

# GEOGRAPHIC MARKET DEFINITION IN THE BCMR

A REPORT PREPARED FOR COLT, SKY, TALKTALK AND VODAFONE  
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## Executive Summary

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- 1.1 Ofcom's current approach to geographic market definition in the BCMR is complex. However, the use of postcode sectors<sup>1</sup> as the smallest unit of analysis, which is fundamental to the current approach, risks creating material errors of regulation. This paper explores why, and recommends that Ofcom consider alternative methods to determine the geographic boundaries of sub national business connectivity markets. In view of the timetable for the ongoing market review and the resources needed to implement a new approach, we also recommended a number of relatively simple changes to the current analysis to reduce the risk of error.
- 1.2 The current approach fails to create a sufficiently precise or detailed categorisation of the variations in competitive conditions to avoid the risk of regulatory failure. Several aspects of the methodology contribute to this conclusion, but the use of postcode sectors lies at the heart of the problem. When using postcode sectors as the unit of analysis, the methodology is not capable of producing a sufficiently detailed map of competition.
- 1.3 This matters because it creates the risk of two types of regulatory error:
- That of finding effective competition, and therefore losing the option to impose ex ante regulation, in a sub national geographic market which contains areas where regulation is still required because competition is not effective in these areas; and
  - That of finding SMP, and consequently setting ex ante regulation, in a sub national geographic market which contains areas where local conditions are equivalent to those found in an effectively competitive market.
- 1.4 Both errors are important, but the detriment to the consumer is likely to be greater with the removal of regulation from sub national business connectivity markets which contain at least some areas which are not effectively competitive. The risks of harm are those associated with the exercise of market power: increased prices, fewer services, damage to existing competition, and increased barriers to the development of competition. Given the importance of connectivity services as a wholesale input, the potential impact extends to almost all communications markets.
- 1.5 In light of these risks, Ofcom must exercise caution if considering any removal of regulation from sub national geographic business connectivity markets. Some of the preliminary BCMR service share estimates<sup>2</sup> could plausibly be interpreted by Ofcom to indicate that competition may be effective in the WECLA for AI services, suggesting that ex ante regulation may no longer be required. We understand that these estimates were presented merely to elicit comment, and will not be relied upon by Ofcom in the forthcoming review. For the avoidance of doubt, we

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<sup>1</sup> The postcode sector consists of the letters and digits before the space in a full postcode plus the number after the space. For example, the postcode sector for W1T 5HP would be W1T 5. A more detailed explanation of postcodes and their boundaries can be found in Annex 1.

<sup>2</sup> From the BCMR Data Analysis Consultation, November 2014.

note that these service share estimates do not accord with CP's anecdotal experience of market conditions<sup>3</sup>: for very large parts of the WECLA there is little or no competition, and CPs continue to rely heavily on BT to supply access circuits.

- 1.6 Competitive conditions vary considerably throughout the WECLA, from streets in the Square Mile where all major and many minor competitors are present, to areas where BT would be the only economic choice of supplier. Given these variations in competitive conditions, any decision to deregulate services in the WECLA could result in a regulatory error harming at least some customers and competitors.
- 1.7 The experience of removing regulation from high bandwidth TI services is not a relevant precedent. These services have been in rapid decline as customers migrate to Ethernet; and there has always existed a regulated substitute to TI services<sup>4</sup> in the form of Ethernet. As such, the impact of TI geographic deregulation was inevitably going to be minimal. In contrast, AI service volumes are still growing rapidly, and were regulation to be removed, there would likely be no suitable alternative regulated access service in these areas.
- 1.8 Ofcom's current methodology assumes that the competitive conditions measured at a small number of sites will be found throughout the rest of the postcode sector<sup>5</sup>. The majority of postcode sectors in the UK are simply too large to support this assumption.
- 1.9 Within a small area in central London, roughly equivalent to the area containing Zone 1 stations, the assumption – and Ofcom's market definition technique in general – works reasonably well. However, this is driven by the unique characteristics of central London: there is a high density of competing network infrastructure; unparalleled high density of businesses; and abnormally small postcode sectors. Under these unique conditions, it is safe to assume that competitive conditions are reasonably homogeneous within postcode sectors.
- 1.10 The largest postcode sector in this area<sup>6</sup> is approximately 20 hectares<sup>7</sup>, and the majority are much smaller (89% are less than 10 hectares)<sup>8</sup>. Across the country as a whole, over 85% of postcode sectors are more than 100 hectares (1km<sup>2</sup>), with most being much larger still, and very

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<sup>3</sup> In this regard, we sound a further note of caution: the figures imply an increase in Virgin Media's volume which does not seem credible. We understand that this is due to a change in data collection method. Given the sensitivity of the competition assessment to market share estimates, it is vital that Ofcom can compare volumes consistently over time and between suppliers.

<sup>4</sup> Albeit not a perfect technological substitute.

<sup>5</sup> More precisely, the assumption is that competitive conditions will be the same at every location of potential demand for leased lines.

<sup>6</sup> The City of London and Westminster up to Hyde Park.

<sup>7</sup> A hectare is 10,000 square metres. As a frame of reference, the footprint of the original Tate Modern building is roughly 1 hectare.

<sup>8</sup> To analyse postcode sectors we have used a boundary dataset supplied by GeoLytx, published under an Open Data licence, and available from <http://geolytx.co.uk/>.

few are of an equivalent size to those found in London.<sup>9</sup> In such large areas, it is likely that competitive conditions will vary much more. For example, a business park in one part of a postcode sector may be well served by competing networks, but the mobile masts, schools, doctors surgeries, etc located elsewhere in the sector may have BT as their only realistic choice of supplier. Ofcom's analysis will treat the entire sector as having homogeneous competitive conditions, which could lead to the removal of regulation despite a number of potential customers facing no choice of supplier.

- 1.11 To address this concern, it is necessary for Ofcom to assess the boundaries of geographic markets at a more granular level. Clearly, a balance must be struck between the risks of regulatory error and the costs of implementing a new approach. An important factor in this assessment is that Ofcom already conducts most of its analysis at postcode level, and only uses postcode sectors to aggregate these more detailed results. We describe a possible extension of this existing technique which will enable a more granular assessment of market boundaries. We also note that a more granular approach may only be required as a second stage test to sit alongside the current approach, to be implemented in areas where deregulation is a possible outcome, or where other indicators suggest competitive conditions within a postcode sector may be heterogeneous.
- 1.12 In light of the limited additional analysis required to undertake a more granular assessment, and given the risk of harm from a loss of regulation to consumers facing little or no effective choice of supplier for leased line services, our view is that the balance of risks and costs indicates that Ofcom should adopt a revised approach.
- 1.13 In addition to the use of postcode sectors, there are a number of other issues with the current methodology which could increase the likelihood of regulatory error. As a result, and especially if a more granular assessment is to be used in parallel with the current approach, we recommend the following adjustments to Ofcom's methodology:
- Change the manner in which alternative assumptions are assessed  
 This is not limited to the geographic market analysis. Ofcom currently builds a best case scenario by choosing a set of assumptions, and testing alternatives against the base (i.e. best) case. As long as the results of the sensitivity test are not materially different, this is interpreted as support for the base case assumptions.  
 Given the wide margin of plausible options for various input assumptions and parameters, Ofcom should,
    - (a) continue to present ranges for market shares; and

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<sup>9</sup> We count 237 postcode sectors across the UK with an area of less than 10 hectares. 195 are in London, 177 of which are in the central 'Zone 1' area considered above. The next greatest concentrations are Liverpool with 14 sectors, Manchester with 11 followed by Glasgow with 6.

(b) take a more cautious approach to the designation of high network reach areas, and only consider an area to be high network reach if it passes the test under all reasonable assumptions.

- Combine existing demand with potential demand location data

At present Ofcom models the location of potential leased line demand using a database of business sites. To improve the accuracy of this model, the database should be augmented (not replaced) with the locations of existing demand for leased lines.

- Reduce buffer (i.e. dig) distance to a more realistic level

As noted by stakeholders in both of the previous BCMRs, the current buffer distance assumption is unrealistic.<sup>10</sup> Certainly in the Central London area, in all but the most exceptional circumstances, civil infrastructure costs imply that an operator would not be competitive trying to supply a new customer 200 metres from its nearest flexibility point. This conclusion is driven by the prevalence of competitor networks, the costs of digging and the current price levels for leased line services. As such, the same result would hold under greenfield assumptions.

- Differentiate between network operators

At present, Ofcom's market definition analysis treats all CPs the same – each competitor is modelled as a set of flexibility points. In reality, of course, customers differentiate between suppliers according to many factors other than the location of network infrastructure. The result is that different operators have a different impact on competitive conditions. These factors may be taken into account at the SMP assessment stage, but given the importance of geographic market definition, it may also be appropriate to analyse network supply areas based on a subset of 'Principal Operators' in a manner similar to the approach used in Ofcom's Review of wholesale broadband access markets.

1.14 One final point is that great care is needed in the treatment of non-geographic postcode sectors.<sup>11</sup> By definition, these sectors have no geographic boundary, but there are 21 such sectors within the current definition of the WECLA. This has the potential to create confusion: a business may be located outside the boundary of the WECLA, but use a non-geographic postcode that falls within a WECLA postcode sector.

<sup>10</sup> See, for example, paragraphs 5.98-9.105 BCMR Statement 2013; paragraphs 6.27-6.37 BCMR Statement 2009.

<sup>11</sup> Non-geographic postcodes are used by some large businesses and those with PO Box addresses.

## Introduction

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- 2.1 Market definition should never be an end in itself. It is just one part of an exercise to assess and understand competition. It provides a framework for competition analysis. In the case of a market review, it provides a framework for competition analysis to determine whether ex ante regulation is needed, and to help determine an appropriate form of intervention.
- 2.2 This paper considers the assessment of geographic market boundaries once the decision has been taken that sub national markets are appropriate. The factors affecting the decision to consider sub national rather than national markets is outside the scope of this paper, and the conclusions within this paper are not necessarily relevant to that decision.
- 2.3 Defining the geographic scope of sub national fixed telecoms markets is both theoretically and practically challenging, especially in relation to leased lines. There are a number of ways one can tackle the problem, and therefore a number of alternative methodologies Ofcom could employ. In assessing the performance of one methodology over another, the most important test is whether it enables an accurate competition assessment: whether the model of competition that the market definition supports accurately reflects competitive conditions.
- 2.4 The approach to geographic market definition currently used by Ofcom in the BCMR works reasonably well for a small area in central London consisting of the City and parts of Westminster<sup>12</sup>. However, outside this small and unique area, it is not capable of producing an accurate picture of competitive conditions.
- 2.5 This paper considers Ofcom's approach to geographic market definition in the BCMR in detail. It explains how the use of postcode sectors risks creating material errors of regulation. It proposes that the solution in this context is likely to require a more granular assessment of competitive conditions using a smaller geographic area than the postcode sector. These conclusions are specific to the circumstances of the BCMR, including the particular characteristics of business connectivity demand and supply and the fact that Ofcom has defined sub national markets during the previous two market reviews.
- 2.6 We recognise that there would be additional costs in developing and implementing a new approach. However, we consider that the ongoing costs of a more precise geographic market definition could be kept in line with those of the existing approach. We also argue that at the current stage of market development, with increasing demand for passive and active wholesale services, the risks of regulatory error stemming from inaccurate sub national market boundaries are significant – and clearly outweigh these implementation costs.
- 2.7 The paper also identifies several other aspects of the methodology which could introduce systematic bias, or otherwise increase the risk of regulatory error. We propose a number of adjustments that should be made to the current approach to reduce these risks.

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<sup>12</sup> Roughly equivalent to the area covered by Zone 1 stations.

