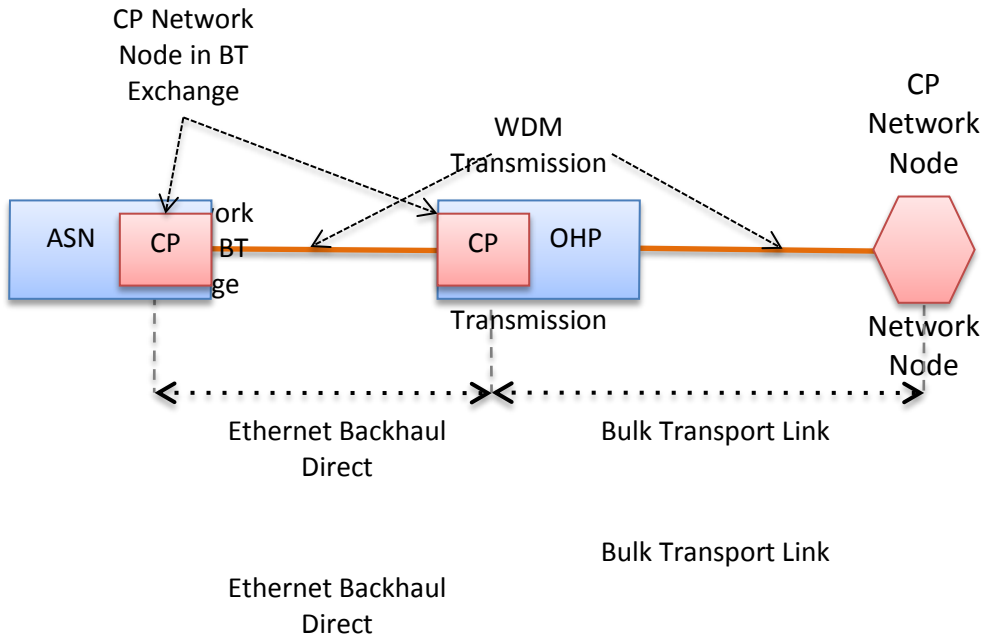
A11.13 Two resilience options are available for WES, WEES and BES. Resilience option 1 (RO1) comprises a single bearer diversely routed over two paths. Both paths terminate on the same NTE. If the worker path fails the NTE automatically switches to the protection path. Resilience option 2 (RO2) comprises two separately routed circuits (primary and secondary). The circuits end on separate NTE. There are

separate ports for connection to both primary and secondary circuits. If the primary circuit fails, it is the CP's, or its end-customer's, responsibility to switch the traffic between the circuits. CPs are free to use each path as they wish.

Wholesale Ethernet backhaul services

A11.14 BT's wholesale backhaul service EBD is used to provide high capacity backhaul links. This service makes use of BT's 21st Century Network (21CN) backhaul transmission systems and aggregates multiple individual circuits into higher capacity links. The associated Bulk Transport Link (BTL) service facilitates handover of multiple EBD services at a CP's network node. Figure A11.2 below illustrates the BT backhaul products EBD and BTL.

Figure A11.2: Wholesale Ethernet backhaul services



A11.15 EBD provides backhaul connectivity from around 1,100 BT exchanges - designated as ASNs, typically located in larger towns and cities - to corresponding major exchanges - designated as OHPs, which are co-located in major urban centres with BT's 21CN core network nodes.

A11.16 EBD only provides connectivity from ASNs to their parent OHPs, and it is therefore only available to purchase from the 1,100 ASNs. It is currently available with bandwidths of 1Gbit/s and 10Gbit/s.

BT's Wholesale WDM services

A11.17 BT currently provides two very high-bandwidth wholesale services which use Wave Division Multiplexing (WDM) technology. These are Optical Spectrum Access service (OSA) and Optical Spectrum Extended Access service (OSEA).

A11.18 OSA and OSEA are provided by Openreach on an EOI basis (with certain exceptions) and are therefore used by both CPs and BT's downstream divisions.

A11.19 OSA is a multiple channel, point-to-point data circuit using WDM technology. OSA has a maximum route distance of 100km.

A11.20 OSEA is a multiple channel data circuit that supports point-to-point, ring or chain configurations using WDM. OSEA has no maximum route distance. End-point and mid-point optical amplification may be required for longer fibre distances.

A11.21 OSA and OSEA support a range of interfaces. These include: Ethernet at bandwidths of 100Mbit/s, 1Gbit/s, and 10Gbit/s, TI (SDH) at bandwidths of 155Mbit/s, 622Mbit/s, 2.5Gbit/s and 10Gbit/s (STM1, STM-4, STM-16 and STM-64; OTU-1, OTU-2); Fibre Channel at bandwidths of 1Gbit/s, 2Gbit/s and 4Gbit/s; FICON and ESCON.

A11.22 OSA and OSEA can be used to provide links between end-customer sites, BT exchanges and CP network nodes. Figures A11.3 and A11.4 below illustrate the OSA and OSEA configurations.

Figure A11.3: Wholesale WDM services – OSA configuration

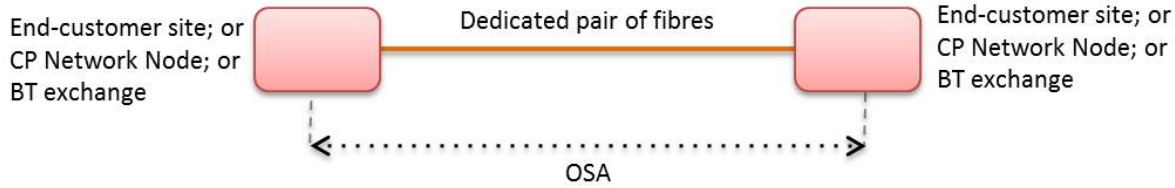
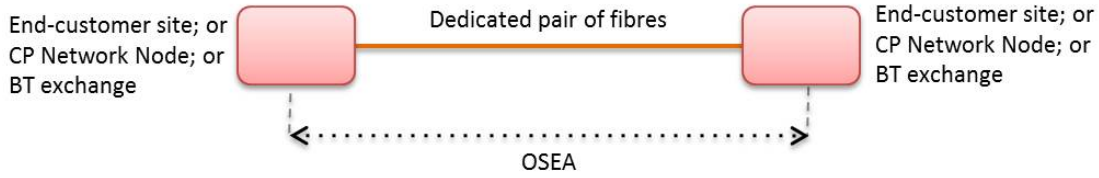
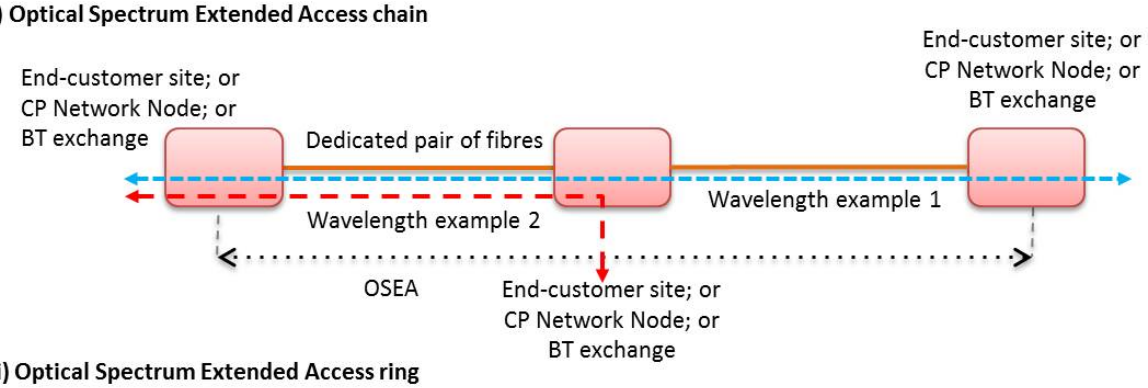


Figure A11.4: Wholesale WDM services – OSEA configurations

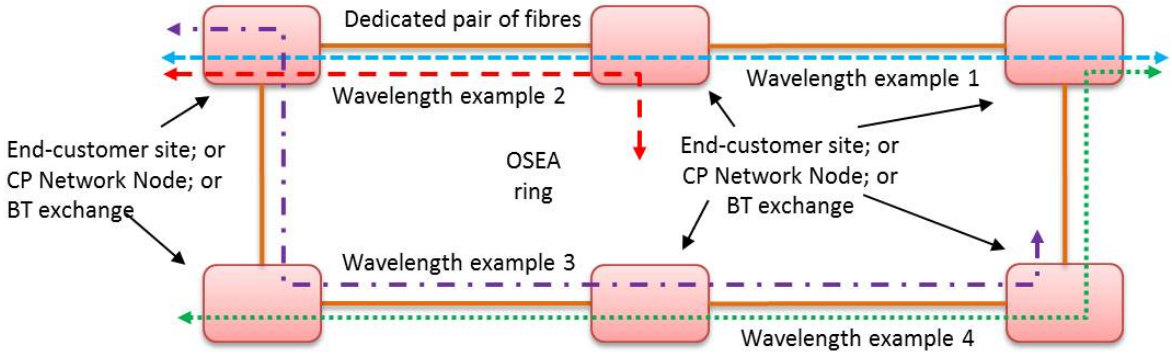
i) Optical Spectrum Extended Access point to point



ii) Optical Spectrum Extended Access chain



iii) Optical Spectrum Extended Access ring



A11.23 OSA and OSEA services have the same RO1 and RO2 resilience options as EAD, WES, WEES and BES services.

Additional support for interconnection of WDM services

A11.24 BT's WDM services support two technologies that provide additional support for interconnection of WDM based leased line services. As we discuss in more detail in Section 11, these have a bearing on the extent to which CPs are able to use BT's WDM services in conjunction with their own inputs to provide end-to-end services to their customers.

Optical Transport Unit interfaces[412]

A11.25 OSA and OSEA support Optical Transport Unit (OTU) interfaces. These provide additional support for interconnection of services over WDM systems by facilitating end-to-end monitoring of interconnected circuits. This is achieved by the transmission of monitoring and supervisory information alongside the main circuit. Using OSA and OSEA OTU interfaces, BT can provide a CP with details of the quality of the service provided to the end-customer on individual channels and facilitate protection switching (where a diverse path is provisioned) in the event of degradation or failure of the primary path.

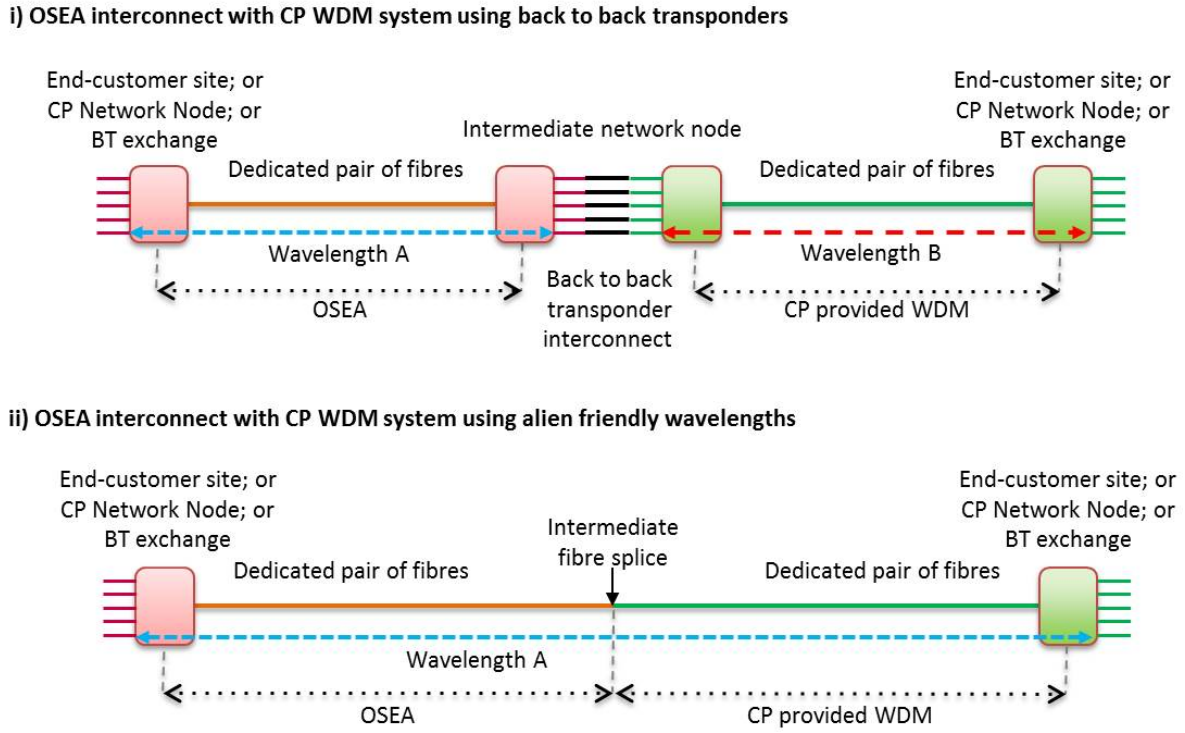
'Alien wavelength' capability of the Ciena 6500 variant of the OSEA product

A11.26 In April 2014 BT introduced 40Gbit/s, OTU-3, 100Gbit/s, OTU-4 and 'friendly alien wavelength' services to the Ciena 6500 variant of the OSEA product range. Friendly alien wavelengths provide the ability to transport a BT-originated wavelength across a CP's own network without the need for back-to-back transponders where the BT service meets the CP's network. In effect, this enables a direct optical interconnection without any intermediate equipment. Only 40Gbit/s and 100Gbit/s wavelengths are supported in this solution and the CP's network must use the Ciena 6500 platform.[413] Figure A11.5 shows how friendly alien wavelengths provide a simplified WDM interconnection.

[412] In the 2013 BCMR we referred to these interfaces as Optical Transport Network, the name of the family of standards of which OTU is part.

[413] 'Alien' refers to the wavelength originating from outside the CP's network. 'Friendly' refers to the alien wavelength originating from the Ciena 6500 equipment, which must also be used by the CP.

Figure A11.5 BT OSEA friendly alien wavelength configuration



BT's Traditional Interface products

A11.27 BT currently offers four main wholesale TI products:

- Partial Private Circuits (PPCs);
- RBS Backhaul;
- the disaggregated TI wholesale products, TDM Access Bearer and TDM Backhaul Bearer

A11.28 PPCs and RBS Backhaul are provided by BT Wholesale on a non-EOI basis and are therefore used by CPs but not by BT's downstream divisions. TDM Access Bearer and TDM Backhaul Bearer are provided on an EOI basis by Openreach.

Partial Private Circuits

A11.29 PPCs provide dedicated symmetric transmission using Plesiochronous Digital Hierarchy (PDH) or Synchronous Digital Hierarchy (SDH) technologies between an end-user's premises and a CP's network via a Point of Connection (POC).

A11.30 PPCs are available with bandwidths of 64kbit/s, n x 64kbit/s (where n can be any integer between 2 and 29 inclusive), 2Mbit/s, 34Mbit/s, 140Mbit/s, 155Mbit/s and 622Mbit/s.

A11.31 There are three main elements to a PPC:

- The 'Local End' is a dedicated link between the end-user premises and the BT serving exchange, generally using BT's copper or fibre access network or, exceptionally, a point-to-point microwave link.

- The 'Main Link' provides dedicated transmission capacity between the BT serving exchange and the CP's POC with BT's network. This Main Link can include both backhaul and trunk network transmission. The boundary between the backhaul and trunk element of a PPC is currently drawn at 46 trunk aggregation nodes corresponding to major population and business centres.

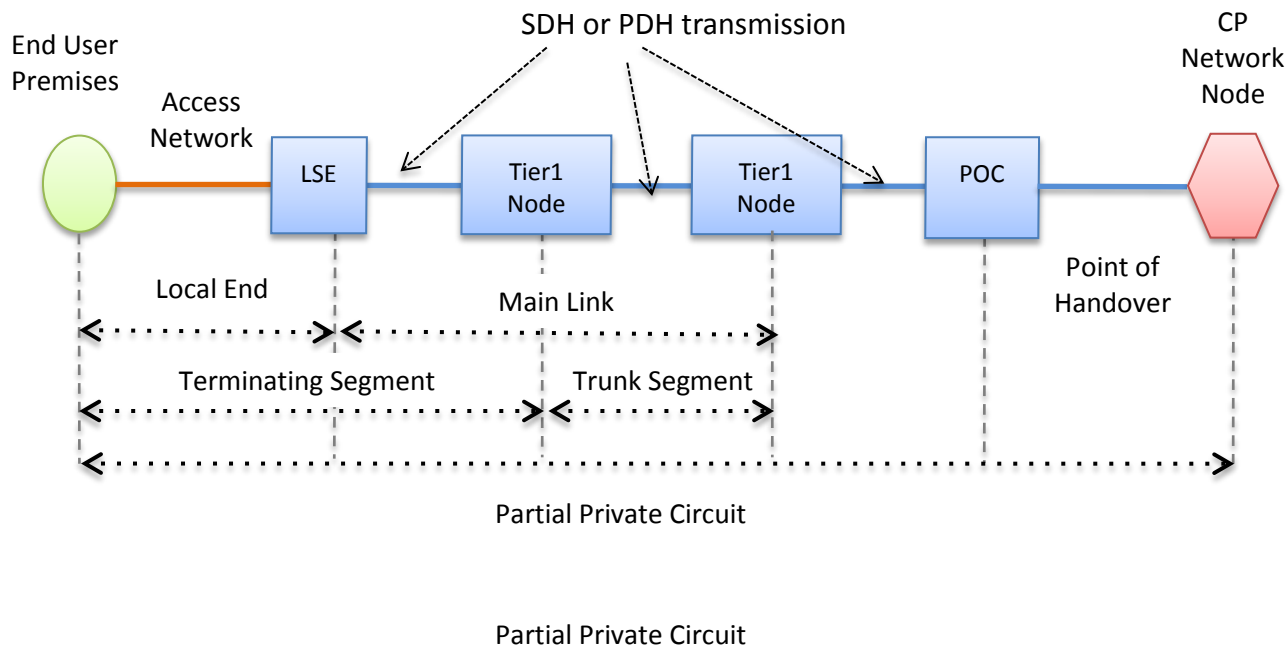
- The Point of Handover (POH) is a high-capacity link, which connects the CP's network with BT's network. A POH can deliver multiple PPCs. BT is required to provide three different types of handover configuration:

  - In-Span Handover (ISH): interconnection is provided at a joint-box or man-hole adjacent to the BT POC exchange;

  - In-Span Handover Extension (ISH Extension): interconnection is provided at a joint-box or manhole further from the BT POC exchange; and

  - Customer Sited Handover (CSH): interconnection is provided at the CP's network node.

Figure A11.6: Partial Private Circuit

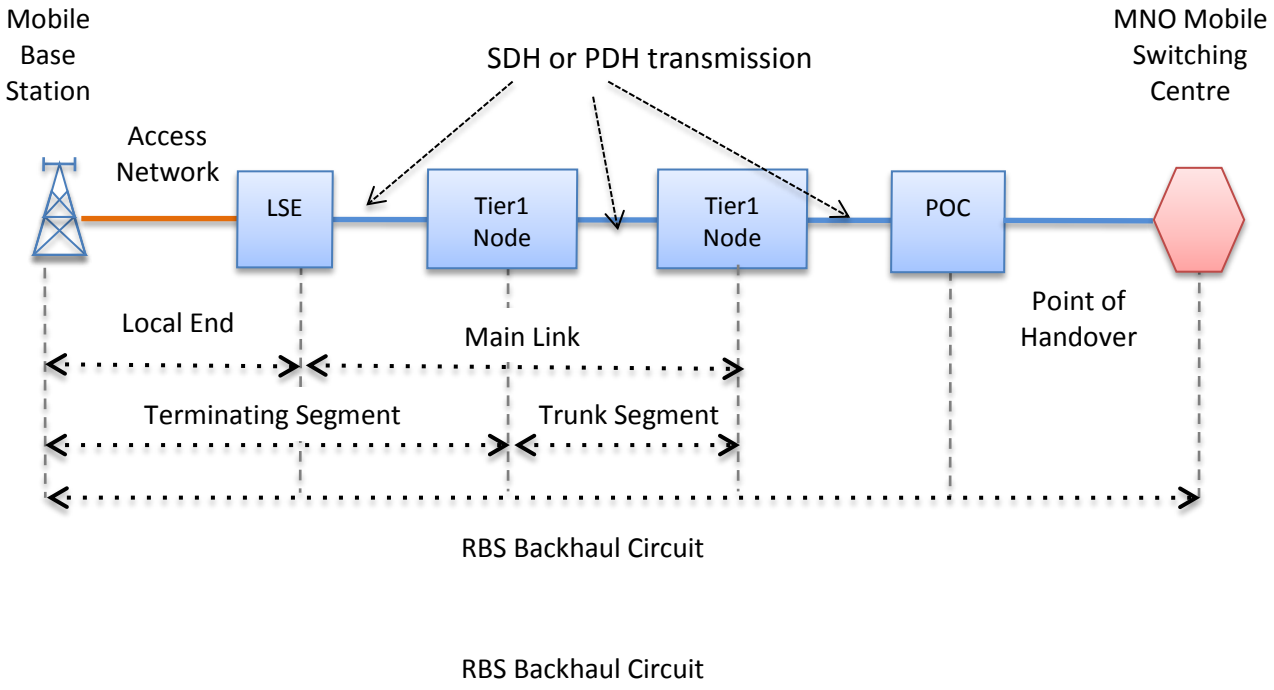


Partial Private Circuit

Radio Base Station Backhaul

A11.32 An RBS Backhaul circuit is a PPC that provides dedicated symmetric transmission at bandwidths up to 2Mbit/s between a Mobile Network Operator (MNO) radio base station and the MNO Mobile Switching Centre (MSC).The base station is linked to BT's local serving exchange using BT's copper or fibre access network or point-to-point microwave links.

Figure A11.7: Radio Base Station Backhaul



RBS Backhaul Circuit

Disaggregated TI wholesale products

A11.33 The disaggregated TI wholesale products, TDM Access Bearer[414] and TDM Backhaul Bearer[415], were developed by BT following the Openreach Industry Commitments in May 2009. They were delivered by Openreach in the summer of 2012.

A11.34 These services use the same technology platform as Openreach's Ethernet services and have similar configurations.

A11.35 The TDM Access Bearer Service provides a permanently connected, point-to-point circuit using a 2.5Gbit/s bearer. It provides a single circuit with an SDH interface with a bandwidth of 155Mbit/s, 622Mbit/s or 2.5Gbit/s (STM-1, STM-4 or STM-16). It is available in same configurations as EAD and EAD Local Access subject to a maximum route distance of 63km.

A11.36 The TDM Backhaul Bearer service operates between a CP's Point of Presence (PoP) in a BT exchange designated by Openreach as an Access Serving Node (ASN) and the same CP's core network PoP located at one of the parent exchanges designated as Openreach Handover Points (OHP) to which the ASN is connected or, if required, one of the other ASNs to which it is connected.

A11.37 The TDM Backhaul Bearer is available with SDH interfaces and bandwidths of 2.5Gbit/s and 10Gbit/s (STM-16 or STM-64).

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[414] Also requested in February 2007 by CPs using the Openreach new product development SoR (Statement of Requirements) process. The TDM Access Bearer service is described in SoR 6165.
[415] Also requested in February 2007 the TDM Backhaul Bearer service is described in SoR 6169.

Interconnection services

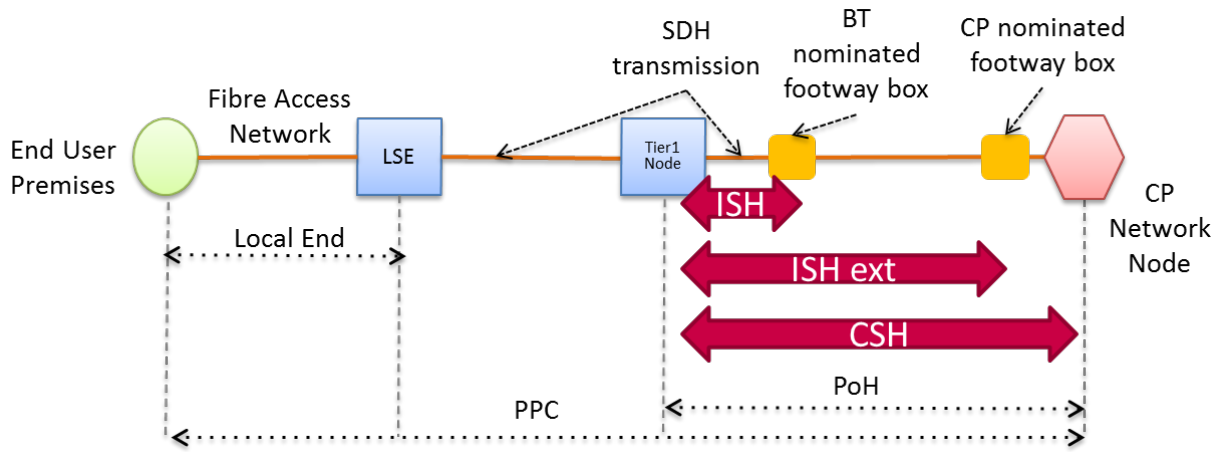
A11.38 A POC (or POH) is the point at which a CP's network interconnects with BT's network. The relevant services which BT provides at a POC can broadly be divided into equipment and links. Equipment is provided at a POC in the form of multiplexers or terminal equipment which are used for the aggregation, disaggregation and termination of partial circuits ready for onward transmission. Links are circuits which link the equipment of two interconnecting CPs in order to allow transmission between their respective networks.

Interconnection for wholesale Traditional Interface services

A11.39 BT currently provides the following types of interconnection service for wholesale TI services:

- Customer Sited Handover (CSH): BT provides a POC at the site of the interconnecting CP. In order to do so, BT has to extend its network out to the point of interconnection and provide a CSH link along with CSH POC equipment;
- In-Building Handover (IBH): BT provides a POC at co-location space rented by a CP in a BT local exchange (in support of disaggregated TISBO services). Currently BT terminates individual circuits in the co-location space without aggregation;
- In-Span-Handover (ISH): both BT and another CP build out their networks to a handover point located between their premises. The handover point is adjacent to the BT exchange and therefore most of the build is the responsibility of the interconnecting CP. BT provides the part of the ISH link running from the handover point to its POC, along with ISH equipment at the POC. The CP provides the ISH equipment for their end of the POC; and
- ISH Extension: similar to In-Span Handover but the handover point is located further from the BT exchange but still within the serving area of the exchange.

Figure A11.8: PPC Point of Handover



A11.40 With the exception of IBH, each of these services supports aggregated handover of terminating segments over high bandwidth links.

Interconnection for wholesale Ethernet services

A11.41 BT currently provides the following types of interconnection service for wholesale Ethernet services:

- CSH. BT provides two types:
- Without aggregation: BT terminates individual circuits at the CP's site without aggregation (i.e. interconnection is part of the service and there is no separate interconnection link). This method is commonly used for WES and EAD circuits;
- With aggregation: BT supplies BTL which aggregates multiple EBD services for delivery using WDM over a single interconnection link to the CP's site. As with TI CSH BT provides a POC at the site of the interconnecting CP. In order to do so, BT has to extend its network out to the point of interconnection and provide a CSH link along with CSH POC equipment.
- IBH: BT provides a POC at co-location space rented by a CP in a BT local exchange. BT terminates individual circuits in the co-location space without aggregation.

