Business Connectivity Market Review

Consultation on Data Analysis

About this document

This document is an interim consultation within Ofcom's current Business Connectivity Market Review (BCMR). The BCMR looks at competition in the supply of leased lines, which we have historically defined as dedicated and symmetric fixed line connections purchased by businesses.

In order to inform our analysis we look at:

- the extent to which BT's competitors have laid their own networks in different parts of the UK ("network reach" analysis); and

- the shares of different types of leased lines that BT and its competitors supply ("service share" analysis).

These analyses are reliant on the collection and processing of large amounts of data from Communications Providers, which we have been gathering over the past several months. In this document we set out for consultation an explanation of the data we have requested and the methodologies, assumptions and judgments we have used to check and clean that data. We also present an indicative set of network reach and service share calculations in order to assist stakeholders in commenting on this data collection and processing exercise.

The comments we receive in response to this consultation will improve our ability to present informed analyses of service share and network reach in our main consultation, which we currently expect to publish in Spring 2015.

Contents

Introduction

Background

1.1 In March 2013 Ofcom completed its most recent Business Connectivity Market Review (BCMR 2013)[1], considering the markets for:

- the retail provision of leased lines[2] in the UK; and

- the wholesale provision of terminating segments[3] and trunk segments[4] in the UK.

1.2 In early 2014, we started the next BCMR (BCMR 2016). Our market review process involves three analytical stages, based on a forward look[5]:

a) to identify and define the relevant markets, appropriate to the national circumstances in the UK, under the regulatory framework harmonised across the EU (market definition);

b) to determine whether any operator has significant market power (SMP) in any of those relevant markets (SMP assessment); and

c) where there has been a finding of SMP, to assess the appropriate remedies which should be imposed, based on the nature of the competition problem(s) identified in the relevant markets or, where we determine that a market is effectively competitive, to remove regulation that currently applies to that market (regulatory remedies).

1.3 In order to undertake each of these three exercises, we will draw on a wide range of evidence. The subjects of this paper are two specific sources of evidence, namely the network flexibility point data and leased line (or 'circuit') data that we have requested from CPs. In the BCMR 2013, we requested similar information in order to carry out our service share and network reach analyses, which were used to inform the definition of product and geographic markets as well as our SMP assessment.[6]

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[1] Ofcom, *Business Connectivity Market Review*, 28 March 2013.
http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/

[2] Leased lines provide dedicated transmission capacity between fixed locations.

[3] Terminating segments link a business end-user site to a CP's network node.

[4] Trunk segments are links that aggregate traffic between major network nodes.

[5] See, in this respect, paragraph 20 of the EC's guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services. In the BCMR 2013, we took a forward look of three years, reflecting the characteristics of the retail and wholesale markets the factors likely to influence their competitive development, as well as the timing of the next review.

[6] A detailed description of the data analysis was provided in Annex 5 of the BCMR 2013 Statement, whilst the network reach and service share analyses are described in Sections 5 and 7 respectively.

1.4   As explained in the following sections, the datasets we construct are unavoidably large and complex because we require detailed and granular information from a number of CPs in order to form an assessment of market definition and market power. Stakeholders had divergent views on our approach to processing and analysing the data in the BCMR 2013, which required a significant investment of resource for both Ofcom and CPs.

1.5   In light of this, immediately following the conclusion of the last BCMR we had a series of meetings with the CPs that had provided the majority of data.[7] The purpose of these discussions was to improve CPs' understanding of the type and quality of data we would require from them for the purpose of conducting this BCMR. It also allowed us to understand in more detail what data each CP holds and how they are recorded, such that we could request information in a manner that did not impose a disproportionate resource burden on CPs. We also sought to minimise the amount of data processing carried out by CPs, with the intention that we would obtain the raw outputs of their information systems and then process and clean the data in a consistent manner.

1.6   Following these discussions, towards the end of 2013, we sent out a draft information request to the largest CPs in order to ensure that we would be able to obtain the data required for the BCMR 2016. We also requested that CPs provide sample data so that we would be better prepared to process the full datasets when they arrived. A further round of discussions was held with CPs to clarify outstanding questions related to the sample data.

1.7   In Spring 2014, we issued the final Section 135 (s135) notices to 17 fixed network operators, four local loop unbundler (LLU) operators and four mobile network operators (MNOs).[8] A full list of operators that received a data request is provided in Annex 5 and we discuss our choice of CPs in the next section. Annex 6 includes the s135 issued to fixed network operators.[9]

1.8   The data we received in response to the s135 notices are not provided in a consistent manner by CPs due to differences in their information systems. Therefore, following receipt of the information, we began cleaning and processing the data, which requires the application of 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.

Objectives

1.9   The objective of the BCMR data workstream is to produce two sets of data (one for network reach and one for service shares) that are sufficiently accurate to allow for reliable inferences to be drawn about competitive conditions in the relevant BCMR markets. We believe that the steps we have taken since the last BCMR have resulted

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[7] This included BT, Virgin Media, Vodafone (following the purchase of Cable & Wireless Worldwide), KCOM, Level 3, COLT and Verizon.

[8] These notices were requests for information made using our formal information gathering powers under section 135 of the Communications Act 2003.

[9] Minor adjustments were made to some CP s135 notices where relevant (e.g. if they did not hold certain information, for example on circuit prices) but the vast majority of questions were the same for all CPs.
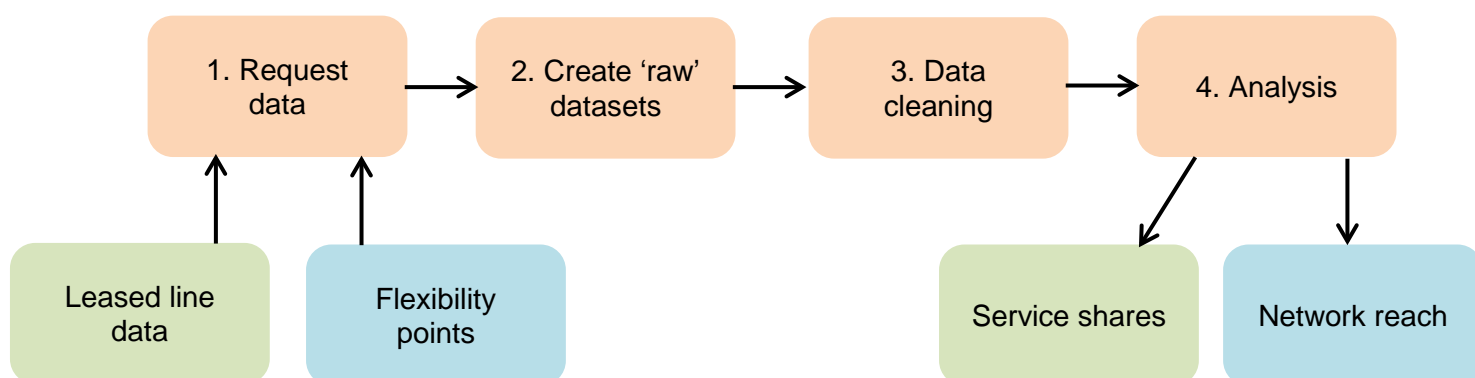
in comprehensive and better quality data submitted by CPs. However, we also wish to test the processes and assumptions we have made when carrying out our data analysis.

1.10   The objective of this consultation is therefore to enable us to present in our planned Spring 2015 consultation a set of data that has been cleaned and processed according to an objective set of methodologies understood by stakeholders. Where certain assumptions or judgements are required and where there are limitations within the data, we will ensure these are clear to all stakeholders and that they are fully taken into account when the data are used for economic analysis.[10]

1.11   In this consultation we therefore provide CPs the opportunity to review our data processing methodology, which comprises the four steps outlined in Figure 1 below. Steps 1, 2 and 3 are explained in the next two Sections. First, we provide a description of the data requested (Step 1 in Figure 1) and explain the work undertaken by Ofcom to check and clean the data (Steps 2 and 3)[11]. We also explain the assumptions made when processing the data and identify any high-level problems we have encountered.

1.12   Secondly, in Section 4 of this consultation we present a set of indicative summary network reach and service share statistics based on our analysis of the current clean datasets. For illustrative purposes only, we present service shares for the markets defined in the BCMR 2013 (Step 4). This will allow CPs (and other stakeholders) to see some aggregate outputs of the data and comment on whether they appear consistent with their recent experience in the sector. However, we do not provide an economic interpretation of the statistics, nor do we draw any inferences about the implications for market definition or competition in the supply of wholesale leased lines. This will be done in the forthcoming BCMR Consultation. Furthermore, as this only represents an interim stage in the processing of the quantitative data, nothing in this document should be considered final, nor should it be taken as a presentation of emerging conclusions by Ofcom within the BCMR.

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[10] Bearing in mind that analysis of quantitative data from CPs is just one source of evidence used in Ofcom's market review.

[11] A more detailed explanation of steps 2 and 3 is provided in Annex 7.

Figure 1: Key Steps in Data Analysis

1.13 Thirdly, at the same time as this consultation is published, we will send each CP a cleaned version of the circuit and flexibility point data they provided. This will enable CPs to review the cleaning rules and assumptions which we have applied to their data. CPs will then have the opportunity to identify any errors they consider we may have made and/or to provide further information to enable us to make any necessary corrections and to improve the quality of the datasets.

1.14 We are therefore only inviting comments on our methodology for data cleaning and processing at this stage, so that we can construct a dataset that has been cleaned on an objective basis and in a manner understood by all CPs. Once we have achieved this objective, we will use the data along with other sources of evidence to inform our analysis of market definition, SMP assessment and regulatory remedies in the BCMR 2016. This analysis will be set out in the BCMR Consultation (due in Spring 2015).

Scope and Coverage of the Data

2.1   In this section, we explain what data we have requested from CPs thus far. We separate this by type of operator (fixed, mobile, LLU) and then discuss quantitative data we have sourced from third parties that we use in our network reach and service analyses.

2.2   There are two important points to note at the outset related to the scope and coverage of the data we have requested. The first is that our information requests thus far have been informed by the scope and coverage of the data we used in the BCMR 2013. Specifically, we have requested data on 'leased lines' as defined in the BCMR 2013 – i.e. a symmetric service of dedicated (uncontended) capacity between two fixed locations.[12] 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)[13] and IP transit.

2.3   Although we allowed CPs to provide data on other types of connectivity (for example ADSL broadband, Next Generation Access (NGA), ISDN), this was not a mandatory requirement and the majority of CPs did not provide us with data on other forms of business connectivity. The reason for limiting the scope in this way was to ensure the provision of timely information, as expanding the data request to include all types of connectivity would have required giving CPs significantly more time to respond, and it was not certain that we would (or will) need the information.

2.4   However, the fact that we have required CPs to provide data only on leased lines does not mean that we have pre-judged our definition of the relevant markets in the BCMR 2016. In this review, we will consider a range of business connectivity services and, should we decide to obtain further information on this during the course of the market review, we shall do so.

2.5   The second point to note is that our information requests (and this consultation) sometimes refer to three distinct parts of a telecommunications network: core, backhaul and access. These are illustrated in Figure 2 below. By 'core', (also sometimes 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.

2.6   '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 may aggregate together different traffic streams by service (e.g. residential broadband traffic from different customers) but

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[12] 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.

[13] 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.

economies of scale and scope in backhaul are typically less significant than in the core network.

2.7   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 the BCMR 2013, our primary focus was 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 as well).

2.8   The figure below provides a stylised example of this network topology. Although each CP will construct their network in a specific manner, the majority can be broadly split into the three segments above.

Figure 2: Stylised Network example

Data from fixed network operators

2.9   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, as discussed above, in the BCMR we are mainly concerned with wholesale leased line services that are provided 'on-net' by CPs in the access network. By 'on-net' we mean leased lines where the CP connects its electronic equipment to physical links that it either owns and operators and/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, optical fibre or a point-to-point microwave radio link). We do not include information from leased line resellers in our wholesale assessment because this would constitute double counting.

2.10   We have not sought to capture data from every single 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 and our experience from the BCMR 2013, we identified 17 operators which own or lease fixed access infrastructure and which also supply leased lines in material quantities. We therefore requested data from these 17 fixed network operators as the main suppliers

of on-net terminating segments of leased line services in the UK.[14] As an additional cross-check, we also issued four s135 notices to large CPs that we understood not to own or lease any access infrastructure (see Annex 6 for a list of these). Each of these CPs responded confirming that this is the case.

2.11   We therefore do not intend to issue an s135 notice to every UK CP that has code powers.[15] However, we welcome comments in response to this consultation on whether we have not requested data from a fixed network operator in the UK that could have a material effect on the statistical outputs presented in Section 4.