## Market definition and the effect of errors

- 2.8 The potential problem with Ofcom’s current approach to geographic market definition is that it might not be sufficiently precise to account for material differences in competitive conditions. It makes an assumption that competitive conditions within postcode sectors will be homogeneous, and therefore postcode sectors can be used as the smallest geographic unit by which competition and therefore regulation will be differentiated.
- 2.9 An insufficient level of granularity risks creating two types of regulatory error:
- Under-regulating: finding no SMP (and hence losing the option to impose ex ante regulation) in a sub national geographic market which contains areas where regulation is still required because competition is ineffective.
  - Over-regulating: finding SMP and consequently setting ex ante regulation in a sub national geographic market which contains areas where at least some customers are competitively served.
- 2.10 Regulation in a market that contains pockets of competitively served customers implies that the behaviour of the regulated firm may be constrained in relation to these customers<sup>13</sup>. In addition, in these circumstances the existence of regulation may affect the behaviour of competitors. For example, encouraging ‘following’ of the regulated firm rather than competing more aggressively with each other. The result is that, in respect of these customers, competitive intensity might be greater were regulation to be removed.
- 2.11 However, these customers will still be benefitting from the fact that they face competitive supply: their loss, if any, relates to the *degree* of competition in this supply. Even with reduced competitive intensity, if regulation set prices at the competitive level, the loss to consumers would be minimal relative to a counterfactual in which regulation had been removed. .
- 2.12 The risks of under-regulation are those associated with the effects of market power. A firm with market power has the incentive and ability to raise prices or reduce the quality of its services: consumers are not protected by competition. This could be particularly damaging in relation to the removal of regulation from sub national geographic markets for wholesale connectivity services containing customers with little or no effective choice of supplier. This lack of choice is driven by the proximity of competitor network infrastructure. The further it is to reach competing networks, the higher the cost of switching supplier. In addition, the services from these wholesale markets are used as an essential input in virtually all downstream communications markets. As such, there is a risk of damage to competition across a wide set of markets in addition to the direct effect on customers of connectivity services.
- 2.13 Both errors are important and could result in consumer detriment. However, given the high switching costs and the potential for damage to competition in downstream markets associated with business connectivity markets, we consider that the risks of deregulation are likely to be greater.

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<sup>13</sup> Although the extent to which behaviour is actually constrained will depend on the specific nature of the regulation.

## What does the market look like?

- 2.14 The problems mentioned above would be immaterial if Ofcom's analysis painted an accurate picture of competitive conditions throughout the UK. However, we do not feel that the description of competition that emerges from the BCMR does capture the principle features of the market, or at least does not convey a sufficiently detailed or rich description of competitive conditions.
- 2.15 The wholesale market for leased lines is complex and multi-layered, with demands ranging from very high capacity 'core' network links carrying highly aggregated traffic; backhaul services for MNOs and LLU operators; increasing amounts of bandwidth to, and between, datacentres catering for a wide variety of downstream applications; through to more traditional leased lines used to create corporate private networks.
- 2.16 Most of the larger network operators supply a full range of wholesale connectivity services. However, their relative strengths – from network technology and coverage, to customer handling capability, to a history of supplying to a particular customer segment – all lead to variations in the level and intensity of competition by geography and by customer segment. Added to this, there are a number of smaller operators, each of whom tends to focus on a geographic, product and / or customer segment niche. In each case, the underlying driver for this focus are the economies of scale and density prevalent in telecoms networks.
- 2.17 The result is a rich tapestry of competition across the country:
- There is intense network based competition between several suppliers throughout most of the City of London, Docklands and parts of Westminster. At least two competitors to BT have networks which cover almost every street within these areas. For ease of reference, we will refer to this area as the Inner London Zone.
  - Network coverage becomes much less comprehensive, and competition therefore less effective, outside the Inner London Zone. Networks tend to follow routes to particular locations rather than attempting universal coverage of roads and streets.
  - However, as the networks follow these routes outside the Inner London Zone they continue to overlap, both by chance, and due to localised concentrations of connectivity demand such as in central business districts and near clusters of offices and datacentres. Specific examples would be Heathrow, Slough and Croydon.
  - Competition based on this rather sporadic patchwork of localised rivalry is also found in other UK cities and some of the larger towns. Competitor networks tend to cover a small number of streets, focussing on areas of high business density and high demand.
  - For much of the rest of the UK, including most residential areas and low density business sites, Virgin Media may have coverage via its cable network footprint, but it will be rare to find any other competitors to BT.
- 2.18 Given this view of competitive activity in connectivity services, we can categorise areas into at least four distinct types:
- The Inner London zone, where for many services and customer segments, there is strong network based competition between several operators. As discussed

elsewhere in this paper, this area is unique in the UK (and probably only matched by a handful of cities around the world for business density). It has therefore always been a uniquely attractive target for network operators.

- Areas where several competitor networks overlap, and therefore where competition could potentially be effective, but would need to be assessed on a case-by-case basis. This can be further subdivided into:
  - The areas immediately surrounding the Inner London Zone, which benefit from proximity to this area (e.g. from the ability to provide Ethernet circuits without trunk networking, and from economic links in general); and
  - Other major metro areas and business centres around the UK.
- The areas where Virgin Media Business has effective network coverage.
- The remaining areas where only BT has coverage, or BT plus one competitor other than Virgin Media.

2.19 This description and categorisation of competitive conditions differentiates between competitors on factors other than the presence of their network infrastructure. This is an important feature of competition in business connectivity markets.

### Outline of the paper

- 2.20 The following chapter considers Ofcom's current methodology in detail and briefly discusses the issues with geographic market definition in fixed telecoms markets. This explains the analysis and assumptions made at various different stages in Ofcom's process. In doing so, it helps to identify where there is scope for simple amendments to improve the robustness of the results and reduce the likelihood of error, and also where more fundamental changes might be needed.
- 2.21 Chapter 4 then outlines two alternative approaches to geographic market definition in the BCMR that could be adopted. Both represent a departure from the current methodology, but would be relatively straightforward to implement, and would improve the accuracy of Ofcom's analysis of competitive conditions. Furthermore, both options could be implemented as a supplement to the existing approach in circumstances where a more detailed examination of market definition and competitive conditions is needed.
- 2.22 The final chapter provides a brief summary of the findings and recommendations made in the paper.

## The current methodology

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### Introduction

- 3.1 This chapter provides an in depth assessment of the current methodology for geographic market definition in the BCMR. We start with a brief look at the conceptual difficulty in defining geographic markets in fixed telecoms markets. This is followed by a description of Ofcom's approach in terms of as a six stage process. We then assess each stage in turn, considering the relevant analysis and assumptions, and make specific recommendations to help ensure that the resulting market boundaries accurately reflect competitive conditions.
- 3.2 Ofcom's method is detailed, and our assessment of this method is therefore similarly involved. Throughout this discussion, it is important to keep in mind that the process should be considered as a whole. The impact of changes to an individual step in the process may be small, but the cumulative effect of a number of these changes could still be material.

### Geographic market definition in fixed telecoms

- 3.3 Facilities based competition in fixed telecoms tends to develop first in areas of high population and business density. Over time, this gives rise to geographic variations in competitive intensity. The analysis of competition in these circumstances may necessitate distinct subnational geographic markets.
- 3.4 This approach is increasingly common in market reviews under the EC Framework. Ofcom has defined a subnational geographic market in London to account for differences in competition between this area and the rest of the country<sup>14</sup> since the 2008 Business Connectivity Market Review<sup>15</sup>. Similarly, Ofcom has defined subnational geographic markets in wholesale broadband access since 2008<sup>16</sup>, and NRAs throughout Europe are increasingly considering distinct subnational markets.
- 3.5 A wide variety of tools and techniques are used to define the geographic scope of the relevant market. Outside fixed telecoms, geographic market definition generally proceeds on the same basis as product market definition, by consideration of SSNIPs and the Hypothetical Monopolist Test.
- 3.6 There is practically no geographic supply or demand substitution in fixed telecoms. As such, the standard approach will almost always conclude that each and every building is a separate economic market. Whilst there is some economic truth to this result, it is of little practical use in conducting an SMP assessment and designing appropriate ex ante regulation.

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<sup>14</sup> Ofcom also define a separate subnational market in Hull. However, this is not due to differences in competitive intensity, but due to there being a different fixed access network incumbent.

<sup>15</sup> <http://stakeholders.ofcom.org.uk/consultations/bcmr08/>

<sup>16</sup> <http://stakeholders.ofcom.org.uk/consultations/wbamr07/>

3.7 The solution adopted by Ofcom is to try to identify geographic areas where competitive conditions are *reasonably* homogenous. In part, this is based on the European Commission SMP Guidelines, which state that,<sup>17</sup>

“According to established case-law, the relevant geographic market comprises an area in which [...] the conditions of competition are similar or sufficiently homogeneous and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different. The definition of the geographic market does not require the conditions of competition between traders or providers of services to be perfectly homogeneous. It is sufficient that they are similar or sufficiently homogeneous, and accordingly, *only those areas in which the conditions of competition are ‘heterogeneous’ may not be considered to constitute a uniform market.*”<sup>18</sup> (Emphasis added).

3.8 The Guidelines note that competitive conditions within an economic market do not need to be uniform throughout a geographic area. But, as highlighted, a single geographic market will not contain major differences in the conditions of competition.

3.9 This is an important point for Ofcom’s assessment of geographic markets in leased lines. As we discuss below, Ofcom currently distinguishes areas based on the presence of two or more competitors to BT. This distinction seems reasonable - competition with 3 firms is significantly different from a duopoly or monopoly. However, the process to discover areas with 2 or more competitors to BT does not preclude the possibility that these areas will contain groups of customers who either face monopoly conditions or have the choice of only one alternative to BT. That is, the areas contain competitive conditions that are materially different. As such, and in accordance with the SMP Guidelines, it may not be appropriate to include these customers within the relevant geographic market.

### Geographic market definition in the BCMR

3.10 Ofcom undertakes a complex assessment of actual and potential supply and demand for leased lines in order to identify areas with reasonably homogeneous competitive conditions. Ofcom’s methodology can be described as a process with the following six steps:

- 3.10.1 Model the geographic location of current and potential future demand for leased lines;
- 3.10.2 Model the geographic location of current and potential future supply from competitors to BT;

<sup>17</sup> The following paragraph of the Guidelines recommends using the standard tools of supply and demand substitution to determine geographic market boundaries. This is not very helpful in relation to fixed telecoms. However, the Guidelines do apply to all electronic communications markets.

<sup>18</sup> Paragraph 56, *Commission guidelines on market analysis and the assessment of significant market power under the Community regulatory framework for electronic communications networks and services*, (2002/C 165/03).

- 3.10.3 Model the areas of overlap between supply and demand;
- 3.10.4 Categorise the areas of overlap according to competitiveness (the number of suppliers operating in an area);
- 3.10.5 Aggregate the individual areas to form candidate markets; and finally,
- 3.10.6 Check using other measures of competitiveness that conditions are different between the candidate areas.