A11.42 BT does not offer ISH products for Ethernet services.

Interconnection for wholesale WDM services

A11.43 BT's WDM services OSA and OSEA are generally provided on an end-to-end basis (i.e. between end-user premises), but BT also offers CSH and IBH.

Annex 12

Review of BT's Quality of Service

Introduction

A12.1 In Annex 17 of the May 2015 BCMR Consultation we set out an assessment of Openreach's recent performance in provisioning and repair of wholesale Ethernet products. This Annex provides an update to this assessment[416] as well as a reiteration of the key conclusions that can be drawn from the analysis we have undertaken. This annex serves to provide context for our decisions relating to quality of service which are set out in Section 13. This Annex is structured as follows:

- first, we provide an overview of the current Openreach Ethernet order and provisioning process;
- second, we analyse various aspects of Openreach's recent provisioning and repair performance;
- third, we investigate the factors affecting provision performance;
- fourth, we describe in detail the determination of the upper limit on the initial Contract Delivery Date (CDD) value;
- fifth, we provide detail on the model determining the percentage discount on Time to Provide (TTP) for in-flight orders; and
- finally, we summarise our survey of customer expectations for Ethernet provisioning and repair performance.

A12.2 Based on the assessment of Openreach's recent performance in Annex 17 of the May 2015 BCMR Consultation and in this Annex, we find that:

- Lead time performance (excluding customer delay) has declined in performance for complex orders (Categories 2, 3 and 4), but has improved in performance for easier orders (Category 1).
- There is a significant issue of uncertainty and volatility in the provisioning process for complex orders which form over 50% of relevant volumes.
- Repair performance has generally been maintained at a good level since 2011.
- The mix of orders being received by Openreach has been relatively stable over time which suggests there is no evidence of a long term change in mix towards

[416] The data we obtained, using our formal powers, for assessment in the May 2015 BCMR Consultation was for the time period until November 2014. For further assessment here we have obtained, using our formal powers, data for assessment covering the time period from November 2014 to November 2015.

orders with typically longer lead times although the mix between Categories 1 and 2 has alternated by around 10%.

- There does not appear to be a significant increase in the quantity of civil work that is required to complete orders for the provision of Ethernet services.

- The ratio of resource to completed orders would appear to be sensitive to changes in closed order category composition (in other words the mix of orders by difficulty), whereas the ratio of resource to demand remains an indicator of the pace at which resource tracks demand. While resource did not keep pace with demand until mid-2014, since then it has increased to approximately the original level.

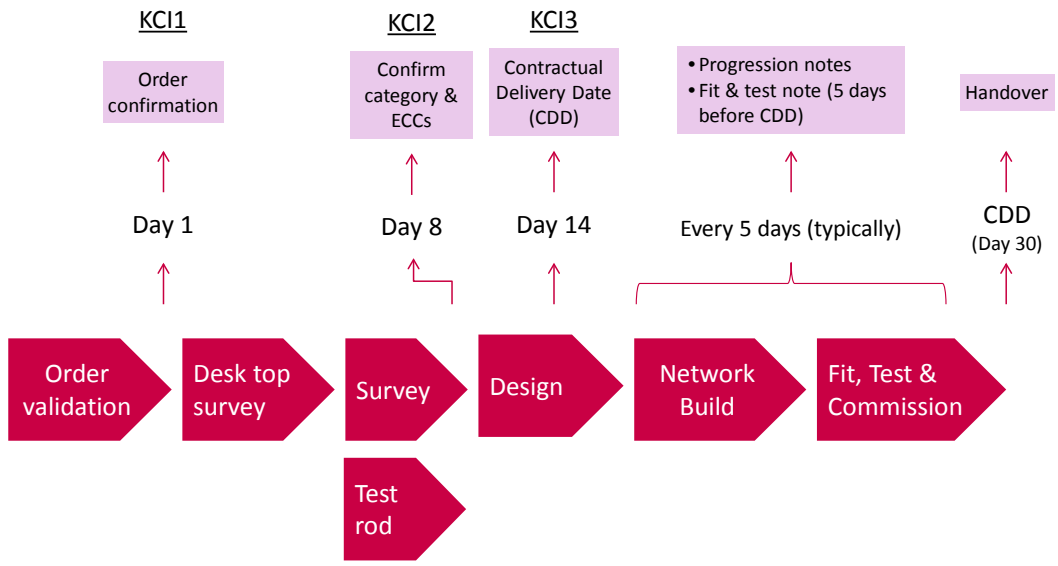
Openreach Ethernet order and provisioning process

A12.3 In this section we present a high-level view of Openreach's Ethernet product provisioning process. We include some details of how it has been operating in practice. We also provide brief details of the changes to the process that are currently being trialled by Openreach and CPs, which could form the basis of the future process.

A12.4 Figure A12.1 presents a high-level view of the current process showing the key processes, milestones and deliverables (information and physical). The process was designed to deliver Ethernet products in a standard 30 working day timescale at a standard basic installation charge. However the evidence we have gathered shows that the majority of orders exceed the standard timescale.

A12.5 Three key milestones relate to the delivery of key information to customers. These are known as "keep customer informed" or KCI milestones and are summarised in the Table A12.1 below. They are further described in the process description which we set out below.

Figure A12.1: Openreach Current Ethernet provisioning process[417]



Source: Ofcom based on Openreach presentation "Ethernet Education Openreach/Ofcom 16th June 2014".

Table A12.1: Keep customer informed (KCI) milestones[418]

Milestone	Target (working day)	Information delivered to customer
KCI1	Day 1	Order acknowledgement including order reference and service ID
KCI2	Day 8	Confirm order category and excess construction charges (ECCs), if any
KCI3	Day 14	Offer contractual delivery date (CDD) to customer

Source: Ofcom based on Openreach presentation "Ethernet Education Openreach/Ofcom 16th June 2014".

A12.6 The first stage in the provisioning process is order validation. Openreach checks that the order contains the information they require and whether the order satisfies Openreach's business rules. The customer is then informed of whether the order is accepted or rejected. Openreach's target to complete this stage is 5pm on the day following the day on which the order is placed. The date when an order is accepted is taken as "Day 1" in the provisioning process for that order.

[417] Combined summary of slides 7 and 25 from presentation titled "Building Britain's Connected Future, Ethernet Education, Openreach/Ofcom 16 June 2014", BT Openreach.
[418] Summary of slide 25 from presentation titled "Building Britain's Connected Future, Ethernet Education, Openreach/Ofcom 16 June 2014", BT Openreach.

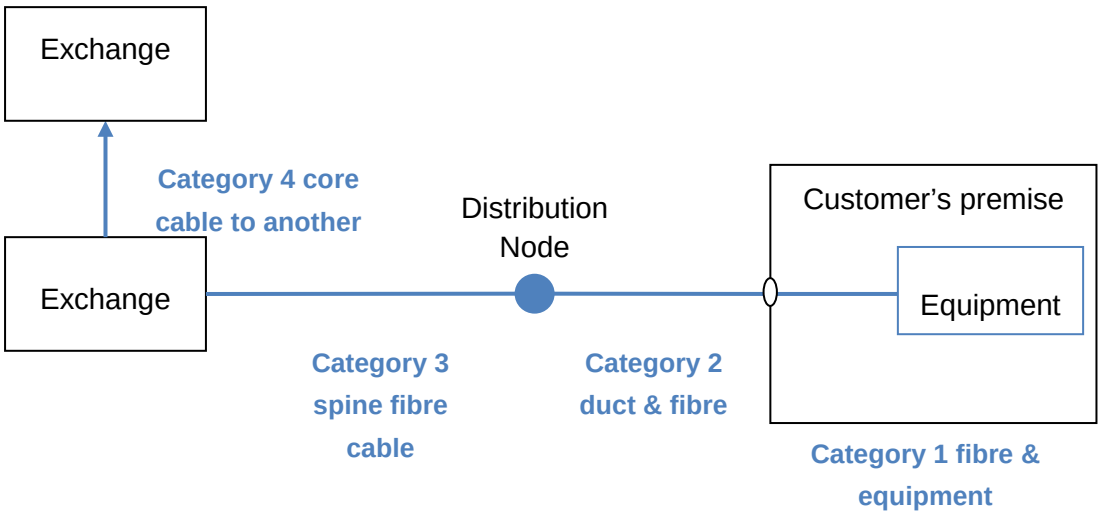
A12.7 Once accepted an order then progresses to the planning stage. A desktop survey determines whether suitable infrastructure and fibre is available between the sites to be connected and the route taken. Surveys of the customer sites are also carried out. Openreach use the findings of these activities to classify the provisioning task into one of four categories, described in Table A12.2 below supported by Figure A12.2 below, and produce a costed solution. These activities should be completed by "Day 8", the KCI2 milestone, when Openreach will inform the customer of the provision category and any excess construction charges (ECCs) required.

Table A12.2: Openreach provision categories for Ethernet products

Category	Definition[419]
1	Fibre connection available between customer's premises. Possible installation and connection of fibre and equipment within the customer's premises and service testing and commissioning required.
2	Fibre connection is available between Openreach network distribution nodes. In addition to possible Category 1 activities installation of duct and fibre (cable or tubing with blown fibre) is required from Openreach network distribution node(s) to the customer's premises.
3	In addition to possible Category 1 and 2 activities a new spine fibre connection is required in part or whole between Openreach distribution nodes and serving exchange.
4	In addition to possible Category 1, 2 or 3 activities a new core fibre cable is required between exchanges.

Source: Ofcom based on Openreach presentations "Ethernet Education Openreach/Ofcom 16th June 2014" and "Ethernet Service Pack, October 2014".

Figure A12.2: Mapping of provision category components in the delivery of Ethernet services



Source: Ofcom based on Openreach presentation "Ethernet Education Openreach/Ofcom 16th June 2014".

[419] The majority of provisions regardless of category will require electronic equipment to be installed at customer sites and possibly in the exchange as well.

A12.8 Openreach require customers to agree the ECCs before they will proceed to the next stage of the provisioning process. This has been a source of delay in completing the provision orders. In order to reduce the number of orders delayed pending agreement of ECCs, Openreach introduced in 2014 flat rate ECCs that cover a wide range of provision orders and do not need the agreement of the customers.

A12.9 Following customer approval of ECCs or the notification of flat rate ECCs, orders progress to the design stage of the planning activity where a range of activities take place, some in parallel, depending on the complexity of the order:

- Design the fibre access network required to deliver the solution including the necessary planning for installation.
- Where necessary plan and perform "test rodding"[420] of the planned fibre route, ordering appropriate rectification activities where blockages are found.
- Determine the equipment needed and design and plan its installation at the customer and exchange sites.
- Order civil infrastructure, fibre, equipment and associated installation as required.
- Where necessary apply for and obtain wayleave and permission for street work activities.

A12.10 Openreach aims to offer the initial contractual delivery date (CDD) at the KCI3 milestone, on working day 14 after the order is validated. This is usually before the above design stage activities are complete. Openreach contractually commits to a CDD of 30 working days, subject to survey. Our analysis, as portrayed in Figure A12.12 below, shows that the mean time to issue the initial CDD is considerably greater than 14 working days after order validation with the possible exception of Category 1 orders.

A12.11 As the order is progressed, Openreach unilaterally updates the CDD through a contractual mechanism called deemed consent where the customer gives prior agreement to a range of changes by accepting the provisioning contract.[421] Openreach have identified many reasons for deeming consent. As well as delays caused by their own activities, Openreach also identify many factors they consider to be outside their control, e.g. customer caused delays, wayleave and street work permission. Table A12.4 presents a list of Openreach deemed consent descriptions and the associated codes. Delays are usually notified to the customer by a progression note including the appropriate deemed consent code.

[420] Test rodding is the physical activity of feeding flexible rods through the duct where a new cable (or sub-duct for blown fibre) is to be installed to determine if there are any blockages due to collapsed ducts, too many cables, etc.

[421] If the customer does not agree to the terms and conditions of the Openreach contract, including the deemed consent clauses, Openreach do not proceed with the order.

A12.12 Many delays subsequent to the initial CDD arise from the design activities not being complete when the initial CDD is issued including the test rod activity, which is often not started until after the initial CDD has been issued, contrary to the current ideal process shown in Figure A12.1 above.[422] Test rodding provides important information about the state of the duct and the amount of work required to complete the provisioning work.[423] Further delay can also occur where Openreach find further duct blockages due to multiple blockages not being detected by the initial test rodding.[424]

A12.13 Near or on completion of the network build or after the end of the planning stage where there is no network build, Openreach plan to notify the customer, typically five working days before the CDD, of an appointment for the fitting and testing of the electronic equipment on the customer site.

A12.14 Once testing and commissioning is complete, Openreach issue a "Completion and Handover Update", ideally on or within 1 working day of CDD, to confirm to the customer that the service is installed and working. This is the end of the provisioning process and the service is transferred into operation and maintenance.

Proposed Differentiated Order Journey (DOJ) Process

A12.15 Openreach has been trialling some significant changes to the Ethernet provision process. The final process, to be launched in a staged process, agreed between industry and Openreach may differ from the initial proposal when the trial commenced. The possible changes include:

- Introduction of further order categories to provide customers with more insight into what is required for delivery (at KCI2) and better match the actual complexity of the required network build, with the addition of categories 'Quick Win'[425], 2.1[426] and 2.2.[427]

- Category-based lead times rather than an overall standard lead time to issue a more accurate initial CDD (KCI3) to reduce the uncertainty and possibly the number of CDD changes for simple EAD orders (Category 1 orders will retain a 30 working day lead time and Category 2.1 orders will have a 57 working day lead time), with a revised planning process for complex orders (the remainder of categories).

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[422] Openreach – Ofcom meeting at Uxbridge control centre on 21 July 2014.
[423] Test rodding is often delayed so that the whole activity of test rodding, duct blockage clearance and fibre installation is all part of the same activity and potentially more efficient but it can cause unexpected delay.
[424] Test rodding can only identify the first blockage in a duct when approached from a particular direction. Consequently at best it can find two blockages in a duct, but a third (or more) blockage between the two points identified cannot be found until the first blockages are cleared.
[425] Quick Wins (QW) need no Excess Construction Charges (ECCs), no duct work (new or clearance), splice only where fibre exists and with a fibre blow of up to 600m either way from the central point externally, or 150m internally, to connect to the desired NTE location.
[426] Involves fibre installation in existing duct between network distribution node and the customer's premise in addition to possibly Category 1 activity.
[427] Involves duct and fibre installation between network distribution node and the customer's premise in addition to possibly Category 1 activity.

- Introduction of additional milestone KCIs, at least one of which will include an update on the CDD based on real planned dates after the physical network has been checked.

- A secondary status, confirmed at KCI2, to each category reflecting the relative complexity within the category.[428]

A12.16 The staged introduction of these first two points above, which CPs can opt out if they wish, is planned to be fully launched on 14th April 2016, with a National Pilot having launched from 15th February 2016.[429]

Recent Performance

A12.17 In this section we analyse Openreach's recent Ethernet provisioning and fault repair performance, including the performance since the May 2015 BCMR consultation.[430] The Ethernet products included in the following analysis unless otherwise specified are EAD, EAD LA, EBD, WES, WES LA, WES Aggregation, WEES, BES, Cablelink, BNS, BTL and ONBS.

A12.18 We obtained performance, demand, resource and civil work data from Openreach using our statutory information gathering powers. The provisioning performance data also included information relating to the causes of delays.

A12.19 This section is structured as follows:

- First, we describe the performance data we obtained and how this influenced our analysis, including updates to the performance data obtained since the May 2015 BCMR Consultation.

- Second, we summarise Openreach's provision performance, against relevant SLAs where applicable, and explore what level of performance can be attributed to Openreach.

- Third, we summarise Openreach's fault repair performance including against SLA targets where applicable.

- Finally, we consider the various factors that may have had an impact on Openreach's recent provision performance.

Availability and Integrity of Ethernet Provision and Repair Performance Data

A12.20 For the May 2015 BCMR Consultation we obtained data, using our formal powers, on Ethernet provision performance which was sufficiently reliable for the period January 2011 to November 2014.

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[428] From slide 29 of presentation titled "Ethernet Products & Commercial Group, 16th February 2016", BT Openreach.
[429] Summary of slide 38 from presentation titled "Ethernet Products & Commercial Group, 19th January 2016", BT Openreach.
[430] Performance data in the May 2015 BCMR consultation covered the period until November 2014.

A12.21 To gauge the Ethernet provision performance since November 2014, using our formal powers we requested Ethernet provision performance data for the period January 2011 to November 2015. This provision performance data included provision orders which were completed, active and suspended as at 10 November 2015.

A12.22 Repair performance data was available across all the relevant products from January 2011. Prior to January 2011 repair performance data was available for a subset of the products but for the period prior to March 2009 Openreach was unable to find and retrieve appropriate data in the time available to respond to our formal requests.[431]

A12.23 Openreach noted in its response that:

- with the inclusion of the DOJ provisioning process trial, there have been a number of new provision categories (refer to paragraph A12.15 for a summary) which are only reliably demarcated from April 2014;
- provision categorisation data for all products was only available on a consistent basis from September 2011, with data prior to this incomplete or unreliable; and
- initial CDD data was generally not available before October 2012, with dates prior to October 2012 only sporadically populated.[432]

A12.24 We concluded in Annex 17 of the May 2015 BCMR Consultation[433] that there were no significant issues arising from provision categorisation from 2011 to 2014, and as a consequence, we believed that the data from 2011 onwards to be sufficiently reliable for our analysis and remedy design purposes. Table A12.3 indicates that in 2015 the percentage of provision orders that was not categorised has decreased, so we reiterate our previous conclusion that there were no significant issues arising from provision categorisation from 2011 onwards and we consequently believe the data to be sufficiently reliable for our analysis and remedy design.

Table A12.3 Percentage of provision orders not categorised[434]

Year	Percentage provision orders not categorised
2011	10%
2012	8%
2013	12%
2014	8%
2015	6%

Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

[431] Openreach response dated 10 October 2014 to our 3rd section 135 notice dated 29 August 2014.
[432] Openreach response dated 11 November 2015 to our 14th section 135 dated 27 October 2015.
[433] Paragraph A17.118.
[434] We recognize that orders may not be categorised because they are cancelled. However the order data from which Table A12.3 was derived did not contain cancelled orders.

A12.25 Openreach has updated its data to reflect the revised provisioning categories as planned under the DOJ provisioning process. As a result, what were previously classified as Category 1 orders are now split into 'Quick Win' and Category 1, whilst Category 2 orders are now split into Categories 2.1 and 2.2.[435]

A12.26 Unless otherwise specified throughout this Annex, where our analysis includes a breakdown of provision order categories, we aggregate 'Quick Win' orders with Category 1 orders, and Categories 2.1 and 2.2 orders with Category 2 orders respectively. This aggregation is required in order that we can allow for comparable historical trend analysis of the performance of Category 1 and 2 orders covering the entire period from January 2011 to November 2015.

A12.27 In reconciling this latest Ethernet provision performance data with that obtained for the purposes of analysis in the May 2015 BCMR Consultation, we discovered a number of orders with the following differences:

- 1,997 orders with a different time to provide value, all of which were completed in 2014[436];
- 2,987 orders with a different total delay value, all of which were completed in 2014[437]; and
- 2,297 orders which had changed their classification of being placed within Project Services to not being placed within Project Services (305 orders) and vice versa (1,992 orders).[438]

A12.28 While the time to provide and total delay changes are limited to 2014 values, the Project Services classification change is not. It causes the differentials between Project Services and Non-Project Services values to increase in some cases and decrease in others. These differentials, however, do not increase or decrease to the extent that the higher of the two corresponding values is switched. Therefore, our consideration that Project Services orders do not receive favourable treatment (e.g. shorter lead times) over the period considered does not change as a result of these classification changes.

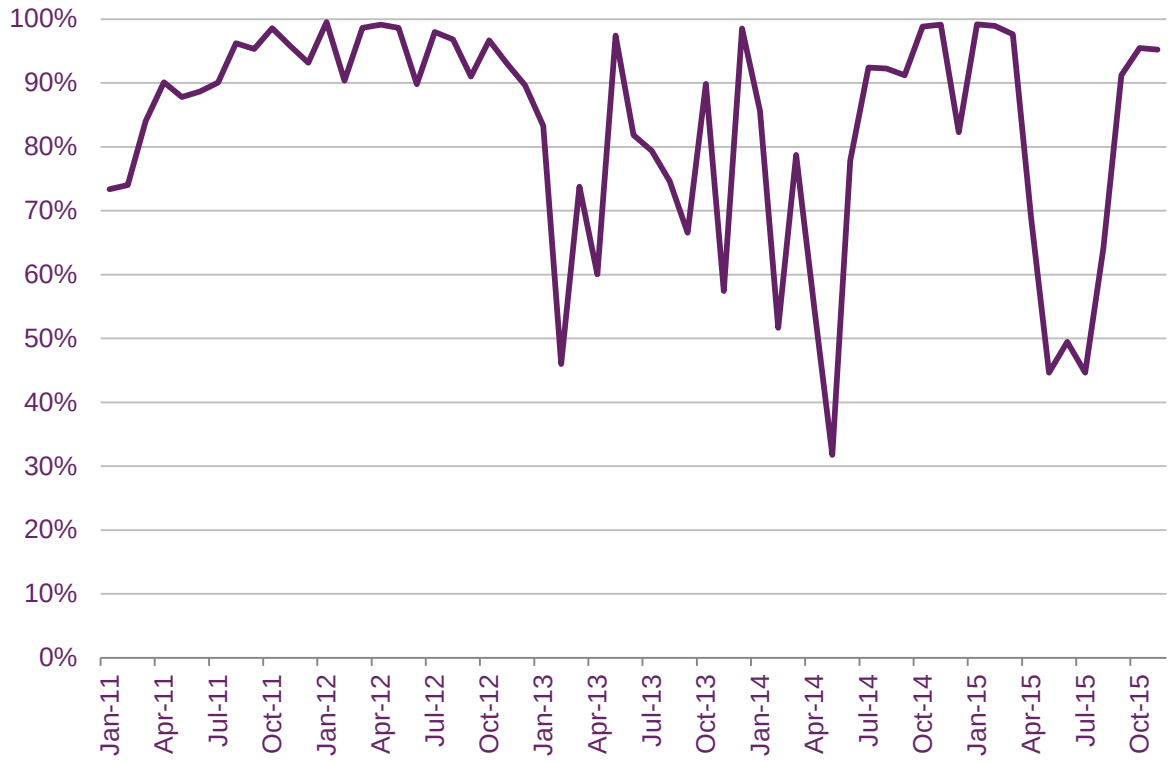
[435] Refer to Table A12.2 for a description on each provision order category and paragraph A12.15 for a description on the DOJ process order categories.
[436] A majority of these orders had a lower time to provide in the latest Ethernet provision performance data. This is not noticeable when looking at the MTTP values below mainly due to the corresponding 2014 values in the May 2015 BCMR Consultation not having the entire year of orders available (which are available in the latest Ethernet provision performance data).
[437] All of these orders had a higher total delay in the latest Ethernet provision performance data, with 51% having a different customer delay value. This is not noticeable when looking at the MTTP values below mainly due to the corresponding 2014 values in the May 2015 BCMR Consultation not having the entire year of orders available (which are available in the latest Ethernet provision performance data).
[438] This refers to Tables A12.9 and A12.10, where several values have increased or decreased, in the range of 0% to 11% and 0% to 75% respectively. These tables are comparisons between Project Services and Non-Project Services orders, where the preferential treatment (e.g. shorter lead times) of Project Services orders is being investigated.

Provision Performance

Order Validation

A12.29 Openreach's target to complete the validation stage (milestone KCI1 in the provisioning process) is 5pm on the next working day after an order is placed. Figure A12.3 below shows Openreach's performance against this target between January 2011 and November 2015 for Ethernet orders. Approximately 95% of orders were validated within the target timescale during the first third of this period. However, between October 2012 and July 2014 performance fluctuated significantly month to month with various peaks and troughs. This stabilised somewhat between approximately 82% and 99% until April 2015 where there was a dip in performance for a few months to approximately 45% and 50%, before finishing the period at approximately 95%.

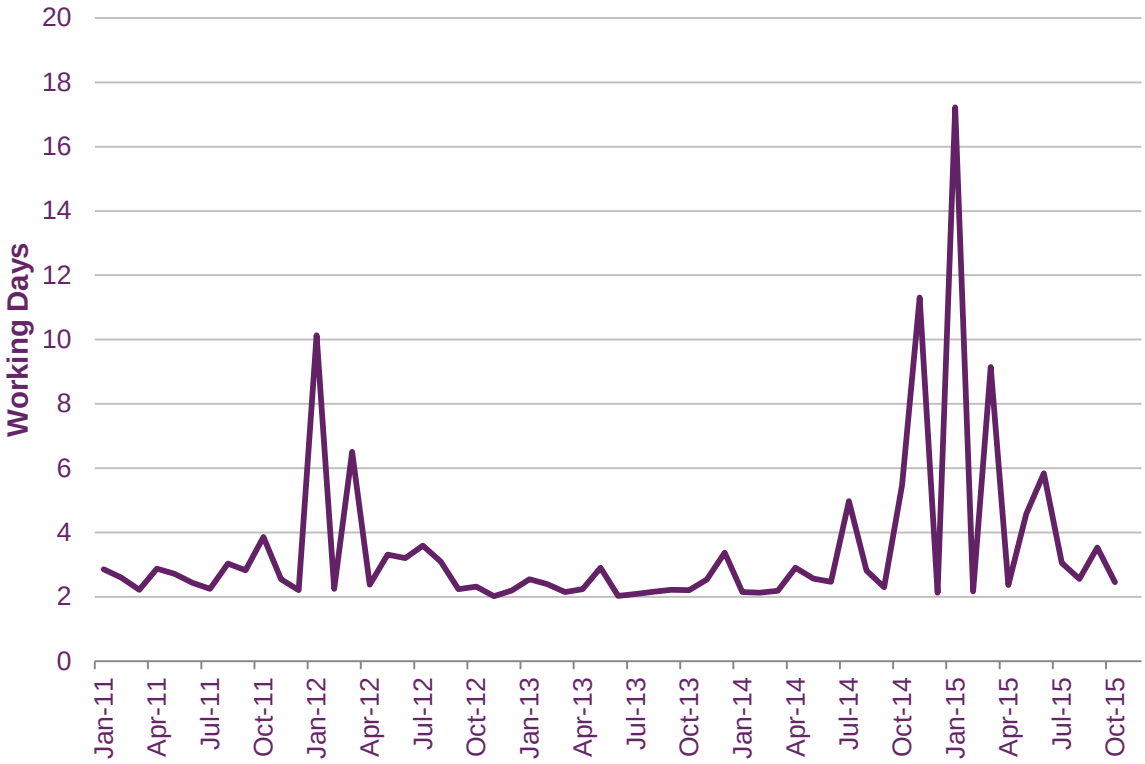
Figure A12.3 Percentage of orders validated by 5pm the next working day



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.30 Figure A12.4 plots the average delay for orders not validated by 5pm the next working day. Until July 2014 the average delay is consistently between two and four working days apart from a couple of outliers. Although the proportion of orders validated within the target timescale fluctuated significantly between October 2012 and July 2014, the average impact of missing the target was relatively stable at just over two working days for this period. After July 2014 the average delay fluctuates considerably with a highest peak of over 16 working days in January 2015, but this corresponds to a high proportion of orders validated within the target timescale. The period of April 2015 to June 2015 where there are a lower proportion of orders validated within the target timescale corresponds to delays of between two and six working days.