> *Question 1: Are you aware of any fixed network operators that have access infrastructure that Ofcom has not requested data from that are likely to have a material impact on our network reach or service share analysis?*

2.12   The remaining part of this sub-section sets out the five broad requirements of the s135 Notice sent to fixed operators.

Sales and purchases of leased lines

2.13   We requested inventories of live leased line sales and purchases.[16] For each leased line, we requested information on:

- the interface used, or a product name to infer the interface;

- whether the service uses WDM technology at the customer's premises;

- the bearer bandwidth;[17]

- 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;

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[14] In the BCMR 2013, 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 BCMR 2013, Section 7, paragraph 7.62 (footnote 742)

[15] Refers to the electronic communications code set out in Schedule 2 to the Telecommunications Act 1984.

[16] By 'live' we mean circuits that are currently active and in use.

[17] 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 155Mbits/s SDH transmission link is used to carry 60 2Mbit/s leased line services then we would consider the 155Mbits/s transmission link as the bearer.

- the connection price; and,

- the name of the wholesale supplier for leased line purchases.

2.14   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).

2.15   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

2.16   We requested CPs to provide the Easting and Northing location details of all their flexibility points. 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 reach 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 requested CPs to provide digital maps of their networks.

Fibre connected buildings

2.17   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.

2.18   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[18] or the route distance[19]);

- 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).

2.19   The data on fibre-connected buildings is a new source of information that was not collected in the BCMR 2013. We are still processing this information, along with the data on dig distances, and so we do not discuss it further in this paper.

Network sites

2.20   We requested from each CP a list of their network sites, which we defined as being locations in the CP's network where they have installed transmission equipment that

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[18] This is the straight line or 'as the crow flies' distance between two points.

[19] This is the actual distance of the physical connection between two points.

is used for leased lines and which is capable of serving more than one business customer. Network sites are distinct from flexibility points as the latter are physical locations from which a CP can extend their 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.

2.21   For each network site, we requested address details, a description of the site and whether it is coincident with a customer site. We also requested CPs to provide details of their interconnect points with BT (in our s135 to BT we requested details of their interconnect points with other CPs).
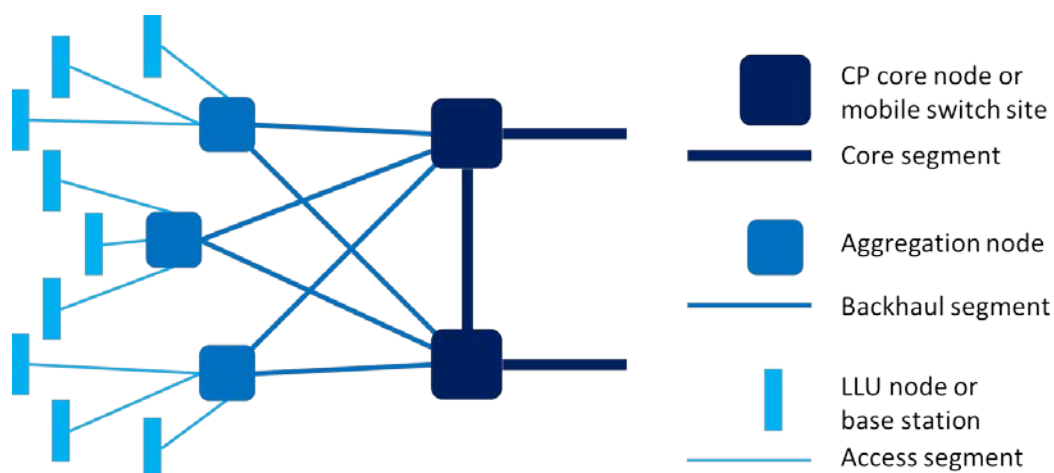
Network architecture

2.22   Lastly, we requested that each CP provide a description of the architecture of their network, the way in which they provide business connectivity services and whether they have plans for network expansion in the next 5 years. As this information is qualitative in nature, it is not discussed further in this paper.

Mobile network and LLU operators

2.23   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 base stations (and BT exchanges for LLU operators) to their core networks. These are illustrated in the figure below.

Figure 3: MNO and LLU network example

2.24   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 supply and purchases from the principal MNOs and LLU operators in the UK. For each leased line, we requested information on:

- the transmission medium (i.e. copper, fibre or microwave);

- 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.

2.25 We also requested an inventory of purchases of dark fibre and duct, with information on location of each end and the supplier.

2.26 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 (and as such was included in the Alternative Interface Symmetric Broadband Origination (AISBO) product market in the BCMR 2013).[20] 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.

2.27 We note that fixed network operators may also use third party leased lines in their backhaul or core networks. However, it is our understanding that these do not constitute a significant proportion of leased line purchases and so we do not intend to analyse them separately (as we do for MNO and LLU backhaul).

Business locations and postcode data

2.28 In order to carry out our network reach analysis, it has been necessary to obtain data on UK business locations and postcodes. For the BCMR 2013 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.

2.29 The data we previously sourced from Experian, and the data we currently have from Market Location, covers all UK businesses with one or more employees. In the BCMR 2013 we decided to use data on businesses with 250 or more employees only for the purposes of the network reach analysis.[21] At this stage of the BCMR we have not reached a view on which businesses to use in the network reach analysis but, for the purposes of comparison, in this paper we have used the same assumptions as in the BCMR 2013.

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[20] 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 Media).

[21] See paragraph 5.54 in Section 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Section5.pdf.

2.30   For the BCMR 2013, geographic market areas were built up by aggregating individual postcode sectors. In 2011 we used Dotted Eyes[22] for an up to date set of postcodes, postcode sectors and their associated polygons.[23] For this BCMR we evaluated a number of options for a postcode database and decided to use Dotted Eyes again.

2.31   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 such that where CPs have given an out-of-date postcode, we are able to identify the most up to date postcode. Our decision to purchase a postcode and postcode sector database does not mean that the BCMR 2016 will necessarily use postcode sectors as the building-block for geographic markets.

2.32   We have checked whether our choice in itself 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. To do this, we have rerun the BCMR 2013 network reach analysis using the BCMR 2013 data on flexibility point locations together with the Market Location 2014 data on business locations and the Dotted Eyes 2014 postcode area definitions. We have then compared the WECLA defined in the BCMR 2013 with the equivalent area derived using the 2014 data.[24] The results are shown in Figure 4 below, which illustrates those sectors defined as high network reach using the 2014 data (coloured in blue) in the WECLA and surrounding areas, compared to the WECLA boundary defined in the BCMR 2013.[25] The areas covered are substantially the same, suggesting that there has been no material loss of consistency.

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[22] Dotted Eyes is a company specialising in digital mapping and geographic information systems.

[23] For mapping purposes, the polygons for each postcode and postcode sector represent the geographic coverage of the postcode or postcode sector.

[24] The WECLA was defined to comprise those (contiguous) postcode sectors which were "high network reach" (HNR). A postcode sector was said to be HNR if, on average, two or more CPs (in addition to BT) had a flexibility point within 200m of the businesses there.

[25] See the BCMR 2013 section 5.72 for the equivalent HNR maps http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/. Postcode sector boundaries have shifted slightly between 2011 and 2014, resulting in minor changes in the shapes of the areas covered.

Figure 4: Network reach using 2011 flex points and 2014 market location data

2013 WECLA

High network reach postcode sectors derived from: 2013 flexibility points; Market location 2014 business locations and 2014 postcode sector definitions

Data Processing

3.1 In this section, we explain some key data processing and analytical issues on which we are seeking stakeholders views. A full explanation of the data processing methods for flexibility point and leased line data is provided in Annex 7. We have identified four key issues which we discuss here:

- Issue 1 – taking account of circuits which may have been omitted entirely from the data supplied by CPs;

- Issue 2 – the classification of WDM and 'Ethernet over SDH' circuits;

- Issue 3 – the classification of circuit ends;

- Issue 4 – the use of data on circuits defined by CPs as "on-net" as a measure of wholesale supply;

- Issue 5 – adjusting the data for those circuits where the data provided is incomplete.

Leased line data

3.2 We have received data on more than 900,000 circuits of all types[26], including both sales and purchases. In order to use the data to carry out an analysis of CPs' shares of leased line supply (their service shares), we need to produce a set of records that 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.

3.3 Details of how we identify the first four categories are provided in Annex 7. As we are particularly interested in stakeholders' views on the on-net/off-net category, we discuss this below (see Issue 4).

3.4 We have been able to identify information on the above five categories for the majority of circuits (99% for interface, 86% for bandwidth, 75% for postcodes, 96% for end-type classification and 89% for on-net/off-net). In order to deal with information that is missing, we intend to use a combination of uplift allocations and sensitivity tests. This is discussed later in this section (see Issue 5).

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[26] We note that not all of these circuits are leased lines as some CPs also provided information on other connectivity services.

3.5   It is also important that we are not missing a material number of circuits from CPs or, if we are, that we develop appropriate methods to quantify any uncertainty. In the following discussion (Issue 1), we explain why it is possible that some circuits may have been omitted from the data supplied by CPs. Our current assessment is that any circuit omissions should not be material to the initial results presented in Section 4 but we will test this during the consultation.

Issue 1 - Circuits omitted from CP data

3.6   In order to understand the data that Ofcom has obtained on leased lines, it is important to understand the context in which leased lines are sold and purchased in the UK.

3.7   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).[27]

3.8   For the purposes of this consultation, there are two broad categories of leased line use on 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 2 above a business customer might purchase a leased line to connect two of its sites.

   ii)   The more complicated scenario is where 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.

3.9   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.

3.10   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 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

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[27] Section 2, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Sections1-4.pdf

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.

3.11   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.

3.12   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 in Issue 5, we intend to deal with this by using uplift allocations and sensitivity tests.

3.13   However, we also note that due to the issues identified above it is possible that our dataset does not represent a complete inventory for each CP. Where possible, we have sought to clarify with CPs the possible extent of missing data. Based on our discussions with CPs so far, we consider that any omissions from the dataset are likely to be small and not material to the results presented in Section 4. However, we will seek to confirm this during the consultation and if some CPs indicate that they do not hold information on all their leased lines, we will work to quantify any uncertainty via a sensitivity test. This was the approach taken in the BCMR 2013, where we carried out sensitivity tests to account for circuits that were potentially omitted.[28]

> *Question 2: Are there any missing circuits in the leased line data you provided to Ofcom? If so, please provide your best estimate (together with, if possible, a lower and an upper-bound estimate) of the number (or percentage) of circuits that are potentially missing and indicate whether they are likely to be accounted for primarily by a particular set of interfaces or bandwidths.*

> *Question 3: Are there other factors relevant to how your leased line sales and purchases are recorded that have implications for Ofcom's service share analysis?*

Issue 2 – Classifying WDM and 'Ethernet over SDH' circuits

3.14   Cleaning and processing the circuit data we have received from CPs requires us to categorise the interface of almost one million circuits. We do this by using information that CPs have provided on circuit types and product names (see Annex 7 for further details on our methodology). Due to the large number of circuit type and product combinations, we do not explain every cleaning rule made in this consultation. As discussed above, at the same time this consultation is published, we will send each CP a cleaned version of the data they have provided. This will give each CP the opportunity to identify any errors they consider we may have made and/or to provide further information to enable us to make any necessary corrections and to improve the quality of the dataset. However, there are some general issues regarding interface classification that we believe are worth highlighting.

3.15   The first is the classification of circuits that use wavelength division multiplexing (WDM) technology. As in the BCMR 2013, we have tried to distinguish between

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[28] Paragraphs A5.79-A5.83 in Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Sections1-4.pdf.

WDM bearers (which were not counted in the 2013 service share analysis) and WDM wavelengths (which were counted). The reason for this is that the wavelength(s) provides the connectivity between two locations, whereas a bearer connection with no wavelength will not provide any connectivity. This bearer/wavelength distinction is straightforward when the circuit type indicates it is a bearer or when the circuit is given as WDM and the bandwidth is 0 (as a wavelength will have a positive bandwidth associated with it). However, in some cases, CPs may not have made the distinction between the two and so we may have classified some bearers as wavelengths. During the consultation, we will ask CPs to distinguish between WDM bearers and wavelengths in their circuit data where possible.