3.11 The following table summarises the six steps and lists the assumptions made at each stage.

Step	Description	Key assumptions
Model demand	A subset of business sites (those owned by businesses with 250+ employees) is taken as a proxy for the location of potential demand for leased lines.	<ul style="list-style-type: none"> <li>• That 'large business sites' provide an unbiased estimate of the geographic distribution of leased line demand</li> <li>• The choice of a particular business site database (Market Location, Experian)</li> </ul>
Model supply	Potential supply is calculated for each CP that owns network infrastructure by measuring a set distance (200m) from the places within the network where new duct infrastructure can be added (flex points).	<ul style="list-style-type: none"> <li>• A 200 metres as-the-crow-flies buffer distance is appropriate</li> <li>• Dig / buffer distance doesn't vary by product market or by geography</li> <li>• Flex points are fixed</li> <li>• There is capacity at every flex point (= underlying network is homogeneous)</li> </ul>
Calculate overlap between supply and demand	For each potential demand location, calculate the number of independently owned network flex points within reach (within 200m). Then calculate the average of this number within every postcode sector.	<ul style="list-style-type: none"> <li>• Competitive conditions will be similar throughout a postcode sector (i.e. that variations of network coverage within a postcode sector are not important)</li> <li>• These conditions can be measured by looking at just the 'large business site' locations within the postcode sector</li> </ul>
Categorise overlap areas	Apply a rule to distinguish between postcode sectors capable of sustaining effective competition and those which are not. The former are defined by having an average number of networks within reach of at least 2 (i.e. at least 2 competitors to BT).	<ul style="list-style-type: none"> <li>• All competitors are treated equally</li> <li>• That an average of any 2 competitors to BT is sufficient to create different competitive conditions</li> <li>• That a binary classification of areas is appropriate</li> </ul>
Aggregate areas	Create candidate markets boundaries by collating high network reach postcode sectors that form a large contiguous block.	<ul style="list-style-type: none"> <li>• That a market must consist of (mostly) contiguous postcode sectors</li> <li>• Candidate markets must be of a material size</li> </ul>
Check heterogeneity	Test that competitive conditions are different between the candidate high network reach area(s) and the remainder of the country.	<ul style="list-style-type: none"> <li>• BT's service share is a valid proxy for competitive conditions in the candidate areas</li> </ul>

**Figure 1** The six steps of Ofcom's geographic market definition analysis

3.12 The remainder of this section assesses each of the six steps in detail. To help navigate this material, each step is split into the following three sub-sections:

- A description of the analysis undertaken by Ofcom;
- A commentary on the analysis and its assumptions; and
- Conclusions and recommendations to improve the analysis.

## Step 1: Model demand

### Description

- 3.13 Ofcom's first step is to model the location of potential (not actual) demand for leased lines. Ofcom uses the location of businesses as a proxy for potential leased line demand. It makes the assumption that larger businesses are more likely to buy leased lines, and so considers the locations of sites used by business which have at least 250 employees. These are referred to as 'large business sites'.
- 3.14 In the 2013 BCMR Ofcom used a dataset of business supplied by Experian, and this resulted a total of approximately 218,000 large business sites. For the current BCMR, Ofcom is proposing to use a similar dataset supplied by Market Location. This results in approximately 163,000 large business sites.

### Comment

- 3.15 The main concern with this step of the analysis is that it has the potential to introduce errors in the determination geographic market boundaries. Ofcom's case for using large business sites is that larger businesses are more likely to use leased lines than smaller businesses. However, it doesn't necessarily follow that the location of large business sites provides an accurate or unbiased estimate of the location of leased line demand.
- 3.16 There are a number of reasons why:
- 3.16.1 MNO and LLU backhaul represent a very significant source of leased line demand. There is no reason to believe that large business site locations will provide a good, unbiased estimate for the location of this demand. In particular, business sites are likely to be a poor estimator of mobile mast locations. Mobile coverage requirements dictate that masts will need to be distributed throughout the country, including within residential and rural areas, whereas business sites will tend to be more heavily concentrated in urban centres and business parks.
- 3.16.2 Although large businesses are more likely to use leased lines, it is not necessarily true that leased lines will be used at every site used by these business. According to ONS data, there are around 9,080 businesses and around 11,810 sites with 250 or more employees in the UK<sup>19</sup>. Many of Ofcom's large business sites will, in fact, have a very

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<sup>19</sup> 2013 data from 'UKBD01 Enterprise/local units by Employment size band and GB Local Authority Districts (including UK total)'. The figure for sites refers to 'local units' which are defined as follows:

small number of employees. For example, the high street retail outlets of large national chains.

- 3.16.3 Many SMEs<sup>20</sup> also use leased lines. Although the proportion using leased lines is far smaller than for larger businesses, in absolute terms there are many more SMEs than larger businesses. The geographic distribution of demand depends on the total number of sites requiring leased lines. It is certainly possible that the absolute number of sites used by SMEs requiring leased lines is greater than the number of large business sites. Either way, the inclusion of sites used by SMEs could result in a materially different distribution of potential leased line demand.
- 3.17 It is not clear whether the large business sites dataset includes public sector organisations. Public sector organisations demand a significant number of leased lines, from schools and various NHS sites, to local government. Business site locations are unlikely to provide an unbiased estimate of the location of these organisations, and so it is important that the relevant dataset includes some public sector sites.

#### *Sensitivity*

- 3.18 The geographic distribution of potential demand cannot be known with certainty. Different datasets will represent better or worse estimates for the potential location of demand, but they are all estimates. A key question is the extent to which the final results of the market definition analysis are sensitive to the assumed distribution at this first stage. Ofcom has considered this question through the analysis of various alternatives to its choice of business site dataset, both in the 2013 BCMR and the more recent data analysis consultation.
- 3.19 Specifically, Ofcom considers the set of high network reach postcode sectors which form the WECLA under various alternative assumptions. In summary, Ofcom finds that changes in the location datasets do affect the classification of some postcode sectors, but not to a material degree. The WECLA always looks substantially the same.
- 3.20 Under most circumstances, this interpretation would be appropriate. A sensitivity of, say, 5% to the adoption of alternative assumptions would not suggest that the original assumptions were flawed, or that the analysis was overly sensitive to the assumptions.
- 3.21 However, in relation to geographic market definition a different interpretation is appropriate. Consider the example from the recent data analysis consultation in which Ofcom reassess the WECLA from the 2013 BCMR using the new dataset supplied by Market Analysis.<sup>21</sup> Figure 2 below reproduces the analysis presented by Ofcom showing the old WECLA and the High

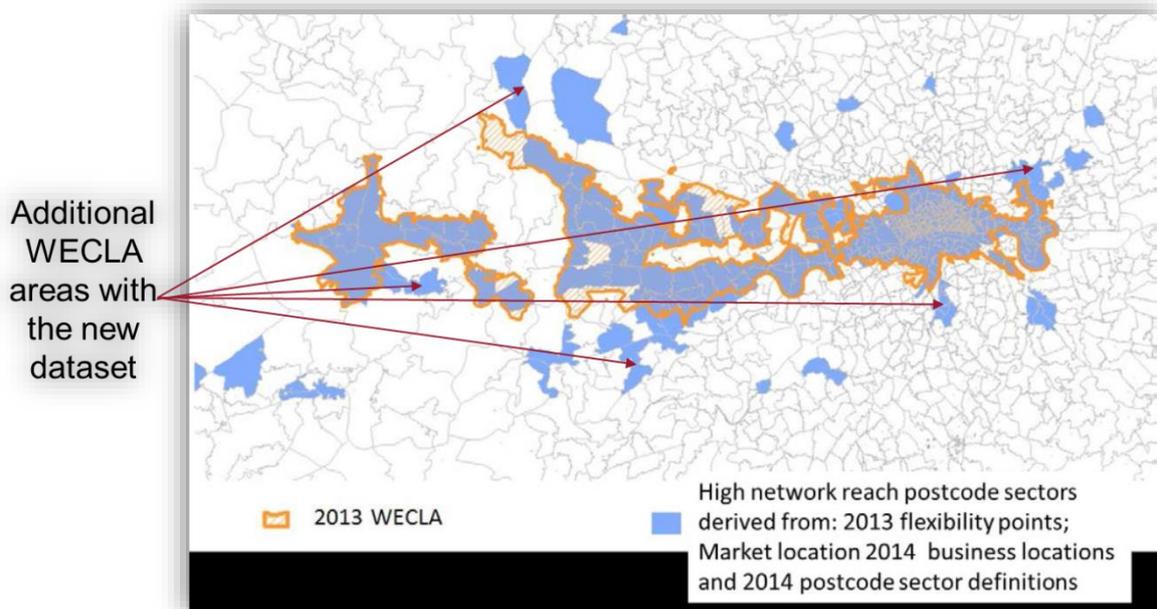
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“A local unit is a statistical unit in an enterprise, defined as the individual site (shop, factory, etc) situated in a geographically identified place. At a local unit, economic activity is carried out by one or more persons (even if only part-time) working for one and the same enterprise.”

<sup>20</sup> That is, businesses with less than 250 employees.

<sup>21</sup> Paragraph 2.32, Business Connectivity Market Review, Consultation on Data Analysis, October 2014.

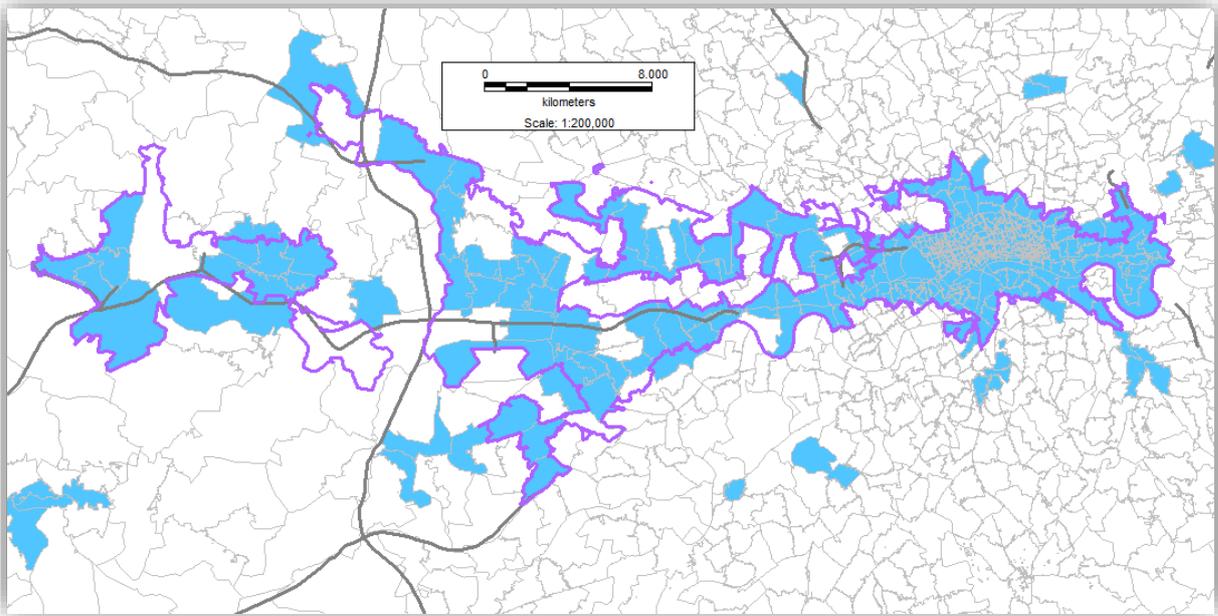
Network Reach postcode sectors based on the revised assumptions. Overall, Ofcom concludes that, “[t]he areas covered are substantially the same, suggesting that there has been no material loss of consistency.”



**Figure 2** Figure 4 from Ofcom’s BCMR data analysis consultation with possible changes to WECLA highlighted.

- 3.22 The proportionate change in the number of postcode sectors is relatively small, and the area is substantially the same. Equally, almost any change in the peripheral postcode sectors of the WECLA would have very little impact on market shares in the WECLA due to the very high concentration of volume in the centre of London.
- 3.23 However, it is also clear that the WECLA would have been a different shape and somewhat larger had the new dataset been used during the last market review, as shown in the figure. This sensitivity becomes a material issue if, hypothetically, the market review were to conclude that there is no SMP within the WECLA. Such a conclusion would be driven by the activity in the central London areas, and unaffected by the inclusion or otherwise of the peripheral postcode sectors.
- 3.24 Within the relevant postcode sectors, the impact of a change in assumptions is quite stark: under one assumption the postcode sector is deemed to be incapable of having effective competition due to a lack of availability of competing network operators; whereas under an alternative, equally plausible, assumption the postcode sector is deemed effectively competitive and regulation is removed.
- 3.25 Clearly, from the localised perspective of the businesses and suppliers operating within the postcode sector, this change is material.