Figure A12.4 Average delay (working days) until validation, for orders not validated by 5pm the next working day[439]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

Overall Lead Time between Order Validation and Delivery

A12.31 We now consider the lead time between order validation and order delivery followed by consideration of what proportion of this lead time it is appropriate to attribute to Openreach. We then consider measures of the time between various stages of the provisioning process using measures we consider appropriate to attribute to Openreach.

A12.32 We analysed the overall lead time (including all delay) between order validation and delivery in the May 2015 BCMR Consultation observing that Category 1 orders slightly improved performance with a mean time to provide (MTTP)[440] of around 40 working days. Category 2 orders showed steady deterioration with MTTP increasing to around 80 working days, whilst the MTTP for Category 3 orders increased significantly to consistently over 140 working days. Category 4 order performance deteriorated slightly.

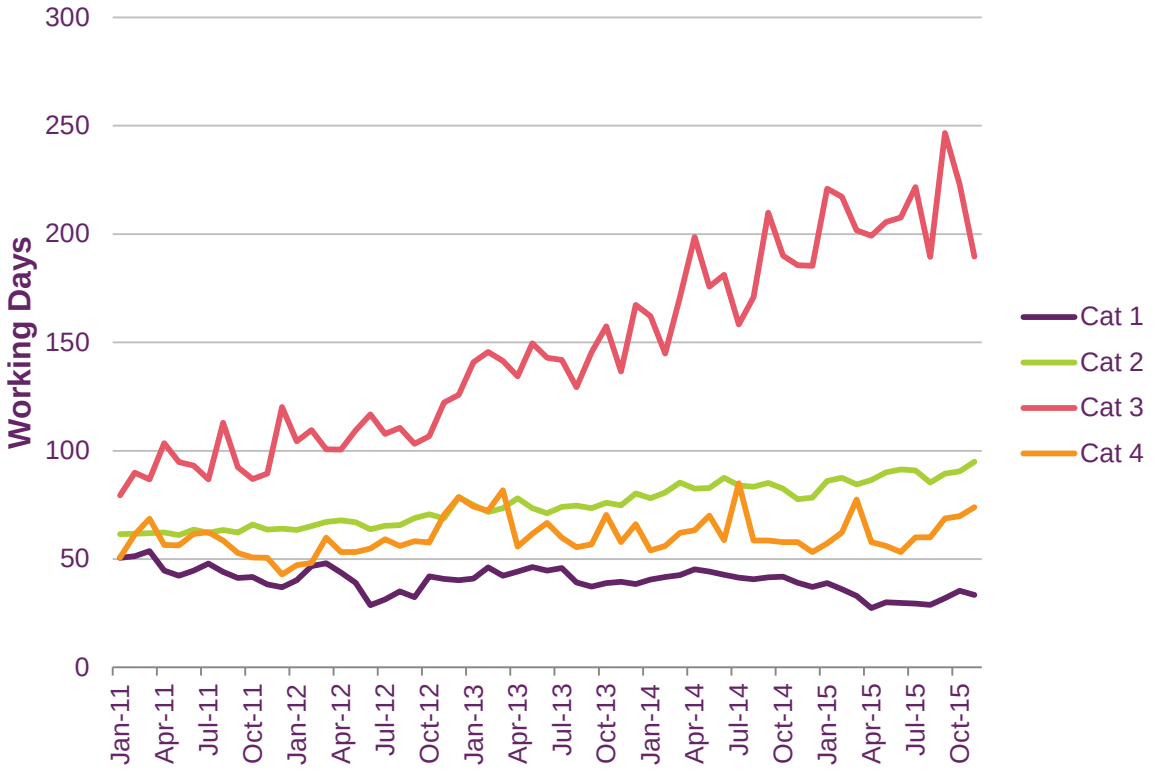
[439] The corresponding figure in the May 2015 BCMR Consultation (Figure A17.7) was constructed using weighted averages based on product order volumes due to limitations in available data at time of publication. Using the latest Ethernet provision performance data available, this figure has been constructed using averages of actual values.
[440] MTTP is defined as the average number of working days between an order being validated and Openreach advising the customer of its completion.

A12.33 Note that all of these measures take the day on which an order is validated as "Day 0", and that "days" refers to working days unless otherwise stated.

A12.34 We focus on performance disaggregated by order category, as this is the main dimension along which orders vary in their complexity.[441]

A12.35 Figure A12.5 shows the MTTP for each order category between January 2011 and November 2015. This portrays a gross measure of performance and includes delays that are not caused by Openreach and are outside Openreach's control.

Figure 12.5 Mean time to provide (MTTP) including all delay, by provision type



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.36 Category 1 orders exhibit a relatively stable, gradually improving performance with an MTTP of about 40 working days throughout most of the period. MTTP for Category 3 increased significantly from around 80 working days at the start of 2011 to around 190 working days by November 2015. The scale of deterioration of Category 3 somewhat masks the steady deterioration of Category 2 MTTP, which increased from 60 working days at the start of 2011 to around 95 working days by November 2015. Category 4 performance varied between around 50 to 75 working days over the period, with a gradual increase in MTTP after Jun 2015 to around 74 working days.

[441] Refer to Table A12.2 for a description of each provision order category.

Lead Time Performance Attributable to Openreach

A12.37 We now explore how much of the above lead time is attributable to Openreach.

A12.38 We analysed the overall lead time performance attributable to Openreach in the May 2015 BCMR Consultation observing the performance excluding customer delay[442], the performance excluding all customer and non-customer delay[443], volume of changes due to deemed consent[444] reasons, and delay of changes due to deemed consent reasons. We concluded[445] from this analysis that it is appropriate to assume that the lead time delay attributed to customers is outside the direct control of Openreach and should therefore be excluded in consideration of Openreach's performance, but it is not appropriate to assume the same for non-customer delay which we considered should not be excluded from our consideration of Openreach's performance.

A12.39 Below we analyse the period since the May 2015 BCMR Consultation to investigate if there is a need to refine this conclusion.

A12.40 The application of deemed consent has in practice been commonplace rather than exceptional; about two-thirds of all provide and regrade orders completed by Openreach in 2015 were subject to at least one deemed consent application, see Table A12.7 below. CPs and end-users have indicated to us that significant uncertainty over the final delivery date, rather than a longer lead time in itself, is their primary concern with recent Openreach provisioning performance.

A12.41 Openreach identify deemed consent changes by applying a set of deemed consent codes (DCC). Each code identifies a specific reason for the change. We have classified the DCC into two groups; one covering those changes that Openreach consider are caused by their customers while the other group covers those DCC that Openreach do not consider are caused by their customers. Table A12.4 below presents the Openreach DCC with their meanings and the group to which they are allocated.

Table A12.4: Deemed consent codes and their meanings[446]

Deemed consent code	Meaning	Cause Group[447]
DC21	Order is awaiting customer acceptance of ECC	Customer
DC7A	Customer site not ready for installation	Customer
DC7B	The Communications Provider is in breach of any part of the contract or Openreach suspends the service or any part of it in	Customer

[442] Resultant delay, in working days, from deemed consent changes classed as customer caused.
[443] Resultant delay, in working days, from deemed consent changes classed as not customer caused.
[444] A contractual term which permits Openreach, under certain defined circumstances, to change the contract delivery date (CDD) of an order.
[445] Paragraphs A17.138 to A17.140 in the May 2015 BCMR Consultation.
[446] There are a small set of internal Openreach delay codes which are not deemed consent codes and do not appear in this table. These include delay codes AY, BT01, CU01, CU02, FY, IY and JY. We have classified these as non-customer caused delay.
[447] This refers to Ofcom's classification.

	accordance with the contract	
DC7C	Customer site access delay/customer down time required	Customer
DC7D	The Communications Provider and Openreach agree a different timescale for performance of the service	Customer
DC7E	Delayed awaiting customer information	Customer
DC7I	The failure is due to an inaccurate order being submitted by the Communications Provider	Customer
DC7J	No access after failing to reach the 3 named contacts	Customer
DC7K	No access after an appointment has been made	Customer
DC7L	No specific location access after appointment made	Customer
DC7M	Customer appointment outside the 48 hour period	Customer
DC7N	Order suspended at customer's request	Customer
DC7O	Delays on driver circuit impacting on this circuit	Customer
DC7P	Weekend or bank holiday access is requested by customer	Customer
DC7Q	Customer network freeze periods in operation	Customer
DC7R	Customer downtime is required to complete provision work	Customer
DC7S	Risk assessment/method statements to be agreed by customer	Customer
DC22	There is a need for infrastructure build	Non-customer
DC23	There is cable or exchange breakdown	Non-customer
DC24	There is collapsed, blocked (e.g. cement) or damaged duct/manhole	Non-customer
DC25	Notice is required under the Traffic Management Act or Traffic Scotland Act	Non-customer
DC26	There is a manhole or footway box that is contaminated with or by a substance which requires special treatment	Non-customer
DC27	Asbestos has been identified	Non-customer
DC28	Security clearance is required but not yet agreed	Non-customer
DC29	Main frame compression or extension is required	Non-customer
DC7F	Customer wayleave	Non-customer
DC7G	The failure is due to a Force Majeure event	Non-customer
DC7H	The failure is due to a scheduled outage	Non-customer

Source: Ofcom based on Openreach information provided in presentation "DC Codes.pptx" in email from Openreach to Ofcom dated 29 July 2014.

A12.42 Technically, deemed consent can only be applied after the initial CDD has been issued. However, Openreach also use the coding to identify and record changes to the delivery date before the initial CDD is issued.

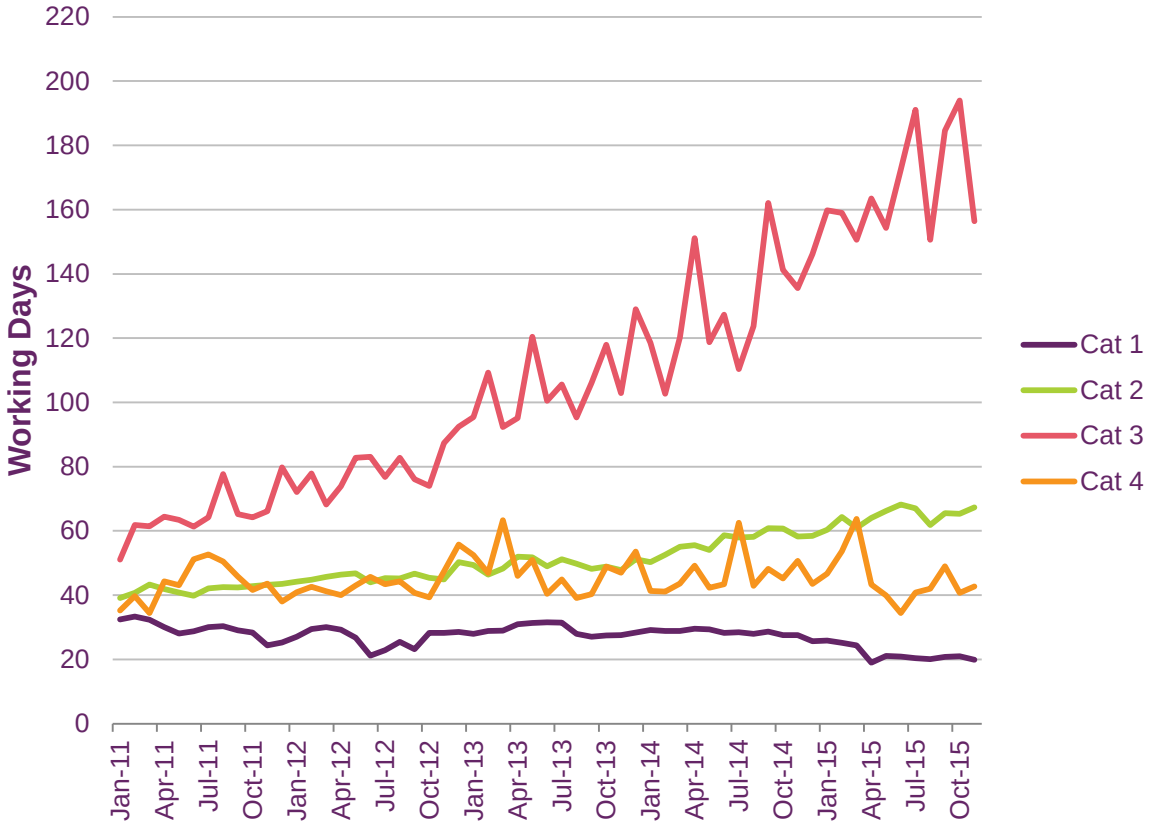
A12.43 We use the Openreach DCC and their groups to analyse how much of the overall lead time delay for each order for the period January 2011 to November 2015 can be attributed to Openreach, their customers or "third party" reasons.[448] The

[448] Openreach classify their DCC into Openreach caused delay, customer caused delay or third party caused delay as defined by Openreach in presentation "DC Codes.pptx" received in email titled Deemed Consent, from Openreach to Ofcom, dated Tue 29/07/2014 17:39.

changes and differences (delay) in lead time identified in our analysis include those contributions due to changes before as well as after the initial CDD is issued.

A12.44 Figure A12.6 shows the MTTP for each order category between January 2011 and November 2015 excluding delay due to changes that Openreach class as customer caused. The chart shows broadly similar patterns for each order category that were portrayed for the gross MTTP in Figure A12.5. The key difference is an overall reduction in the MTTP for each category of about 20 working days for Category 1, about 28 working days for Category 2, about 30 working days for Category 3 and about 20 working days for Category 4.

Figure A12.6 Mean time to provide (MTTP) excluding customer caused delays

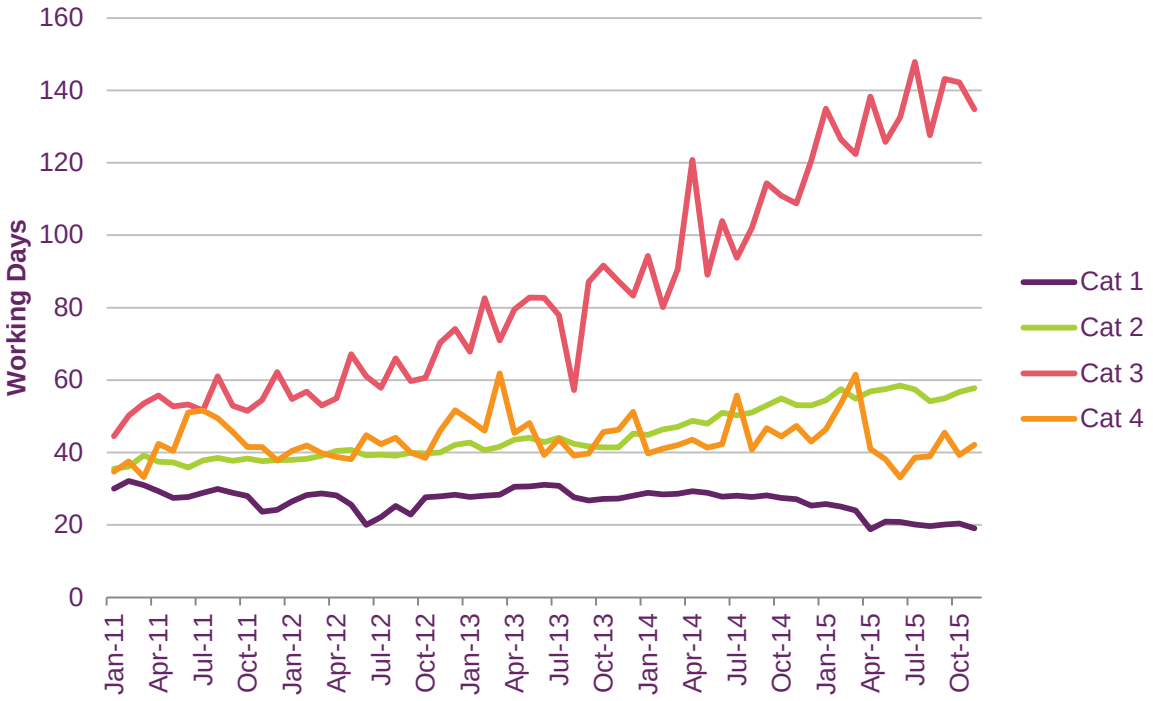


Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.45 In Figure A12.7 we additionally exclude the changes and delays attributed by Openreach to the "third party"[449] DCC as well as those attributed to customers. Compared to Figure A12.6 there is no significant difference in performance of categories 1 and 4 and the deterioration in MTTP for the other categories remains, although the MTTP for Category 2 is generally lower by around 5 working days and for Category 3 the MTTP is generally lower by around 10 working days.

[449] As defined by Openreach in presentation "DC Codes.pptx" provided in email from Openreach to Ofcom dated 29 July 2014. This "third party" delay includes deemed consent codes DC25, DC26, DC7F and DC7G.

Figure A12.7 Mean time to provide (MTTP) excluding customer and "third party"[450] delays



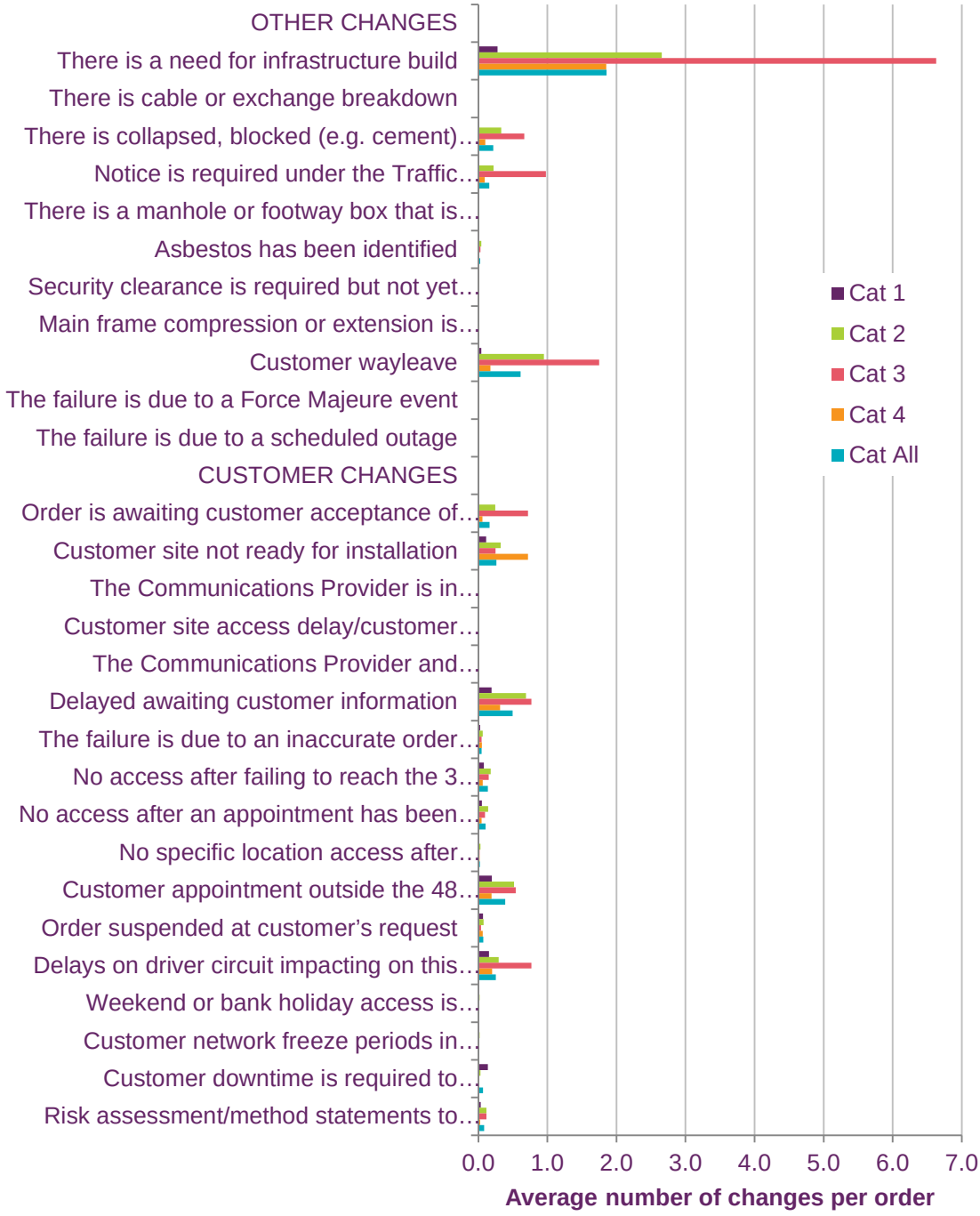
Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.46 To better understand the causes of the changes in lead times, we investigated the DCC registered against each change for each order for each year in the period 2011 to 2015. Figure A12.8 presents the average contribution each type of change identified by DCC makes to the number of lead time changes for each category of order in the year 2015[451] whilst Figure A12.9 shows the corresponding contribution to the associated delay.

[450] As defined by Openreach in presentation "DC Codes.pptx" provided in email from Openreach to Ofcom dated 29 July 2014. This "third party" delay includes deemed consent codes DC25, DC26, DC7F and DC7G.

[451] Other years were similar but reflected the lower MTTP in earlier years. The corresponding figures in Annex 17 of the May 2015 BCMR Consultation (Figures A17.12 and A17.13) show the year 2014.

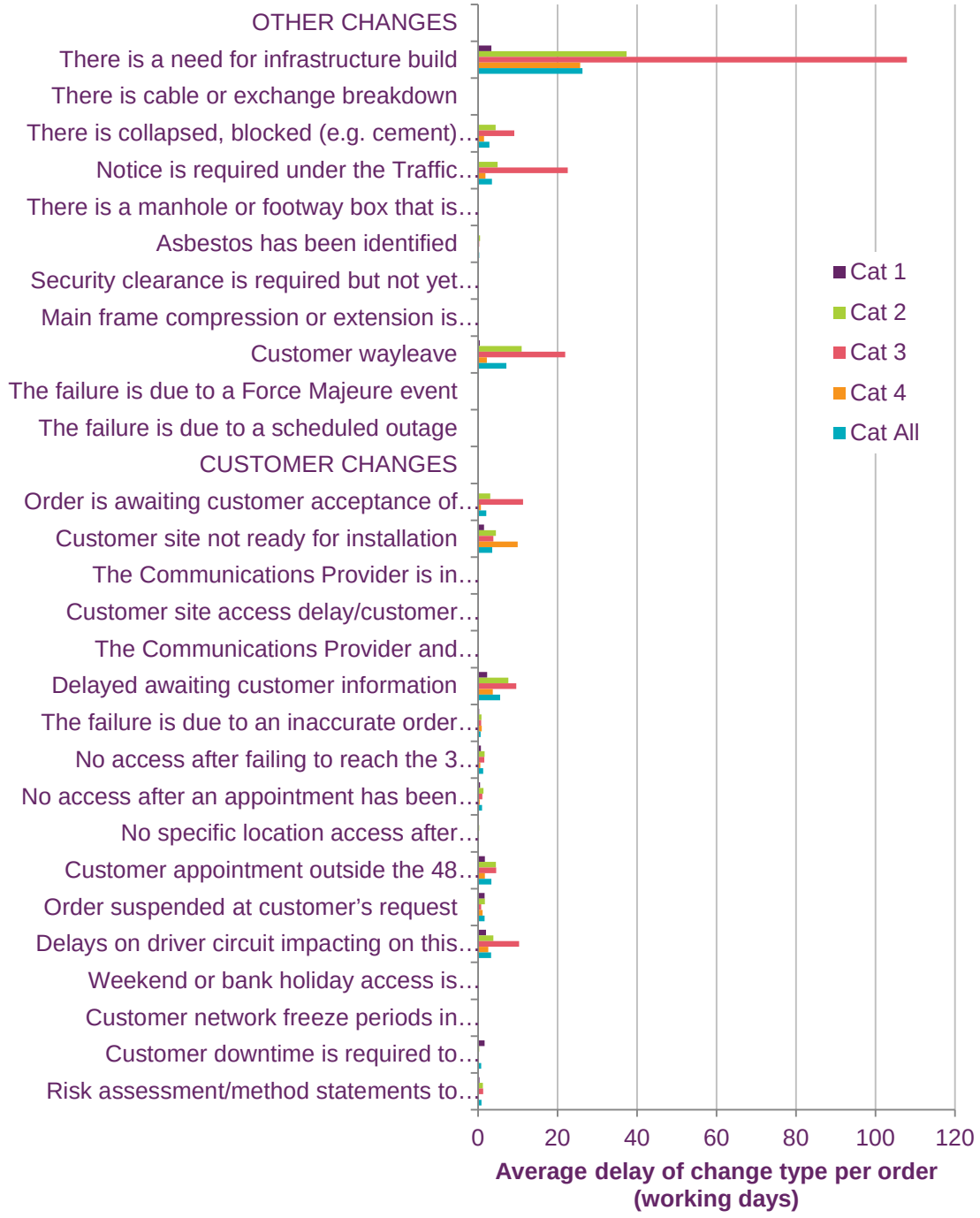
Figure A12.8 Volume of CDD changes per order arising from given deemed consent reasons, 2015[452]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

[452] The volume of changes is averaged across the total volume of orders or the total volume of orders within a category as appropriate.

Figure A12.9 Lead time change delay per order arising from given deemed consent reasons, 2015[453]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

[453] The lead time delay change is averaged across the total volume of orders or the total volume of orders within a category as appropriate.

A12.47 With respect to the changes attributed to customers (via the DCC) there appears to be a wide spread of reasons with none dominant. Table A12.7 below shows that around 53% of the changes in 2015 are attributed to customers.