3.16 Another issue regarding WDM classification is that in the BCMR 2013, we made a distinction between one scenario where the customer specifically requests a WDM service in order to potentially use multiple wavelengths to scale up their bandwidth at relatively low cost (such a circuit was classified as WDM) and a scenario where the customer was purchasing a single link that the CP happened to provide using WDM technology (such a circuit was classified by the relevant interface, such as Ethernet or SDH/PDH). An example of the latter is BT's Ethernet Backhaul Direct (EBD) product, which is delivered using WDM technology but is classified as Ethernet because, from the customer's perspective, they are purchasing a single Ethernet circuit. In making this distinction in the current dataset, we have tried to make use of the information CPs provided on whether the circuit has WDM equipment at the customer's premise. However, this information is often missing as CPs do not record it systematically. Therefore, for circuits that appear to be WDM we have sought to clarify with CPs how they should be classified, with particular reference to the circuit's characteristics, the customer's requirements and pricing. However, it is possible that our current classifications contain errors and so we will use this consultation phase (particularly by sending CPs our interface allocation rules) as a way of seeking further clarity with CPs that provided the data.

3.17 A final issue worth highlighting in relation to interface classification is our treatment of circuits that utilise an Ethernet interface over an SDH transmission (often known as 'Ethernet over SDH'). We classify these as Ethernet circuits on the basis that the connectivity service being provided to the end customer is Ethernet-based and has the characteristics of an Ethernet service. However, we welcome comments from CPs on whether or not this is appropriate.

Question 4: Do you agree with our approach to classifying circuits that are delivered using WDM technology? Have we correctly classified circuits as WDM in the data you have provided, based on our current definition?

Question 5: Do you agree that 'Ethernet over SDH' circuits should be classified as Ethernet circuits? If not, please explain why.

Issue 3 – Classifying circuit-ends

3.18 In order to ensure that circuit ends are counted consistently across different CPs, our estimates of service shares should only include leased lines that terminate at a customer site (by "customer" we mean an end-user that is not a fixed operator).[29]

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[29] We include mobile network operators in our definition of end-users as MNOs purchase leased lines for backhaul (see Section 2).

This requires a methodology to identify circuit ends that terminate at a CP network site such that we can exclude these from our calculations.

3.19   We have identified network sites by asking each CP for a list of all their network site locations (specifically part D1 of the s135 request – see Annexes 6 and 7 for further details). We then aggregate all CP network sites to give a list of 8,544 unique postcodes where at least one network site is located and we exclude circuit ends that terminate in these postcodes from our service share estimates. This is consistent with our methodology in the BCMR 2013.

3.20   However, following our discussions with CPs after the last BCMR, 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 a customer's premise; and,

ii)   many customers require connections to data centres, which serve as network sites for a number of CPs.

3.21   In principle, it could be appropriate to include all circuit ends at customer sites in our service share calculations, regardless of whether such a location also happens to be a network site or not. However, by including in our calculations *all* circuit ends that terminate in a postcode that has been identified as a customer-network site (e.g. a data centre), we are also likely to include some circuit ends that do not terminate at a location requested by a customer and are in fact network ends. For example, if a customer requests a connection between points A and B and a CP chooses to route this via a data centre, thereby reporting two entries (one between A and the data centre and another between B and the data centre), we would only want to count the circuit customer ends at points A and B. However, by including postcodes in which data centres are located in our analysis, we would also count two data centre connections, even though the customer does not require these (rather they are circuit network ends required as a result of the way the CP has chosen to route the circuit).

3.22   A further complication is that there may be more competition in the provision of services between some customer-network sites, notably large data centres, than between such a site and customer sites nearby. This is an important consideration, since the building block for geographic market definition purposes may be significantly larger than an individual postcode, and we need to be confident that competitive conditions throughout a geographic market are sufficiently homogeneous for it to be regarded as a single market area, and are accurately reflected in our measure of service shares.

3.23   Therefore, if we exclude all joint customer-network sites from our analysis, we may exclude some customer ends from our analysis. On the other hand, if we include all customer-network sites, we are likely to include circuit-ends that are not relevant to the assessment of competitive conditions in the provision of terminating segments of leased lines and which may distort this assessment. Given this, we present ranges for our service share estimates in Section 4 below with the ranges bounded by the shares resulting from the two different treatments of customer-network sites. The range of service shares for the AI WECLA market is particularly sensitive to inclusion or exclusion of customer-network sites. We will use this consultation to seek views from stakeholders on appropriate methods to deal with this issue. We propose to consider separately how competition in the provision of services terminating at data-

centre sites should be assessed and, in the light of this, how such sites should be treated for the purposes of this review.

> *Question 6: Do you agree that presenting a service shares range is the most appropriate way of quantifying the uncertainties involved in identifying network sites for the purposes of this review? Are there alternative methodologies for dealing with this issue?*

Issue 4 - Using on-net and off-net information

3.24 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.[30] 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).

3.25 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.

$$Wholesale\ Supply = \begin{pmatrix} Wholesale\ circuit\ ends\ sold \\ + \\ Retail\ circuit\ ends\ sold \end{pmatrix} - \begin{pmatrix} Wholesale\ circuit \\ ends\ bought \end{pmatrix} \quad (1)$$

3.26 In theory, this formula is appropriate. 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.

3.27 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.[31]

3.28 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 in the BCMR 2013 is that there were instances where equation (1) indicated negative wholesale supply for some CPs in certain

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[30] 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.

[31] Although such errors should not affect the overall estimate of wholesale supply using the above formula, they could lead to errors in estimating the merchant market (i.e. sales between OCPs).

postcode sectors (i.e. they recorded greater (net) wholesale purchases than their overall retail sales implied they would need).[32]

3.29   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'.

3.30   We therefore requested in the s135 that CPs indicate whether each circuit end sold is on-net or off-net. The majority of respondents were able to do this for most of their circuit sales[33] and we were able to identify on/off net information for 89% of circuit end sales. For the remaining ends where we do not have information, we intend to apply a set of uplift allocations. However, due to the complexity of implementing this methodology (discussed under Issue 5) we have not yet developed the capability in our service share model. Therefore, for the purposes of this consultation, we have classified circuits with missing information as on-net (off-net) if the majority of the CP's circuits for which we have information are on-net (off-net). So if a CP provides 100 circuit sales and indicates that 60 are on-net and 20 are off-net, we will assume that the remaining 20 are all on-net. We note that this is a simplification that has been adopted in this consultation for reasons of practicality. Once our service share model is finalised, however, we intend to allocate the missing circuits in proportion to the known circuits (in this example, 75% or 15 would be assumed as on-net and 25% or 5 would be assumed as off-net).

3.31   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).

3.32   We therefore believe that counting on-net circuits is a more reliable methodology for estimating wholesale service shares. However, as discussed earlier, we have requested data from CPs on leased line purchases so that we can estimate service shares using the same methodology as in the 2013 BCMR.

> *Question 7: Do you agree with our preferred approach of estimating the supply of wholesale leased lines by counting 'on-net' circuits only? Do you have any concerns with this approach?*

Issue 5 - Dealing with missing data

3.33   Some CPs have supplied incomplete data for a number of 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 assume that the various bandwidths, postcodes etc. are distributed among the circuits with missing data in the same proportions as they are

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[32] 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.

[33] The on-net/off-net distinction is not relevant to leased line purchases as these are by definition all off-net.

found in the circuits for which we have complete data. We then apply appropriate pro rata uplifts to the number of circuits for which we have data. The following numerical hypothetical example illustrates how this is done where we are unable to identify geographic location and bandwidth information for all circuits. The example is based on a CP providing Alternative Interface (AI)[34] leased lines in three postcode sectors.

Table 1: Allocation example

	AI<=1G	AI>1G	Unknown bandwidth
Postcode Sector 1	2	3	5
Postcode Sector 2	4	6	5
Postcode Sector 3	4	3	14
Unknown postcode	5	4	11

3.34 In this case, we have:

- complete information for 22 circuits (the boxes shaded in blue);

- known bandwidth and unknown postcode information on 9 circuits (shaded in green);

- known postcode and unknown bandwidth information on 24 circuits (shaded in red);

- unknown bandwidth and postcode information on 11 circuits (shaded in yellow).

3.35 The allocation process works in two steps for each defined market. Taking AI<=1G as an example, we allocate the 5 circuits with unknown postcode information based on the 10 circuits where we do have information. This is shown in the table below.

Table 2: Geographic allocation

	AI <=1G	Allocation
Postcode Sector 1	2	(2/10)*5 = 1
Postcode Sector 2	4	(4/10)*5 = 2
Postcode Sector 3	4	(4/10)*5 = 2

3.36 We then follow a similar process for allocating the 24 circuits with unknown bandwidth. In this case, we use the data for which we have bandwidth information to allocate these.

Table 3: Bandwidth allocation

	AI <=1G	Allocation
Postcode Sector 1	2	(2/5)*5 = 2
Postcode Sector 2	4	(4/10)*5 = 2
Postcode Sector 3	4	(4/7)*14 = 8

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[34] AI leased lines are a product market defined in the BCMR 2013. They generally use an Ethernet interface.

3.37   Following a similar process for the AI >1G market gives us the following table, where we have allocated circuits where one variable (either bandwidth or postcode sector) is unknown and we add these to the circuits with complete information.

Table 4: Total Circuit numbers with bandwidth and geographic allocations

	AI <=1G	AI >1G
Postcode Sector 1	5	7
Postcode Sector 2	8	11
Postcode Sector 3	14	10

3.38   The remaining step is to allocate the 11 circuits with no bandwidth or postcode information. This is done using the 55 circuits in Table 4.

Table 5: Remaining allocations

	AI <=1G allocation	AI >1G allocation
Postcode Sector 1	(5/55)*11 = 1	(7/55)*11 = 1.4
Postcode Sector 2	(8/55)*11 =1.6	(11/55)*11 = 2.2
Postcode Sector 3	(14/55)*11 = 2.8	(10/55)*11 = 2

3.39   The final circuit numbers are then produced by summing Tables 4 and 5 together. In the above example, we had two variables where data were not always known (bandwidth and postcode sector). In this two-va riable case, we can describe the following $2^2 = 4$ possible scenarios resulting in $(2^2-1) = 3$ different uplifts:

   i)   Scenario 1 - circuits where we have complete information;

   ii) Scenario 2 - circuits with known bandwidth and unknown postcodes (first uplift);

   iii) Scenario 3 - circuits with unknown bandwidth and known postcodes (second uplift);

   iv) Scenario 4 - circuits with unknown bandwidth and unknown postcodes (third uplift).

3.40   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; whether each end is on-net or off-net. As we have not been able to obtain complete information for all circuits on any of these five variables, in principle we would have to calculate 2^5-1 = 31 separate uplifts to complete our dataset.

3.41   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 1% and 4% respectively. Therefore, we intend to estimate allocations for 3 unknown variables only: bandwidth; postcode sector; and whether the circuit is on-net or off-net.

3.42   However, implementing such a model remains complex and we are currently working on this. For the purposes of this consultation, we have estimated allocations for two

variables (bandwidth and postcode) and, for the on/off-net variable, we have made a simplifying assumption whereby if the majority (i.e. more than 50%) of a CP's sales are on-net (off-net) then we assume that circuits with missing information are also on-net (off-net). In our final model, which will be prepared in advance of the main BCMR consultation, we aim to develop the capability to apply an uplift to missing on/off-net information.

3.43   As in the BCMR 2013, we have assumed that any end-type we are unable to identify is a customer end. For the interface, in the BCMR 2013 we allocated unknown interfaces by CP. In this consultation we have excluded circuits with unknown interfaces from our analysis and will seek to identify these during the consultation.

3.44   Should we be unable to identify circuits without an interface in our final dataset, we will quantify the uncertainty in the results by presenting ranges in our service share estimates or sensitivity tests. We will follow a similar approach to end-types that we are unable to classify. We consider this is the most appropriate and proportionate approach, given the complexity involved in applying uplifts to more than three variables.

> *Question 8: With respect to missing information, do you agree with our proposed approach of using uplifts for three variables and presenting ranges for two variables? Should we consider alternative methodologies for dealing with missing information?*

> *Question 9: Do you have any views on other aspects of our data processing and cleaning, as set out in Annex 7?*

Data Outputs

Introduction

4.1 In this section, we present a set of network reach and service share outputs using the data described above. We do not provide an economic interpretation of the statistics, nor do we draw any inferences about the implications for competition in the markets for wholesale leased lines. The market definitions from 2013 have been used purely for this illustrative exercise and no assumptions should be drawn as to the analysis of market definition we plan to present in Spring 2015.

4.2 The purpose of presenting the results is to allow CPs and other stakeholders to see some aggregate outputs of the data and identify any issues relevant to the data cleaning and processing exercise, for example by reference to whether they appear consistent with their recent commercial experience. In particular, if stakeholders do not consider the results to be accurate then we are inviting their views on:

- why our methodology for data processing and cleaning has led to erroneous results;

- why the assumptions and judgements we have made in our data analysis has led to erroneous results; and/or,

- alternative more appropriate methods and assumptions.