- 3.26 What the sensitivity test shows is the uncertainty surrounding the result that a particular postcode sector is classified as high network reach. As discussed at several points in this paper, we recommend that Ofcom should reduce this uncertainty by only classifying postcode sectors as high network reach if they pass the relevant tests under all reasonable assumptions.
- 3.27 As a second example, we consider Ofcom’s analysis in the 2013 BCMR Statement in which it substituted customer end locations for large business sites.<sup>22</sup> This is a less neutral change of assumption since the customer ends location dataset only shows actual demand, and is arguably a less reliable estimator of the location of potential demand.
- 3.28 The result of this change in assumption is that 18 postcode sectors in the WECLA (from a total of 421) are no longer classified as being high network reach when using customer ends; and a handful outside the WECLA become HNR. Ofcom concludes that there is a reasonable degree of overlap, and so this sensitivity test supports the use of the Experian large business site dataset.



**Figure 3** HNR sectors using customer ends from Figure 5.13, BCMR Statement 2013.

- 3.29 Though small in number, some of these changes in postcode sector are material. For example, as shown in Figure 3, Slough becomes (further) dislocated from the rest of London. It would have been much more difficult for Ofcom to conclude that the Slough postcode sectors were contiguous with the rest of London, with one isolated High Network Reach (“HNR”) postcode sector having to act as a stepping stone to bridge the gap between Slough and London.

<sup>22</sup> Paragraphs 5.128-5.131. BCMR Statement, March 2013.

## Conclusions and recommendations

- 3.30 It is only ever possible to estimate the location of potential future demand for leased lines, and as a result this step of the process increases uncertainty and may also introduce systematic bias. It is also not clear that this step is necessary. In chapter 4 below, we consider two alternatives which avoid the need for modelling demand, and therefore remove this potential source of bias and uncertainty.
- 3.31 However, should Ofcom continue to use its existing methodology, including aggregation at postcode sector level, we recommend the following changes to its methodology:
- 3.31.1 It seems reasonable to assume that existing demand locations are a subset of potential locations of demand for leased lines. Therefore, we strongly recommend that Ofcom supplement, and not replace, the database of business site locations with the locations of all circuit ends in its circuit inventory. To account for the possibility that the circuit inventories might be missing some self-supplied circuits, Ofcom should also include the location of MNO base stations and BT local exchanges.
  - 3.31.2 Ensure that business site locations are geocoded according to their full address rather than postcode. The problems associated with the use of postcode coordinates are explained below from paragraph 3.84.

## Step 2: Model Supply

### Description

- 3.32 Ofcom models potential supply by collecting data from operators regarding the location of their network infrastructure. Specifically, Ofcom ask for the location of 'flexibility points' which are defined as being the points in the network from which the operator can add physical connections.
- 3.33 These points are converted into potential supply areas by adding a 200 metre buffer<sup>23</sup>. This is based on the assumption that in at least some circumstances operators will be prepared to dig to connect premises within this 200 metre radius of the flexibility point.
- 3.34 This analysis is conducted for competitors to BT. It is assumed that BT has universal coverage.

### Comment: Flexibility Points

- 3.35 Ofcom's approach to modelling supply is reasonable, but it depends crucially on the interpretation of flexibility points, and on the availability and consistency of the network data supplied by CPs.
- 3.36 It is clear from the discussions in the BCMR Statement that CPs interpreted flexibility points in different ways, or at least supplied data which implied a different interpretation. For example,

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<sup>23</sup> 'Buffer' is a term used in Geographic Information Systems (GIS) to refer to the area defined by measuring a specified distance from the boundaries of another object – a point, line or polygon. Buffering from a point location, such as a flexibility point, creates a circular area with radius equal to the buffer distance.

Virgin Media supplied information about its street cabinets. Other CPs are more likely to have provided information about junction boxes and manholes.

- 3.37 Inaccuracies and inconsistencies in the flexibility point data can lead to two forms of bias:
- First, if the dataset is incomplete, then the CP's true network reach will be understated;
  - Secondly, if the dataset includes flexibility points that are uneconomic to use, or otherwise constrained (for example, due to capacity in that part of the network), network reach will be overstated.
- 3.38 In addition, on a forward looking basis, flexibility points are not fixed. CPs will build new manholes and chambers along duct routes rather than digging from an existing flexibility point. This will be a more efficient way to connect a new customer relative to digging a trench and building new duct in parallel with an existing route.<sup>24</sup>

Comment: buffer distance

- 3.39 Ofcom collected evidence on dig distances, and has repeated this exercise for the forthcoming BCMR. Its interpretation of this data in the previous BCMR was that, although the majority of digs are much shorter, CPs will sometimes dig in excess of 200 metres, and so a 200 metre assumption can be justified.
- 3.40 It is unclear how to infer an appropriate buffer assumption from build distance data. As discussed below, the data only tells you where CPs have successfully won business to connect new sites. It cannot tell you where they were prepared to dig to but were not competitive. Perhaps of greater importance than the actual distances themselves is the relative infrequency of digging to connect new customers at all. In practice, CPs dig very rarely.
- 3.41 It is useful to put the 200 metre buffer area into context. A single flexibility point creates an area of 12.6 hectares – larger than 188 out of 200 postcode sectors in Central London and the City. Although postcode sectors are irregular shapes, in many cases a single flexibility point would be sufficient for a network operator to be considered to have coverage over the entire sector.<sup>25</sup>
- 3.42 Strictly speaking, Ofcom conducts wholesale market definition under greenfield assumptions<sup>26</sup>. Ofcom suggests that in the absence of regulated access services CPs would be forced to compete by digging longer distances. As such, it was argued that the actual dig distances could underestimate the appropriate level for the buffer assumption. Ofcom has supported this case by pointing to the evidence that historically, before regulated access services were available, CPs did dig further and more often.

<sup>24</sup> For example, using BT's PIA price list as a benchmark, a new footway box costs between £766 and £2,920. New footway duct costs £45 per metre, and so a new footway box is equivalent to between 17 and 65 metres of new duct.

<sup>25</sup> As a purely mathematical exercise, one could cover an area equivalent to the City of London (290 hectares) with just 37 judiciously placed flex points.

<sup>26</sup> See, for example, paragraph 5.141 BCMR 2013 Statement.

- 3.43 CPs will dig for miles if they can pass on the connection costs and still win the customer's business. The fact is that beyond a certain distance, BT and possibly other competitors are likely to be closer to the customer, and will be able to provide the service at a lower cost. As a general rule, CPs will pass on the cost of digging for new connections to the customer. Therefore, beyond a certain build distance a CP becomes uncompetitive.
- 3.44 The very low frequency of digs at and beyond 200 metres suggests that CPs are simply not competitive if they have to dig this far.<sup>27</sup> The data should not be interpreted as a reflection of their willingness to dig<sup>28</sup>. The absence of a regulated wholesale service under greenfield assumptions makes no difference to the relative competitiveness of a CP using its own network. Its chances of winning business for a given build distance remain the same.
- 3.45 What is important is the price level relative to costs. Historically, leased line prices were considerably higher, and this allowed CPs to be competitive at longer distances. To argue that these historic distances continue to be relevant is an example of the cellophane fallacy: the reason longer distances were economic in the past is because the market price was significantly above the competitive level.
- 3.46 In addition to greenfield assumptions, market definition ought to be carried out assuming competitive conditions prevail. Obviously, these are a rather difficult set of requirements to meet in markets that are currently regulated and not effectively competitive. However, prices have been regulated to bring them into line with the competitive level, and in any event will be much closer now than they were previously, and therefore provide a better guide as to appropriate build distances.
- 3.47 Our conclusion is that the current build distance assumption of 200 metres materially overstates the effective supply area for normal market transactions. There will always be exceptions where a supplier is willing to cross-subsidise the connection cost to win or keep an important customer (on the expectation of other, more profitable business); or a customer is willing to pay extra to connect to a particular CP network, or perhaps to gain physical network diversity. However, in the vast majority of cases, CPs are not competitive unless the customer is already connected to the network. This is borne out by the very low proportion of new physical connections.
- 3.48 Secondly, the build distance data shows that digs of around 200 metres are very rare. It would seem reasonable to conclude that at a distance of 200 metres, again barring exceptions such as datacentres, a CP will certainly not be competitive with network operators already connected to the site, and is unlikely to be competitive with CPs with network much closer to the site.

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<sup>27</sup> As an alternative to recovering the connection costs from the customer, the CP could maintain standard pricing. However, this risks making a loss on the customer if the lifetime margin on ongoing revenues do not exceed the build costs. Clearly, in the long run, a CP cannot continue to operate in this manner. Put another way, being forced to operate at a loss tends to indicate that a CP is uncompetitive.

<sup>28</sup> Much of the debate around dig distances has been phrased in terms of the furthest distance a CP would be prepared to dig. For example, Ofcom state that it is, "trying to estimate the area (in relation to a flexibility point) in which an OCP would be prepared to provide a service". (Paragraph 5.141, BCMR 2013 Statement)

## Conclusions and recommendations

- 3.49 The simplest step to improve the accuracy and precision of the market definition analysis would be to reduce the dig distance assumption. Ofcom notes (para 5.142 BCMR Statement) that a reduction to 150 metres would reduce the number of postcode sectors in the WECLA by 11% (43). As discussed above, even small changes in the number of High Network Reach postcode sectors can have a material impact on the shape of the WECLA. A change of just a handful of postcode sectors could lead to the loss of contiguity through West London, and through to Slough. Equally, the impact of these changes is material from the localised perspective of suppliers and customers within the relevant postcode sectors. As such, moving to a 150 metre assumption would be a step in the right direction, reducing the risk of regulatory error for those in the affected postcode sectors.
- 3.50 However, we consider a more appropriate buffer assumption to identify the areas within which a CP will be able to supply on a competitive basis (that is, adding to rivalry within the market, and helping to create an effective competitive constraint on other operators) to be considerably below 100 metres. Even a low figure such as 50 metres may still overstate supply areas in dense urban areas where street works costs tend to be higher.
- 3.51 We appreciate that much shorter build distances start to cause problems with the analysis due to the relative precision of postcode coordinates. We assume that the business locations from the Market Analysis or Experian database are geocoded using the postcode rather than the full address of the business site. The coordinates for neighbouring postcodes may be several hundred metres apart – much further than the buffer assumption. This can lead to incorrect assessments of network reach, and the problem is exacerbated by shorter dig distances.<sup>29</sup>
- 3.52
- 3.53 The main alternative to flexibility points is to consider duct routes. Using a buffer distance from duct routes would give a more precise picture of network supply areas, accounting for the fact that CPs can build new flexibility points along duct routes. This would also reduce the risk of CPs providing inconsistent data due to misinterpretation of the data request: duct routes are easier to define than flexibility points. However, we acknowledge that gathering appropriate duct route data would not be without difficulty given that routes would need to be classified according to whether new connections could be made along a particular route<sup>30</sup>.

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<sup>29</sup> To some degree this problem is overcome by considering a buffer distance from duct routes. Duct routes tend to follow roads, as do postcode areas. Therefore, if a duct follows a particular road, it is likely to include the postcode centroid of the buildings along that route. Similarly, if the buffer area includes the postcode centroid, it is likely that the duct does pass the other buildings within the relevant postcode. There are counter examples where mapping postcodes to duct buffer areas will result in errors, but we consider that using duct routes would result in fewer errors than flexibility points, especially when assuming more realistic, lower, buffer distances.

<sup>30</sup> Trunk, or long distance, network routes are often reserved for that purpose. To maintain the security and integrity of these links, it is not possible to break out except at existing network nodes.

- 3.54 A further refinement would be to continue collecting flexibility point data, and to add duct routes to produce a better model of supply areas. Under this model, it would make sense to have two buffer assumptions: a longer assumption for flexibility points (e.g. 75m), and a shorter assumption for duct routes (e.g. 40m) to account for the fact that to extend from a duct route may require a new junction box.
- 3.55 An alternative solution would be to consider the intersection between buffer areas and postcode unit *areas* rather than point locations. Regardless of how these areas are defined (see annex 1 for further details regarding the derivation of postcode areas), they are likely to extend sufficiently close to the road to intersect with even very short buffer distances.