A12.48 In the case of the changes attributed to non-customer causes, our analysis shows that there are four DCC categories contributing to most of the increase in non-customer caused lead time volume changes and added delay. They are:

i) "A need for infrastructure build" (DC22);

ii) "Notice is required under the Traffic Management Act or Traffic Scotland Act" (DC25);

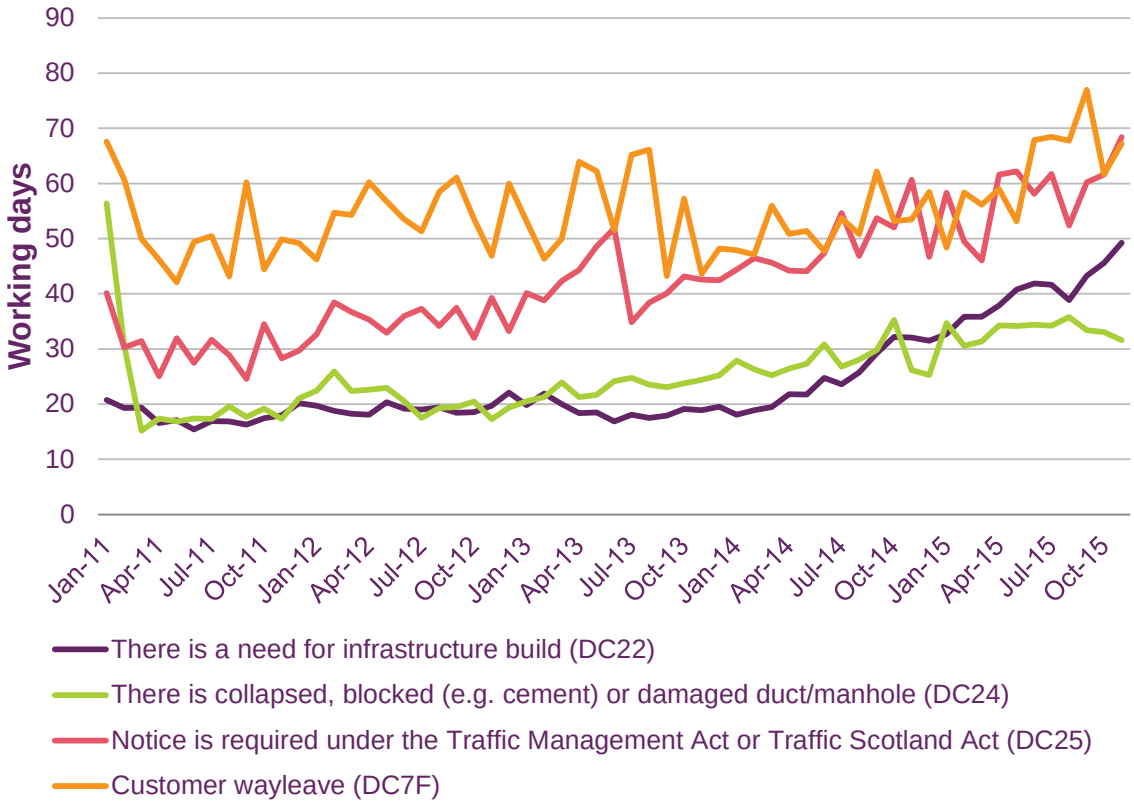
iii) "Customer wayleave" (DC7F); and

iv) "A collapsed, blocked or damaged duct/ manhole" (DC24).

A12.49 Figure A12.10 shows the average delay, in working days, per delayed order[454] for each of the above four DCC categories. Average DC25 delay for each order experiencing DC25 delay has increased over the period, from around 30 working days to around 70 working days. Average DC22 delay remained relatively stable at around 20 working days, until the start of 2014 where it increased to finish the period at around 50 working days. Average DC24 and DC7F delay both slightly increased over the period, finishing at around 30 working days and 65 working days respectively.

[454] I.e. When an order receives a particular type of delay, what is the average delay that order receives relating only to that type of delay.

Figure A12.10 Average delay per order which experiences that type of delay, in working days



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.50 In comparing Figures A12.9 and A12.10, it is evident that a higher proportion of orders experience DC22 delay over the period (37%) compared to the three other causes of delay. This is because the delay due to DC22 is the largest (whether averaged over each category or all orders), see Figure A12.9, while it mostly exhibits the lowest delay when averaged across just those orders that are subject to a DC22 delay, see Figure A12.10.

A12.51 Table A12.5 below shows the level of incidence of those orders subject to a DC22 change, a DC24 change or a DC22 and a DC24 change together as a percentage of all orders. We observe that apparent jump in levels between 2013 and 2014 for DC22 and note that this aligns with the increase in Category 2 orders illustrated in Figures A12.21 and A12.22. We also observe that levels for DC24 have increased between 2011 and 2015. We further discuss the incidence of these deemed consent codes in relation to question 13.12 and 13.13 in Section 13.

Table A12.5 Level of incidence of deemed consent codes DC22 (there is a need for infrastructure build) and DC24 (there is collapsed, blocked (e.g. cement) or damaged duct/manhole)

Year	Percentage of orders subject to a DC22 change	Percentage of orders subject to a DC24 change	Percentage of orders subject to both a DC22 and a DC24 change together
2011	32.1%	3.2%	33.0%
2012	33.1%	4.4%	33.9%
2013	30.5%	4.2%	31.2%
2014	43.9%	4.8%	44.2%
2015	43.6%	5.2%	43.8%

Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.52 Similar to our earlier findings[455], we believe that none of the above three reasons (DC22, DC25 and DC7F) can be attributed completely to third parties or natural events external to Openreach. The "need for infrastructure build" (DC22) is probably the least attributable to causes external to Openreach, but for example Openreach could engage in a more proactive approach in managing this task to reduce its effect on lead time. Both "Traffic Management" (DC25) and "Customer wayleave" (DC7F) could result from late application to the respective third parties just as much as there could be a delay in third parties responding or delaying the time when access is permitted. Just as we had done previously[456], here we note the observation from the City of London Corporation (CoLC)[457] that Openreach does not liaise with the CoLC streetworks team in a timely fashion.

A12.53 Our conclusions are therefore consistent with those set out in the May 2015 BCMR Consultation[458], namely that it is appropriate to assume that the lead time delay attributed to customers is outside the direct control of Openreach and should therefore be excluded from further analysis and consideration of Openreach's performance.

A12.54 However we also conclude it is not appropriate to assume the same for the non-customer delay. The non-customer delay is as much attributable to Openreach as it is to genuine third parties and while it may be outside Openreach's direct control, we believe Openreach could and should influence these parties to behave in a timely manner. Therefore we consider it appropriate to assume the non-customer delay is not excluded from further analysis and consideration of Openreach's performance.

A12.55 Consequently we concentrate the remainder of our analysis on lead times and other performance parameters that exclude customer caused delays but include delays arising from non-customer causes.

[455] Paragraph A17.137 in Annex 17 of the May 2015 BCMR Consultation.
[456] Paragraph A17.137 in Annex 17 of the May 2015 BCMR Consultation.
[457] Paragraph A17.81 in Annex 17 of the May 2015 BCMR Consultation.
[458] Paragraph A17.138 in Annex 17 of the May 2015 BCMR Consultation.

A12.56 We therefore believe Figure A12.6 appropriately portrays Openreach lead time MTTP performance. Along with Table A12.6, it shows a decline in performance over the period 2011 to 2015 for provision order categories 2, 3 and to a lesser extent category 4, but an improvement in Category 1 orders. Category 3 orders exhibit the worst performance and the worst decline although Category 2 also declines significantly.

Table A12.6 Mean time to provide (MTTP) in working days for lead times excluding customer caused delay but including non-customer caused delay

	Provision Category				
Year	1	2	3	4	All
2011	29	42	64	43	40
2012	26	46	78	43	39
2013	29	49	105	47	41
2014	28	57	129	46	45
2015	22	64	168	44	48

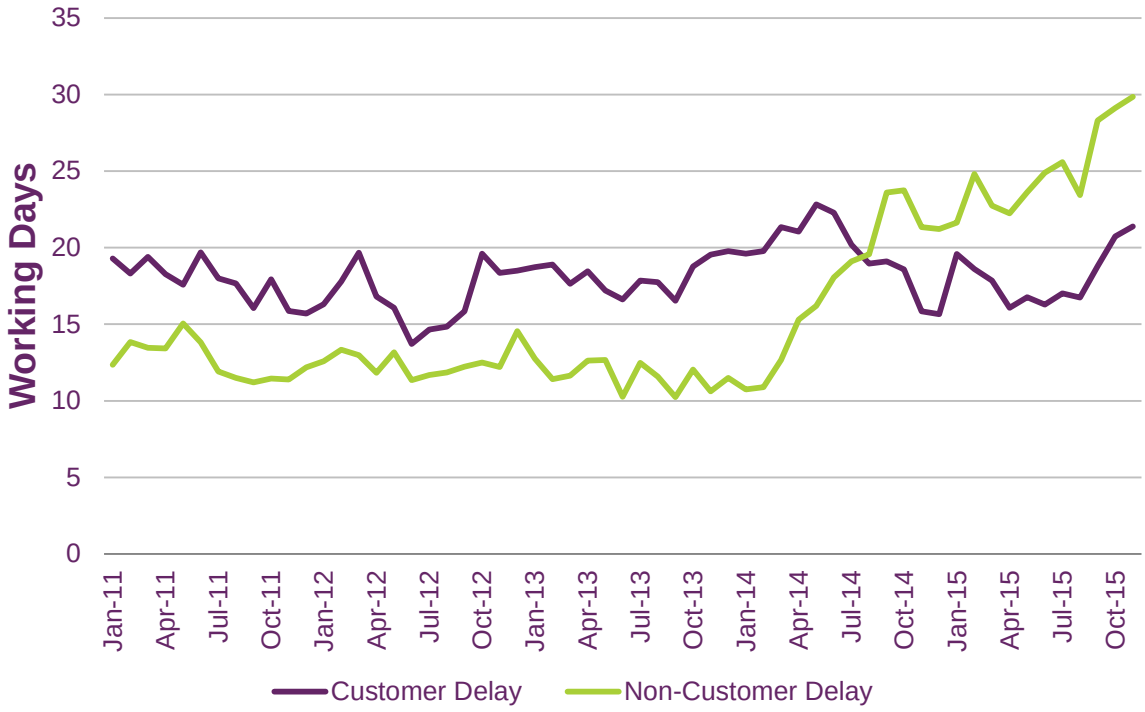
Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.57 We noted in Annex 17 of the May 2015 BCMR Consultation[459] that the impact of customer and non-customer delays whilst substantial, was relatively stable over time. We therefore do not think that customer and/or non-customer delays are a significant factor in explaining Openreach's recent provision performance.

A12.58 Based on new analysis, we now look at the average total delay (in working days) to the time to provide on all orders, as well as the contribution of customer and non-customer delay as shown in Figure A12.11. Both customer and non-customer delay remain relatively stable over time, at about 12 working days and between about 15 and 20 working days respectively, until just after the start of 2014 where we start to see a steady trend of increasing non-customer delay to about 30 working days, whilst customer delay remains relatively stable.

[459] Paragraph A17.142.

Figure A12.11 Average Delay to an order over time, categorised as customer or non-customer delay[460], in working days



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

Other Aspects of Lead Time Performance

A12.59 Having established an appropriate measure of lead time performance we now consider other aspects of lead time, i.e. the average time to issue an initial contractual delivery date (CDD) and the average time between validation and the value of the initial CDD. We exclude customer caused delay from these measures for the reasons given above.

A12.60 We analysed these other aspects of lead time performance in the May 2015 BCMR Consultation observing that there is a relatively narrow window between the time taken to issue the initial CDD and the value of the initial CDD (both measured from order validation). We were unable to explain why this was the case but it suggested that the initial CDD was being issued close to the initial CDD value.

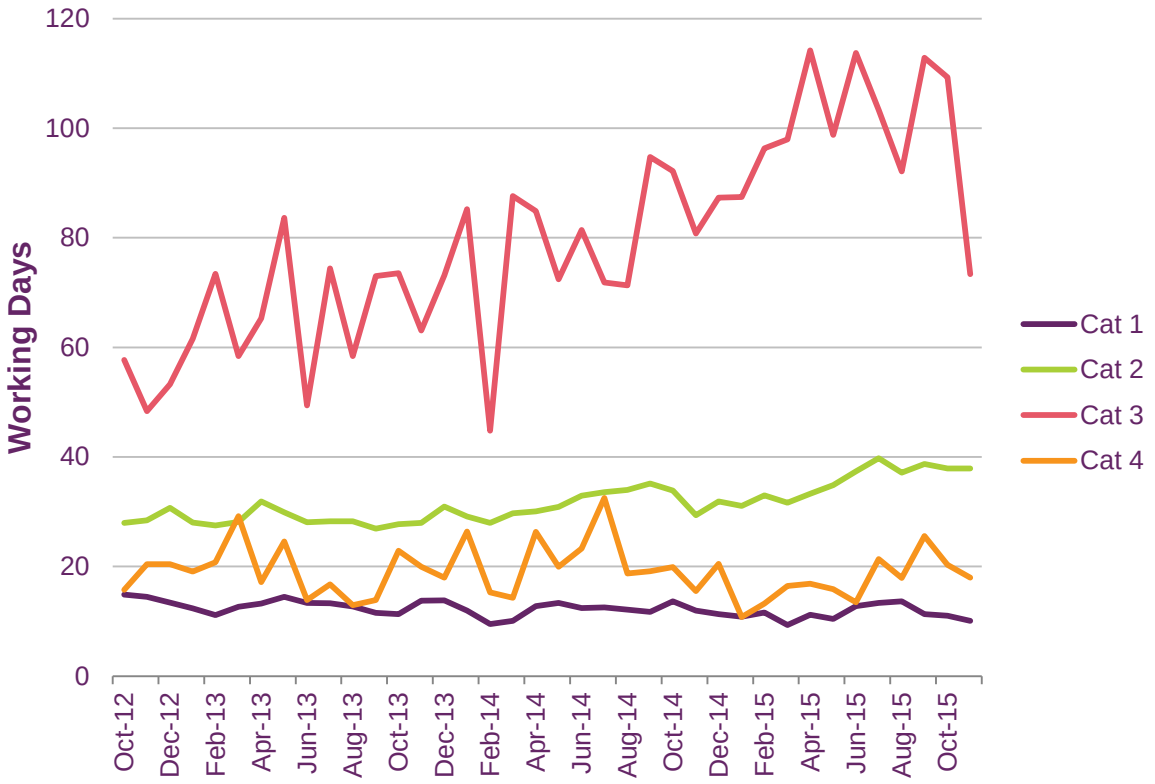
A12.61 We analysed the period since the May 2015 BCMR Consultation to investigate if there is a need to refine this conclusion.

A12.62 Figure A12.12 shows the average time taken by Openreach to issue customers with an initial CDD between October 2012 and November 2015 from order validation.

[460] Here 'non-customer delay' includes those types of delay that are deemed consent codes as found in Table A12.4 above as well as those other types of delay specified in the footnote for Table A12.4 above.

Openreach's target for issuing an initial CDD, which corresponds to milestone KCI3 in the provisioning process, is approximately 14 working days.[461]

Figure A12.12 Average time to issue initial CDD excluding customer caused delays[462]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.63 Category 1 orders consistently achieve 14 working days or are within 1 working day of it throughout the period. An initial CDD is also at times issued within 14 working days for Category 4 orders. However, on average Category 2 and 3 orders fail to meet the approximate 14 working day target. Category 2 orders deteriorate from an average of around 30 working days to around 40 working days. Category 3 performance is highly volatile ranging from an average of 50 working days to around 90 working days until August 2014 where further deterioration shows a range from around 80 working days to 115 working days.

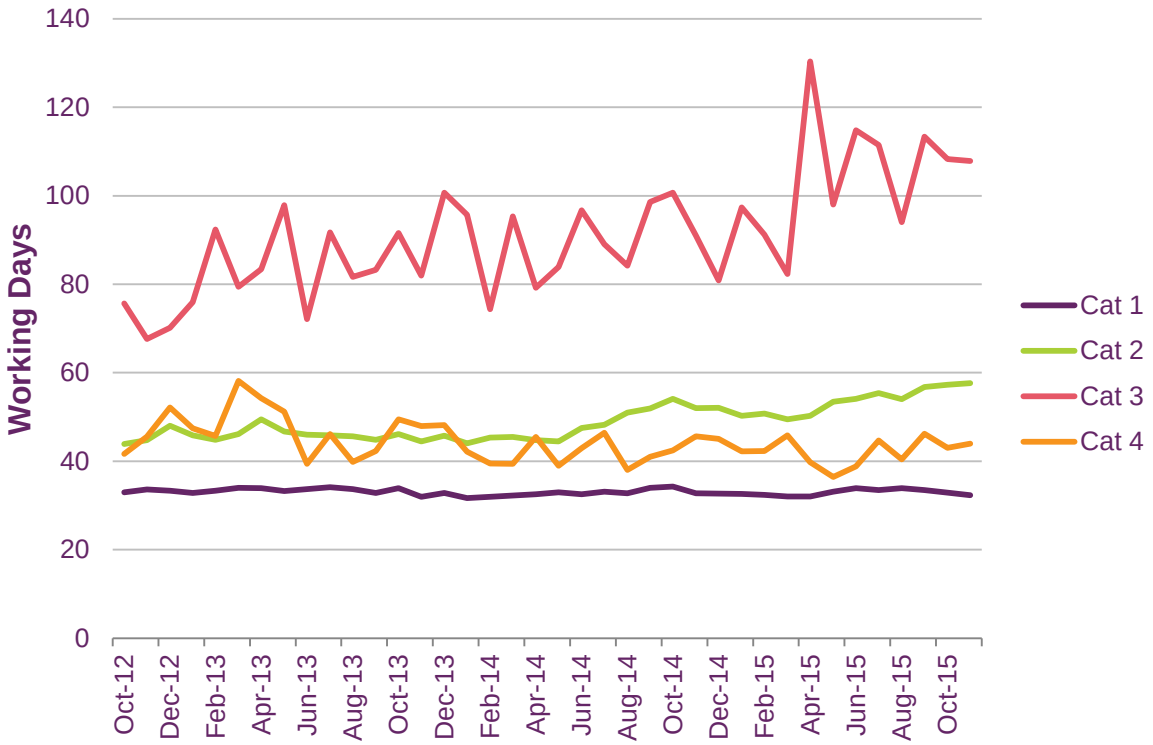
A12.64 Figure A12.13 shows the average time between order validation and the initial CDD value issued by Openreach. Category 1 orders remain stable at around 30 working days. Category 2 orders remained relatively stable at around 45 working days until June 2014 where the average time deteriorates to around 58 working days. Category 4 orders are more variable, fluctuating between around 35 working days to 60 working days throughout the period with no long term trends in either

[461] "Connectivity Services Schedule 4 - Service Levels. Effective until 14/04/16", Openreach Connectivity Services Contracts available at https://www.openreach.co.uk/orpg/home/products/ethernetservices/contracts/contracts.do

[462] In this case the customer caused delay that is excluded is the amount of customer caused delay which occurs before the initial CDD is issued.

direction. For Category 3 orders, performance against this measure increases from around 70 working days in October 2012 to consistently above 80 working days until February 2015 where deterioration shows orders ending the period with an average over 100 working days.

Figure A12.13 Average time between order validation and initial CDD value, excluding customer caused delays[463]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.65 Comparing Figures A12.12 and A12.13, we note for categories 1 and 2, 3, and to a lesser extent 4, the similar profile shapes in the time to issue the initial CDD and the value of the initial CDD (both measured from order validation) over time. We consider this evidence continues to suggest that the date on which the initial CDD is issued is intentionally close to the initial CDD value that is given to customers, in order to improve the accuracy of the initial CDD at the expense of the time by when the customer is informed of the initial CDD.

Lead Time Uncertainty – Volumes of CDD Changes and Associated Delays

A12.66 We now consider the key characteristics of lead time uncertainty, the number of changes an order experiences and the associated delay (change in lead time).

[463] The corresponding figure in the May 2015 BCMR Consultation (Figure A17.16) was constructed using weighted averages based on product order volumes due to limitations in available data at time of publication. Using the latest Ethernet provision performance data available, this figure has been constructed using averages of actual values.

A12.67 We analysed these other aspects of lead time performance in Annex 17 of the May 2015 BCMR Consultation observing that nearly three-quarters of all orders experience some form of delay, and Category 3 (and to a lesser extent Category 2) orders experience a much greater number of changes and much greater associated additional delay than those in Categories 1 and 4. Approximately half the changes occurred after the initial CDD was issued, and given that changes before the initial CCD is issued are seen as part of the initial CDD[464], there was uncertainty when an order was placed as to whether the 30 working day standard lead time would be adhered to, as well as uncertainty in the CDD value once it has been issued.

A12.68 Based on these observations we concluded that there was a significant issue of uncertainty and volatility in the provisioning process for Category 2, 3 and 4 orders, which formed over 50% of relevant volumes.

A12.69 We analyse the period since the May 2015 BCMR Consultation to investigate if there has been a change to what we previously observe, and conclude that there remains uncertainty in the lead time of issuing a CDD and in the initial CDD value itself.

A12.70 For each year in the period 2011 to 2015, Table A12.7 below presents a summary of the average volume of changes and average delay in lead time per order (split by provision category), that can be attributed to the deemed consent codes and other internal delay codes.[465] The table also shows the proportion of changes attributed to customers as well as identifying the proportion of changes made after the initial CDD is issued that customers will see as changes to the CDD.

Table A12.7 Lead time change volume and associated delay[466]

Provision Category	Year	Proportion of Orders Changed (%)	Mean Volume of Changes to Lead Time per Order	Mean Lead Time Change per Order (working days)	Proportion of Changes Attributed to Customers (%)[467]	Proportion of Changes Made After Initial CDD Issued (%)[468]
All	2011	76	3.0	30.3	66	53
	2012	70	3.3	29.2	63	49
	2013	69	3.0	29.7	66	49
	2014	74	3.3	37.3	60	50
	2015	66	3.4	42.9	46	48
1	2011	64	2.2	19.3	85	69

[464] Changes made before the initial CDD is issued appear as an apparent delay compared to the standard 30 day lead time, and are included in the initial CDD value.
[465] See Table A12.4 for a description of each deemed consent code, including its classification as either customer or non-customer delay.
[466] In this table the lead time change and delay include all deemed consent codes as found in Table A12.4 and other types of delay specified in the footnote for Table A12.4 above.
[467] The proportion of delay attributed to customers is 6 to 27 percentage points greater than the proportion of changes attributed to non-customers.
[468] The proportion of delay that occurs after the initial CDD is issued due to these changes is about 0 to 7 percentage points less than before the initial CDD is issued.

	2012	53	1.9	14.9	84	65
	2013	53	1.6	14.9	89	74
	2014	53	1.6	16.2	86	76
	2015	38	1.1	13.2	77	72
2	2011	87	3.8	35.6	63	50
	2012	87	4.7	39.5	59	45
	2013	91	4.6	44.7	61	44
	2014	94	4.8	54.2	55	44
	2015	86	5.1	64.1	43	45
3	2011	95	5.4	66.5	50	48
	2012	94	8.0	80.7	44	41
	2013	95	9.6	111.5	41	33
	2014	99	10.9	149.6	38	36
	2015	98	12.8	189.6	27	38
4	2011	74	2.2	18.9	70	65
	2012	64	2.5	22.5	67	60
	2013	80	2.9	30.3	64	58
	2014	90	2.8	33.2	49	43
	2015	89	3.0	38.7	47	56

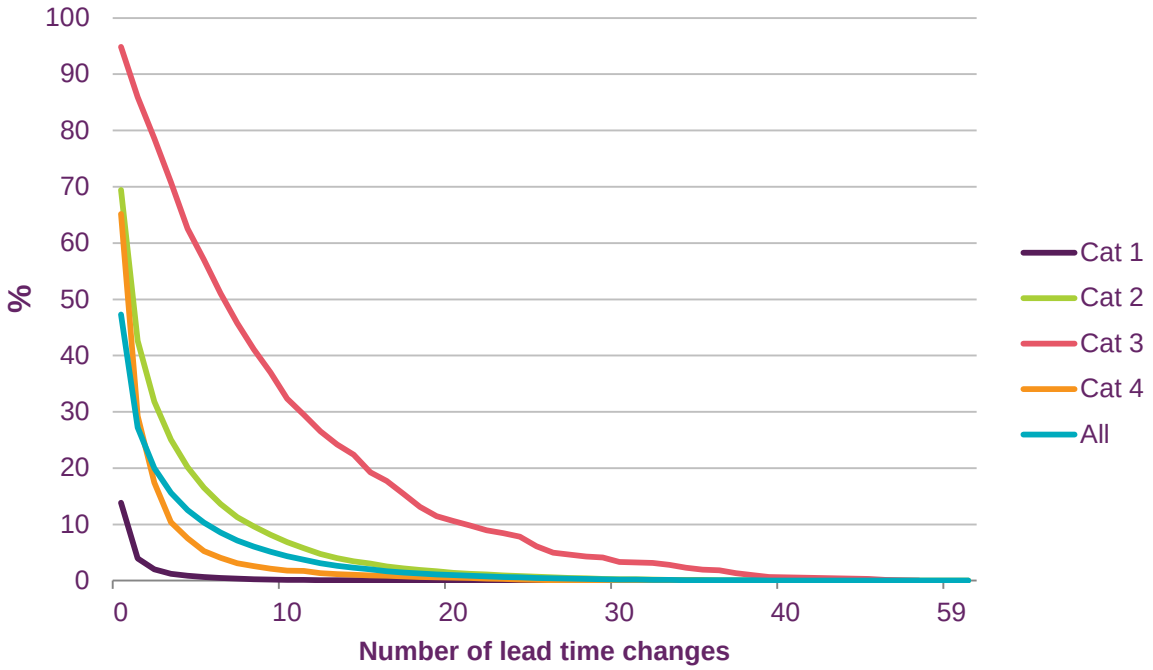
Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.71 About two-thirds of orders experienced some form of delay in 2015 (compared with over three-quarters in 2014). Orders in Category 3, and to a lesser extent those in Category 2 and Category 4 (in the past two years), experience a much greater number of changes and much greater associated additional delay than those in Category 1. This possibly reflects the need for civil infrastructure build in these categories.

A12.72 Approximately half the changes to the CDD occur after the initial CDD is issued, although this does vary by category with Category 3 generally exhibiting fewer changes and Category 1 the most, possibly due to the late issue of initial CDD for Category 3 as shown in Figure A12.12. This shows the uncertainty when an order is placed as to whether the 30 working day standard lead time will be adhered to and once the initial CDD has been issued there is uncertainty in the CDD issued.