Network reach analysis

4.3 Network reach provides a measure of how many independent physical networks are within a set 'buffer' distance of business locations. In the BCMR 2013 we defined the buffer as 200m and took the view that, on average, the presence of two or more operators (in addition to BT) with flexibility points within 200m of business sites was a reasonable basis for distinguishing between areas where there was some potential for competition and those where the minimum conditions for effective competition were unlikely to be met.

4.4 In the light of this, we distinguished between those postcode sectors where, on average, BT and two or more other operators were within 200m of the business sites and those postcode sectors where, on average, only one other operator was within 200m, or BT was the only operator. We referred to the former as 'high network reach' (HNR) sectors and the latter as 'low network reach' sectors. The buffer also helps mitigate the uncertainties in business and flexibility point locations.

4.5 We have repeated the BCMR 2013 network reach analysis using the updated flexibility points and the Market Location data, filtered to select all business locations where the business employed a total of 250 or more people. This does not mean that we will follow the same approach in the current BCMR but we adopt this method in this consultation in order to provide comparison with previous results.

4.6 Figures 4 and 5 present the network reach results for the UK based on 2011 and 2014 data respectively (the blue postcode sectors are high network reach). Figures 6

and 7 present the same analysis for the WECLA and surrounding areas. The black dots in Figures 6 and 7 show the locations of businesses we use in our analysis.

4.7   In Table 6, we present some descriptive statistics on the number of high network reach postcodes sectors and the number of businesses in HNR sectors.

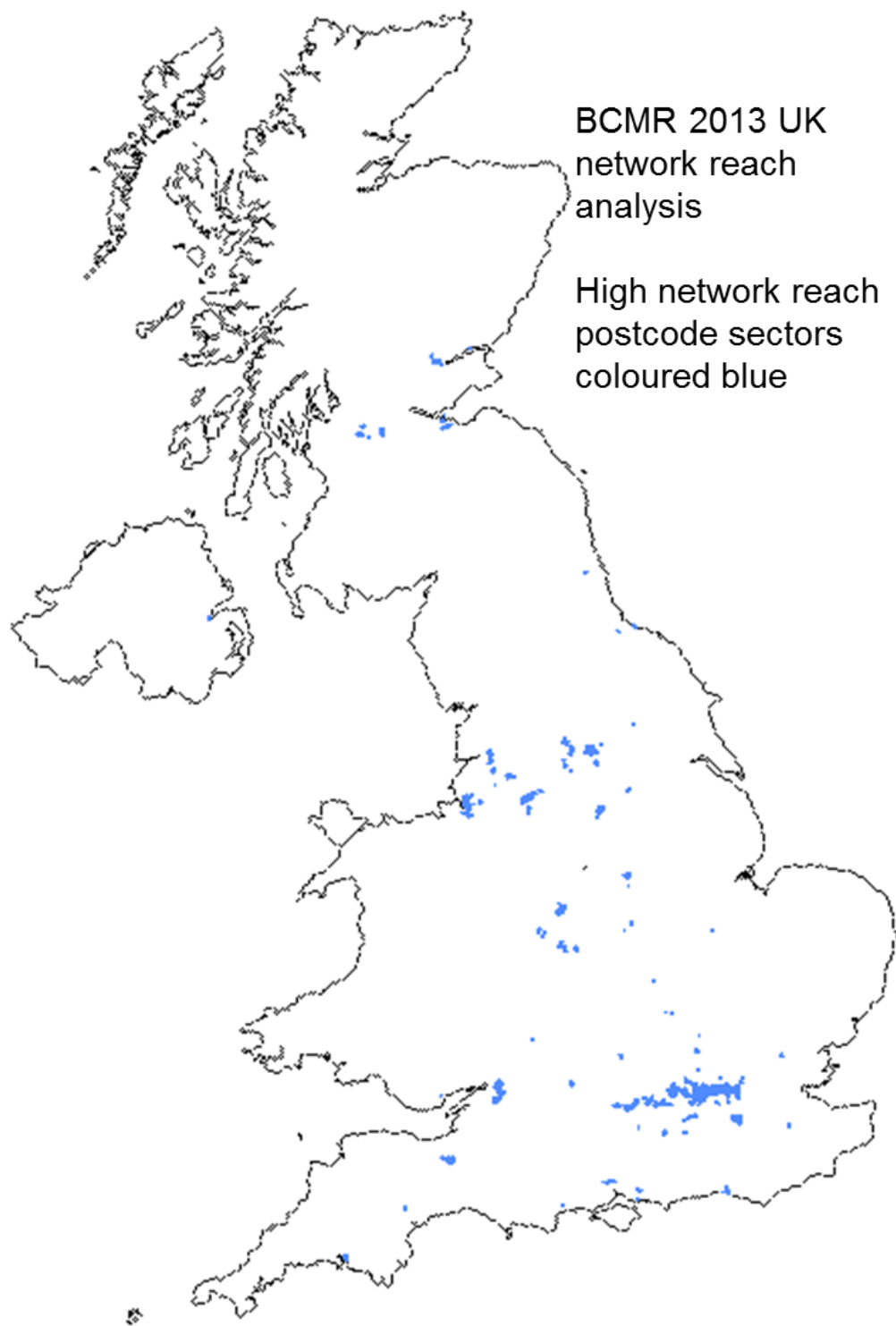**Figure 4: 2011 Network Reach Analysis**

BCMR 2013 UK
network reach
analysis

High network reach
postcode sectors
coloured blue

Figure 5: 2014 Network Reach Analysis

BCMR 2014 UK
network reach
analysis

High network reach
postcode sectors
coloured blue

Figure 6: 2013 Network Reach Analysis in and around WECLA

2013 analysis

High network reach postcode sectors coloured blue
BCMR 2013 WECLA boundary coloured red
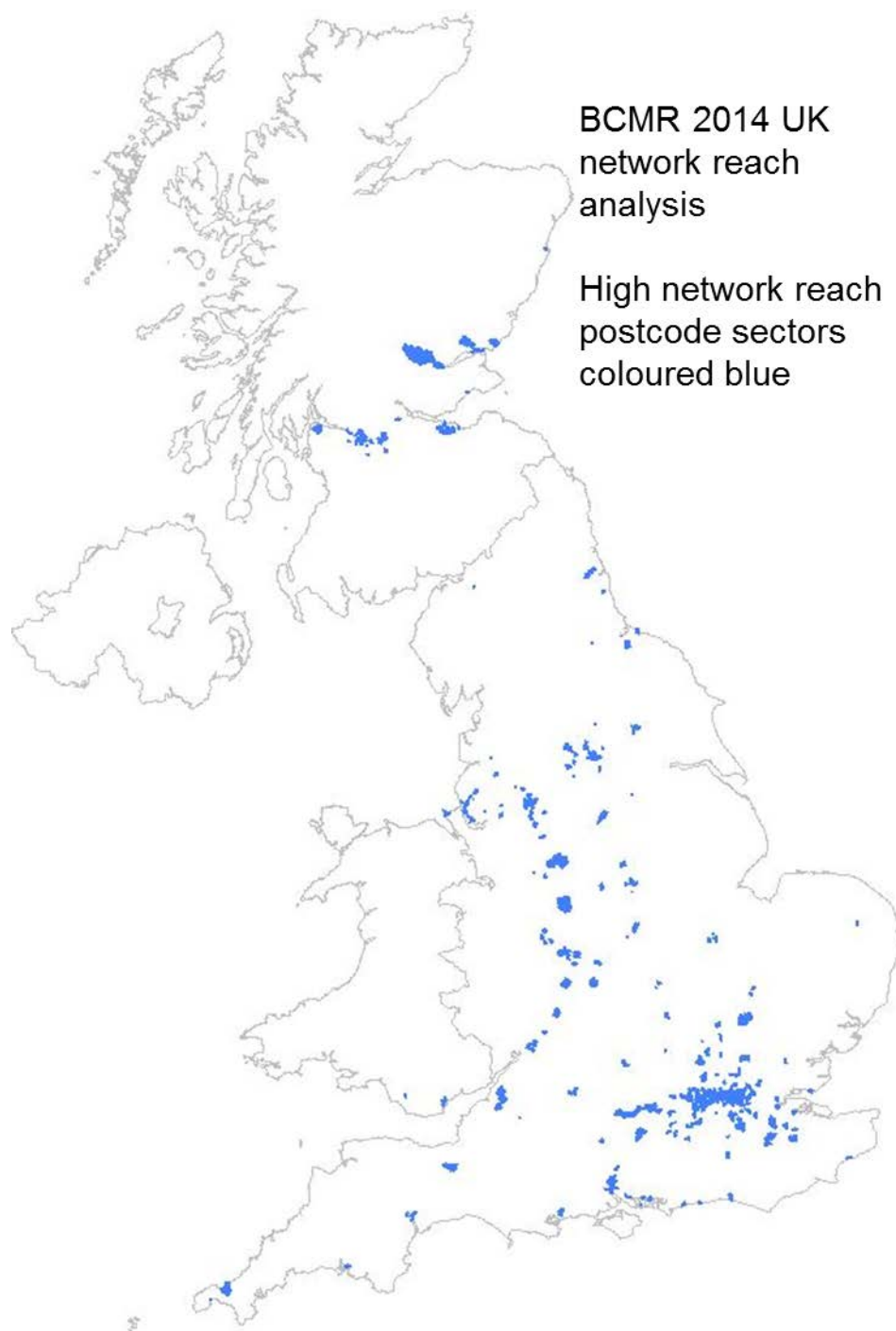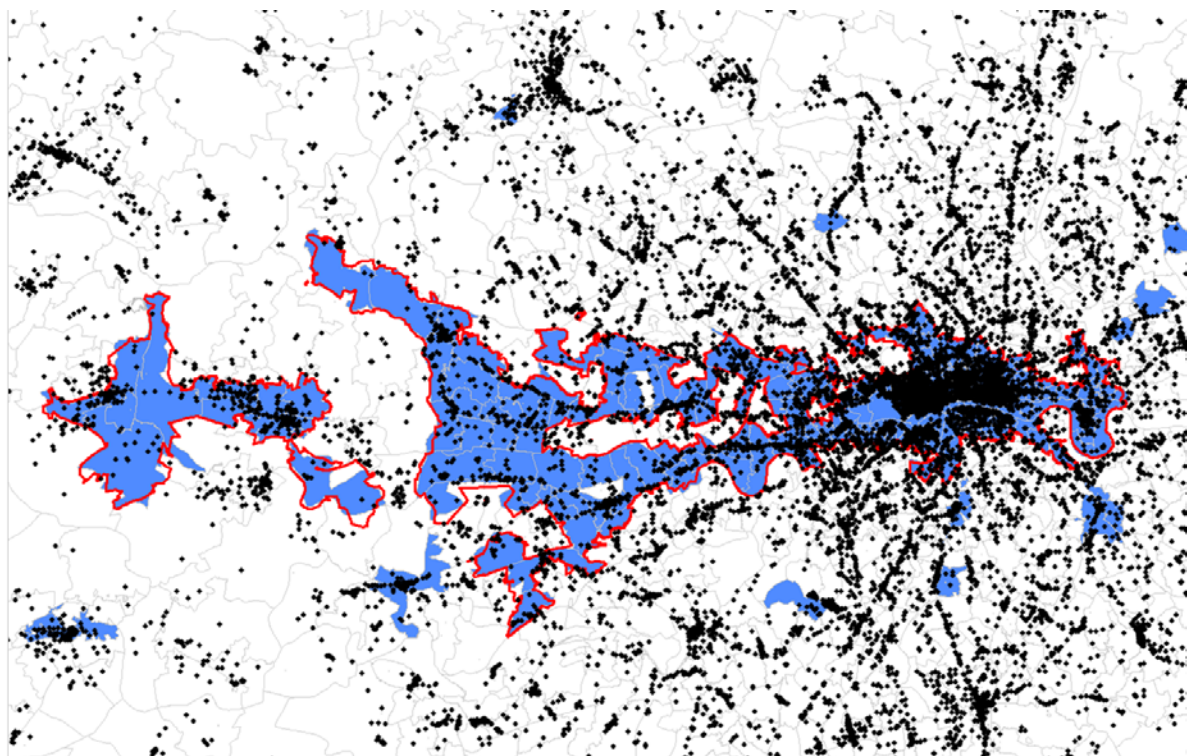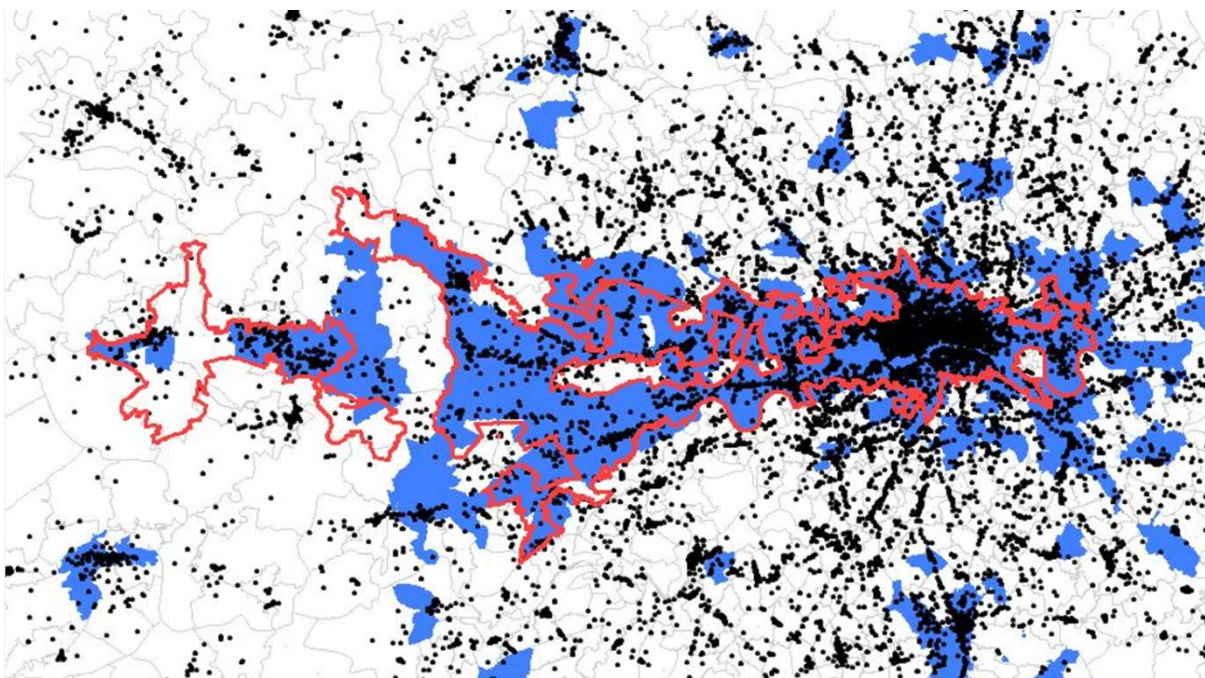Black dots mark the location of businesses used in our analysis