### Step 3: Model supply and demand overlap

#### Description

- 3.56 For each large business site, i.e. for each location of potential demand, Ofcom counts how many suppliers have a flexibility point within an economic build distance (200 metres under current assumptions). This creates a measure of competitiveness of supply for each *point* location of demand.
- 3.57 Ofcom then creates a competitiveness measure *by area* by aggregating within postcode sectors. Specifically, it takes the average of the count of suppliers within reach across all the large business sites within a postcode sector.

#### Comment: the method in general

- 3.58 There are two important assumptions implicit in this method:
- 3.58.1 that competitive conditions within the area are (reasonably) homogeneous, and can therefore be described by a single measure; and
  - 3.58.2 that the average level of competitiveness across a subset of sites within an area is a good (by which we mean both unbiased and accurate) estimator of competitive conditions throughout the area.
- 3.59 We can further refine the second assumption since we are not necessarily interested in competitive conditions throughout the area, but only in relation to locations where there is potential for leased line demand. In conjunction with the assumptions made in step 1, Ofcom is assuming that the average competitiveness at large business sites within the area is a good estimator of competitive conditions for leased line services throughout the area.
- 3.60 There are two important reasons why these assumptions might not hold:
- 3.60.1 First, and foremost, the larger the area the more difficult it becomes to maintain the assumption that competitive conditions will be even reasonably homogeneous throughout the area.
  - 3.60.2 Secondly, the average becomes a much less reliable estimator in circumstances where the sample volume (i.e. the number of large business sites) is small in a

particular area. That is, the variance of the competitiveness measure increases if there are only a handful of business sites in a postcode sector.

- 3.61 Ofcom’s choice of area is the postcode sector, which we discuss in detail below.
- 3.62 The second issue falls away if the set of large business sites provides an accurate assessment of the total population of potential locations for leased line demand: the measure of competitiveness is no longer a sample estimate, but a direct measure of the population average. However, as discussed above, large business sites represent a sample based estimate, and a potentially biased estimate, of the location of potential leased line demand. As such, the average number of networks within reach will be an uncertain measure of competitiveness, and may also be statistically biased.
- 3.63 The risk of regulatory error associated with this second issue is greatest in relation to relatively large postcode sectors, i.e. when both assumptions fail. In these circumstances the measure of competitiveness can be extremely sensitive to small changes in the assumptions and data used in the analysis. The addition or subtraction of a single flexibility point could potentially swing a postcode sector’s classification as High Network Reach. This is likely to be the driver for many of the changes to the status of large postcode sectors peripheral to the WECLA under various different assumptions regarding buffer distance and demand location datasets.
- 3.64 A good example would be postcode sector SL9 7 which lies to the north of the M40 and just outside the M25. It is large area of approximately 670 hectares, i.e. more than twice the size of the City, but contains only a handful<sup>31</sup> of large business sites. This sector is included in the current definition of the WECLA. However, from the various analyses presented by Ofcom we know that it would not be classified as high network reach:
- had Market Location data been used in the last BCMR;
  - had customer ends been used instead of large business sites;
  - had mobile sites been used instead of large business sites; or
  - if Market Location data were used with the latest flexibility point data.<sup>32</sup>

Comment: postcode sector aggregation

- 3.65 Ofcom considers the postcode sector to be “the most appropriate unit for assessing the leased lines geographic market definition”<sup>33</sup>. Its choice of postcode sectors is based on a number of factors. In particular, Ofcom suggests that postcode sectors satisfy the following criteria:
- “they are mutually exclusive and less than national;

<sup>31</sup> As noted elsewhere, we do not have access to the business database used by Ofcom, but from the information presented in various Ofcom documents and our own research, there would appear to be less than 10 large business sites in this postcode sector.

<sup>32</sup> In order, the relevant source maps are as follows: figure 4 BCMR data analysis consultation; figure 5.13 BCMR Statement; figure 5.17 BCMR Statement; figure 7 BCMR data analysis consultation.

<sup>33</sup> Paragraph 5.28, BCMR Consultation, 2012.

- the network structure of all relevant operators and the services sold on the market can be mapped onto the geographic units – i.e. the postcode sectors;
- they have clear and stable boundaries; and
- they are small enough that competitive conditions are unlikely to vary significantly within the unit but at the same time large enough that the burden on operators and us, the relevant NRA, with regard to data delivery and analysis is reasonable.”<sup>34</sup>

3.66 None of the criteria are fully satisfied by postcode sectors. We discuss the criteria below, starting with the most important issue – that of the variation of competitive conditions within postcode sectors. We then raise the question of practicality: how difficult would it be to assess competitive conditions at a more granular level. Lastly, we look at whether supply and demand can be mapped onto postcode sectors. The two remaining criteria of mutual exclusivity and clear and stable boundaries are considered in annex 2. Although interesting, the reasons why postcode sectors fail these criteria are unlikely to be material.

*Small enough to assume similar competitive conditions*

3.67 Most postcode sectors are too large to support an assumption that competitive conditions are similar throughout the sector.

3.68 A small area within central London is the exception to this rule. Many postcode sectors in the City of London and Westminster are very small. There are at least 40 which have an area of less than 2 hectares (i.e. an area equivalent to 200 metres by 100 metres). This is driven by the very high density of postcodes in these areas. The larger postcode sectors in this central London area are those containing parks, or large single organisations such as hospitals<sup>35</sup>. It seems reasonable to assume that competitive conditions will be similar, albeit not the same, within these relatively small areas.

3.69 In contrast, SL1 3, which is still within the WECLA, adjacent to Slough town centre and relatively densely populated, is about 260 hectares. The largest sector in the WECLA is SL6 2, which is around 1,360 hectares (i.e. 13.6km<sup>2</sup>). This is equivalent to the more than 230 of the smallest WECLA postcode sectors combined.

3.70 As discussed above, we are really only interested in competitive conditions at locations of potential leased line demand, rather than conditions throughout the entire postcode sector area. Much of SL6 2 consists of fields. The location of *potential* leased line demand cannot be known with certainty, and we consider that large business sites will understate the distribution of demand locations. Implicitly, Ofcom’s analysis assumes that competitive conditions throughout the postcode sector will be similar to the conditions measured at a relatively small number of business sites within the sector.

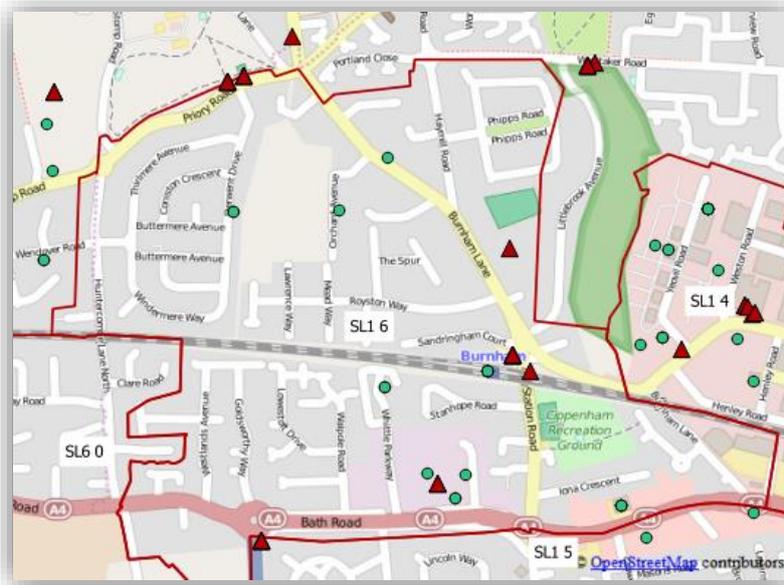
3.71 As the area gets larger, it becomes more difficult to sustain this assumption. It becomes increasingly likely that we will find geographically distinct clusters of leased line demand within the postcode sector. With increasing distances between these clusters, one cannot safely

<sup>34</sup> Paragraph 5.28, BCMR Consultation, 2012.

<sup>35</sup> For example, WC2A 3 which contains Lincoln’s Inn and is around 13 hectares.

assume that the same network infrastructures will exist in all the locations. Therefore, competitive conditions will vary for (potential) leased line customers within the postcode sector.

- 3.72 We are not able to replicate Ofcom’s analysis due to the confidential nature of the network infrastructure data, and because we have used alternative sources for the location of business sites and postcode sector boundaries. Therefore, it is difficult to provide concrete examples to support this case. However, we have identified the following example which demonstrates *the potential* for heterogeneous competitive conditions.
- 3.73 Figure 4 below shows postcode sector SL1 6, which is around 130 hectares in size. This is a largely residential area, but immediately to the west of the postcode sector containing the Slough trading estate (SL1 4) and still within the WECLA.



**Figure 4** Business and mobile site locations in postcode sector SL1 6.

- 3.74 Business sites are represented by green dots. These are concentrated in the south of the sector around the Bath Road. The businesses in the south are likely to be well served by networks running along the Bath road or the railway line. The average measure of competitive conditions will be skewed by the higher density of well served businesses in the south, contributing to, and possibly determining the result that the entire sector is classified as High Network Reach.
- 3.75 Mobile sites are shown as red triangles<sup>36</sup>. As previously noted, the geographic distribution of mobile mast sites will be much more evenly spread relative to business sites. Similarly, public sector organisations that may demand leased lines (schools, hospitals, doctors, etc) are likely to be found outside business districts<sup>37</sup>. It is certainly possible that the rest of the postcode sector,

<sup>36</sup> Data for mobile site locations comes from Ofcom’s Sitefinder dataset.

<sup>37</sup> The two isolated green dots in the middle of SL1 6 represent schools.

and these other sources of potential leased line demand in particular, are poorly served by competitor networks.

- 3.76 We are not able to test this hypothesis, and so it may be the case that all the relevant sites within SL1 6 are well served by competing networks. The purpose of this exercise is merely to demonstrate that this is a possible, and not unrealistic, outcome when dealing with larger postcode sectors such as SL1 6.
- 3.77 The problem is more likely to occur the larger the postcode sector. SL1 6 is around 130 hectares. The vast majority – around 80% – of postcode sectors in the UK are larger than 130 hectares. As such, we consider that it is highly likely that there will be many examples throughout the UK where competitive conditions vary within postcode sectors at locations of potential demand for leased lines. In these circumstances, Ofcom’s approach of taking an average across a sample of sites within a postcode sector will provide an inaccurate description of competitive conditions. This has the potential to result in inappropriate regulation for existing and potential customers of leased lines within the postcode sector.

#### *Practicality*

- 3.78 Ofcom identifies a trade-off between the granularity of the geographic assessment and practicality. That is, it would be more difficult to implement a more granular assessment of competitive conditions.
- 3.79 There is, of course, some truth in this statement. However, it is important to appreciate that a considerable amount of Ofcom’s analysis already takes place at a lower level of granularity than the postcode sector. In fact, very little analysis is conducted at postcode sector level. It is simply used as an aggregation area. The bulk of the analysis is conducted at the point (postcode) location of large business sites, plotting a buffer area of 200 metres around this site, and then finding flexibility points within these 200 metre radius areas.
- 3.80 By way of example, Figure 7 below reproduces the results of Ofcom’s analysis at postcode level for the London area. This analysis considers the number of networks within reach of customer circuit end postcodes. Clearly, the existing technique could be used to assess any chosen set of postcodes, and extended to form the basis of Ofcom’s market definition. We explore this option in more detail in chapter 4 below.

#### *Supply and demand can be mapped onto the units*

- 3.81 In one sense, this requirement is trivial: the coordinates of network locations and customer sites can be mapped onto any geographic area.<sup>38</sup> However, some postcode sectors are explicitly non-geographic. The postcodes within these sectors are used by businesses with PO Boxes and others that receive a large amount of mail.<sup>39</sup>

<sup>38</sup> Admittedly, the computation required to map from postcodes to postcode sectors is much simpler than mapping from coordinates to an arbitrarily defined shape, but the latter is a common function built into all GIS software and therefore also straightforward to implement.