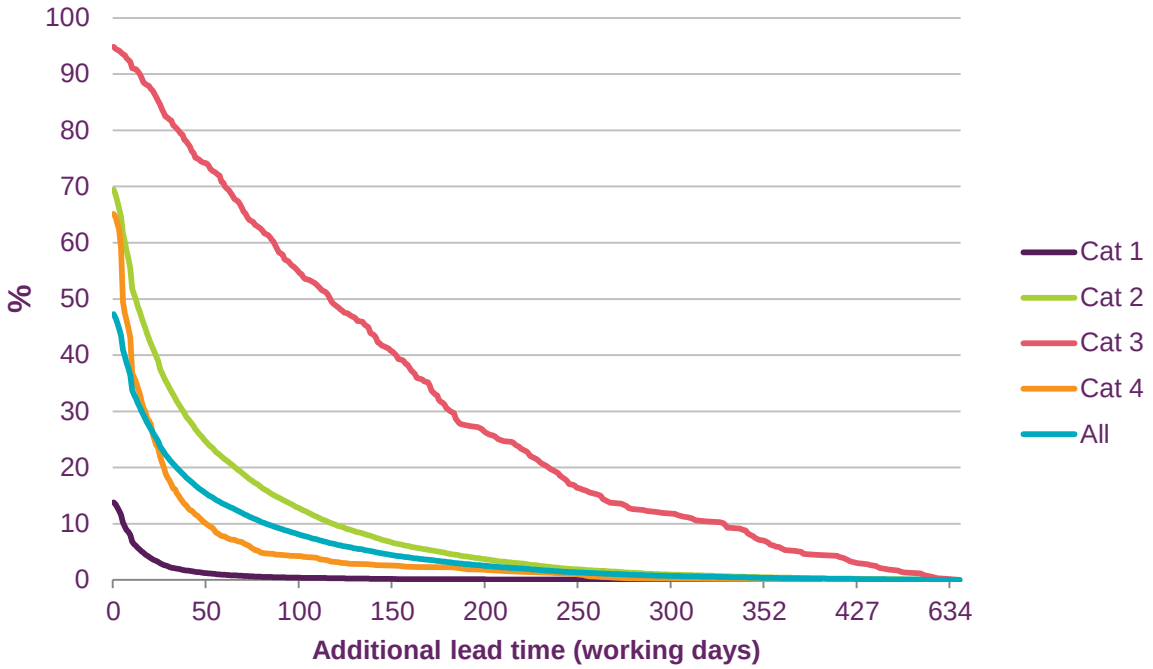
A12.73 The average values in Table A12.7 above mask the spread in the number of changes and associated delay in the CDD. Figures A12.14 and A12.15 present the percentage of orders experiencing more than a given number of changes or delay (excluding customer caused changes). As set out in both figures, the spread in values is dependent on provision categories.

Figure A12.14 Percentage of orders experiencing more than a given number of changes in lead time (excluding customer caused changes), 2015



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

Figure A12.15 Percentage of orders experiencing more than a given level of change in lead time, i.e. delay (excluding customer caused changes), 2015



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.74 We conclude, just as we did in the May 2015 BCMR Consultation, that there is a significant issue of uncertainty and volatility in the provisioning process for Category 2, 3 and 4 orders, which form over 50% of relevant volumes.

SLG Payments

A12.75 Another indicator of performance is the level of SLG payments made. Openreach is liable for SLG payments in the event that an order is not completed by the final CDD to be issued and not the initial CDD. Notwithstanding this, we have found that both the percentage and the total value of provisioning SLGs has risen since 2011 and substantially so in 2013/14.

A12.76 Table A12.8 below reproduced from our analysis in Annex 17 of the May 2015 BCMR Consultation[469] shows Openreach's provision SLG payments in each financial year from 2011/12 to 2013/14. Table A12.8 shows that there has been an approximate fivefold increase in the proportion of Openreach provisions subject to an SLG payment.

Table A12.8 Openreach provisioning SLG payments

	Percentage of provisions subject to an SLG payment	Total value of provisioning SLG payments
2011/12	[✂]	[✂]
2012/13	[✂]	[✂]
2013/14	[✂]	[✂]

Source: Ofcom analysis of Openreach section 135 response dated 19 September 2014.

Project Services

A12.77 Project Services is a premium project coordination and management service offered by Openreach. As outlined in Annex 17 of the May 2015 BCMR Consultation, some CPs raised in their responses to the CFI concerns about orders placed with Project Services possibly receiving preferential treatment, for example better lead times or better information concerning lead time delays.

A12.78 In Annex 17 of the May 2015 BCMR Consultation we observed that orders placed with Project Services were on average likely to be more complex to provision than standard orders. Evidence of similar or slightly worse performance observed in Annex 17 of the May 2015 BCMR Consultation did not necessarily rule out the possibility that such orders were expedited or received relatively higher quality of service in other aspects of the provisioning process such as certainty of the CDD. Overall, we did not consider that there was evidence that Project Services orders received favourable treatment over the period considered.

A12.79 We analysed the period since the May 2015 BCMR Consultation to investigate if there has been a change to what we observed and whether more consideration is required.

A12.80 Table A12.9 shows MTTP (excluding customer caused delays) for orders placed both with and without Project Services, disaggregated by order category. We observe that performance for Category 1 to 3 orders placed via Project Services is slightly worse, possibly reflecting that the delivery to sites on some multiple site

[469] Paragraphs A17.155 to A17.156.

orders are delayed so that delivery can be synchronised across the sites. Category 4 orders placed via Project Services appear to receive consistently lower lead times over the period investigated compared to Non-Project Service orders. However we note that over the period Category 4 orders constitute less than 5% of all orders.

Table A12.9 Comparison of MTTP (working days) excluding customer caused delay between orders placed with and not with Project Services (PS)[470]

	Category 1		Category 2		Category 3		Category 4	
Year	PS	Non-PS	PS	Non-PS	PS	Non-PS	PS	Non-PS
2011	29	29	42	42	70	63	38	52
2012	33	25	56	43	86	75	43	43
2013	31	29	55	47	111	102	42	50
2014	30	28	63	54	140	120	44	48
2015	28	20	84	59	191	152	40	53

Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.81 Table A12.10 compares orders placed with and without Project Services across a range of metrics relating to the application of deemed consent. Project Services orders are typically subject to more changes and greater delay than standard orders.

Table A12.10 Project Services, comparison of lead time changes[471][472]

	Year	Proportion of Orders Changed (%)		Average No. of Changes		Average Delay (working days)	
		PS	Non-PS	PS	Non-PS	PS	Non-PS
All	2011	80	75	3.9	2.7	38	28
	2012	79	67	5.6	2.9	50	24
	2013	77	66	4.2	2.5	42	25
	2014	80	71	4.4	2.8	50	32
	2015	80	63	5.2	2.9	68	36
Cat 1	2011	72	61	2.9	1.9	26	17
	2012	71	49	3.6	1.5	30	12
	2013	60	51	2.0	1.5	19	14
	2014	60	50	2.0	1.4	21	14
	2015	56	35	1.9	1.0	25	11

[470] A number of the MTTP values in this table are different to the corresponding table in the May 2015 BCMR Consultation (Table A17.21) due to the a number of orders having changed from being placed with Project Services to not placed with Project Services, and vice versa, as detailed in paragraphs A12.26 and A12.27 above.

[471] In this table the lead time change and delay include all deemed consent codes as found in Table A12.4 and other types of delay specified in the footnote for Table A12.4 above.

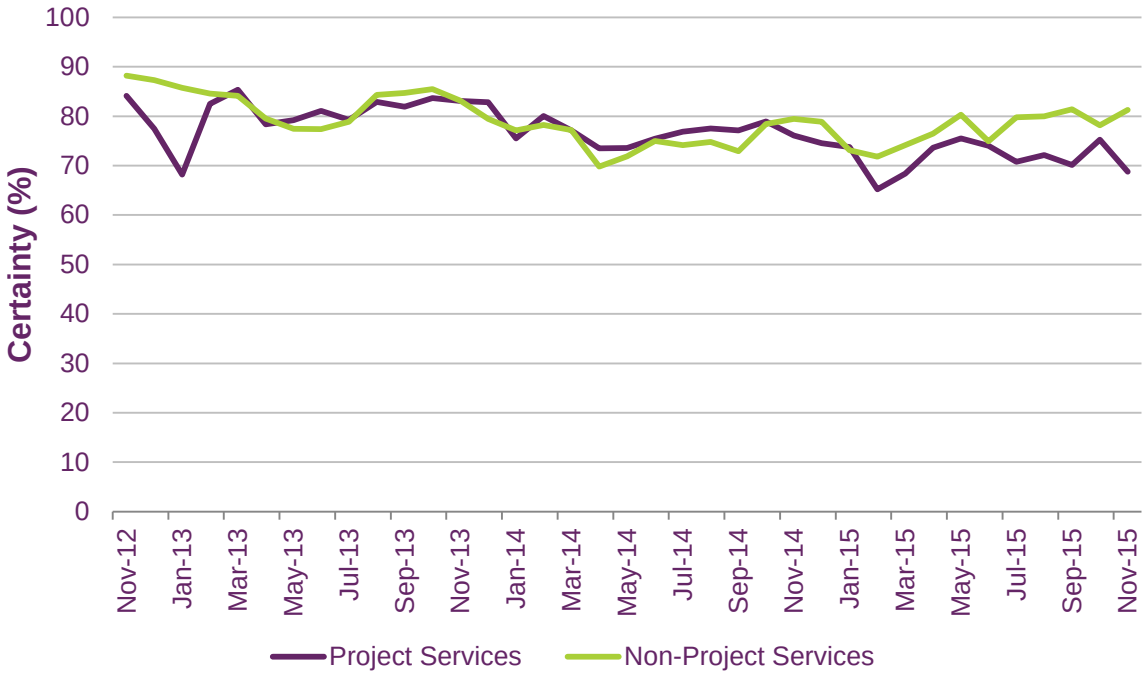
[472] A number of the MTTP values in this table are different to the corresponding table in the May 2015 BCMR Consultation (Table A17.22) due to the a number of orders having changed from being placed with Project Services to not placed with Project Services, and vice versa, as detailed in paragraph A12.27 above.

Cat 2	2011	93	86	5.5	3.4	54	31
	2012	92	86	7.8	4.0	70	33
	2013	91	90	5.9	4.1	58	39
	2014	95	93	6.1	4.3	68	48
	2015	92	85	7.4	4.6	96	56
Cat 3	2011	98	94	7.5	5.0	98	60
	2012	98	93	9.7	7.3	103	72
	2013	98	94	11.2	8.8	124	105
	2014	99	99	12.2	9.8	168	134
	2015	100	96	15.6	10.7	221	167
Cat 4	2011	64	89	1.8	2.8	14	28
	2012	49	82	1.3	4.1	13	35
	2013	78	82	2.9	2.8	33	28
	2014	88	92	2.9	2.8	34	32
	2015	92	82	2.7	3.7	35	47

Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.82 Figure A12.16 compares the certainty in CDD (excluding customer caused delay) of project services orders and non-project services orders. We observed that certainty performance remains reasonably consistent between both project services and non-project services orders. There has been some divergence in terms of performance against certainty in the past 12 months for each of these two categories, although the updated analysis shows that non-project services orders have the higher certainty in CDD.

Figure A12.16 Percentage of orders delivered by CDD excluding customer caused delay, both project services and non-project services orders



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.83 We observe here that, just as we observed in Annex 17 of the May 2015 BCMR Consultation, orders placed with Project Services are on average likely to be more complex to provision than standard orders, as can be seen in Tables A12.9 and A12.10, and Figure A12.16. We understand that many orders are subject to coordinated delivery across a number of sites. Therefore, evidence of similar or slightly worse performance does not necessarily rule out the possibility that such orders are expedited or receive relatively higher quality of service in other aspects of the provisioning process. Overall, given the evidence that is available, we do not consider that Project Services orders received favourable treatment over the period considered.

Comparison of Internal and External Provisioning Performance

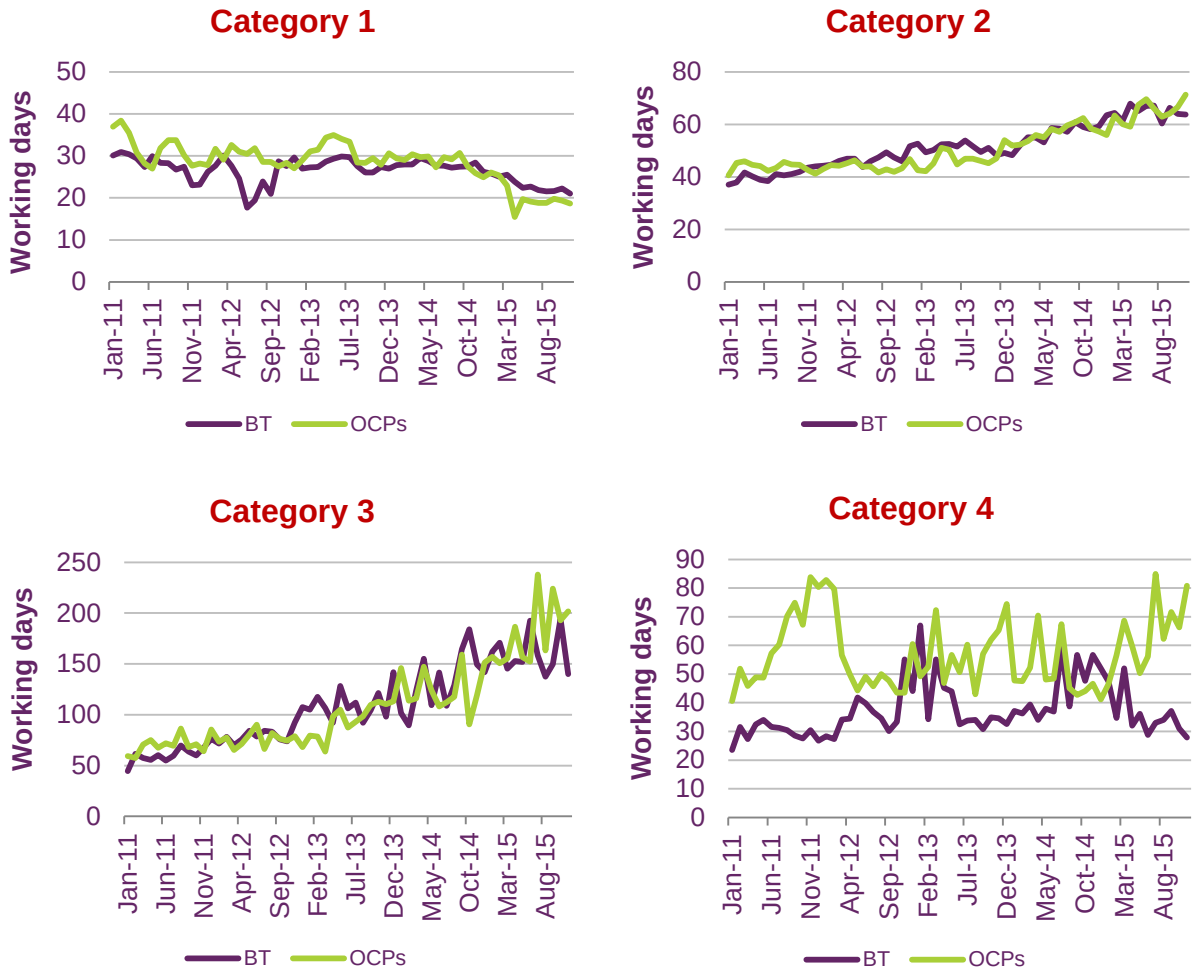
A12.84 The final aspect of provisioning performance that we consider is whether there has been any significant difference in the quality of service provided by Openreach to downstream divisions of BT, in comparison to that provided to other Communications Providers (OCPs) purchasing Openreach inputs. We restrict our attention to potential differences in provisioning performance, given that repair performance has been maintained at a generally good standard.

A12.85 We observed in Annex 17 of the May 2015 BCMR Consultation that there was little evidence of any systematic bias in Openreach performance in favour of either downstream divisions of BT or OCPs in terms of MTTP with the possible exception of Category 4 orders, where BT downstream CPs appear to receive consistently lower lead times (MTTP) than the OCPs.

A12.86 The charts in Figure A12.17 below show MTTP (excluding customer caused delay) for each order category, distinguishing between orders placed by downstream divisions of BT[473] and OCPs. Once more there is little evidence of any systematic bias in Openreach performance in favour of either downstream divisions of BT or OCPs in terms of MTTP. We previously observed that Category 4 orders could be an exception. This also appears to be the case between July 2014 and January 2015 where OCPs receive consistently longer lead times compared to BT downstream divisions.

[473] BT Business, BT Wholesale and BT Global Services.

Figure A12.17 Comparison of internal and external MTTP by category of provision



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.87 Table A12.11 summarises the incidence, frequency and impact of deemed consent on orders depending on whether they were placed by downstream divisions of BT or OCPs. Once more we do not consider that there is evidence of systematic bias with the possible exception of Category 4 orders. However we note that over the period 2011 to 2015 Category 4 orders constitute fewer than 5% of all orders.

Table A12.11 Deemed consent, internal[474] vs external[475]

	Year	Proportion of Orders Changed (%)		Average No. of Changes		Average Delay (working days)	
		BT	OCPs	BT	OCPs	BT	OCPs
All	2011	75	80	3.1	2.9	31	29

[474] The corresponding table in the May 2015 BCMR Consultation (Table A17.24) excluded several of BT's downstream services that are now included in the construction of this table using the latest Ethernet provision performance data, which is why a couple of the values in this table differ.
[475] In this table the lead time change and delay include all deemed consent codes as found in Table A12.4 and other types of delay specified in the footnote for Table A12.4 above.

	2012	66	75	3.4	3.2	30	28
	2013	68	70	3.1	2.8	31	28
	2014	73	75	3.2	3.3	36	39
	2015	67	66	3.5	3.3	44	42
1	2011	63	67	2.2	2.1	20	18
	2012	48	63	1.8	2.1	14	17
	2013	51	56	1.5	1.7	14	17
	2014	52	54	1.5	1.7	15	18
	2015	40	36	1.2	1	14	12
2	2011	86	89	3.9	3.6	37	33
	2012	86	89	4.9	4.2	42	35
	2013	90	91	4.9	4.2	48	40
	2014	94	93	4.9	4.8	54	54
	2015	85	88	5.3	5	65	63
3	2011	93	97	5.5	5.3	67	65
	2012	93	96	8.3	7.5	85	74
	2013	96	94	10.3	8.4	120	97
	2014	99	99	11.3	10.4	154	145
	2015	98	97	11.5	14.2	172	210
4	2011	67	83	2.1	2.3	16	23
	2012	48	81	1.7	3.5	15	31
	2013	76	85	2.6	3.1	26	35
	2014	87	93	3	2.7	34	33
	2015	87	91	2.6	3.8	32	49

Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

Repair Performance

A12.88 In Annex 17 of the May 2015 BCMR Consultation[476] we observed Openreach's performance for Ethernet repairs looking at fault reports as a percentage of installed volumes, Ethernet fault report volumes, percentage of faults where service was restored within the time specified by the SLA, and the average time to clear faults for EAD.

A12.89 Table A12.12 below summarises the volume of fault reports received by Openreach for Ethernet products relative to installed volumes, as well as the proportion of these faults that were classified as "fault not found". Together these two indicators provide a high-level overview of the demand faced by Openreach for Ethernet repairs, which appears to be relatively stable over time.

[476] Paragraphs A17.164 to A17.167.

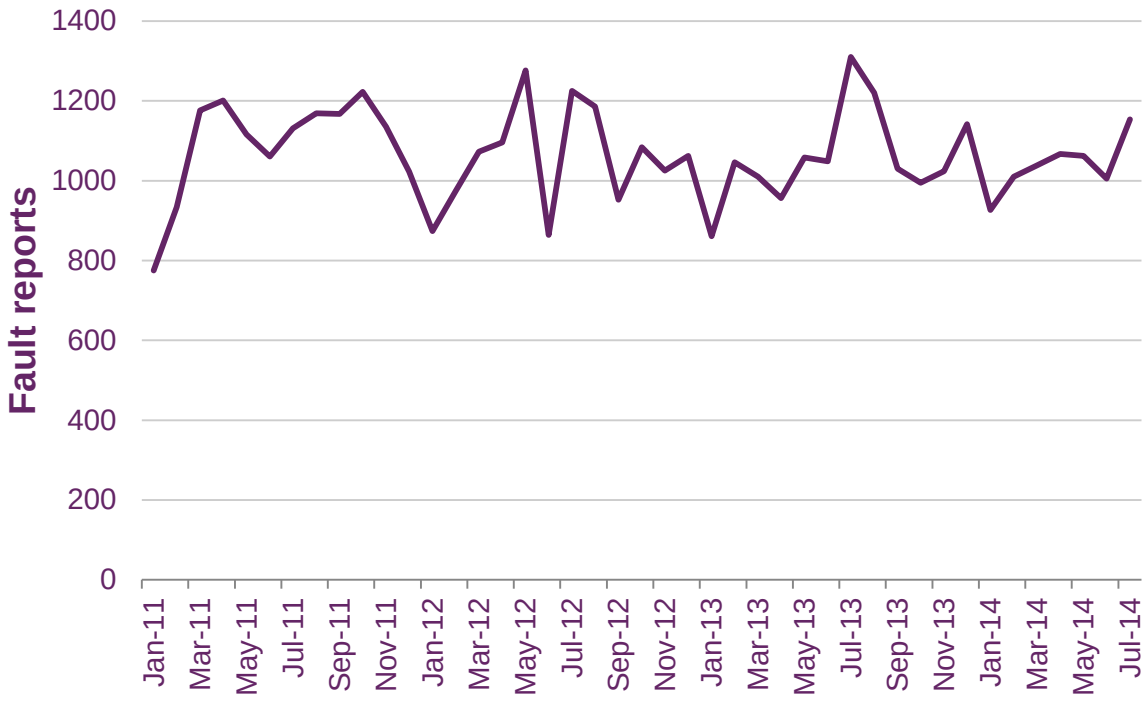
Table A12.12 Fault reports as a percentage of installed volumes[477]

Year	Fault reports as a percentage of installed volumes	Percentage of reports classified as "fault not found"
2011/12	9.2%	38%
2012/13	7.8%	38%
2013/14	7.4%	39%

Source: Ofcom analysis of Openreach section 135 response dated 10 October 2014.

A12.90 Figure A12.18 plots the volume of fault reports received by Openreach for Ethernet products on a monthly basis between January 2011 and July 2014. It can be seen that even on a monthly basis the volume of fault reports did not vary significantly over this period.

Figure A12.18 Ethernet fault report volumes

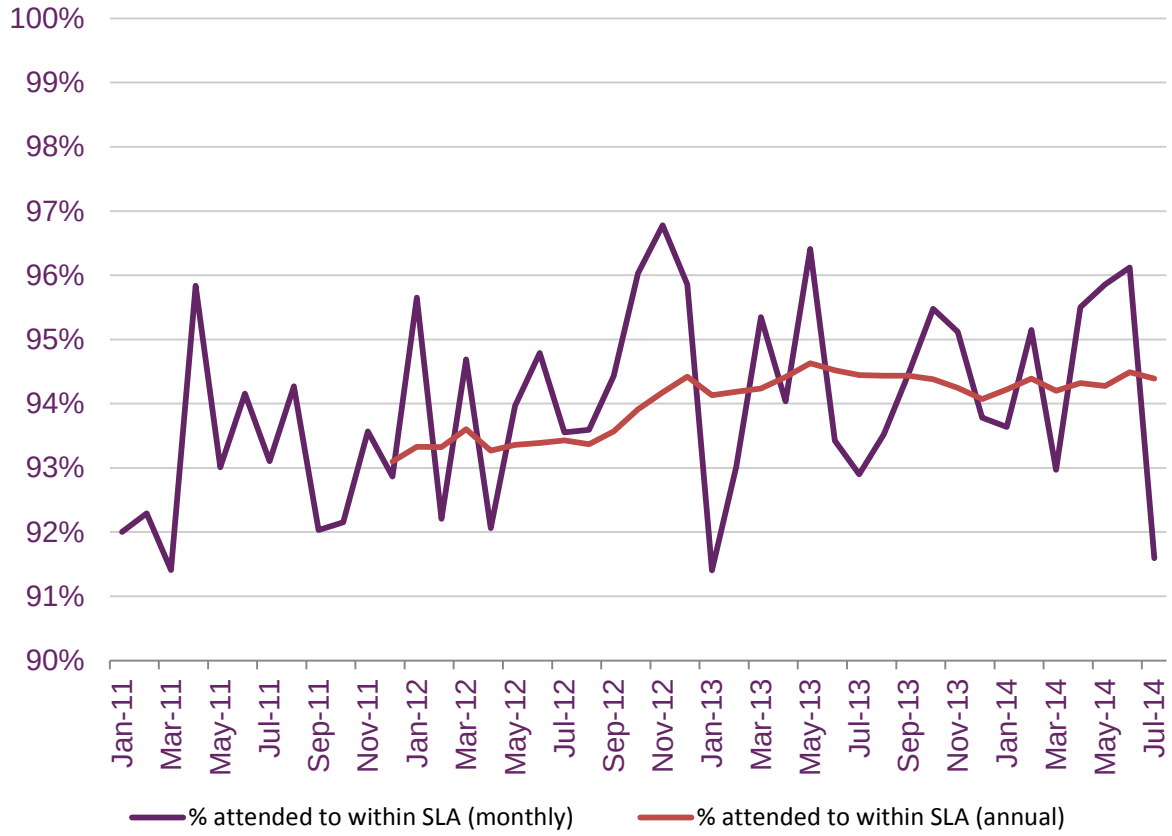


Source: Ofcom analysis of Openreach section 135 response dated 10 October 2014.

A12.91 Figure A12.19 shows the percentage of faults where service was restored within the timeframe specified by the SLA. The repair SLA for Openreach Ethernet products is five hours, with the exception of Cablelink which was covered by a 48 hour SLA until it was changed to a five hour repair time in early 2015. Openreach performance against repair SLAs is fairly stable over the period, fluctuating at around an average of 94% and never falling below 91%. The annual measure, which would be used for minimum standard compliance assessment, has never been below 93% and has exceeded 94% since the start of 2013.

[477] Ofcom analysis of Openreach data includes the following products: EAD, EAD LA, WES, WES LA, WES Agg, EBD, BES and Cablelink.

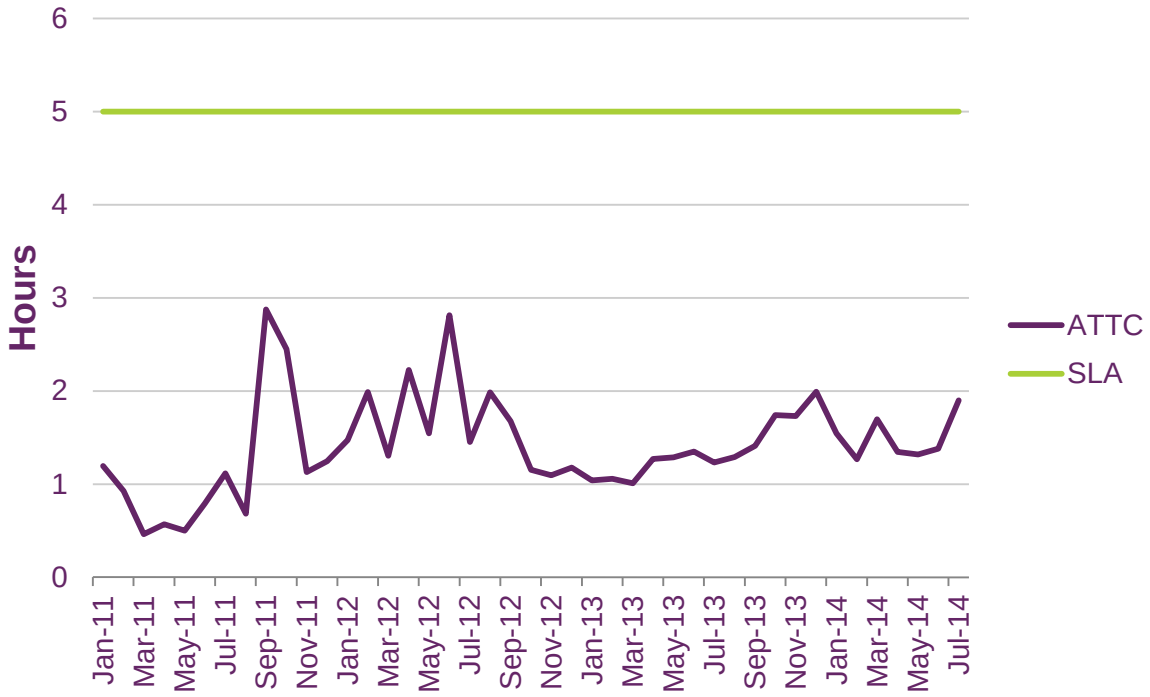
Figure A12.19 Percentage of faults repaired to within time specified by SLA



Source: Ofcom analysis of Openreach section 135 response dated 10 October 2014.