Figure 7: 2014 Network Reach Analysis in and around WECLA

2014 analysis

High network reach postcode sectors coloured blue
BCMR 2013 WECLA boundary coloured red
Black dots mark the location of businesses used in our analysis

Table 6: Network Reach Descriptive Statistics

	2011 Analysis		2014 Analysis	
	UK excl. WECLA	WECLA	UK excl. WECLA	WECLA
No. of large business sites	207,080	10,807 (5%)	155,410	7,611 (5%)
No. of postcode sectors	9,622	421	9,645	404
No. of HNR postcode sectors	420 (4%)	404 (96%)	779 (8%)	394 (98%)
No. of business sites in HNR sectors	17,732 (9%)	10,793 (100%)	24,781 (16%)	7,494 (98%)
No. of businesses with HNR (all sectors)	41,602 (20%)	10,270 (95%)	45,679 (29%)	7,183 (94%)

4.8   As shown in Table 6, the total number of large business sites is significantly lower in the 2014 data than in 2011. This is probably due, at least in part, to our selection of Market Location over Experian as the source of business data. However, as discussed in Section 2, we have re-run the 2011 network reach analysis using 2011 flexibility points and the current Market Location data and postcode sector boundaries, and we found no significant difference in the results. Therefore we consider that, although some of the changes in the proportions of high network reach postcode sectors, and in the proportion of business sites located in high network reach postcode sectors, between 2011 and 2014 may result from our use of a different business database and from postcode sector boundary changes, others will reflect real changes in business locations and in flexibility point data that have occurred over the period since 2011. We consider that the methodology and data are appropriate to enable us to identify variations in local competitive conditions.

Question 10: Do you have any comments on our methodology for processing data on flexibility points and business locations in light of our network reach outputs? Would you suggest alternative methods or assumptions?

Service share analysis

4.9   In this sub-section, we provide indicative estimates of service shares based on the leased line data we have received. We do so using the same geographic market definitions (i.e. WECLA, Hull and the rest of the UK) and product market definitions that were used in the BCMR 2013. The relevant interface types, for which separate markets were defined, are:

- Alternative interface (AI) leased lines – leased lines that use modern interfaces that are more suitable for transmission of Internet protocol (IP) data, such as Ethernet.

- Multiple interface (MI) leased lines – leased lines with bandwidths greater than 1Gbit/s and leased lines of any bandwidth using WDM equipment at the customer's premises.

- Traditional interface (TI) leased lines – leased lines that use legacy analogue and digital interfaces based on legacy TDM technical transmission standards such as PDH and SDH.

4.10   The following table shows which product market each circuit category falls in.

Table 7: 2013 Market Definitions used for Service Shares

Circuit Category	Relevant market
ADSL	Not leased line
Analogue	TI
ATM	TI
Broadcast Access	Not leased line
CCTV	Not leased line
Dark fibre	Not leased line
EFM	AI
Ethernet	AI
Fibre Channel	AI
FICON	AI
Frame Relay	TI
NGA	Not leased line
PSTN/ISDN	Not leased line
Radio/Microwave[35]	Not leased line
SDH and PDH	TI
SDSL	TI
WDM (bearer)	Not leased line
WDM (wavelength)	MI
xDSL	Not leased line
X25	TI
Other (not leased line)	Not leased line

4.11   In Table 8 below we present the results of our service share analyses using both the proposed 'on-net' methodology and the 2013 methodology for counting circuits (i.e. subtracting purchases from sales). As discussed in Section 3, we present ranges for the 2014 data such that one estimate excludes all circuit ends that terminate in a postcode where a network site is located and the other includes circuit ends that terminate in a postcode with a joint customer-network site (e.g. a data centre).

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[35] 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.

4.12   We also present the results using both 2014 data and the 2011 data that was
        published in the BCMR 2013. The changes between the 2011 and 2014 results
        reflect actual changes in CP circuit volumes but also:

        i)   improvements in data gathering (due to our engagement with CPs following the
             BCMR 2013) and processing (due to the analytical tools we have developed);
             and,

        ii) assumptions and judgements made in classifying and counting circuits (further
             details on these points are provided in Annex 7).

4.13   We note that in the BCMR 2013, we found that our service share calculations in the
        Hull area for KCOM using the s135 data provided were not correct due to missing
        data. Specifically, other CPs did not have complete records of purchases from KCOM
        (meaning that our estimates of wholesale supply did not correctly net off) whilst some
        of BT's wholesale purchase data were missing geographic information and so we
        could not identify its purchases related to the Hull area.[36] Taking these caveats into
        account led us to conclude that KCOM's share of leased lines was at, or very close to
        100%, in the Hull area.

4.14   It appears that the issues raised last time may also be relevant to the 2014 data we
        have requested, in particular inconsistencies between data recorded in sales and
        purchase databases. However, this issue should not apply to the methodology where
        we only count on-net sales and so we present results using this approach in the Hull
        area in the table below.

> *Question 11: Do you have any comments on our methodology for processing circuit
> data in light of our service share outputs? Would you suggest alternative methods or
> assumptions?*

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[36] Paragraphs 7.629-7.633 in Section 7, Ofcom, *Business Connectivity Market Review*, 28 March
2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-
connectivity/statement/Sections6-7.pdf.

Table 8: Leased line Service Shares – Preliminary Estimates

Product	Bandwidth (Mbit/s)	Geographic Market[37]	Volumes (customer ends only)			Service shares[38]		
			2011 data (Base case)	2014 data (sales less purchases)	2014 data (on-net only)	2011 data (Base case)	2014 data (sales less purchases)	2014 data (on-net only)
TI	<=8	UK less Hull	373,947	206,370 - 235,068	196,621 - 226,605	BT: 88%	BT: 81% - 83%	BT: 84% - 87%
		Hull	-	-	1,927 – 1,937	-	-	KCOM: 81%
	>8, <=45	UK less WECLA less Hull	3,389	2,786 - 3,185	2,453 - 2,826	BT: 77%	BT: 66% - 68% Virgin: 13% - 15%	BT: 76% - 77%
		WECLA	1,698	989 - 1,704	964 - 1,707	COLT: 46% Verizon: 19%	BT: 30% - 34% COLT: 30% - 32%	BT: 33% - 37% COLT: 31% - 33%
		Hull	-	-	9	-	-	Not material
	>45, <=155	UK less WECLA less Hull	1,517	1,374 - 1,669	1,215 - 1,497	BT: 51% C&WW: 25%	BT: 60% - 63% Virgin: 21% - 23%	BT: 68% - 70% Virgin: 23% - 25%
		WECLA	919	528 - 1,162	499 - 1,141	COLT: 45% Verizon: 21%	COLT: 33% - 41% BT: 20% - 25%	COLT: 35% - 42% BT: 21% - 27%
		Hull	-	-	6	-	-	Not material
	>155, <=1000	UK less Hull	273	372 - 550	329 - 502	Level 3: 26% Verizon: 22%	Virgin: 53% - 71% Level 3: 3% - 11%	Virgin: 55% - 76% COLT: 5% - 11%
		Hull	-	-	0	-	-	-
AI	<=1000	UK less WECLA less Hull	122,016	294,797 - 315,271	281,390 - 300,654*	BT: 74% Virgin: 22%	BT: 52% - 53% Virgin: 33% - 34%	BT: 55% - 57% Virgin: 34% - 35%
		WECLA	27,929	43,654 - 81,794	42,515 - 79,618*	BT: 51% COLT: 27%	BT: 36% - 48% Virgin: 17% - 26% COLT: 17% - 18%	BT: 38% - 50% Virgin: 18% - 27% COLT: 18% - 19%
		Hull	-	-	966 - 970	-	-	KCOM: 84%
MI	>1000 and WDM	UK less WECLA less Hull	3,139	7,297 - 9,427	7,166 - 9,155	BT: 57% Virgin: 11%	Virgin: 50% - 60% BT: 31% - 33%	Virgin: 51% - 61% BT: 32% - 34%
		WECLA	1,333	2,074 - 6,036	2,016 - 5,943	COLT: 38% BT: 24%	COLT: 18% - 23% Zayo: 18% - 19% Level 3: 6% - 17%	COLT: 19% - 24% Zayo: 17% - 18% Virgin: 17% - 22%
		Hull	-	-	0	-	-	-

* Approximately 10% of AI circuit-ends are EFM, the volumes of which have increased compared to the 2011 data

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[37] For the purposes of compiling this table, the product and geographic markets defined in the BCMR 2013 have been used. This is without prejudice to the markets to be defined in this review.

[38] The range of 2014 service shares reflects the two different possible treatments of customer-network sites described in Section 3. In most cases, the range for BT's service share is narrow. The exception is AI <=1000Mbit/s in the WECLA. This may, for example, reflect the significance of data centres in the WECLA.

Responding to this consultation

How to respond

A1.1   Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 19 November 2014**.

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

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

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

Kalvin Bahia
Ofcom, 4th floor
Riverside House
2A Southwark Bridge Road
London SE1 9HA

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

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

Further information

A1.7   If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Kalvin Bahia on 020 7783 4360.

Confidentiality

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

all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

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

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

Next steps

A1.11   Following the end of the consultation period, Ofcom intends to publish the main BCMR Consultation in Spring 2015.

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

Ofcom's consultation processes

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

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

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

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email   Graham.Howell@ofcom.org.uk

Ofcom's consultation principles

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

Before the consultation

A2.2   Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

During the consultation

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

A2.4   We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

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

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

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

After the consultation

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

Consultation response cover sheet

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

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

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

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

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

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing ☐   Name/contact details/job title ☐

Whole response ☐   Organisation ☐

Part of the response ☐   If there is no separate annex, which parts?

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

DECLARATION

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

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

Name   Signed (if hard copy)

Consultation questions

Scope and Coverage of the Data

Question 1: Are you aware of any fixed network operators that have access infrastructure that Ofcom has not requested data from that are likely to have a material impact on our network reach or service share analysis?

Data processing

Question 2: Are there any missing circuits in the leased line data you provided to Ofcom? If so, please provide your best estimate (together with, if possible, a lower and an upper-bound estimate) of the number (or percentage) of circuits that are potentially missing and indicate whether they are likely to be accounted for primarily by a particular set of interfaces or bandwidths.

Question 3: Are there other factors relevant to how your leased line sales and purchases are recorded that have implications for Ofcom's service share analysis?

Question 4: Do you agree with our approach to classifying circuits that are delivered using WDM technology? Have we correctly classified circuits as WDM in the data you have provided, based on our current definition?