<sup>39</sup> Royal Mail maintains a list of all non-geographic postcode sectors currently available at [http://www.royalmail.com/sites/default/files/12jan\\_current\\_non-geos-original\\_0.pdf](http://www.royalmail.com/sites/default/files/12jan_current_non-geos-original_0.pdf)

- 3.82 Supply and demand cannot be mapped directly onto these sectors since, by definition, they have no geography. 21 of the WECLA postcode sectors are non-geographic sectors, details of which are provide in annex 3. It is not clear how the existing SMP conditions should be applied in relation to businesses using postcodes from these sectors. The WECLA is defined as an area consisting of certain postcode sectors, but some of these postcode sectors do not themselves have any area.
- 3.83 In many cases a non-geographic postcode sector will be used by businesses located within the relevant postcode district (the next level up in the postcode hierarchy – represented by the characters and digits before the space in a full postcode). This appears to be the case for most, but not all, of the sectors within the WECLA. For example, SL1 0 is a PO Box sector used by businesses within postcode districts SL1 and SL2. This includes sectors outside the WECLA. As such, there may be businesses which are located outside the WECLA boundary but with an address that is considered to fall within the WECLA due to the postcode.<sup>40</sup>

Comment: Postcode precision

- 3.84 Assuming that businesses are located using the geographic coordinates of a postcode, the size of the postcode area can be greater than the buffer / build distance. Postcodes refer on average to 15 premises, but this can vary from a single building up to at least 100. Postcode coordinates – the postcode centroid – are generated by taking the average of the coordinates of the addresses which make up the postcode.
- 3.85 The postcode centroid can therefore be some distance from the furthest buildings sharing the same postcode even in urban areas. In the example show in Figure 5 below, EX2 4LA contains around 30 buildings, with the furthest being 185 metres from the postcode centroid (the green dot).

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<sup>40</sup> The non-geographic postcodes are generally geocoded to a mail sorting office. This creates two problems. First, a business located outside the WECLA may be geolocated to a mail sorting office inside the WECLA. Secondly, this geocoding to the same mail sorting office location creates a very high apparent concentration of demand at one site. This has the potential to create anomalies in both Ofcom’s network reach analysis and market share estimates.



- There will be sites within High Network Reach postcode sectors which are potential or actual sources of demand for leased lines which face little or no effective choice of supplier; and
- Competitively served buildings will be included in postcode sectors that are deemed incapable of supporting effective competitive (i.e. low network reach).

3.89 Although not directly addressing this question, the evidence from Ofcom’s extensive analysis supports this argument. Consideration of different demand location datasets and different buffer assumptions shows that the shape of the WECLA would change, albeit not dramatically. The results of the tests are generally only presented for the London area. This is always skewed by the fact that the central London area is unique in having consistently very small postcode sectors. For example, out of 237 postcode sectors across the UK with an area less than 10 hectares, 195 are in London.

3.90 The tests show a consistent picture of competition within central London, but this consistency falls away as soon as you move beyond Zone 1. Many of the peripheral postcode sectors change their network reach status under different, but still reasonable, assumptions. In part, this sensitivity is due to the increased size of the postcode sectors, and the consequent lack of homogeneity of competitive conditions within them.

3.91 It cannot be emphasised enough just how different the central London area is from the rest of the country. The relative amounts of office space give a good indication of the magnitude of the difference. As a broad indicator, office floorspace provides a reasonable proxy for the likely level of demand for leased lines. The following table shows the amount and density of office floorspace in the centres of London, Birmingham, Manchester, and Leeds.<sup>41</sup>

	Total office space (1000s m <sup>2</sup> )	Total area (hectares)	Number of MSOA areas	Overall density (office space per unit area)
<b>London</b>	17,572	4,149	46	0.42
<b>(City of London)</b>	4,849	290	1	1.67
<b>Manchester</b>	2,110	2,153	9	0.10
<b>Birmingham</b>	1,509	1,240	5	0.12
<b>Leeds</b>	1,152	1,609	5	0.07

**Figure 6** Office space comparison between several UK cities

3.92 For every square metre in the City of London, there are 1.67m<sup>2</sup> of office space. This area alone has almost as much office space as Leeds, Birmingham and Manchester put together. It is little surprise, therefore, that it has been the target for considerable amounts of network investment.

<sup>41</sup> The statistics come from the Valuation office and are presented by census output area (Middle Layer Super Output Area - MSOA). There are just under 7,000 of these areas in the UK, so on average they are not too dissimilar from postcode sectors. However, they are designed to capture roughly equal numbers of households and population, and therefore tend to be quite large in central business districts. The MSOA areas for each city were chosen by selecting a largely contiguous set of MSOAs with the greatest amount of office floorspace.

3.93 The conditions in this small area in central London, in conjunction with the abnormally small postcode sectors, mean that Ofcom's geographic analysis tends to work reasonably well. However, these conditions do not hold elsewhere. Other urban centres tend to have a handful of postcode sectors which are small enough to support the assumption of homogeneity, but these soon give way to much larger postcode sectors.

*Options for a more granular analysis*

3.94 The only solutions to address the problem directly would be to use a smaller aggregation area, or to adopt a different technique which avoids the use of averaging across an aggregation area.

3.95 Ofcom has considered a range of alternatives to postcode sectors, none of which appear to be very promising. One additional alternative would be lower layer census super output areas (LSOAs)<sup>42</sup>. There are approximately 34,000 of these in England and Wales, and so on average they will tend to be smaller than postcode sectors (of which there are approximately 10,000 across the UK). However, these don't work well for these purposes since they are designed to contain roughly equal numbers in terms of population and households, and are therefore likely to be large when considering business districts.

3.96 One candidate for more granular analysis is to consider postcode unit areas. This would certainly produce significantly more accurate results, but it implies a significant change in methodology since it amounts to the removal of aggregation areas altogether. This simplifies the current stage of the analysis, but merely shifts the burden to the next stage where individual postcode areas would need to be aggregated into candidate markets. A potential solution to this aggregation problem is discussed in chapter 4 below.

3.97 Our conclusion is that, as a minimum, a more granular analysis is needed in circumstances where the market is a material ongoing concern for consumers and CPs, and where the SMP assessment of the relevant geographic market indicates a possibility that the market could be effectively competitive. That is, a more granular analysis would be preferable in any circumstances, but as a practical matter, it is perhaps only necessary when the results of geographic market analysis are material to the ultimate regulatory determinations.

3.98 As such, we make the following proposals:

- That Ofcom develop new techniques to enable the assessment of competitive conditions at a more granular level than postcode sector. This could amount to little more than a consideration of the existing postcode level analysis of network reach, and a different approach to aggregation of this data. However, it may be prudent to develop a new approach designed with the objective of delivering a more granular analysis. We set out, at a relatively high level of abstraction, a proposal for such an analytical framework in chapter 4 below.

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<sup>42</sup> For details, see <http://www.ons.gov.uk/ons/guide-method/geography/beginner-s-guide/census/super-output-areas--soas-/index.html>.

- That, at the very least, Ofcom should employ a more granular analysis within borderline cases where the market analysis suggests that competition may be effective and deregulation may be justified.
- In addition, if Ofcom is to continue using its current methodology, then it should build in a test for homogeneity within postcode sectors. This could be as simple as looking at descriptive statistics other than the mean number of networks within reach. For example, there could be a test to flag postcode sectors where more than a certain number (and/or proportion) of sites have no effective choice of supplier. See paragraph 3.109 below for further suggestions.

## Step 4: Categorise overlap areas

### Description

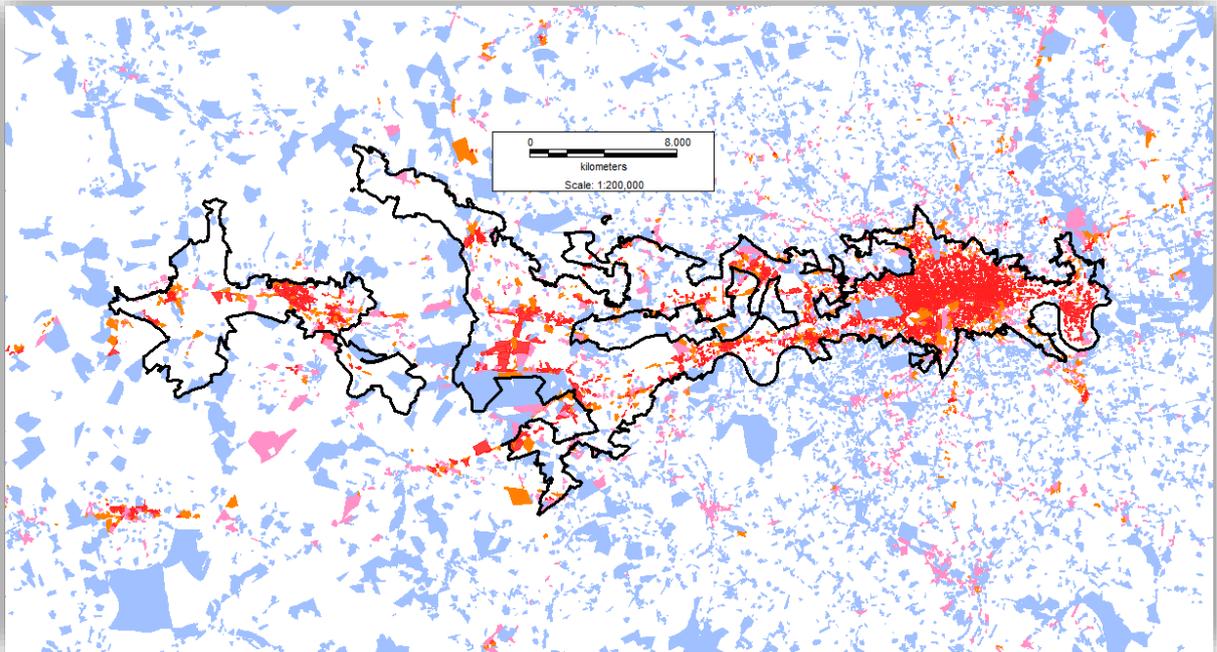
- 3.99 By step 4 we have a measure of competitiveness for a set of postcode sector areas. These must be categorised as part of the process to create candidate market areas.
- 3.100 Ofcom applies a simple threshold test: if the average number of suppliers within reach of business sites in a postcode sector is 2 or more, the postcode sector is classified as high network reach (and is otherwise classified as low network reach).

### Comment

- 3.101 If conditions within a postcode sector are genuinely homogenous, then a simple binary rule may be appropriate. However, to a large degree, this stage subsumes the SMP assessment. For example, in conjunction with a low and falling market share, it would be difficult for Ofcom to reach a conclusion other than no SMP in a candidate geographic market.
- 3.102 There are several reasons why such a conclusion might not be appropriate. Foremost is that fact that competitive conditions may well not be homogeneous within the market area. As discussed above, this is likely to be the case in the context of sub national leased line markets defined on the basis of postcode sector areas.
- 3.103 More generally, it is important to keep in mind that market definition should only ever be a means to an end, and should not be determinative of a competition assessment. The reduction of the measurement of competitive conditions to high or low network reach removes potentially important information from the SMP assessment stage. In doing so, it increases the burden of robust geographic market boundaries and analysis.

### Conclusions and recommendations

- 3.104 The main improvement that Ofcom could make at this stage of its analysis would be to adopt a larger number of categories of competition, rather than the binary high/low network reach. Lots of useful information about competitive conditions is lost at this stage by reducing everything to high and low.
- 3.105 A good example comes from Figure 5.11 from the BCMR Statement 2013, reproduced below. Red indicates a postcode unit area (i.e. more granular than postcode sector) with 4-16 networks within reach; orange 3 to 4; pink 2 to 3; and blue is 0 to 2 networks.