A12.92 Figure A12.20 shows the average time to clear faults for EAD (all variants) between January 2011 and July 2014. The average time to clear is within the five hour SLA. We also investigated this metric for other Ethernet products, observing broadly similar results.

Figure A12.20 Average time to clear (ATTC), EAD all variants



Source: Ofcom analysis of Openreach section 135 response dated 10 October 2014.

A12.93 We reiterate what we observed in Annex 17 of the May 2015 BCMR Consultation[478] in that overall our analysis of Openreach repair data supports the view that Ethernet repair performance has generally been maintained at a good level since 2011.

Factors Affecting Provision Performance

A12.94 We now consider potential explanations for the deterioration in Openreach's provision performance that has been observed since 2011, and then in particular in 2015.

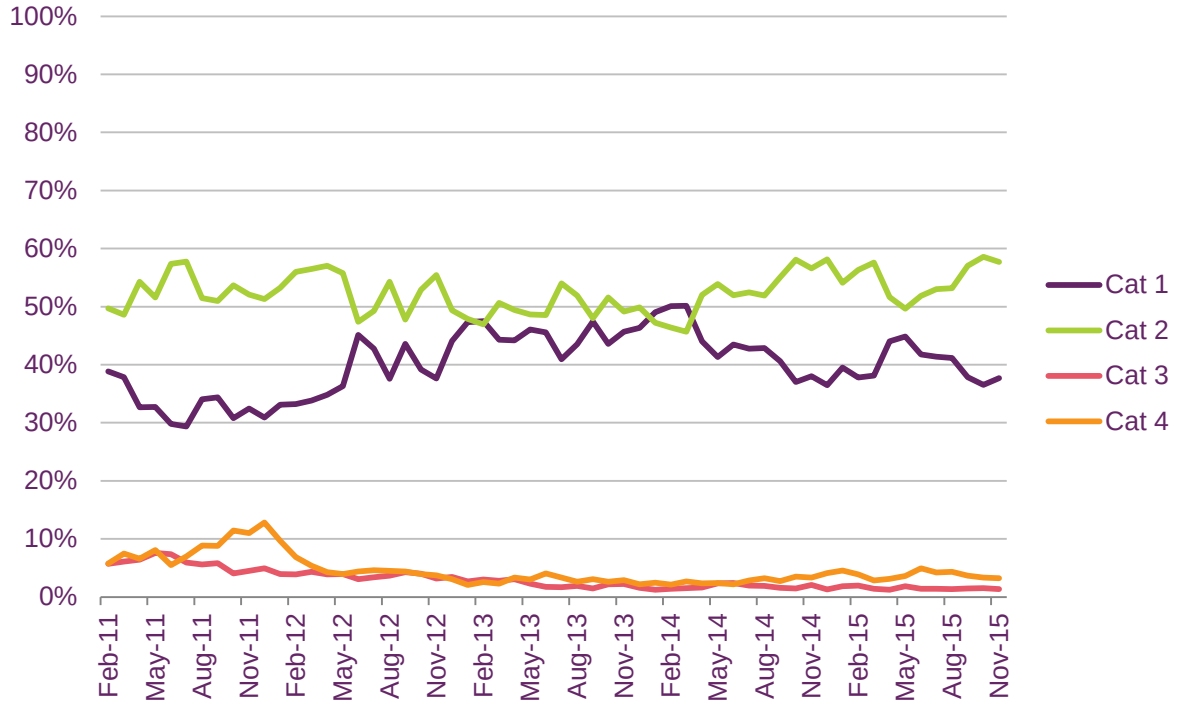
Composition of orders

A12.95 It is possible that longer lead times could be driven by a shift in the relative volumes of each provision order category. For instance, a shift in the composition of orders by category away from Category 1 orders towards Category 2, 3 and 4 orders that require network build would naturally lead to an increase in the MTTP calculated across all orders. Further, given that resources are to some extent fixed in the short term, it is also likely this change would increase the MTTP for each order category.[479]

[478] Paragraph A17.167.
[479] In the long term, if the shift in the relative volumes of each order category was not transitory, we would expect Openreach resources to adjust accordingly to re-establish some target level of performance for each category.

A12.96 Figure A12.21 shows the composition of completed orders by category. This figure shows that the composition of orders is relatively stable over time. Both categories 3 and 4 have remained relatively stable over time at proportions fewer than 5%. Over the last 18 months there has been a trend of an increase in Category 2 orders and a decrease of Category 1 orders, with Category 1 orders being at a similar proportion to in 2011, but Category 2 orders at a slightly higher proportion than in 2011.

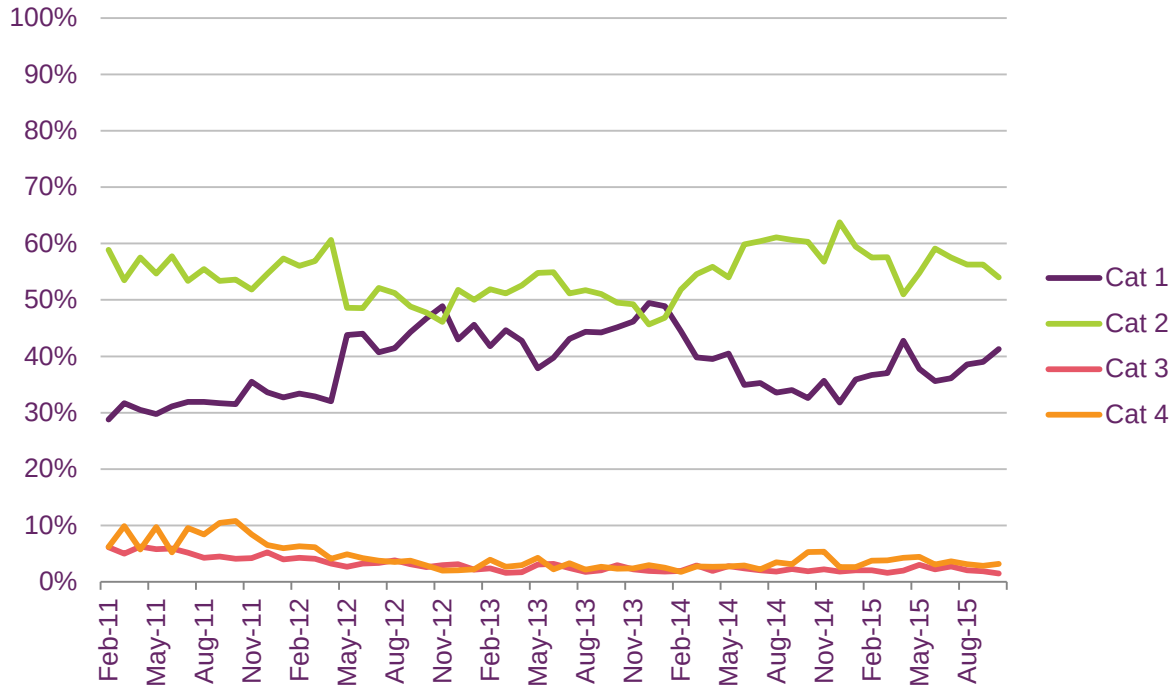
Figure A12.21 Composition of closed orders by provision category



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.97 Whilst the above figure shows a composition of the orders being completed over time, it does not give a representation of the orders Openreach are receiving (or validating) over time. To determine this, the orders which are being validated and entering the backlog of open orders (in other words, the workstack) are shown in Figure A12.22 below.

Figure A12.22 Composition of orders being validated by provision category – i.e. orders entering the workstack[480]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

A12.98 We observed that the mix of orders is relatively stable over time, finishing with a profile at the end of the period analysed at approximately similar levels to those seen at the start of 2011. The one exception was for category 1 orders which are approximately 10% higher in proportion than at the start of 2011. The only exception to this relative stability was in the period between about May 2012 and the start of 2014, where there was an increase in category 1 orders and a decrease in category 2 orders, with proportions returning to previous levels after June 2014. The proportion of both category 3 and 4 orders have slightly declined over the period to fewer than 5%. This observed relative stability of order mix entering the workstack over time suggests that the likelihood of a long term change to a mix that contains a high proportion of orders with longer lead times is low. However we recognize the shorter term variations of approximately 10% between Categories 1 and 2 which could have relatively small short term effects.

Difficulty of orders

A12.99 Provision performance may also be affected by an increase or decrease in the difficulty of provision orders. For instance, a significant increase in the average length of fibre being blown into ducts may indicate an increase in difficulty in provisioning orders which require fibre being blown into ducts.

[480] This volume mix does not include provision orders which Openreach accepted but were subsequently cancelled by either Openreach or their customer.

A12.100 To investigate provision order difficulty we obtained data, using our formal powers, on civil work for the period January 2011 to November 2015. This included information for each provision order on the length of fibre installed in the customer's premises, the length of blown fibre installed in the ducts in Openreach's network, the length of fibre cable installed in the ducts in Openreach's network, the length of new duct installed, and the number of new manhole/ footway boxes installed.

A12.101 Openreach noted in their response that:

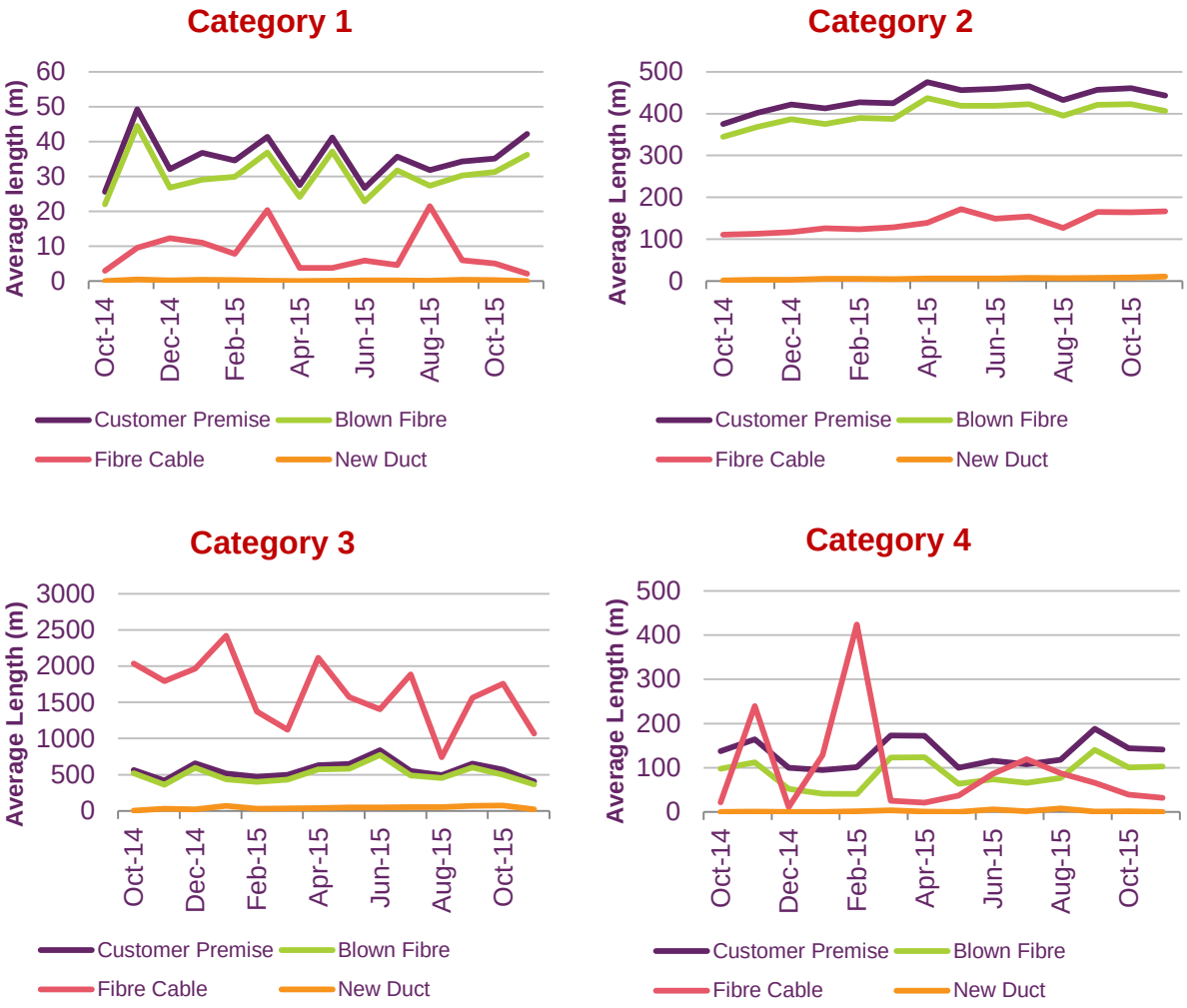
- The internal definition of one of their Work Allocation Units fits into the categorisations of both 'length of fibre installed in the customer's premises' and 'length of blown fibre installed in the ducts in Openreach's network'. This definition therefore has been provided to both categorisations and because of this there may be some double counting in the response;
- The data provided from April 2015 to present is complete;
- The data provided from April 2014 to April 2015 is mostly complete, and can be considered reliable for the purposes of looking at trends over this period; and
- The data provided prior to April 2014 will be partially complete and partially reliable, and not comparable to post April 2014.[481]

A12.102 In light of the notes Openreach made in their response, we consider the civil work data sufficiently reliable for the period April 2014 to November 2015.

A12.103 Figure A12.23 below shows the average lengths of fibre installed in the customer's premises, blown fibre installed in the ducts in Openreach's network, fibre cable installed in the ducts in Openreach's network, and new duct installed for each provision category.

[481] Openreach response dated 4 December 2015 to our section 135 dated 26 November 2015.

Figure A12.23 Comparison of average civil work lengths[482]



Source: Ofcom analysis of Openreach section 135 response dated 4 December 2015.

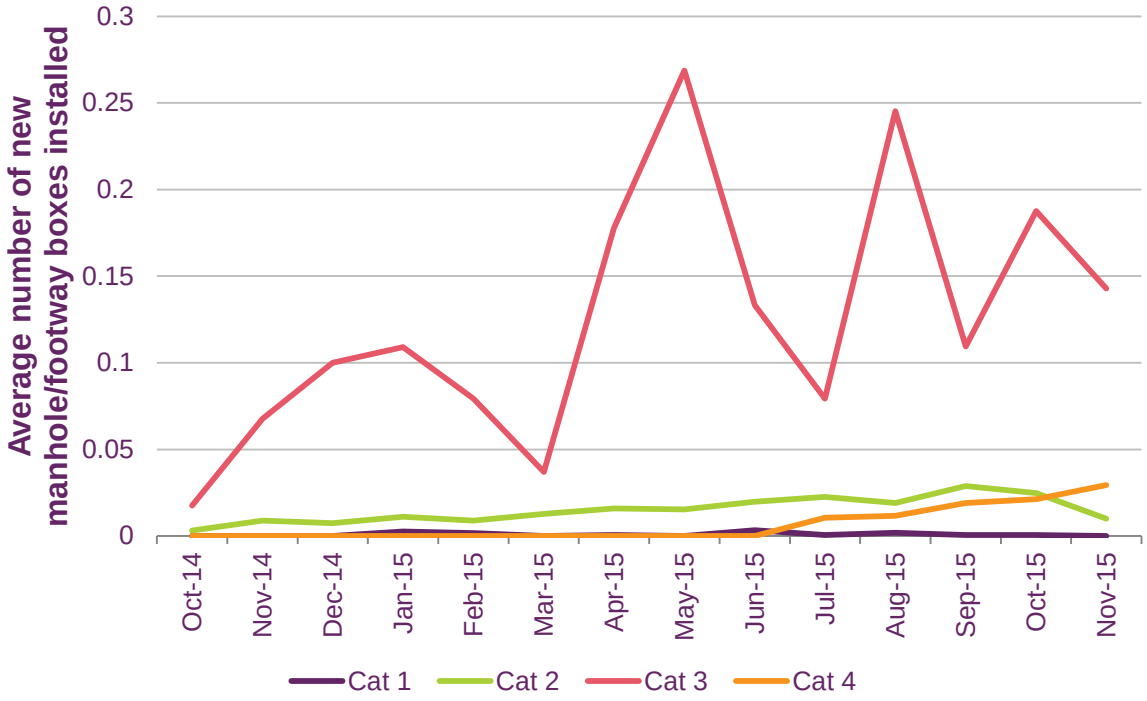
A12.104 There appears to be no general trend of either increasing or decreasing average lengths of civil work in the above figure. The average lengths of civil work remain relatively stable for each provision category with the exception of:

- the average length of fibre cable installed for category 4 is volatile throughout the period;
- rises in the length of customer premises fibre (circa 380m to 450m), blown fibre (circa 350m to 410m) and fibre cable (circa 110m to 180m) for Category 2; and
- a significant decrease in Category 3 fibre cable.

[482] These figures are plotted from Oct '14 onwards. This is due to the exclusion of orders prior to Apr '14 (in line with Openreach's response on the reliability of the data) resulting in small volumes of orders being completed in the period Apr '14 to Oct '14 distorting the results.

A12.105 Figure A12.24 shows that whilst provision categories may require different numbers of new manhole/footway boxes installed on average (which is in line with the definitional separation of the provision categories[483]), there appears to be a small increasing trend for Categories 2 and 4 (to circa 0.025 per order) and a larger increase with much variability for Category 3 (to circa 0.15 per order).

Figure A12.24 Average number of new manhole/footway boxes installed per provision category



Source: Ofcom analysis of Openreach section 135 response dated 4 December 2015.

Fault repair

A12.106 Another factor that may affect provision performance is the amount of resource required by Openreach to repair faults. For instance, a significant increase in faults due to an external factor (e.g. unusually high rainfall) may divert resources from provisioning to repair, which could in turn lead to longer lead times in provisioning.

A12.107 Table A12.12 shows that the fault report rate[484] for Ethernet services has been stable at approximately 8% of installed volumes between 2011/12 and 2013/14. Further, the table also shows no significant change in the proportion of faults classified by Openreach as "fault not found". This second indicator is important to consider, as a decrease in the proportion of faults classified as "fault not found" implies that a greater amount of resource is required to address a given fault report rate. However, as both indicators of repair demand are very stable over time, we

[483] Provision category definitions found in Table A12.2.
[484] The volume of fault reports submitted, expressed as a proportion of installed volumes.

conclude that Openreach's provision performance is not explained by interactions with its repair activities.

Resources and demand

A12.108 In Annex 17 of the May 2015 BCMR Consultation[485] we found that, based on the volume of accepted orders, Openreach faced an increase in demand for Ethernet services of approximately 40% over the period 2011 Q1 to 2014 Q2. We also found that the amount of resources deployed by Openreach had increased proportionately less than demand, which was reflected by the decline in the ratio of resource to demand over the period. We did not observe any significant reduction in resource per completed order, therefore did not believe changes in Openreach provisioning efficiency account for resources not keeping pace with demand.

A12.109 To investigate the resources and demand since 2014 Q2 we obtained data, using our formal powers, on Openreach resources for the period August 2014 to October 2015. This included information on a monthly basis on all products, planning time, and survey time.

A12.110 Table A12.13 shows a summary of Openreach order volumes and resources, along with the ratios of resource to demand and completed orders. Since 2014 Q2, the ratio of resource to demand has risen slightly, although the ratio of resource to completed orders has dropped slightly from a peak in 2014 Q2.

[485] Paragraphs A17.173 to A17.175 in the May 2015 BCMR Consultation.

Table A12.13 Summary of Openreach order volumes and resources[486]

	Accepted Orders	Completed Orders	Total kilo-man-hours	Ratio of resource to demand [✂]	Ratio of resource to completed orders [✂]
2011 Q1	14772	11518	✂	✂	✂
2011 Q2	14222	11392	✂	✂	✂
2011 Q3	16456	12908	✂	✂	✂
2011 Q4	16770	14123	✂	✂	✂
2012 Q1	16494	13151	✂	✂	✂
2012 Q2	18579	15226	✂	✂	✂
2012 Q3	18180	14464	✂	✂	✂
2012 Q4	16478	14040	✂	✂	✂
2013 Q1	17911	13112	✂	✂	✂
2013 Q2	20313	15696	✂	✂	✂
2013 Q3	19497	15651	✂	✂	✂
2013 Q4	20667	14641	✂	✂	✂
2014 Q1	21208	15447	✂	✂	✂
2014 Q2	24784	12926	✂	✂	✂
2014 Q3	23231	16969	✂	✂	✂
2014 Q4	20926	16950	✂	✂	✂
2015 Q1	21563	15843	✂	✂	✂
2015 Q2	24388	17359	✂	✂	✂
2015 Q3	24133	18992	✂	✂	✂

Source: Ofcom analysis of Openreach section 135 responses dated 22 October 2014, 4 December 2015, and 20 January 2016.

A12.111 In investigating these ratios since 2014 Q2 we discovered their sensitivity to, in particular, the mix of provision categories of closed orders. Figure A12.25 shows the three month moving average of both of these ratios.[487]

Figure A12.25 Ratio of resource to demand and completed orders, three month moving average

[✂]

Source: Ofcom analysis of Openreach section 135 responses dated 22 October 2014, 4 December 2015, and 20 January 2016.

A12.112 We observe here that each of the ratios vary up or down in a similar pattern (excluding the [✂] difference between the two), with the exception being at the start

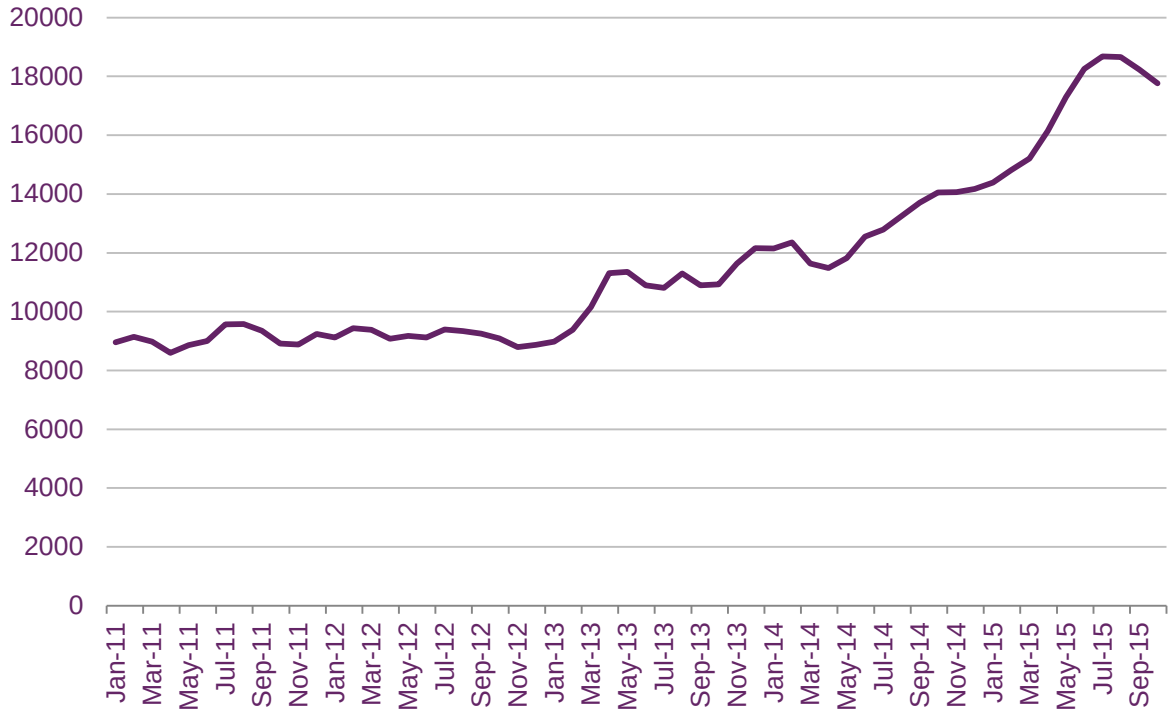
[486] To best match the relevant products associated with these resource values (Total kilo-man-hours), the accepted and completed order volumes here exclude the BTL, BNS and ONBS products.
[487] A three month moving average was performed to reduce the month-to-month variability of the ratios whilst retaining the trends of the ratios.

of 2014 where the ratio of resource to completed orders increases and the ratio of resource to demand decreases. The timing of this exception to the ratios, compared to Figure A12.21, coincides with an increase of category 2 orders and decrease in category 1 orders, indicating that the higher proportion of complex orders (i.e. orders requiring more resource) being completed is contributing to the increase in the ratio of resource to completed orders.

A12.113 We maintain that the ratio of resource to demand remains an indicator of the pace at which resource tracks demand. We observe in Figure A12.25 that there is a slight decreasing trend in this ratio until mid-2014 after which there is then a slight increasing trend.

A12.114 Figure A12.26 below shows that the volume of live orders on the workstack at the end of each month has increased steadily over time, increasing at a greater rate from 2014 onwards. This lasts until around July 2015, after which we observe a decrease in live orders.