Question 5: Do you agree that 'Ethernet over SDH' circuits should be classified as Ethernet circuits? If not, please explain why.

Question 6: Do you agree that presenting a service shares range is the most appropriate way of quantifying the uncertainties involved in identifying network sites for the purposes of this review? Are there alternative methodologies for dealing with this issue?

Question 7: Do you agree with our preferred approach of estimating the supply of wholesale leased lines by counting 'on-net' circuits only? Do you have any concerns with this approach?

Question 8: With respect to missing information, do you agree with our proposed approach of using uplifts for three variables and presenting ranges for two variables? Should we consider alternative methodologies for dealing with missing information?

Question 9: Do you have any views on other aspects of our data processing and cleaning, as set out in Annex 7?

Data Outputs

Question 10: Do you have any comments on our methodology for processing data on flexibility points and business locations in light of our network reach outputs? Would you suggest alternative methods or assumptions?

Question 11: Do you have any comments on our methodology for processing circuit data in light of our service share outputs? Would you suggest alternative methods or assumptions?

List of operators that received s135 Notice

Fixed operators

- British Telecommunications (BT)
- Cityfibre Infrastructure Holdings (Cityfibre)
- Colt Technology Services (Colt)
- Easynet
- EU Networks Fiber UK (EU Networks)
- Gamma Business Communications (Gamma)
- Interoute Communications (Interoute)
- KCOM Group (KCOM)
- Level 3 Communications (Level 3)
- MS3 Networks (MS3)
- Neos Networks (Neos)
- Surf Telecoms (Surf)
- Verizon
- Virgin Media (Virgin)
- Vodafone
- Vtesse Networks (Vtesse)
- Zayo Group (Zayo) – includes Fibrespeed and Geo Networks

Mobile operators

- Everything Everywhere
- Hutchison 3G (Three)
- Mobile Broadband Network Limited (MBNL)
- Telefonica
- Vodafone

LLU operators

- British Sky Broadcasting (Sky)

- Talk Talk Telecom Group (Talk Talk)

- Updata Infrastructure (Updata)

- Zen Internet (Zen)

Non-access infrastructure operators

- AT&T Global Markets

- Exponential-E

- MLL Telecom

- Orange Business

Section 135 Notice issued to Fixed Network Operators

Background to the review

Ofcom is the independent regulator and competition authority for the UK communication industries.

We have a statutory duty to periodically review the extent of competition in the provision of certain communication services. This is 3-stage process consisting of: (i) defining markets in terms of products and their geographic scope; (ii) assessing whether any Communications Provider (CP) has a position of significant market power (SMP) in any of those markets; and (iii) assessing which regulatory remedies we should impose to address competition concerns where we do find a CP has SMP.

In March 2013 we published our conclusions on our review of competition in the provision of leased lines in the UK[39] - the Business Connectivity Market Review (BCMR). In the BCMR, we described a leased line as a symmetric service of dedicated (i.e. uncontended) capacity between two fixed locations.

Leased lines are components of some important services that business customers buy, such as managed ICT services, connections between customer sites and connections for the provision of internet access, storage and cloud services. In addition, providers of mobile services and of residential fixed broadband services use leased lines to "backhaul" traffic from radio base stations and from BT local exchanges respectively.

We are now carrying out our next review of competition in the provision of leased lines in the UK. As part of our assessment, we require that you provide detailed information about your network, the services that you sell and that you purchase. Our information request is set out in Annex B, parts A-E. At Annex A, we provide some examples of leased lines and a set of definitions in order to provide some context to the request.
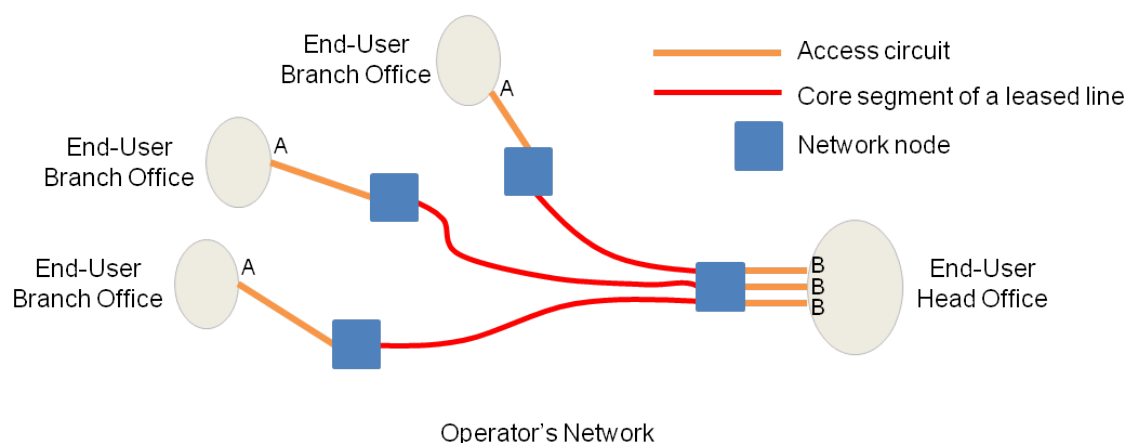
Annex A – Context of this review

Leased line examples

To help explain our requirements for data, we illustrate below examples of the use of leased line services to connect between the sites of an organisation.

Figure 1:

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[39] http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/

Leased line example – direct connections between branch offices and a head office
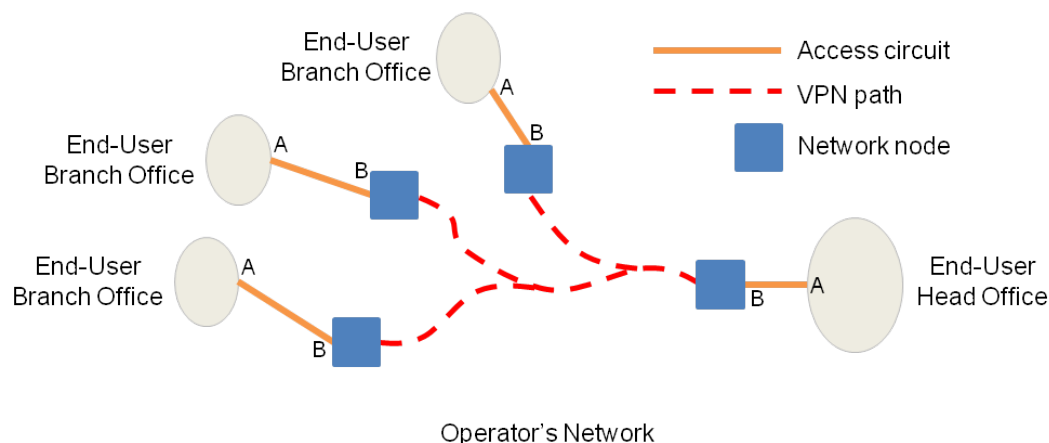

In the figure above the leased lines pass through an operator's core network. The term 'core' network is also sometimes referred to as 'trunk' or 'backbone'. The end-to-end circuits comprise two access segments and one core segment. Collectively, the leased line circuits provide the end-user with its own private network.

Over the last twenty years network operators have developed other methods of connecting business sites using a type of shared infrastructure called Virtual Private Networks (VPN). In the VPN case, the multi-site business only needs a leased line service from each of its sites to the nearest network operator's site, where access can be provided to the VPN.

Figure 2:

Leased line example – connections between branch offices and a head office using a VPN

In order to provide some context to our data request, which is set out below, you can think of our requirements essentially as data about the end points (marked A and B in the figures) of each leased line, the type of site at the end point (for example, whether it is the site of a business end-user or your company's network site), the bandwidth and the interface used.

In addition to providing connectivity for business customers[40], we also know that a large proportion of demand for leased lines comes from CPs buying components to extend the reach of their own networks. Two examples are mobile network operators (MNOs) buying 'backhaul' circuits from radio base stations and fixed operators buying 'backhaul' circuits from network nodes that they are not connected to[41]. As such, we also want to understand competition in the supply of these types of circuits and so require data on them.

Physical links, 'on-net' and 'off-net' sales

A leased line service requires physical links to connect the premises at its two end points. By a 'physical link' we mean:

> a) copper wire without electronic equipment, or
>
> b) optical fibre without electronic equipment, or
>
> c) a point-to-point microwave radio link.

We are primarily interested in leased line services that your company provides 'on-net', i.e. by connecting its electronic equipment to physical links which it either:

> a) owns and operates, and/or
>
> b) leases from another company.

In the case of (b) above, the most common arrangement is leasing of so-called "dark fibre", though an alternative method could be to lease duct from a supplier and install your own fibre.

We are also requesting information about your company's 'off-net' sales of leased line services. These are instances in which your company buys a leased line service from another communications provider, such as Openreach for example, and then resell it to a business customer or another CP (possibly combined with capacity on your own network).

In addition, we are requesting information about commercial transactions involving just the physical links (such as dark fibre, i.e. without providing a leased line service). These include instances in which your company leases physical links to other companies, whether they be end-user organisations or other communications providers, and instances in which your company leases physical links from other companies.

Interfaces

Any leased line needs to provide an interface to the customer which complies with a technical standard which the customer requires e.g. Ethernet, SDH or PDH. We are

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[40] By 'business customer', we are referring to the end user (or customer) of the service that leased lines help to deliver.

[41] You can think of the 'A' end of the backhaul circuit in Figure 2 as being the radio base station (or a network site which the CP has no on-net connection to) and the 'B' end as being the network node at which the CP takes over the connection.

interested in the specific technical interfaces presented by leased lines because there can be significant variations in the costs and quality of service associated with different interfaces.

In some cases the interface's name is wrapped up with a physical transmission medium e.g. EFM is Ethernet.

Wavelength Division Multiplexing (WDM) technology enables an optical fibre to carry multiple services, which, in turn, can be presented using different interfaces. For example, different wavelengths in the same optical fibre can be used to carry services presented to the end-user using Ethernet and SDH.

The leased line inventories that we are requesting should include and identify separately services supplied using any of the following interfaces:

- Ethernet;
- SDH/PDH;
- EFM;
- SDSL;
- Analogue; and
- Any other interfaces that support dedicated capacity presented to the customer (e.g. Fibre Channel, ATM, Frame Relay, broadcast-specific interfaces such as SDI).

In addition, the inventories should note where the above services are deployed using WDM technology at the customer's premises where possible. They should also include details of any sales and purchases of dark fibre and duct.

Other business services

We are aware that CPs often provide a broad range of services to businesses that are not solely restricted to leased lines. These can include contended and/or asymmetric connections, for example residential-style or business grade broadband, as well as managed services and multi-site packages.

As part of our market review, we will analyse the extent to which these other services impose a competitive constraint on the provision of leased lines. We may therefore request data on these services at a later date. At this stage, however, the scope of our formal request is restricted to leased lines, as defined above.

If it is easier for you to provide data on *all* types of services in your response to this request, then you may do so. However, this is not a mandatory requirement.

Network reach

A key input to our analysis is an understanding of the geographic reach of your company's network.

We are requesting information about your company's network flexibility points. These are the points:

a) where existing physical links can be accessed to connect an end-user premise; and

b) from which you would consider, within your current network planning practice, extending your network reach in order to provide services to additional end-user premises.

For example, flexibility points may be 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. The key point is that if an enterprise customer came to you wanting a leased lines service, a flexibility point would be the nearest point on your existing network it would be feasible for you to physically connect that customer and from where you build out to the customer building.

In addition to a list of flexibility points, we are also requesting digital maps of your network and the addresses of buildings which are connected to your company's owned or leased optical fibres.

Annex B – Data requirements to analyse the leased lines market

A. Circuit inventories

Please provide:

A1.   An inventory of all live leased lines[42] that you supply, whether to business customers or to other CPs.

A2.   An inventory of all live leased lines which you purchase.

A3.   An inventory of all duct and dark fibre that you currently lease from other operators.

A4.   An inventory of all duct and dark fibre that you currently lease to other operators and end-users.

For each entry in these inventories (A1 to A4), please supply the following information:

- The 'interface' used, or a product name so that we can infer the interface used.
- Whether the service uses WDM technology at the customer's premises (if possible).
- The bandwidth of the circuit. We would like to know both:
  - the bearer bandwidth[43]; and

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[42] By 'live' we mean circuits that are currently active and in use.

- the bandwidth that has been sold to the customer.

If you can only provide one of these, please identify which it is.