**Figure 7** Network reach for postcodes using customer ends – Figure 5.11, BCMR Statement.

- 3.106 As discussed above, it would also be important to consider measures of the distribution of the number of networks within reach other than the mean as a test for homogeneity of competitive conditions. The standard deviation would be a good starting point. For example, a simple test would be if the standard deviation is greater than the mean, this tells you that the number of networks within reach within the postcode sector are relatively widely dispersed, i.e. competitive conditions appear to be heterogeneous.
- 3.107 It would also be appropriate to flag postcode sectors with low numbers of potential demand locations (i.e. large business sites within the current analysis) to highlight the fact that the average is then a less reliable guide to conditions in the sector.
- 3.108 These additional measures would create a richer picture of competitive conditions for Ofcom to consider at the next stage of the analysis. Alternatively, if Ofcom is to continue using a binary categorisation, it is important that unreliable estimates of high network reach are filtered out. On this basis, it would be appropriate to require that a postcode sector satisfy additional criteria to be classified as high network reach.
- 3.109 The following set of tests are provided as an example of the type of criteria that could be applied to reduce the risk that a postcode sector is classified incorrectly:
- The average the number of networks within reach is 2 or more;
  - The standard distribution of the number of networks within reach is less than 2;
  - No more than 2 (or 10% - whichever is greater) demand site locations have no competitor networks within reach; and

- No more than 5 (or 25% - whichever is greater) demand site locations have only 1 competitor network within reach.

## Step 5: Create candidate markets

### Description

3.110 Ofcom now has a set of high- and low-network-reach postcode sectors. These are aggregated to form candidate market areas. Ofcom performs this step by applying the following rules to high network reach postcode sectors:

- The postcode sectors should be contiguous to one another; and
- These contiguous postcode sectors must form a considerable area.

3.111 The contiguity requirement is relaxed slightly, on a case-by-case basis, to form a coherent market area. For example, small holes in the contiguous area are included even if they do not meet the high network reach threshold.

### Comment

3.112 Both rules are reasonable to some degree, but somewhat opaque. A patchwork market area is unlikely to capture the essence of competitive conditions on a forward looking basis, in which we might expect suppliers to build network coverage in a reasonably contiguous manner.

3.113 Similarly, effective competition is unlikely to be sustainable in small and isolated geographic markets due to the considerable economies of scale and scope in fixed telecoms. Effective competitors to BT need to operate at scale, which precludes operating *solely* in such small geographic areas.

3.114 The exception to this rule is London, but as described above, London is unique. Both in terms of the density and sheer number of businesses, and from its position as a hub for international telecoms traffic, it presents a target market which is larger than many countries<sup>43</sup>.

3.115 Once a firm has reached a minimum efficient scale within London, it may then be able to justify expanding to reach neighbouring areas with high demand for leased lines such as Heathrow, Slough and Croydon. However, these linkages do not require contiguity of postcode sectors between the two locations. Network extensions to reach places like Slough are built through areas in which there may be no leased line demand. Competitive conditions at either end of the extension could in theory be similar, with the same set of suppliers and the same types of business demanding leased lines. At the same time, competitive conditions along the route between these locations could be completely different.

### Conclusions and recommendations

3.116 Ofcom would make its analysis at this stage more robust by considering a richer description of competitive conditions from the previous steps, rather than a binary classification of postcode sectors as high or low network reach; and the use of other sources of evidence. In particular, it

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<sup>43</sup> Continuing the analysis presented above, the City of London has more office floorspace than Wales.

is important acknowledge the unique characteristics of London, and its role in generating different competitive conditions in the surrounding areas.

- 3.117 Without its proximity to London, Slough would not be a hub for datacentres and network connectivity. However, it is near London and has benefitted from being on the route of many networks heading west out of London. It now represents a significant source of concentrated leased line demand.
- 3.118 On one level, competitive conditions in Slough are clearly different to those found in Zone 1 of central London. However, if we focus attention on just the Slough Trading Estate, then competition to supply customers on this small site may possibly match levels of competition found in the City.

## Step 6: Check heterogeneity between candidate markets

### Description

- 3.119 The final step in the process is to check that competitive conditions are different between the candidate areas. Ofcom performs this step by comparing BT's share of supply across a broad set of products in the candidate areas. In most cases there is a material difference in BT's service share between the candidate high network reach areas and the rest of the country.

### Comment

- 3.120 The test used by Ofcom is appropriate, but it should also be noted that it is relatively weak. There will almost always be a difference in BT's service share between the two areas given how they are defined. In relation to the WECLA, almost regardless of the scenario being modelled, the volume of circuits and competitiveness of central London will mean that the candidate area appears to be materially different from the rest of the country.
- 3.121 The test assumes that competitive conditions are reasonably homogeneous throughout the candidate areas. It therefore cannot be used to distinguish between different candidate areas, for example between sets of contiguous high network reach postcodes produced using different business location data sources, or different buffer distances.

### Conclusions and recommendations

- 3.122 In addition to a check for heterogeneity between candidate areas, it would also be important for Ofcom to apply a further cross-check to consider homogeneity within these areas. This is not without difficulty since we would not expect to find evenly distributed service shares within an economic market. Equally, however, we would not expect to find sizable areas where BT's share was consistently higher than the rest. Were Ofcom to find such an area, it may indicate sufficiently different competitive conditions to warrant a distinct geographic market.

## Alternatives to the current approach

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- 4.1 This section considers two specific alternatives to the current approach to geographic market definition. Both would generate a more accurate and geographically precise assessment of competition conditions in leased lines markets in the UK. Both could be employed alongside the current approach to consider areas where a more detailed investigation of competitive conditions is needed.
- 4.2 These are certainly not the only alternatives, but we believe that they would deliver more accurate results, and therefore reduce the risk of regulatory error. They are also both viable, practicable options that could be implemented without a significant difference in the ongoing burden on CPs or Ofcom.
- 4.3 The first option we consider is to extend the current analysis that Ofcom undertakes at postcode level. As a second option, we consider an approach based on supply areas measured by duct routes. The options are presented at a conceptual level, with sufficient detail to demonstrate that they are computationally possible, and would give reliable results. However, many details would need to be worked out in due course.
- 4.4 Given the timing of the current market review, it may be difficult to develop and implement a new approach. Therefore, should Ofcom continue with its existing approach, there are a number of small changes Ofcom could make to improve its analysis. These were discussed in the previous chapter, and are summarised in the conclusions in chapter 5 below.

### Option 1: Extending Ofcom's postcode level analysis

- 4.5 Ofcom's current analysis includes an assessment of competitive conditions at postcode level. This produces a measure of competitive conditions by postcode area, as shown in Figure 7 above. This analysis underlying Figure 7 calculates the number of networks (i.e. flexibility points controlled by different network operators) within reach of the postcode locations of existing leased line customers. As is clear from Figure 7, there are many postcodes, and hence large areas, where there is currently no leased line demand, and hence there are many gaps in the picture of competitive conditions that this technique creates.
- 4.6 A simple solution to fill in these gaps and create a more comprehensive map of competitive conditions would be to perform the same analysis for all live postcodes. There are 1.7 million live postcodes in the UK, so the computation required is not trivial, but it does not amount to a significant hurdle.
- 4.7 To test of this assertion, we calculated the number of mobile antennae 'within reach' of postcodes in the UK using Ofcom's Sitefinder dataset. To start, we created a 200m buffer shape for each live postcode. This took around 10 minutes, but it is a task that only needs to be

carried out once, with the resulting polygons stored in a database.<sup>44</sup> The Sitefinder dataset contains over 140,000 antennae spread over around 56,000 unique mast locations. The equivalent calculation to Ofcom's network reach analysis, which involved counting the number of antennae within each postcode 200m buffer area, with each MNO being counted only once within each area, took less than a minute.<sup>45</sup>

- 4.8 A possible concern might be that the analysis would then consider postcode locations which are highly unlikely to generate leased line demand. This is not really an issue. We are only concerned with finding areas where there is potential for competing supply. It is of little consequence if this happens to occur by chance in an area with no potential demand.
- 4.9 The main issue with this approach lies in aggregating the individual postcode areas to generate candidate markets. This is difficult with relatively large postcode sector areas. With the much larger number of postcode unit areas, the process of finding contiguous regions would need to be automated. Fortunately, there are specialist GIS tools to help identify contiguous regions.<sup>46</sup>
- 4.10 It would perhaps be beneficial to conduct the contiguity analysis in two stages:
- 4.10.1 First, stitch together the contiguous blocks of postcode sectors categorised by the number of networks within reach (perhaps in groups similar to those used in Figure 7). To the extent that networks are contiguous, and that the flex point data is complete, this process should result in relatively large areas.
  - 4.10.2 Then, and depending on the results of this first step, further aggregate (again using the automated process) the larger blocks according to the relevant rules to distinguish candidate markets. That is, something equivalent to the 2+ networks within reach requirement for postcode sectors.
- 4.11 This process should create, at least around central London, relatively large and mainly contiguous candidate market areas.
- 4.12 There remains the issue of how to calculate market shares in these areas. The candidate market areas are defined by reference to a list of postcodes rather than postcode sectors. Therefore, although the calculation required to identify whether a circuit end lies inside a candidate market is more complicated than the comparison to postcode sectors, it is still a computationally straightforward task.

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<sup>44</sup> One can buffer either flex points or the demand locations – the results of the analysis will be the same. Therefore, the most efficient overall approach is to buffer the small of the two sets of locations. Despite the larger number, we have chosen to buffer the postcode locations to match Ofcom's current approach. In any event, as noted, this is a one-off exercise and so not a very important consideration overall.

<sup>45</sup> The analysis was carried out on a desktop PC with quad core Intel i7 processor running 64bit version of Windows 7. The data was stored on a PostGIS enabled PostgreSQL database. PostGIS allows complex GIS functions to be carried out within SQL queries.

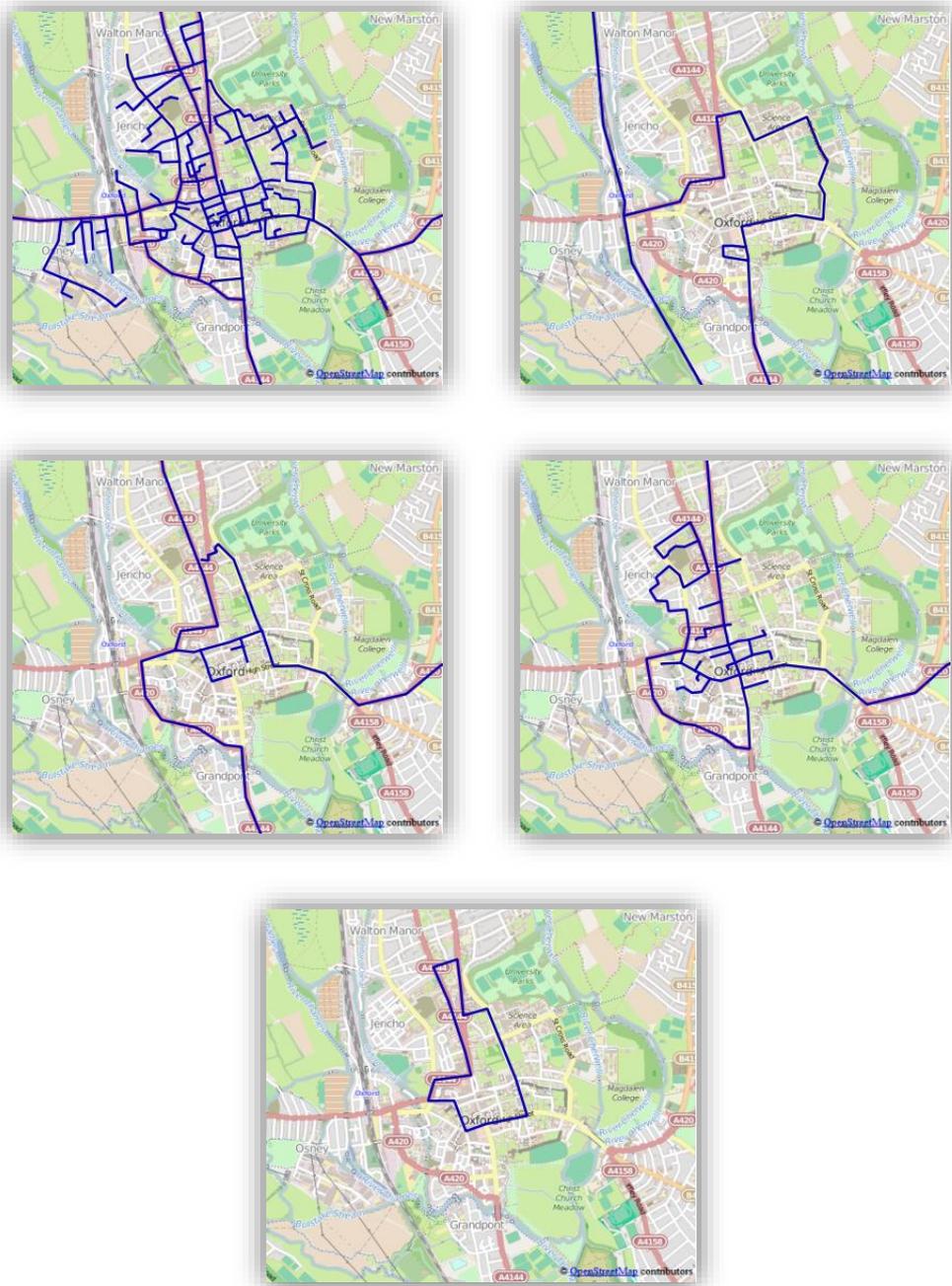
<sup>46</sup> For example, PySAL (<http://pysal.readthedocs.org/en/latest/>) is an open source Python library that contains a set of spatial analytical functions. This includes a set of functions for calculating spatial weights matrices, i.e. working out whether geographic areas neighbour each other.