Figure A12.26 Volume of Live Orders[488] at the end of each month[489]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

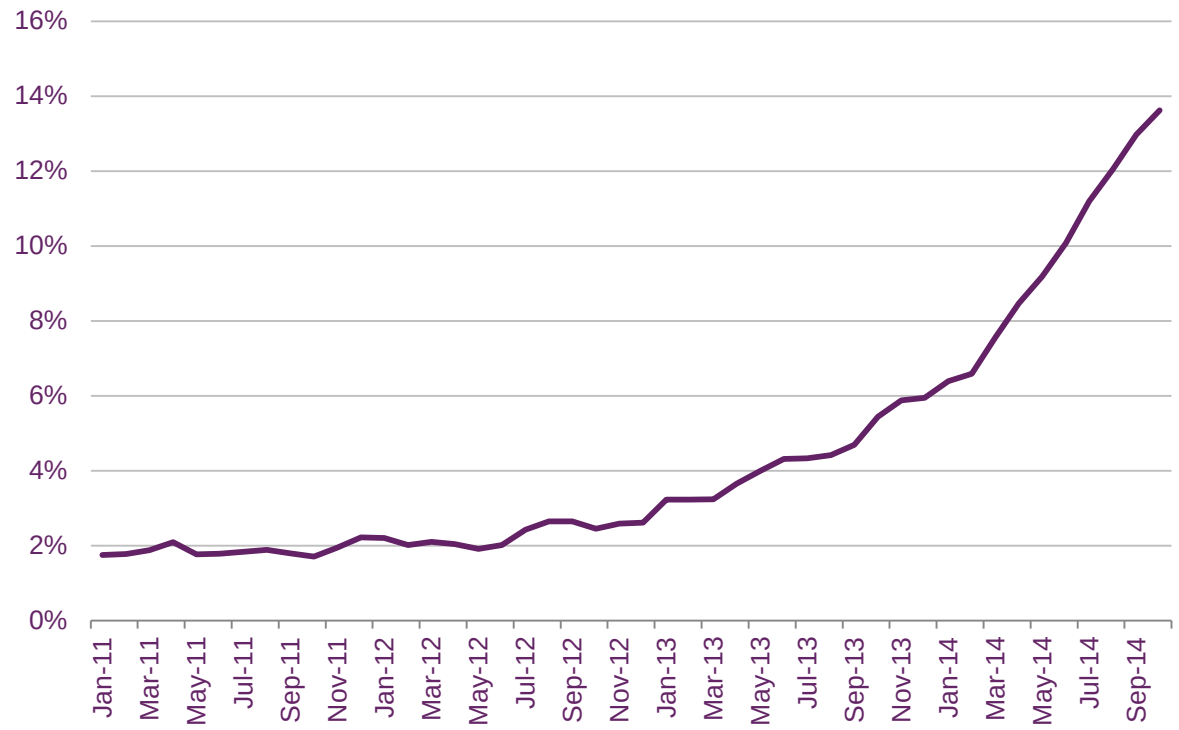
A12.115 Figure A12.27 below shows the proportion of live orders at the end of each month which have remained live 12 months later. The higher this proportion, the higher the

[488] These volumes do not include provision orders which Openreach accepted but were subsequently cancelled by either Openreach or their customer.

[489] The corresponding figure in the May 2015 BCMR Consultation (Figure A17.31) was constructed using order volumes for all types of orders. Using the latest Ethernet provision performance data available which included the current workstack as at 11 November 2015, this figure has been constructed working back from this known workstack size. We note that the overall trend of orders increasing over time in this corresponding figure was consistent with the figure shown here.

"age", in terms of time to provide, of the backlog of orders. This proportion remained relatively stable at about 2% until the start of 2013 where there then was a steady increase to about 6% at the start of 2014, with the remainder of 2014 showing a sharper increase to about 14% in Nov '14. We observe here the sharp increase in this proportion since the start of 2014, which when considered in conjunction with overall increase of live orders in Figure A12.26 over the same time period, provides an indication of the increase in "aged orders" present in the order backlog.

Figure A12.27 Proportion of Live Orders at the end of each month which remain live 12 months later[490]



Source: Ofcom analysis of Openreach section 135 response dated 11 November 2015.

Customer expectations for Ethernet provisioning and repair quality of service

A12.116 We presented above our analysis and conclusions concerning current and past levels of quality of service for Ethernet provisioning and repair activities and their impact on downstream competition and customers. We now consider end customer expectations for Ethernet provisioning and repair quality of service.

A12.117 For the May 2015 BCMR Consultation[491], we engaged BDRC Continental to conduct research into the value businesses and public sector organisations place on those elements of service performance which are directly attributable to

[490] These volumes do not include provision orders which Openreach accepted but were subsequently cancelled by either Openreach or their customer.
[491] Annex 17 of the May 2015 BCMR Consultation, paragraph A17.177 – A17.199.

Openreach's service quality. The BDRC report was published alongside our May 2015 BCMR Consultation.

A12.118 In order to put the evidence from our market research in context, it is important to be clear about the provisioning processes with which we are making comparisons. Openreach's installation order processes cover a range of products and varying degrees of complexity. The categories are detailed in Table A12.2.

A12.119 The actual process, and timing, involved with provisioning can vary significantly depending on the nature of the order. In particular the timescale depends on whether network provision already exists, in whole or in part along the route of the circuit which is reflected in the provision category assigned to the order as discussed above. In particular Category 3 orders and to a lesser extent Category 2 orders exhibit significant deteriorations in performance in respect of lead time and CDD certainty. Category 3 orders are a small proportion (circa 3% to 5%) of the overall mix of orders and we assume that customers are referring to the predominant Category 1 and 2 type orders when they responded in the following survey.

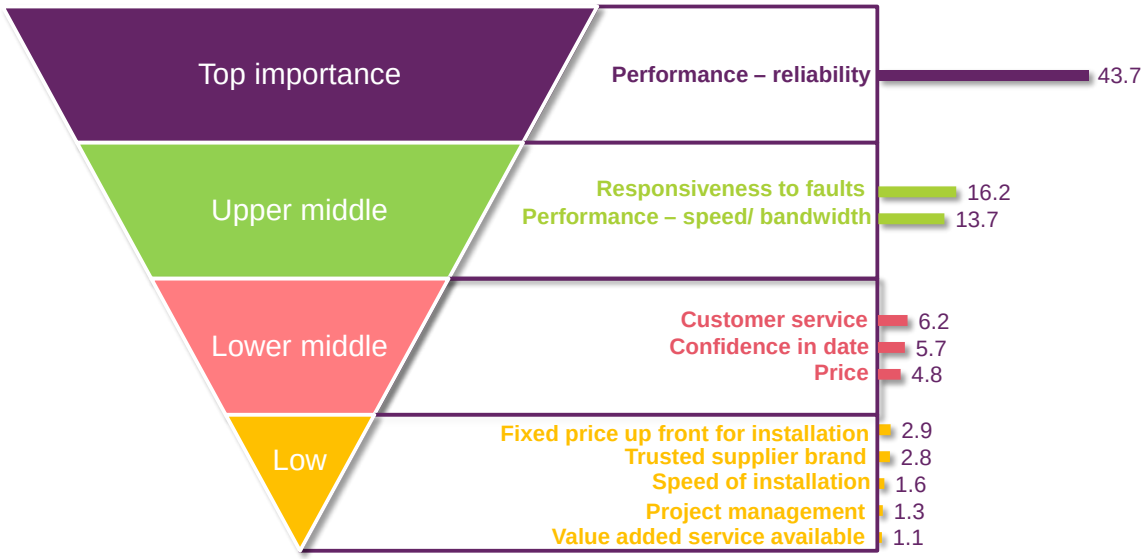
Service Priorities

A12.120 BDRC Continental used a Max Diff approach to assess which service attributes are of most importance to customers. This allows the service attributes to be scored, and their relative importance to be scored. The attributes were then allocated to groupings of top, upper middle, lower middle and low to aid interpretation.

A12.121 The attribute of most importance to businesses in their selection of a provider for Ethernet leased lines was 'Performance – reliability'. With a score of 43.7 for all businesses this is more than twice as important as the next ranked attribute – 'Responsiveness to faults' – 16.2.

A12.122 The only attribute related to delivery of installation which was not in the 'low' range was 'Confidence in installation date' (5.7). This scored more than price (4.8).

Figure A12.28 Relative importance of service features when choosing a supplier



Source: BDRC Quality of Service: Ethernet Leased Lines 2014 survey report.

‘Reasonable’ and ‘expected’ provisioning processes

A12.123 Participants were asked to choose between various provisioning scenarios in order to establish the relative importance of characteristics of the provisioning process. Four attributes came out with approximately equal importance:

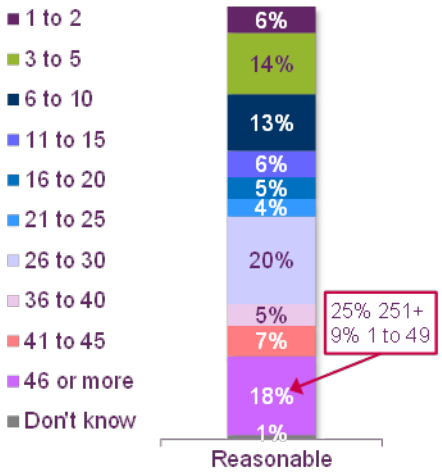
- having an installation date within 50 working days;
- having the service activated on the scheduled date;
- being provided with regular updates; and
- The supplier meeting other key milestones.

A12.124 It is worth noting that installations within 20 days and 30 days were found to be similarly ‘reasonable’ to those within 50 days.

A12.125 Attitude statements confirmed the findings of the conjoint analysis, as there were a majority of respondents indicating that they preferred a degree of certainty in their completion dates (76% agreed) and costs (73% agreed), even if it meant longer timings.

A12.126 The averages for reasonable installation lead times mask the range of responses that we received. What was considered to be ‘reasonable’ ranged from 6% for 1 to 2 days to 18% tolerating 46 days or more (mostly comprising 60 days for 8% and 90 days for 8%).

Figure A12.29 Reasonable lead times by organisation size



	Total	1-250	(251+)	251-499	500+
Mean	30	30	*34*	34	33
Median	26	26	*28*	28	29
1-5 days	20%	20%	*11%*	10%	11%
6-20 days	25%	24%	*29%*	30%	25%
21-50 days	36%	36%	*36%*	36%	36%
51+ days	18%	18%	*24%*	22%	26%

Base: All businesses (n=450), 1-250 employees (157), 251+ (293), 251-499 (118), 500+ (175)*
Source: Q1. You call a communications provider to place an order for a new Ethernet leased line for your business. How long do you think is ‘reasonable’ for the maximum wait until the service is activated? ‘Reasonable’ does not have to mean your ‘ideal’ situation, but one that would be generally satisfactory to you. Please give your answer in terms of working days. UNPROMPTED

Source: BDRC Quality of Service: Ethernet Leased Lines 2014 survey report.

A12.127 We note therefore that on average customers perceive installation times of c30 days to be reasonable.

Relative importance of installation timing

A12.128 We also asked respondents to rate the importance of different components of service installation in order to understand how important the timing of installation is relative to other aspects of the installation.

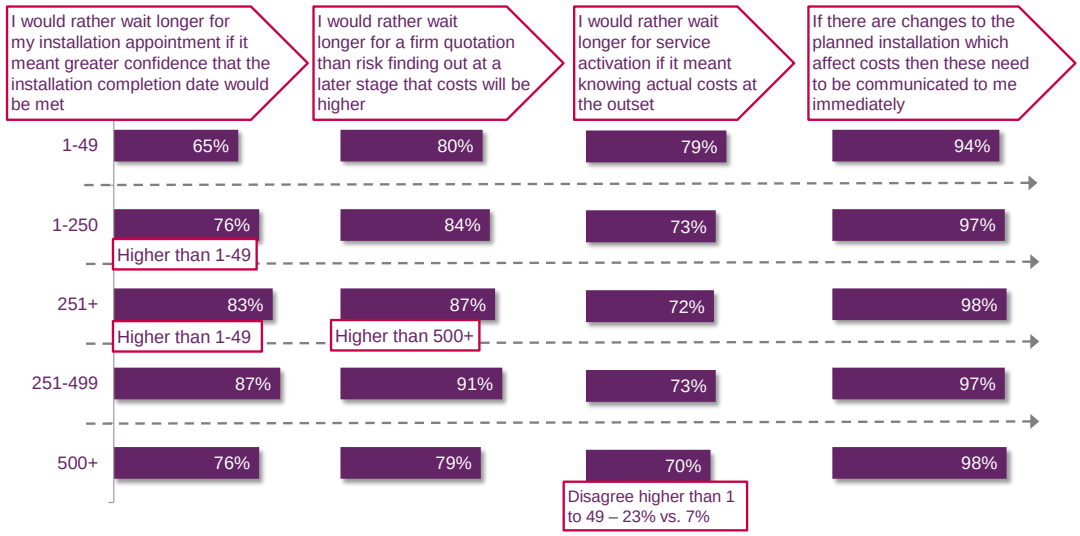
A12.129 Customers expressed a strong preference for certainty in both costs and timescales, over the actual delivery time itself.

A12.130 Three in four businesses (76%) surveyed indicated they agreed that they 'would rather wait longer for my installation appointment if it meant greater confidence that the installation completion date would be met' (36% strongly, and 40% slightly).

A12.131 (84%) agreed overall that they 'would rather wait longer for a firm quotation than risk finding out at a later stage that costs will be higher' (61% strongly, and 23% slightly). Just under three in four (73%) agreed they 'would rather wait longer for service activation if it meant knowing actual costs at the outset' (44% strongly, and 29% slightly).

A12.132 While there was a small level of variation in the strength with which customers valued certainty by organisation, there are only three data points which demonstrate a statistically significant difference. All customer groups demonstrated a strong desire for rapid communication of cost changes.

Figure A12.30 Priorities in installations – by company size



Source: BDRC Quality of Service: Ethernet Leased Lines 2014 survey report.

Value placed on installation timescales

A12.133 All respondents were asked how likely they would be to consider using four different types of 'enhanced' services that they would need to pay for. These were:

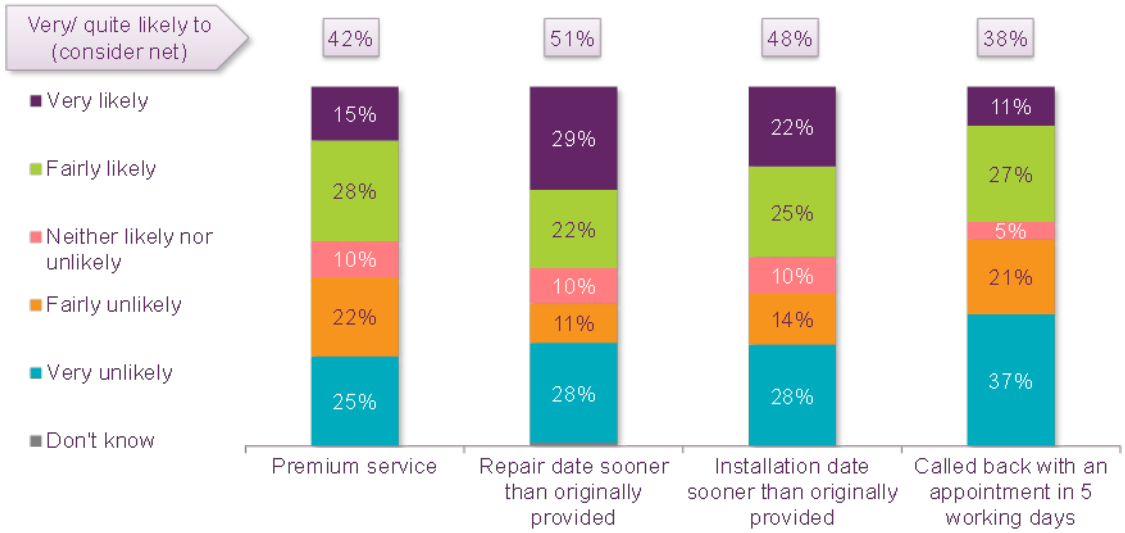
- Premium Service (where you paid more than for the standard service but were provided with a dedicated project manager who liaised with you on a regular basis. It could also increase the chance of an agreed installation completion date being met);
- Repair date sooner than originally provided;

- Installation sooner than originally provided; and
- Called back with an installation appointment within 5 working days.

A12.134 Overall approximately 2 in 5 customers said they would be very likely or fairly likely to pay for a premium service, faster installation date, and being called back with an appointment within 5 working days, and half were very likely or fairly likely to pay for faster repair.

A12.135 This indicates a reasonably consistent segment of the market that is willing to consider paying for enhanced levels of service. The price these customers are willing to pay varies from around £50 for faster installation and repair to £65 for confirmation of an installation appointment in 5 working days, and £277 for premium services.

Figure A12.31 Likelihood of purchasing enhanced services



Source: BDRC Quality of Service: Ethernet Leased Lines 2014 survey report.

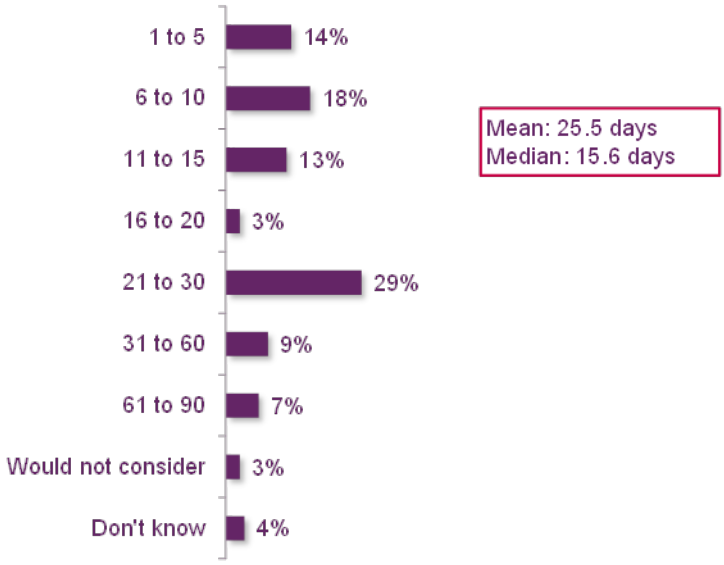
Installation timescales leading to consideration of switching

A12.136 Leased line switching rates are higher than in consumer markets, with a range of 7 – 22% switching provider in the last 12 months and 12-19% 1 to 3 years ago(based on size of business).

A12.137 Respondents were asked what action they would take where installation arrangements were not considered reasonable. The most common action indicated was to 'complain to provider/ chase up/ escalate it' (71%), followed by 'look into switching to an alternative provider of the same service (38%). A fifth (18%) would 'request compensation from provider', and this is something more likely to be considered by those in organisations with more than 250 employees (24%).

A12.138 Those respondents that indicated they would consider switching were asked how long they would wait for an installation of an Ethernet leased line before they would consider this course of action, with results shown in Figure A12.32. There was a wide range in the level of wait that could trigger consideration of a switch – from 14% for 1 to 5 days to 7% for 61 to 90 days. The average (median) was 16 days, whereas the longer waits tolerated by some respondents pushes the mean to 26 days.

Figure A12.32 Length of wait for installation before considering switching



Source: BDRC Quality of Service: Ethernet Leased Lines 2014 survey report.

Summary of results on provisioning timescales and comparison to current performance

A12.139 Taken at face value, this research indicates that satisfaction with installation service is likely to be maximised if timescales are around 30 days.

A12.140 We also consider it is important to balance these views on installation times against the value which consumers and SMEs place on these timescales. It is clear that speed of installation is not the most important issue when choosing a CP. Customers place considerably more weight on service reliability and responsiveness to faults. When considering the actual installation scenario, more importance is placed on the installation being carried out successfully on the first appointment. Therefore, it seems likely that they would be more willing to accept a longer lead time beyond 30 days, provided that that installation can be guaranteed and the number of delays is reduced.

A12.141 It is clear that the lead times being experienced in 2014 in relation to provisioning were considerably out of line with both consumer and SME expectations.

Other potentially relevant benchmarks

Comparison with other European countries

A12.142 We contacted other European national regulatory authorities ('NRAs') in order to determine what service standards apply in other markets. We received a range of responses, covering a variety of scenarios. A summary of the results for Ethernet services is given below:

Table A12.14 Ethernet lead time comparisons

Country	Lead time where fibre is present	Lead time where build is required
Austria	31 working days	
Belgium	30 working days	
Czech Republic	14 days	
France	56 days	Subject to survey
Germany	40 working days	4-6 months
Portugal	20 to 40 days	40 to 80 days
Spain	60 days to be met in 85% of cases by CP customer	

Source: Ofcom based on responses from European NRAs received circa August 2014.

A12.143 Although the results were not directly comparable, there is a distinct clustering of expected lead times for less complex / fibre present type orders in the 30-40 day range, and considerable scope for variation with complex orders.

SLAs in other industries

A12.144 In terms of other industries we have found limited comparable benchmarks. Ofgem publishes a list of standards for electricity and gas distribution networks which it monitors and enforces. These include SLAs such as a requirement for electricity supply to be restored within 18 hours if there is an interruption to supply under normal conditions, and within 48 hours when there are severe weather conditions, keeping to timed appointments, as well as a requirement to provide two days' notice for a planned interruption of an electricity supply and five working days for gas supply. If the networks do not meet these conditions they are required to pay penalties to the customer.

A12.145 Ofwat also sets out guaranteed service standards for water supply companies and where the suppliers do not meet these service levels they are required to pay compensation to their customers. These standards include making and keeping appointments, notification of any interruption to supply at least 48 hours in advance, restoring service within 48 hours if it is due to a leak or burst pipe.

Annex 13

Dig distance and the costs of new connections

Introduction

A13.1 This Annex sets out our analysis of the distances that CPs typically dig to extend their network to new customers' sites. We use this to inform our analysis of differences in competition by geographic area. The approach is largely that set out in Annex 18 of the May 2015 BCMR Consultation and we have therefore summarised in places for the sake of brevity. We also summarise comments received on that Annex, reply to those comments and report the results of some additional analysis we have carried out.

A13.2 In Part I we provide an overview of digging costs. In Part II we present the available evidence on CPs' actual dig distances. In Part III we provide our observations on stakeholders' responses to Annex 18 of the May 2015 BCMR Consultation and our conclusions on the buffer distances.

A13.3 A CP's ability to compete in the provision of a leased line is determined largely by the proximity of its physical network infrastructure to the customer's premises. This is because the construction costs associated with a new service are likely to correlate with the distance from the relevant flexibility point to the customer site. However, we cannot observe directly which CPs compete to provide leased lines to particular customers' premises. We therefore use a parameter, which we term the "buffer distance", as a proxy for the distance by which a CP would be likely to extend its network in order to connect to a customer's premises.[492] The buffer distance is a key parameter in the "network reach" analysis which informs our assessment of how competitive conditions vary between geographic areas and hence our definition of geographic markets, described in Section 4. We can also use the data on the distances CPs actually dug in 2013 to reveal the extent of the advantage BT derives from its larger network, which is relevant to the analysis of SMP, also set out in Section 4.

A13.4 In summary, we find that a buffer distance of up to 100m is appropriate to use for the purpose of identifying areas where competition in the CISBO market is effective. A buffer distance in this range:

- is consistent with the data on actual dig distances which CPs provided, as it is reasonable for the buffer distance to be longer than the distances actually dug in many cases; and

[492] We note that the CP may not have to dig this far in all cases in order to connect the customer if it has existing duct which passes closer to the customer site. The CP may then be able to reduce costs by running fibre through existing duct partway, and only digging the minimum amount necessary. In other cases the CP may need to dig further than we calculate if the connection requires a route that deviates from the straight line distance between the flexibility point and the customer site.

- is consistent with the balance of what CPs have told us in responses to the May 2015 BCMR Consultation.

A13.5 We have used a buffer distance assumption of 100m for the purposes of determining the boundary of the CLA geographic market. We find that varying the buffer distance to 50m or 200m (other things equal) leads, as would be expected, to some changes around the edge of the CLA, but the core area which includes the majority of the postcode sectors in the CLA is unchanged.[493] This gives us confidence that the market boundary is robust. Analysis of network reach with a 200m buffer remains useful as a means of distinguishing areas where there is somewhat more infrastructure-based competition than in the rest of the UK.

A13.6 We find evidence that BT incurs construction costs for a smaller proportion of new connections than OCPs. Additionally, when a new connection requires BT to extend its network, this extension is generally shorter than for other CPs. Having to build less often and over shorter distances means BT may also need less time to provide new customers with leased line services. This suggests that BT will often have a material advantage over OCPs.

Part I: The costs of new connections

A13.7 When a CP wants to provide leased line services to a new customer it needs to connect that customer's sites to its network infrastructure. Some of the customer's sites might be located outside of the CP's network coverage area and the CP might therefore need to build additional infrastructure in order to extend the reach of its network.

A13.8 The costs associated with extending physical infrastructure are largely sunk, common to most fixed telecommunications services, and represent a significant proportion of total costs.

A13.9 When deciding whether to extend its network to reach a new customer, a CP will compare these costs to the revenues it expects to earn and to the costs of any available alternative means of supplying the customer without incurring the costs of construction. CPs are often faced with a decision to either 'build' their own network or 'buy' wholesale services from BT on regulated terms (or sometimes on commercial terms from other networks). In order to understand incentives to invest, it is useful therefore to compare estimated construction costs to BT's regulated wholesale prices.

A13.10 The typical construction cost per metre varies depending on location and reflects a range of cost variables such as the material being dug, surface type (e.g. block paving has higher reinstatement costs), wayleave costs, construction permits (including lane closures, parking bay suspensions, etc.), restrictions on the time of works (higher labour rate for night work), traffic management, and contract size (construction firms offer volume discounts).

[493] The "CLA boundary sensitivity analysis" is set out in Annex 10

A13.11 A report to Ofcom by CSMG provided some estimates of typical dig costs in early 2010 by location geo-types. The results were reproduced in Annex 18 of the May 2015 BCMR Consultation, and are also reproduced in Table A13.1 below.[494]

Table A13.1: CSMG estimates of the average costs of construction for "traditional trenching" in £ per metre

Cost [£/m]	Lowest	Lower Quartile	Mean	Upper Quartile	Highest
Urban	75	120	134	156	181
Suburban	63	76	98	118	160
Footway	30	42	57	58	120
Soft Ground	15	27	33	40	50

A13.12 In Figure A18.1 of Annex 18 of the May 2015 BCMR Consultation, we used the data above to show how construction costs vary with distance dug. This is reproduced in Figure A13.1 below, assuming average construction costs for a suburban area (£98/m) and recovery on an annualised basis over a 3 or 5 year term.

[494] The Economics of shared infrastructure access, CSMG, Final report 18 February 2010: http://stakeholders.ofcom.org.uk/binaries/consultations/wla/annexes/csmg.pdf. Although now clearly several years old, the report provides a well-researched indication of the range of costs involved in extending networks in urban areas using different construction methods, and remains useful for illustrative purposes. We have not adjusted for inflation in view of the illustrative nature of the calculation.

Figure A13.1: Construction costs and dig distance

A13.13 For example, a CP seeking to recover the construction costs of a 200 metre dig over 3 years would need to charge £8,000 per annum and this excludes any other costs such as equipment, fibre and installation. However, CSMG also suggested that costs could be reduced by using alternative construction methods such as slot trenching.[495] With slot-trenching (or "micro-trenching"), very narrow trenches are dug into which thin plastic ducting is then placed. Fibre can then be blown along the duct. This reduces the costs of digging and repairing the carriageway.

A13.14 Below, we look at evidence we have gathered from CPs on the distances they have actually dug to connect new customers, noting that this will reflect the impact of existing regulation.

Part II: Dig distance analysis and methodology

A13.15 Using data collected from all major network-operating CPs[496], we have looked at the extent to which they extended their networks in 2013.[497] Each CP submitted information for each new connection made in 2013 and requiring network extension. This information included the distance dug to make the connection and costs associated with the necessary civil work.[498]

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[495] We also note in the "Strategic Review of Digital Communications Discussion document", 16 July 2015, that "the introduction of micro trenching…has reduced somewhat the cost of deploying fixed access infrastructure" (paragraph 9.32).

[496] CityFibre, Colt, EU Networks, FibreSpeed, Gamma, Geo, KCOM, Level 3, MS3, Surf, Verizon, Virgin, BT, and Vodafone.

[497] We consider that digging conditions have not changed substantially since 2013, and therefore, that this data remains indicative of current digging conditions. At the time of sending the formal information request, 2013 was the latest year for which data were available. The request asked CPs for "information for the on-net buildings that you connected last year".