- The postcode of each end of the circuit (i.e. the A and B ends in the Figures 1 and 2 above).
- Whether each end is on-net or off-net. That is, whether the circuit end is supplied over your own network infrastructure. (Note that we would count services supplied across dark fibre, or through duct, that you have leased as being on-net).
- The name of the wholesale supplier (for A2 and A3)
- The annual rental price and the connection price (paid to you by your customer) for circuits in A1 and A4
- The annual rental cost and the connection cost (paid by you to your supplier) for circuits in A2 and A3

As discussed above, we do not yet require data on services other than leased lines. However, if it is easier for you to provide data on all services (for example including broadband, ISDN and managed services) in one response, then you may do so. If you provide us with information on business services other than leased lines, please do so separately or if the data is included in your response to A1 and A2, then please ensure you include a field that will allow us to identify products and services that are not leased lines. Please also indicate clearly the type of service in each case (for example whether it is an asymmetric broadband access service, a managed service etc.) and include any additional details you hold in your systems (e.g. contention).

B. Network flexibility points

B1. Please provide the Easting and Northing location details of all your flexibility points.

B2. Please provide a digital map of your entire duct network (preferably in a .shp file but where this is not possible, please provide the Eastings and Northings).

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[43] By 'bearer' we are referring 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 155Mbits/s SDH transmission link is used to carry 60 2Mbit/s leased line services then we would consider the 155Mbits/s transmission link as the bearer.

C. Fibre connected buildings

C1.   Please provide a list of fibre-connected buildings (both business customer sites[44] and network sites)[45]. This should be a list of full postal addresses (including postcodes).

C2.   For the on-net buildings that you connected last year (the period 1 January 2013 – 31 December 2013), please also provide the following information:

      i.   The actual distance dug (please indicate whether this is the point-to-point distance or the route distance).

      ii.   The distance between the newly connected building and the nearest flexibility point (as provided in your response to part B1).

      iii.   The interface used for delivery. If more than one interface is used, please provide information on all of them.

      iv.   The bandwidth delivered to the building.

      v.   The total cost of connecting to the building. This includes the cost of digging trenches, duct construction, cable installation and installing transmission equipment. If there are any other costs you incur from extending your network, please provide a description of these.

If you have extended your network to buildings with a non-fibre connection (e.g. copper, coaxial cable and microwave) in the last year, please also provide the information set out at C2(i) - C2(v)for these connections.

D. Network sites

D1.   Please provide a list of all of your network sites. We define these as being the locations in your network where you have installed transmission equipment that is used for leased lines and which is capable of serving more than one business customer[46]. You should provide:

- full address details (or geographic coordinates if there is no postal address); and
- a brief description of the nature of the site (e.g. mobile base station, core network node, local exchange, data centre etc). You should also tell us if a network site is coincident with a customer site.

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[44] Please do not include residential buildings that are fibre-connected.

[45] Please include buildings where you lease the fibre and buildings where you have duct but no fibre.

[46] For example your own network equipment rooms, the common equipment room in a multi-tenant building, or an end-customer equipment room from which you serve other customers.

If it is easier for you to submit this information as part of your response to Question C1, you may do so, as long as the network sites are clearly identified and the above information is provided.

D2.　　Please provide details of all your interconnect points with BT as follows:

    i.　　PPC points of handover interconnect links: a list of all the BT exchanges where you purchase PPC points of handover (PoH). Please provide the BT exchange name, capacity and volumes of PoH circuits purchased at each exchange location (e.g. PDH, SDH, Type I or Type II, In-span or Customer sited Handover).

    ii.　　Ethernet interconnection links: a list of all the BT exchanges where you purchase Ethernet interconnect links including Bulk Transport Link or Cable Link External. Please provide the exchange name, circuit capacity and volumes at each exchange location.

    iii.　　Please also provide the name of the BT exchanges where you have co-located equipment but for which you do not interconnect your own network at that location (an example of this might be co-location equipment in a BT exchange in order to backhaul a number of individual access circuits over an aggregate backhaul link). For those locations please provide details of whether the backhaul circuits are provided by BT or another third party supplier (including the capacity and volume of that backhaul link and the relevant network node that link connects to).

E. Network architecture

E1.　　Please provide a short general description of the architecture of your network, and the way in which you provide business connectivity services, possibly by means of generic network diagrams. The description should set out the following.

- The number of network nodes at different levels in your network hierarchy, from the nodes nearest to the customer up to the core nodes in your network, i.e. the total number of flexibility points, access nodes, backhaul, core nodes and interconnect points with other operators.
- The technology and interface(s) used to provide network connectivity.
- Whether and to what extent your backhaul and core network convey traffic from different services (e.g. data, voice, broadband, mobile traffic) and whether you have separate TDM and Ethernet networks to provide leased line services.

- Please highlight the network nodes on your network (situated in the UK) that you would use to route leased lines from an end-user's premise situated in the UK to a destination outside of the UK.

Please explain any future plans to increase your network reach by extending your core, backhaul or access networks over the next four years (i.e. up to and including 2019).

Data Processing

A7.1 In this Annex, we explain in detail our methodology for cleaning the flexibility point and leased line data.

Physical network flexibility point data

A7.2 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.

A7.3 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 obtain the former from Market Location (discussed in section 2) whilst network location information is gathered from CPs who own or have access to physical network infrastructure (including dark fibre and LLU). From the business and network location information we can build a map showing where independent networks exist that can serve the needs of business consumers.

A7.4 For the 17 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.[47]

A7.5 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.

A7.6 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 their 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 there may be no space in the duct.

A7.7 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

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[47] Flexibility points are where existing physical links can be accessed to connect an end-user premise and from which CPs would consider extending their network reach 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.

was able to consistently identify flexibility points that were unavailable. Given that all CPs suffer from such limitations to their physical network access, we propose to treat all flexibility points as being equally available. We note that this assumption is only made for the purpose of our network reach analysis. If there are areas where CPs do not use their physical networks to provide wholesale leased lines, this is likely to be reflected in our service share analysis.

Processing and cleaning

A7.8   In many cases flexibility point data was provided as Eastings and Northings.[48] 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. In some cases CPs provided their network as .kml or .kmz files. Such files can be read to provide a list of coordinates that we can use. Other corrections we made include:

- converting text to numbers;

- removing leading zeros from Eastings and Northings;

- splitting 12 digit references into two 6 digit Eastings and Northings;

- converting two letter based 4 digit references to 6 digit references;

- requesting missing and incomplete references;

- checking the total number of flexibility points against the last BCMR totals; and

- checking the total number of flexibility points against artificial limits e.g. 65k lines for older version of Excel.

A7.9   As a further check we plotted the data received and performed a set of visual checks, which involved:

- checking each dataset against the 2013 results[49] to compare coverage;

- comparing the network coverage plot to any information available from the operators' websites regarding network coverage;

- performing a further sense-check by asking our internal experts to compare the network coverage as arrived at through our analysis with their knowledge of the topology of different operators' networks;

- checking that locations in Northern Ireland had been correctly coded as NI coordinates can be referenced to the Great Britain origin or to the Irish origin; and

- contacting the CP in all cases where the above checks raised concerns so as to discuss the matter until the concern was dealt with.

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[48] 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.
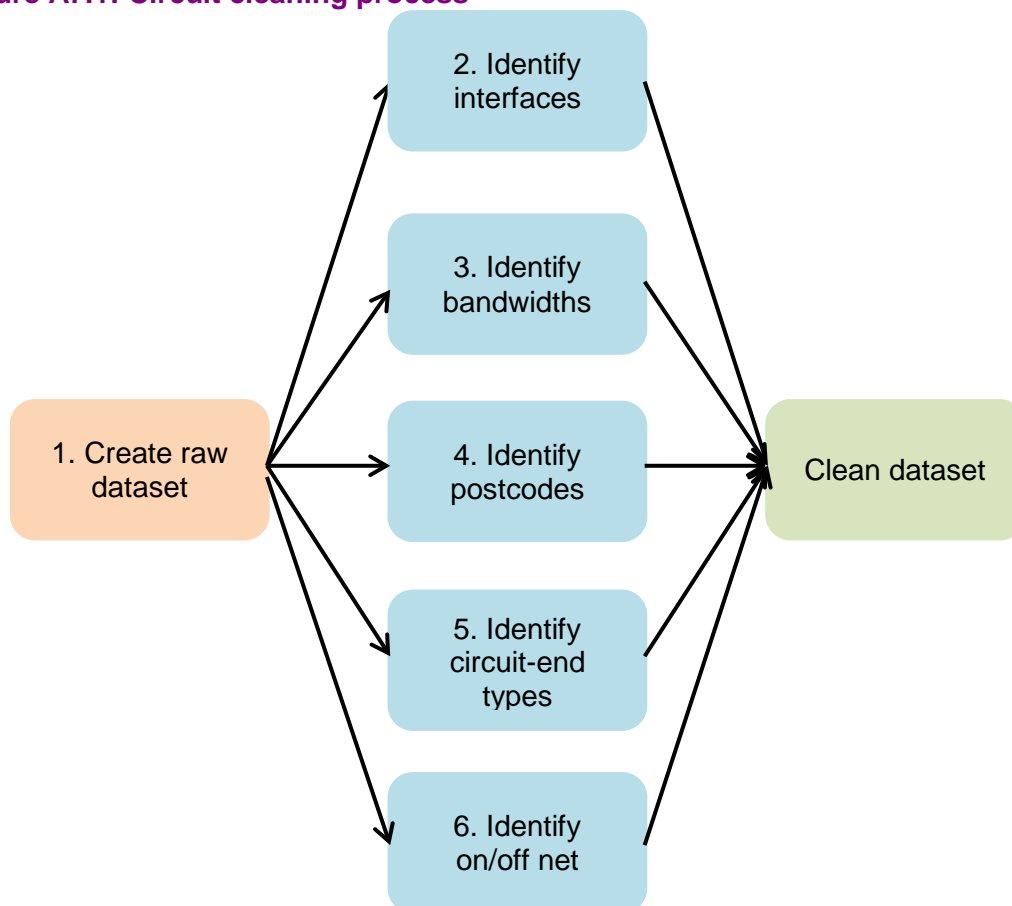
[49] We note that the results presented in the BCMR 2013 were based mostly on data collected in 2011, meaning there is a three year period between the two datasets.

A7.10   It is important to understand that the accuracy of the location data we gather and the physical nature of business sites would limit the usefulness of any attempt to analyse competition at very narrowly defined locations. In particular:

- The accuracy of CP-supplied flexibility point data varies, with some data given in 1 metre Eastings and Northings and other 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. Typically, postcodes are small in densely populated and business regions and large in rural regions. Previous network reach analyses show that multiple physical networks are most likely to be found where there is high business density, which is also where postcode areas are small. Nevertheless even postcodes in city centres cover areas of the order of 1,900m^2.

- Business sites also cover an appreciable area and a single point location cannot describe it completely.

Leased line data

A7.11   There are a number of steps involved in processing the leased line data we receive from CPs. This is illustrated in the figure below.

Figure A7.1: Circuit cleaning process

Create raw dataset

A7.12   We consider that data cleaning and processing should be done by Ofcom rather than by CPs themselves to ensure consistency. Hence we 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 called 'RawData', which encompassed CP responses to parts A1 and A2 of the s135 (see Annex 6).

A7.13   We did this by creating several fields to manage the data. These are listed in the table below.

Table A7.1: 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
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)

A7.14   We then created a mapping file that lists all of the source data files provided by CPs. In their submitted files, the CPs include their own field headings to provide information on each circuit. For each field given by the CP, the Ofcom mapping file identifies which field we have used in creating the 'RawData' dataset. For example, two CPs may provide information on interface but in the files they have provided, one will use a field called 'Interface' and another will use a field called 'Technology'. The mapping file shows that for the first CP, 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.

A7.15   We did not expect to (and did not) find entries for every heading in the data from every CP. The purpose of multiple headings is to gather the most data from each CP and then use our cleaning process to extract the information we require.

A7.16   Having finished this part of the process, we then use the 'RawData' file to start the data cleaning. At this point, we have information on 918,730 circuits (though not all of these are leased lines as some CPs provided information on other types of connectivity and services). In order to make the data useful for economic analysis (for example to understand whether competitive conditions differ across interface types, bandwidth and geographic areas), 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.

A7.17   We explain how we identify the first four categories below. Details on on-net/off-net identification are provided in Section 3.

Identify interface

A7.18   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.

A7.19   For the purposes of our analysis of circuits by interface type, we classify circuits into the following four categories:

   • we identify services that directly fall inside the scope of relevant BCMR markets, as currently defined, and which operators often refer to in their responses (for example analogue, EFM, Ethernet, Fibre Channel, FICON, SDH and PDH);

   • we identify services that are currently outside of the scope of the market but *may* be considered in the BCMR 2016 (for example ADSL, NGA, CCTV and Broadcast Access);

   • we identify delivery mechanisms that may or may not be relevant to the market review (for example radio/microwave and WDM); and,

   • we identify 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).

A7.20   Although not all of our categorisations would be considered as 'interfaces' from a technical or network perspective, we use the term 'interface' to describe how we categorise the circuit, based on the considerations listed above.

A7.21   In order to identify the interface of each circuit in our database, we follow a similar sequential approach to that used in the BCMR 2013 statement.[50] 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 (so, for example, the table 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). Where it is possible to infer two or more different interfaces from these fields (for example if the circuit type is given as SDH but the product name contains the word 'Ethernet') we have sought to clarify with CPs the correct interface.

A7.22   Table A7.2 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. The categories we have used also allow us to produce a set of statistics in Section 4 that is consistent with the analysis we carried out in the BCMR 2013.

Table A7.2: 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
SDSL
WDM (bearer)
WDM (wavelength)
xDSL
X25
Other (not leased line)
Unknown

A7.23   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 indirectly determine the interface 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 following assumptions.

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[50] Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/annexes1-7.pdf.

Table A7.3: 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 1Gbit/s)	Ethernet
Above 1Gbit/s	WDM
Different download and upload speeds	ADSL (up to 30Mbit/s download) / NGA (above 30Mbit/s download)

A7.24   This step allowed us to classify the interface of an additional 6% of the circuits in the dataset, or 99% overall. For the remaining circuits where we do not have any information to infer an interface, we have classified these as 'Unknown' and will use this consultation to discuss with CPs whether they have any information which could enable us to categorise the circuit. Should the final dataset include some circuits with unknown interfaces, we may take this into account by presenting a set of service share sensitivities (see Section 3).

A7.25   Due to the large number of circuit type and product combinations, we do not explain every cleaning rule, assumption and judgement made in this consultation. As discussed above, at the same time this consultation is published, we will send each CP a cleaned version of the data they provided as well as the relevant parts of our interface translation tables. This will give each CP the opportunity to identify any errors they consider we may have made and/or to provide further information to enable us to make any necessary corrections and to improve the quality of the dataset. However, there are some general issues regarding interface classification that we have discussed in Section 3.

Identify bandwidth

A7.26   In the s135 notice, 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 service in the same quantity but the data would suggest that the first CP is selling more connections.

A7.27   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/purchased and so we use this measure in the clean bandwidth data.[51] This is also our preferred metric because it reflects the services that customers are receiving and paying for.

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[51] Though in many cases, the bandwidth that is sold is the total circuit capacity, especially for Ethernet services.

A7.28   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 dataset but not always. We therefore applied the following cleaning rules:

- 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.

A7.29   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 consistent unit (Mbit/s). Where the entry was not a leased line (for example ADSL, colocation services etc.) the bandwidth field was given as null.

A7.30   Having cleaned the data using the methodology described above, 86% of leased line entries in our dataset have an identifiable bandwidth. Where we do not have bandwidth information, any aggregated analysis of the data will need the application of uplifts (described in the Section 3).

Identify postcodes

A7.31   In order to carry out any geographic analysis of leased line circuits, we need to establish the postcode of each circuit end. As we did in the BCMR 2013[52], we developed a macro to perform an automated search through all the circuit data to find postcodes. This allowed us to identify postcodes that were in fields other than the two postcode fields (e.g. in an address field). Once a postcode was extracted, we validated each one against the latest postcode list provided by Dotted Eyes. This allows us to filter out erroneous postcodes and it also updates postcodes that are no longer in use. It also provides Easting and Northing details for each postcode.

A7.32   Once this geographic cleaning has been carried out, we have 'clean' postcode data for 75% of circuits. A significant proportion of the missing postcodes (50%) are relevant to the B-ends provided by two CPs. We have sought further postcode information from these CPs but it is not readily available. However, the CPs have clarified that the B-ends are largely network sites, with the A-end representing the customer location (and for which the information is much more complete). Given that we are primarily interested in customer sites (see next sub-section), the fact that the B-ends are missing should not represent a material issue for our service share analysis of terminating segments.

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[52] Paragraph A5.46 in Annex 5, Ofcom, *Business Connectivity Market Review*, 28 March 2013, http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/annexes1-7.pdf.

A7.33   Where we do not have postcode information for non-network sites, any aggregated analysis of the data will need the application of uplifts (see Section 3).

Identify circuit-end types

A7.34   As discussed in Section 3, it is important to determine whether leased lines terminate at a customer site (by "customer" we mean an end-user that is not a fixed operator[53]) 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 A7.2: Generic circuit diagram

A7.35   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. By not distinguishing 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.

A7.36   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).[54] Requesting this information again would therefore have not been appropriate as we would not have considered it reliable.

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[53] We include mobile network operators in our definition of end-users as MNOs purchase leased lines for backhaul (see Section 2).

[54] 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.

A7.37   Therefore, in order to identify network ends, we have built a list of postcodes of network sites that is drawn from CP responses to part D1 of the s135. Based on this data, we have a list of 8,544 unique postcodes (spread across 5,065 postcode sectors) where there is at least one network site located. 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:

- 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;

- 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);

- 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; or else,

- we assume it is a customer site.

A7.38   The last assumption affects 4% of entries and so should not have a material effect on our analysis.

A7.39   This was the same approach we used in the BCMR 2013.[55] 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 in Section 3, we have mitigated this to some extent by obtaining data from CPs on whether any of their network nodes are coincident with a customer premise (this includes some data centres). This allows us to exclude these postcodes when identifying network sites.[56] However, as set out in Section 3, there is a risk that such an approach will include circuit ends that do not terminate at a location requested by a customer. We therefore presented a range of service share estimates in Section 4 to quantify this uncertainty.

A7.40   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

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[55] 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.

[56] We were unable to do this in the BCMR 2013 as we did not have data from CPs on whether their network sites were coincident with a customer premise.

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 customer connections and network nodes. The status of data centres is being considered independently within the BCMR and should we decide to carry out an analysis of such connections, we will use information on the postcodes of data centres to infer the supply of connections to these locations. As noted above and in Section 3, some connections to data centres will be included in our service share ranges where CPs have identified them as joint customer-network sites.

A7.41   The second caveat is that any service share analysis that is based on customer ends only will exclude leased line sales to the fixed network operators we have requested data from. So 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.

Data from MNOs and LLU operators

A7.42   The circuit cleaning process described above was applied to all sales and purchases of active leased lines by the 17 CPs with fixed access infrastructure. We created two additional databases for MNO purchases and LLU operator purchases. A similar mapping and cleaning process will be used for these datasets as was used for the active leased lines.

Network site data

A7.43   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 8,544 unique network site postcodes).

A7.44   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 available.

Annex 8

Sources of evidence

Ofcom documents

A8.1   Business Connectivity Market Review, Ofcom, March 2013.
        http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/

Information requests

A8.2   Information requests of March 2014 covering specified information about leased lines, flexibility points, connected buildings, interconnection points and network architecture.

- Response from BT;

- Response from Cityfibre;

- Response from Colt;

- Response from Easynet;

- Response from EU Networks;

- Response from Gamma;

- Response from Interroute;

- Response from KCOM;

- Response from Level 3;

- Response from MS3;

- Response from Neos;

- Response from Surf;

- Response from Verizon;

- Response from Virgin Media;

- Response from Vodafone;

- Response from Vtesse;

- Response from Zayo.

A8.3   Information requests of March 2014 covering specified information about leased line purchases.

- Response from Everything Everywhere;

- Response from Hutchison 3G (Three);

- Response from Mobile Broadband Network Limited (MBNL);

- Response from Telefonica;

- Response from Vodafone.

A8.4   Information requests of April 2014 covering specified information about EFM sales, leased line purchases and flexibility points.

- Response from Sky;

- Response from Talk Talk;

- Response from Updata;

- Response from Zen.

A8.5   Information requests of May 2014 covering specified information about access infrastructure.

- Response from AT&T;

- Response from Expontential-e;

- Response from MLL;

- Response from Orange Business Services.

Other information

A8.6   UK business locations from Market Location.

A8.7   Postcode list and polygons from Dotted Eyes.

A8.8   2003 - 2012 postcode lists from Ordnance Survey.

Glossary

ADSL	Asymmetric Digital Subscriber Line. A data communications technology that enables data transmission over copper telephone lines.
Alternative interface symmetric broadband origination (AISBO)	A form of symmetric broadband origination service providing symmetric capacity between two sites, generally using an Ethernet IEEE 802.3 interface.
Asynchronous Transfer Mode (ATM)	A network technology that uses asynchronous time division multiplexing techniques and which supports data transmissions at up to 622Mbit/s.
Bandwidth	In digital telecommunications systems, the rate measured in bits per second (bit/s), at which information can be transferred.
BCMR 2013	The statement published in 2013. See Annex 8 for a link to this document.
Bearer	A transmission link that carries one or more multiplexed smaller-capacity connections.
Communications Provider (CP)	An organisation that provides electronic communications services.
Digital Subscriber Line (DSL)	A family of technologies generically referred to as DSL or xDSL that enable ordinary copper telephone lines to transmit broadband signals. ADSL (Asymmetric Digital Subscriber Line), HDSL (High bit rate Digital Subscriber Line) and VDSL (Very high data rate Digital Subscriber Line) are all variants of xDSL.
Ethernet	A packet-based technology originally developed for and still widely used in Local Area Networks. Ethernet networking protocols are defined in IEEE 802.3 and published by the Institute of Electrical and Electronic Engineers. Developments of this technology known as Metro Ethernet or Carrier Ethernet are now being used in communications providers' networks to provide leased line and backhaul services.
Ethernet in the First Mile (EFM)	A network technology for the delivery of Ethernet services over access networks. Although the technology also encompasses fibre access networks, in common usage, EFM refers to the provision of Ethernet services over copper access networks.
Fibre Channel	Standardised SAN protocol running at rates between 1 and 16 Gbit/s

FICON	IBM specific SAN protocol based on Fibre Channel running at 1, 2, 4 or 8Gbit/s
Frame Relay	A packet-based technology used to connect several Local Area Networks.
Gigabit Passive Optical Network (GPON)	A shared fibre network architecture that can be used for NGA.
Internet Protocol (IP)	A network technology used in packed-switched networks to route packets across network nodes.
ISDN	A digital telephone service that supports telephone and switched data services.
Leased line	A permanently connected communications link between two premises dedicated to the customers' exclusive use.
Local Loop Unbundling (LLU)	A process by which a dominant provider's local loops are physically disconnected from its network and connected to competing provider's networks. This enables operators other than the incumbent to use the local loop to provide services directly to customers.
Multiple Interface symmetric broadband origination (MISBO)	A form of symmetric broadband origination service providing symmetric capacity from a customer's premises to an appropriate point of aggregation in the network hierarchy for services with bandwidths greater than 1Gbit/s or services of any bandwidth delivered using WDM equipment at the customer's premises.
Next generation access (NGA)	A new or updgraded access network capable of supporting much high capacity broadband services than traditional copper access networks. Generally an access network that employs optical fibre cable in whole or in part.
Other Communications Providers (OCPs)	A communications provider other than BT.
Plesiochronous Digital Hierarchy (PDH)	An older digital transmission technology that uses Time Division Multiplexing. Although PDH systems are is still in widespread use, they are being replaced by SDH and increasingly Ethernet services.
Public Switched Telephone Network (PSTN)	A telecommunications network that uses circuit switched technology to provide voice telephony services.
Storage Area Network (SAN)	A network dedicated to data storage. SAN protocols include additional checking of transmitted data integrity and can be

	distance limited.
Synchronous Digital Hierarchy (SDH)	A digital transmission standard that is widely used in communications networks and for leased lines.
Symmetric Digital Subscriber Line (SDSL)	A DSL variant that allows broadband signals to be transmitted at the same rate from end user to exchange as from exchange to end user.
Traditional interface symmetric broadband origination (TISBO)	A form of symmetric broadband origination service providing symmetric capacity from a customer's premises to an appropriate point of aggregation in the network hierarchy, using a ITU G.703 interface.
Time Division Multiplexing (TDM)	A method of combining multiple data streams for transmission over a shared channelby means of time-sharing. The multiplexor shares the channel by repeatedly allowing each data stream in turn to transmit data for a short period. PDH and SDH are examples of systems that employ TDM.
Virtual Private Network (VPN)	A technology allowing users to make inter-site connections over a public telecommunications network that is software partitioned to emulate the service offered by a physically distinct private network.
Wave Division Multiplex (WDM)	An optical frequency division multiplexing transmission technology that enables multiple high capacity circuits, to share an optical fibre pair by modulating each on a different optical wavelength.
Western, Eastern and Central London Area (WECLA)	The geographic market defined by Ofcom in the BCMR 2013.