[498] One CP [✂] calculated the length of individual network extensions from information on the costs of civil work needed and information on the average costs of digging one metre. Later in this

A13.16 In Annex 18 of the May 2015 BCMR Consultation,[499] we looked at what proportion of new leased lines connected by CPs in 2013 required extension of their networks.[500] Table A13.2 shows this proportion with the number of new leased lines connected in 2013 by each CP and the number (and share) of leased lines which required new physical connection.

Table A13.2 – New Leased line connections requiring network extension in 2013

	New connections requiring digging	Total new connections	Share of total new connections requiring digging
[✂] Operator 1	✂	✂	✂
[✂] Operator 2	✂	✂	✂
[✂] Operator 3	✂	✂	✂
[✂] Operator 4	✂	✂	✂

Source: Data obtained from CPs under S135

A13.17 BT extended its network by digging for only [✂] of the new leased lines it connected in 2013.[501] Other CPs had to create new physical connections significantly more often – for example Virgin had to extend its network for [✂] of the new leased lines it sold in 2013. The disparity is likely to be due to the greater size of BT's network. However, this may not be the only reason. For example, the difference between the proportion of [✂]'s circuits which required network extension and that of [✂] may be at least partly explained by differences in business strategy, where new connections are added through the latter's existing network instead of through digging.

Annex we report the results of an analysis of the effect of this CP's data on average and median dig distances.

[499] http://stakeholders.ofcom.org.uk/consultations/bcmr-2015/

[500] New leased lines refer to any leased lines newly provided in 2013 by a given CP. This includes new leased lines provided to new customers as well as to existing customers. The data does not included upgrades of existing leased lines.

[501] This is the proportion of new connections in 2013 where BT extended its network by digging. In Section 13 ("Remedies – Quality of Service"), we distinguish between order categories where fibre connection is available at the customer's premises and other order categories involving some degree of "network build" by BT. For these purposes, "network build" is defined more broadly to reflect Openreach's order categories for Ethernet provision and may also include blowing new fibre in existing access duct, installing new spine fibre connections etc.

A13.18 As we recognised in Annex 18 of the May 2015 BCMR Consultation, the size of BT's network gives a considerable advantage as it does not need to undertake costly network extensions for the great majority of its new connections. As a result, BT is likely to incur lower costs than OCPs in making new connections.[502]

A13.19 We then looked in more detail at new connections for which CPs had to extend their networks.[503] Data was provided on a per-circuit basis and includes details on the bandwidth and interface of each circuit and on the costs incurred to connect the circuit to the customer's site. The costs used in the analysis include the costs of digging trenches, duct construction, cable installation and installing transmission equipment.

Results of Dig Distance Analysis

A13.20 We compared, in Annex 18 of the May 2015 BCMR Consultation, the data on dig distance statistics with equivalent figures reported in the previous BCMR.[504] These are summarised in Table A13.3.

Table A13.3 – BCMR 2013-2016 Dig Distance Comparison

	BCMR 2013	BCMR 2016
Average distance dug	65m	95m
Median distance dug	22m	40m
Percentage of digs shorter than 200m	95%	93%

A13.21 These dig distance statistics indicate that the mean and median distance dug by OCPs have increased since the previous BCMR. We note also that in 93% of cases, network extensions were less than 200m. In the March 2013 BCMR Statement, we said that it was appropriate for the buffer distance to be some way above the observed mean dig distance for two main reasons:[505]

[502] This should not be taken to mean that there are no costs associated with new connections that do not require digging. For example, it may be necessary to install new fibre in existing duct, repairs to the duct may be needed, etc.
[503] The analysis is based on data provided in response to the first formal information request issued by Ofcom on 7th March 2014. Question C2 asked each CP to provide details on distance dug when connecting new on-net buildings during the year 2013.
[504] See paragraph 5.48 and Figure 5.3 of the March 2013 BCMR Statement.
[505] March 2013 BCMR Statement, paragraph 5.59. See also paragraphs 5.133 – 5.141 at http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Section5.pdf

- observed dig distances are likely to have been affected by the availability of regulated wholesale products from BT. It is possible that operators would be prepared to dig further than they actually dug in practice if such products were not available as an alternative to investment in their own infrastructure; and

- in most cases, the actual distance which an operator needs to dig to reach a customer will be less than the maximum, simply because some businesses will inevitably be located less than the maximum distance from a flexibility point.

A13.22 We recognised in the May 2015 BCMR Consultation that in 7% of cases CPs dug more than 200m, but said that the instances of longer dig distances did not indicate that OCPs were likely in general to be able to compete for leased line sales where they have to dig 200m or more. The longest distance dug may reflect special circumstances, for example connecting particularly high-value customers or where there is a particular concentration of customers (such as to a data centre), perhaps combined with lower than average costs in a particular location.

A13.23 As can be seen in Table A13.3, the average value is higher than the median because the average is influenced by a small number of cases in which OCPs dug very long distances, whilst most digs are much shorter.[506] As we noted in Annex 18 of the May 2015 BCMR Consultation, for this reason, the median is the better measure of the typical distance that CPs dig to connect new customers. However, typical actual dig distances are likely to be lower than the maximum distances CPs might be prepared to dig so, although we put some weight on the median (40m), it would be appropriate for us to assume a buffer distance somewhat above this distance.

A13.24 We also consider that the fact that average dig distances are substantially less than 200m supports our view that in most cases, an OCP would not find it commercially viable to dig as much as 200m in order to connect a new customer. Accordingly we think a substantially shorter buffer distance is appropriate when we are seeking to determine geographic areas in which alternative infrastructure is sufficient to support effective competition, such as in determining the boundary of the CLA. We therefore consider that the buffer distance should, for these purposes, be somewhat more than 40m but significantly less than 200m. A buffer distance of around 100m is consistent with these criteria.

A13.25 However, it is clear that CPs are sometimes willing to dig 200m or more and we continue to use a 200m buffer distance as a basis for distinguishing those areas in which there is greater infrastructure-based competition than in the UK overall.

A13.26 We have previously noted that the actual distance which operators would be willing to dig would depend on the value of the business they would gain by doing so, and this would in turn depend on the type of customer and particularly the margins that can be earned on the circuits to be supplied.[507] We recognise that, given BT's current pricing structure, services providing higher bandwidths generate higher

[506] Statisticians describe distributions like this as "positively skewed". This skew is also clear from Figure A13.2, which shows that most digs are relatively short, whilst a small number are very much longer than the average.
[507] See for example the 2013 BCMR Statement, paragraphs 5.62 and 5.105.

margins and therefore increase CPs' ability to undercut BT's regulated prices, notwithstanding the substantial costs of digging a connection.

A13.27 Table A13.4 shows the average and median distances by which OCPs extended their networks when providing different leased lines services.[508] The results provide some indication that CPs tend to extend their networks for longer distances when connecting to provide higher-value services. A clear difference is noticeable between TISBO, CISBO and, the data suggests, very high CISBO services. With only 63 observations and a large difference between the average and median distance (which indicates the presence of some very long dig distances that are unlikely to be representative), we treat the very high CISBO data with caution.

Table A13.4 – Descriptive statistics by product segment

	Bandwidth (Mbit/s)	Number of observations	Average distance (m)	Median distance (m)
TISBO	<10	125	25	16
Low CISBO	<=10	2,178	109	41
Mid CISBO	>10 & <=100	3,264	94	45
High CISBO	>100 & <=1000	842	81	36
Very high CISBO[509]		63	339	129

A13.28 Comparisons between the distances dug by different CPs can also inform our SMP analysis by revealing the extent of BT's advantage over other CPs as a result of its larger network. Figure A13.2 below shows the frequency of network extensions for OCPs and BT by their distance. It can be seen that the vast majority of network extensions were shorter than 100 metres. This is true for [✂] of extensions by OCPs and [✂] of extensions by BT.

A13.29 Figure A13.2 shows that BT benefits from its large network as it connects new customers using a shorter extension to its network on average. For [✂] of the new

[508] This was Table A18.4 in the May 2015 BCMR Consultation.
[509] Defined for these purposes as "any WDM connection and all connections above (and excl.) 1Gbps" (equivalent to the MISBO market defined in the March 2013 BCMR Statement).

connections made by BT and which required BT to extend its network, the distance dug was shorter than 25 metres. The same is true for only [✂] of new connections made by OCPs.

A13.30 The results of this analysis suggest that BT can connect new customers at lower costs than OCPs as it incurs construction costs in a smaller proportion of cases. Additionally, when a new connection requires BT to extend its network, this extension is generally shorter than for other CPs and BT may also need less time to provide new customers with leased line services. Overall, BT benefits from this competitive advantage even in areas where competitors have their own access network infrastructure.

Figure A13.2 – The distribution of build distance in network extensions in 2013 [✂]

Sensitivity analysis on [✂] dig distance data

A13.31 In the May 2015 BCMR Consultation, we explained that one CP, [✂], does not monitor the length of individual network extensions. It does, however, collect information on the costs of civil work needed to make new connections. Using this information and information on the average costs of digging one metre, it calculated the distance dug in each case and submitted this data to Ofcom. The length of new connections made by this CP was calculated using a cost assumption of [✂] per metre of civil work.

A13.32 In the May 2015 BCMR Consultation we compared the average digging costs per metre for CPs covered in the dataset. We identified that the average dig costs for this CP were significantly lower than the average dig costs for other OCPs.[510] As a result, and given the way this CP calculates dig distance, the reported average distance dug by the particular CP is longer than the average for other operators, as shown in Table A13.5.

Table A13.5 Average construction cost in £ per metre and dig distance for selected CPs

	Average costs £/m	Distance dug	
		Average	Median
✂ Operator 1	✂	✂	✂

[510] They also appear to be in the lower part of the range of CSMG estimates of the average costs of "traditional trenching" shown in Table A13.1. There may be some tendency for average costs per metre to be lower the longer the dig, because there are setup activities associated with digging - getting the crew to site, setting up traffic control etc. In addition, cost reductions may be possible by using more modern trenching methods.

✂ Operator 2	✂	✂	✂
✂ Operator 3	✂	✂	✂

A13.33 As we noted in the May 2015 BCMR Consultation,[511] the CP provided an explanation of how it calculates costs for one metre of digging.[512] In the light of this, we consider that the dig cost value used by the CP is appropriate, as it is an output of an internal database tracking the CP's network extensions, although of course it reflects the specific CP's mix of dig geotypes, which may not be the same as for other CPs.

A13.34 We performed a sensitivity analysis in the May 2015 BCMR Consultation,[513] in which we recalculated this CP's dig distances with the original assumption of [✂] replaced by the average cost per metre of other OCPs (£153/m). This naturally produced a lower figure for the CP's average dig distance and it also affected the average distance dug across all CPs (which include [✂]). Table A13.6 shows the results of the sensitivity analysis as well as the values based on the original data.

Table A13.6 Dig distances – sensitivity analysis with higher dig cost for particular CP ([✂])

	BCMR 2013	BCMR 2016	BCMR 2016 (adjusted)
Average distance dug	65m	95m	58m
Median distance dug	22m	40m	14m
Percentage of digs shorter than 200m	95%	93%	95%

[511] Annex 18 of the May 2015 BCMR Consultation, paragraph A18.30.
[512] [✂
✂]
[513] Annex 18 of the May 2015 BCMR Consultation, paragraph A18.31.

A13.35 The average and median distances dug by OCPs are substantially lower under our sensitivity analysis (and are now much closer to the dig distances relied on in the March 2013 BCMR Statement). This supports our view that, in general, dig conditions are unlikely to have changed much since the March 2013 BCMR Statement, and that CPs are unlikely to dig long distances in many instances.

Analysis of dig distances by geographic area

A13.36 Table A13.7 shows the dig distances split into their geographic areas. It can be observed that both the average and median dig distances are longest in the CLA, then shorter in the LP and shorter again in the CBDs. In the RoUK, the average dig distance is longest second only to the CLA; however the median dig distance is the shortest of the areas. This would suggest a skewed distribution for the RoUK dig distances, with a majority of digs at short distances but a small number of digs at very long distances.

Table A13.7 Dig Distances by area

Area[514]	No. of Digs	Average Dig Distance (m)	Median Dig Distance (m)	% of Digs <= 100m	% of Digs <= 200m
CLA	2291	101	50	78%	92%
LP	440	79	40	81%	94%
CBDs	598	54	32	90%	97%
RoUK (inc. CBDs)	6598	82	28	86%	95%

A13.37 When comparing these to the overall dig distance statistics shown in the column headed “BCMR 2016” in Table A13.3, it appears that only the CLA has an average dig distance greater than the national average. This is reflected in the median dig distance as well. It is also notable that the CLA accounts for more than twice as many digs as the LP and CBDs together.

A13.38 However, the values in the above table include the dig distance data from one CP, [✂], which, as detailed above, are calculated from data on the costs of new connections and a cost assumption per metre. This CP, [✂] This means that the longer than average distance dug by this CP, [✂].

[514] Central London Area (CLA); London Periphery (LP); Central Business Districts (CBDs); Rest of UK (RoUK).

A13.39 The question then is whether there is evidence, from other CPs' data, that dig distances vary systematically between areas. As we would expect dig costs to vary by region with, for example, the CLA requiring higher costs to dig than other parts of the UK, we performed a sensitivity analysis of dig distances by area without this CP's dig distances, and this is shown in Table A13.8.

Table A13.8 Dig distances by area – sensitivity analysis without dig distances for particular CP ([✂])

[Area	No. of Digs	Average Dig Distance (m) - Adjusted	Median Dig Distance (m) - Adjusted	% of Digs <= 100m - Adjusted	% of Digs <= 200m - Adjusted
CLA	✂	✂	✂	✂	✂
LP	✂	✂	✂	✂	✂
CBDs	✂	✂	✂	✂	✂
RoUK (inc. CBDs)	✂	✂	✂	✂	✂

A13.40 The average and median distances dug per area are substantially lower under this sensitivity analysis than those in Table A13.7 and consistent with those shown in Table A13.6. The incidence of very long digs seems to be lower in the CLA than in the LP and the RoUK. This may be because dig costs are likely to be relatively high in the CLA and because the density of customers and networks would be expected to reduce the need for long digs. However, the dig distances for all the areas are close together, and typical (median) dig distances in the CLA are not notably lower than in other areas. In the light of this, we do not consider that there is a strong case for a shorter (or longer) buffer distance in the CLA than in the other geographic areas.

Part III: Stakeholders' views and interpretation of results

A13.41 In this section we consider stakeholders' responses to Annex 18 of the May 2015 BCMR Consultation relating to dig distance. Table A13.9 below summarises stakeholders' comments and provides our responses. We then set out our proposed buffer assumptions in light of these and the analysis of dig distances set out above.

Table A13.9 Ofcom responses to stakeholder comments on May 2015 BCMR Consultation

Comment Reference	Respondent	Comment	Ofcom Response

A13.42	BT	"Ofcom plots the business sites at the location of the postcode centroid but this is not the location a CP has to build to in order to provide service and introduces errors of serving capability."[515]	In the CLA, the LP and the CBDs, the size of postcode is small relative to the buffer distance of 100m, as can be seen in Table A10.1. The scope for error is minimal as the size of the postcode is smaller than the buffer distance in 100% of postcodes in the CLA, 97% in the LP and 96% in the CBDs. Even in the rest of the UK, 78% of postcodes have a radius of <= 100m. Moreover, the largest postcodes are likely to be in the more rural areas where there is little competition.
A13.43	BT	"Using BT as an example of a CP, in [NW10 7] postcode sector we have a comprehensive network infrastructure and can provide services across the area, but Ofcom's methodology of assuming a coverage of 100m from fibre flexibility points would lead to the conclusion that we can only cover about half of the postcodes."[516]	BT's flexpoint locations reflect its own network build practices. As we have previously recognised in the June 2012 BCMR Consultation[517], in financial and business districts BT's "recommended build distance from a flexpoint to a new customer" was 200m. This could be one reason why, in this postcode sector, not all of BT's flexpoints are within 100m of the area's business sites. However, as can be seen in Figure A13.2, a high proportion of BT's digs are shorter than 100m. This would suggest that the average distance of customer sites from BT's flexpoints is a poor indicator of the distance BT actually has to dig, and hence its ability to compete, and is instead a likely reflection of the extent of its duct network and existing connections. OCPs are in a less strong position competitively, and a CP that had to dig 100m or more would be at a

[515] BT's response to Ofcom's consultation document "Business Connectivity Market Review: Review of competition in the provision of leased lines" Part B: Economic analysis responding to Ofcom's detailed proposals, paragraph 11.30.
[516] BT's response to Ofcom's consultation document "Business Connectivity Market Review: Review of competition in the provision of leased lines" Part B: Economic analysis responding to Ofcom's detailed proposals, paragraph 11.44.
[517] June 2012 BCMR Consultation, paragraph 5.109.

			significant disadvantage. As described in Annex 18 of the May 2015 BCMR Consultation[518] as well as below, a buffer distance of 100m is consistent with the data on actual dig distances. We continue to use a 200m buffer distance as a basis for distinguishing those areas in which there is greater infrastructure-based competition than in the UK overall.
A13.44	Colt	"Reduce buffer distance to an even more realistic level (i.e. we believe 75m would be more credible)."[519]	Whilst a buffer distance of 75m is within the range of assumptions we consider reasonable, for the purposes of defining the CLA boundary, we regard 100m as a reasonable assumption that is consistent with the data, whilst a significantly shorter distance could mean that competitive locations were overlooked. As can be seen from the results of the CLA boundary sensitivity analysis changing the buffer distance from 100m to 50m[520], network reach at this smaller buffer distance does not have a substantial effect on the CLA boundary.
A13.45	BT (in a report by DotEcon)	"We maintain that by using a short dig distance Ofcom may be missing competitively supplied/prospectively competitive areas where high value businesses (i.e. those demanding high bandwidth services) are located and clustered, because operators are more likely to dig further to	As described in Annex 18 of the May 2015 BCMR Consultation[522] as well as below, a buffer distance of 100m is consistent with the data on actual dig distances. We continue to use a 200m buffer distance as a basis for distinguishing those areas in which there is greater infrastructure-based competition than in the UK overall. As can be seen from the results of the

[518] May 2015 BCMR Consultation, paragraphs A18.50 to A18.55.
[519] *Business Connectivity Market Review: Consultation Response by Colt Technology Services*, page 5.
[520] Annex 10, paragraphs A10.218 - A10.219.

		meet the demands of these customers."[521]	CLA boundary sensitivity analysis with a buffer distance of 200m,[523] using this longer buffer distance has, as expected, some effect on the position of the CLA boundary, though this effect is relatively small, increasing the number of postcode sectors within the boundary by about 20% (for a doubling of the buffer distance). Similarly, when we use a 200m buffer distance to identify high network reach areas in other parts of the UK, we observe a small increase in their size when compared to the areas defined using a buffer distance of 100m. However, this does not affect our market definition or SMP findings. We also note a point we made in the March 2013 BCMR Statement in response to DotEcon: our objective is not to identify individual business sites within a given distance of two or more networks, but to identify geographic areas within which competitive conditions are broadly homogeneous. In addition, where there are variations in competitive conditions within a market, we have taken these into account in our impact assessments of remedies.
A13.46	Six Degrees Group	"Generally in our experience dig distances beyond 10m-50m depending on provider will not be considered commercially viable."[524]	As can be seen in Figure A13.2 the majority of digs are less than or equal to 50m, but approximately 34% of digs are longer, suggesting that dig distances above 50m are considered commercially viable in a material proportion of cases.

[522] May 2015 BCMR Consultation, paragraphs A18.50 to A18.55.
[521] Ofcom's Business Connectivity Market Review Consultation: A DotEcon report for BT, section 2.2.2 page 36.
[523] Annex 10, paragraphs A10.220 - A10.221.
[524] Six Degrees Group response to OFCOM Business Connectivity Market Review, section 2.3 page 5.

A13.47	Six Degrees Group	"Note also that there is a strong differentiation between radial distance and actual dig distance, rarely is the dig "as the crow flies", therefore given the buffer is being given as 100m radial this seems overly optimistic on both counts."[525]	As we say in footnote 492 above, it is possible that a CP may have to dig further than the buffer distance if a connection requires a route that deviates from the straight line distance between the flexibility point and the customer site, but, on the other hand, a CP may not have to dig the entire buffer distance in all cases in order to connect the customer if it has existing duct which passes closer to the customer site.[526] As detailed in Annex 10,[527] we performed various sensitivity analyses to ascertain the robustness of the CLA boundary. This included deriving the boundary with a buffer distance of 50m and 200m. We consider the boundary to be robust to a 50m and a 200m buffer distance. The conditions of the boundary test, as detailed in Annex 10[528], which require the presence of four or five OCPs within the buffer distance, allow some scope for CPs with network not to compete for business at a particular site if there are, for example, routing issues. That is, the design of the test allows for the possibility that, for any given site, not all CPs within the buffer distance actually bid. In addition, EFM operators are able to supply low bandwidth circuits using existing copper connections.
	Towerhouse LLP	"Also, since Ofcom's 100 metre buffer is measured in a straight line, and the network will follow roads and footpaths, the dig distance may be somewhat more than 100 metres.[529]"	
A13.48	Towerhouse LLP	"First, and quite simply, for customers requiring a single CISBO circuit, for all except very high bandwidths, the costs of a	In its earlier submission, Towerhouse itself had proposed a buffer distance of 75m. In the May 2015 BCMR Consultation, we said that we regarded

[525] Six Degrees Group response to OFCOM Business Connectivity Market Review, section 2.3 pages 5 to 6.
[526] Refer to footnote on buffer distance, paragraph A13.3.
[527] Paragraphs A10.218 – A10.221.
[528] Paragraph A10.160.
[529] Geographic market analysis in the BCMR: A Response to the Consultation on Behalf of the Colt, Sky, TalkTalk and Vodafone, paragraph 3.21.

		network extension anywhere approaching 100 metres would be prohibitive."[530]	this as an indication of "broad agreement" with Ofcom as it was within the range of assumptions we considered reasonable.[531] As noted above, the results of our sensitivity analysis with 50m and 200m buffer distances give us confidence that the CLA boundary is robust. As Figure A13.2 shows, the proportion of digs of over 100m in length is small but material, though these may not be for single circuits. For the purposes of defining the CLA boundary, we regard 100m as a reasonable assumption that is consistent with the data, whilst a significantly shorter distance could mean that competitive locations were overlooked.
A13.49	Towerhouse LLP	"Perform additional checks by varying the assumptions used in its network reach analysis, e.g. test network reach at the median dig distance of 40 metres."[532]	As can be seen from the results of the CLA Boundary sensitivity analysis with a buffer distance of 50m,[533] network reach at this smaller buffer distance does not have a substantial effect on the CLA boundary.
A13.50	Vodafone	"Ofcom appears to have taken a nationwide measure of dig distances which isn't reflective of the economics and practicalities of digging the road in CLA."[534]	As Table A13.8 shows, the dig distance figures for all the areas are close together, and typical dig distances in the CLA are not notably lower than in other areas, although the incidence of very long digs appears to be lower. This may be because dig costs are likely to be relatively high in the CLA and because the density of customers and networks would be expected to reduce the need for long digs.

[530] Geographic market analysis in the BCMR: A Response to the Consultation on Behalf of the Colt, Sky, TalkTalk and Vodafone, paragraph 3.21.
[531] May 2015 BCMR Consultation, paragraph A18.46 and Towerhouse LLP, paragraph 3.54. http://stakeholders.ofcom.org.uk/binaries/telecoms/market-reviews/Geographic_market_definition_Towerhouse.pdf
[532] Geographic market analysis in the BCMR: A Response to the Consultation on Behalf of Colt, Sky, TalkTalk and Vodafone, paragraph 3.42.
[533] Refer to paragraphs A10.218 - A10.219.
[534] Response to Ofcom's Consultation: Business Connectivity Market Review, section 5 page 17.

			As detailed in Annex 10,[535] we performed various sensitivity analyses to ascertain the robustness of the CLA boundary. This included deriving the boundary with a buffer distance of 50m. We consider the boundary to be robust to this lower buffer distance.

A13.51 One CP, [✂], set out the assumptions underlying its business model.[536] [✂].

[Table A13.10 [✂] cost based Capex distance

Capex/distance (metres)	£ per circuit	Distance
Mobile backhaul	✂	✂
Public sector sites	✂	✂
Business sites	✂	✂

Our decision on the appropriate buffer distance

A13.52 In Annex 18 of the May 2015 BCMR Consultation we set out our view that the appropriate buffer distance for the CISBO market[537] was 100m, and that a 200m buffer distance remains useful as a means of identifying areas with greater infrastructure-based competition than in the UK overall.[538]

A13.53 We proposed that a buffer distance of up to 100m would identify areas where competition in the CISBO market is effective, and considered a buffer distance in this range:

- is consistent with the data on actual dig distances which CPs provided, as it is reasonable for the buffer distance to be longer than the distances actually dug in many cases; and
- is consistent with the balance of what CPs have told us, for example, the response by Colt suggesting a buffer distance of 75m, as well as one CP's, [✂].

[535] Paragraphs A10.218 – A10.219.
[536] Annex C of [✂] letter of 17th March 2015, page 10.
[537] A single CISBO market comprising services at all bandwidths and interfaces (except low bandwidth TISBO), whilst markets for higher bandwidth TISBO services are no longer defined.
[538] Annex 18 of the May 2015 BCMR Consultation, paragraphs A18.47 to A18.55.

A13.54 When dig distances are broken down by geographic area, it can be seen that the CLA, somewhat surprisingly, had the longest average and median dig distance. However, this result is affected by the inclusion of one CP's, [✂], dig distances which are derived from estimates of national average dig costs. When this CP's digs are removed from the calculations, the CLA has the shortest average dig distance. However, the figures for all the areas are close together and typical dig distances in the CLA are not notably lower than in other areas. The incidence of very long digs appears to be lower, perhaps because dig costs are likely to be relatively high in the CLA and because the density of customers and networks would be expected to reduce the need for long digs.

A13.55 In light of the additional analysis conducted here to take into account the distances dug by CPs in different geographic areas and having considered stakeholders' arguments for different buffer distances, we consider that a buffer distance of 100m is appropriate for determining the boundary of the CLA geographic market.

A13.56 Drawing a precise market boundary is never straightforward and, in principle, this could be done taking account of a range of measures of competitive intensity. In the case of the CLA, we find that, selecting any criteria within a reasonable range, the area which emerges is very similar. This gives us confidence that the proposed market boundary is robust. The test used for delineating boundaries of the CLA is described in more detail in Annex 10.

A13.57 We also consider that analysis of network reach with a 200m buffer is a useful means of identifying areas with somewhat greater infrastructure-based competition in the rest of the UK, which might then merit a separate analysis. In this review, we use a 200m buffer distance to identify the boundaries of the CBDs and, implicitly (since it is the same as the WECLA boundary defined in 2013), the outer boundary of the LP. A business located in an area which did not pass a test based on a 200m buffer might very likely have no effective alternative supplier to BT (or KCOM). The presence of two or more OCPs within 200m, by contrast, is consistent with the presence of some competition, though its extent may vary from site to site within the market. Where an SMP finding is made in such an area, it may also be appropriate to consider whether there should be some variation in remedies, in the impact assessment of remedies.