## Option 2: Markets defined by potential supply areas

- 4.13 The second option for an alternative methodology is similar to the first, but uses the areas created by adding a buffer to network location data (i.e. a dig distance) without having to match to postcodes.
- 4.14 The process would require the following steps:
  - 4.14.1 Start with the same network reach data, or better still flex points and duct routes.
  - 4.14.2 Add a buffer based on an economic dig distance to these routes and points. This creates areas of potential supply for each network operator.
  - 4.14.3 Calculate the intersection of each of these network supply areas. This will create a set of areas according to how many networks overlap.
  - 4.14.4 Finally, aggregate these areas to create candidate markets using rules similar to current contiguity and minimum size requirements.
- 4.15 To demonstrate how this might work, we consider a hypothetical example below.

### Step 1: Plot duct routes

- 4.16 As we do not have real network data, we have created an entirely hypothetical example of a set of networks in Oxford. These are not intended to represent any of the current competitors, or otherwise provide an analogue to current competitive conditions, but merely to demonstrate the technique.
- 4.17 We have plotted duct routes for 5 network operators around the centre of Oxford.



**Figure 8** Hypothetical example - duct networks for 5 operators in Oxford

4.18 The networks vary in extent from one operator with coverage of most roads within the centre of the city, to the final operator with a single duct ring around the centre. There are routes where there is only one network, and some areas where all five operators are present. We want to

identify the areas of potential supply overlap where the operators will be in competition with one another.

#### Step 2: Add buffer / dig distance

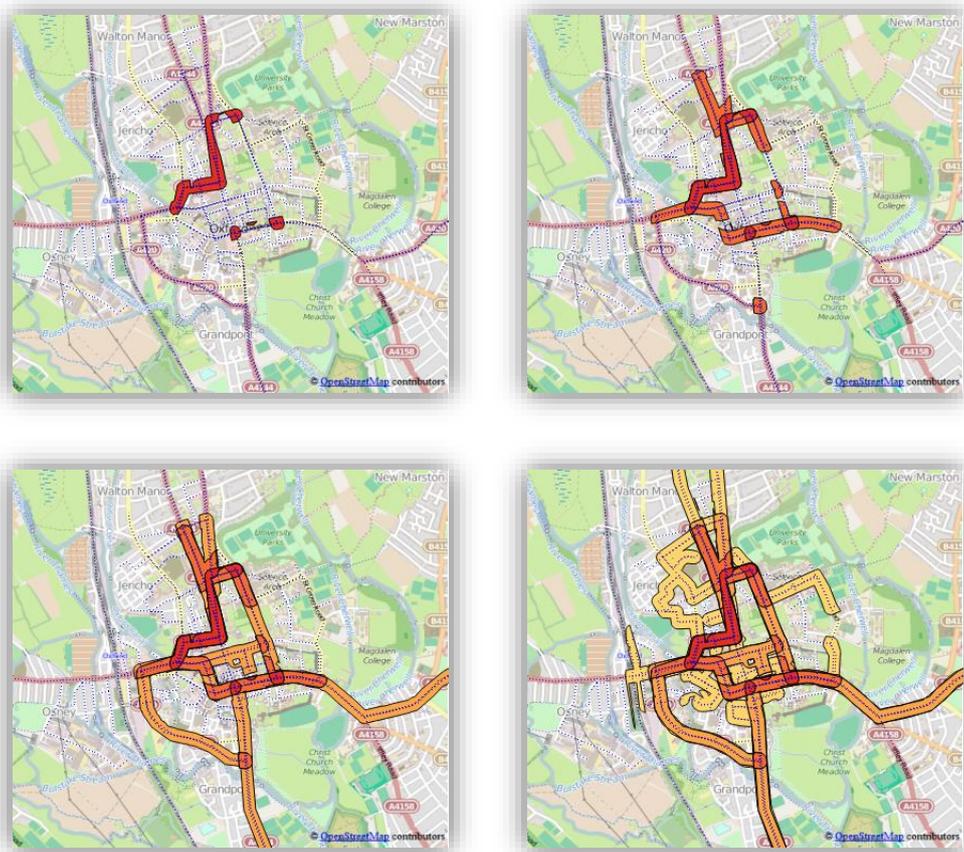
- 4.19 Similar to Ofcom's existing analysis, we add a buffer to the duct routes based on an assumed dig distance to generate network supply areas. The following diagram shows the network supply area created by adding a 50m buffer from all the duct routes. This is the combined area considering all 5 network operators.



**Figure 9** Combined network supply area

#### Step 3: Calculate the intersection

- 4.20 It is easy to see the intersection between respective network supply areas, but rather more difficult to calculate them. In particular, care is needed in calculating the intersection between more than two areas and maintaining a count of how many areas overlap. Various GIS tools will perform the intersection calculation, but scripting is required to automate the process of counting overlaps.
- 4.21 Despite the complexity, once a working process is established, the calculation is performed very quickly. This is important as it allows alternative scenarios to be run – for example, testing different buffer assumptions, or running the analysis for a subset of network operators.
- 4.22 The following maps show the areas where 2 or more, 3+, 4+ or all 5 operator network supply areas overlap.



**Figure 10** Areas with 2+, 3+, 4+ or 5 competitors present

#### Step 4: Aggregate to create a candidate market

4.23 The final step would be to aggregate areas to create a candidate market. In our hypothetical example, looking at the bottom right diagram showing the areas with 2 or more network operators, there are no isolated regions of network coverage. However, with a more realistic dataset there would likely be a more complex picture, and decisions would be needed analogous to those made under the current approach to decide which areas should be considered to form a single candidate market area.

4.24 Were this abstract area to be defined as a market, it begs the question of how market shares would be calculated, and how any subsequent regulation would be defined. One relatively simple option would be to translate the area into postcodes. That is, find all the postcodes contained within the network overlap area. It would then be relatively straightforward to calculate market shares, and to define regulation.

4.25 A potential issue with such an approach is that the coordinates of a postcode may be farther from the road (where duct network is likely to be found) than the buffer distance. A solution is to consider postcode unit areas rather than point locations. These areas are likely to extend to close enough to the road to intersect with the network supply buffer areas.

## Conclusions

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- 5.1 Ofcom's geographic market analysis is both detailed and complex. However, the aggregation of competitive conditions with postcode sector areas rests on the assumption that competitive conditions within postcode sectors will be reasonably homogeneous.
- 5.2 Outside a small area in central London consisting of the City and Westminster as far as Hyde Park, Ofcom's method creates a risk of regulatory failure. To the extent that SMP is found throughout the country, i.e. within in all sub national geographic markets, these errors are unlikely to have a serious detrimental effect on consumers or competition.
- 5.3 However, should Ofcom define a sub national business connectivity market (using its current methodology) for which the evidence indicates there may be effective competition, then it should take extra care that the analysis supporting its decision is robust. Differences in competitive conditions within larger postcode sectors are likely to mean that at least some customers are poorly served by competition, possibly to the extent that BT is the only realistic choice of supplier. Deregulating in these circumstances would constitute a regulatory error that could damage competition and consumers.
- 5.4 Ultimately, the solution to this problem is to assess competitive conditions in leased line markets at a more granular level than postcode sector. Although this will require additional processing, Ofcom already undertakes most of its analysis on the basis of full postcodes (before aggregating to postcode sector level). As such, the implementation costs could be kept to a manageable level. By way of example, we set out two alternative approaches to geographic market definition. These are not the only possibilities, but we consider that both options would generate a much more accurate and realistic picture of competitive conditions in business connectivity markets. Both would be feasible to implement, and could be employed alongside the current approach to consider areas where a more detailed investigation of competitive conditions is needed.
- 5.5 It is likely that Ofcom will need to continue to use its assessment based on postcode sectors for some time. Therefore, we have made a number of suggestions to improve the accuracy and reduce the potential for systematic bias in its analysis, including:
- Add existing leased lines (including network ends) to the large business site database to model demand locations;
  - Use coordinates of the full address of business sites rather than postcode;
  - Reduce the dig distance assumption to something more credible; and
  - Differentiate between suppliers in a manner analogous to the designation of Principal Operators in Ofcom's review of wholesale broadband access markets.
- 5.6 In addition, Ofcom should change the way it interprets the results of tests of alternative assumptions. The current method is analogous to the standard scientific method of testing a null hypothesis:

- Ofcom has a base case which it believes to be 'correct' and represents the null hypothesis; and
- Variations in assumptions are considered. If the end result is significantly different from the original results, then we reject the null hypothesis.

- 5.7 This is a valid approach in most circumstances, but it places a large burden on the judgement as to whether the new results are significantly different from those under the base case. In relation to the categorisation of high network reach postcode sectors, Ofcom needs more robust evidence to support these decisions. As we have seen, even a small change in the number of high network reach postcode sectors in London can lead to a loss of contiguity between central London, West London and Slough, and therefore result in a materially different candidate market.
- 5.8 As an alternative, we recommend that Ofcom adopt a more systematic approach to the use of its sensitivity tests, and only categorise a postcode sector as high network reach if it fulfils the relevant criteria under all reasonable assumptions. This would reduce uncertainty over market boundaries, and reduce the risk of regulatory error.
- 5.9 Finally, we note that any geographic analysis – both at market definition stage and SMP assessment – is likely to rely on postcodes to some degree. Great care must be taken in dealing with non-geographic postcodes. 21 of the postcode sectors in the current WECLA are non-geographic which creates ambiguity over the implementation of the current SMP conditions.

## Annex 1: Postcodes, postcode sectors and the derivation of their boundaries

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A1.1 Postcodes are used by the Royal Mail to help deliver mail to UK addresses efficiently. They are hierarchical, with the first set of letters and numbers referring to broad areas, and subsequent characters providing increasing precision as to the location of the relevant address.

A1.2 The following table explains the constituent elements of a postcode.

Postcode segment	Example	Approximate number in UK
<b>Unit (i.e. a full postcode)</b>	SE1 9HA	1.7 million
<b>Sector</b>	SE1 9	10,000
<b>District</b>	SE1	3,000
<b>Area</b>	SE	120

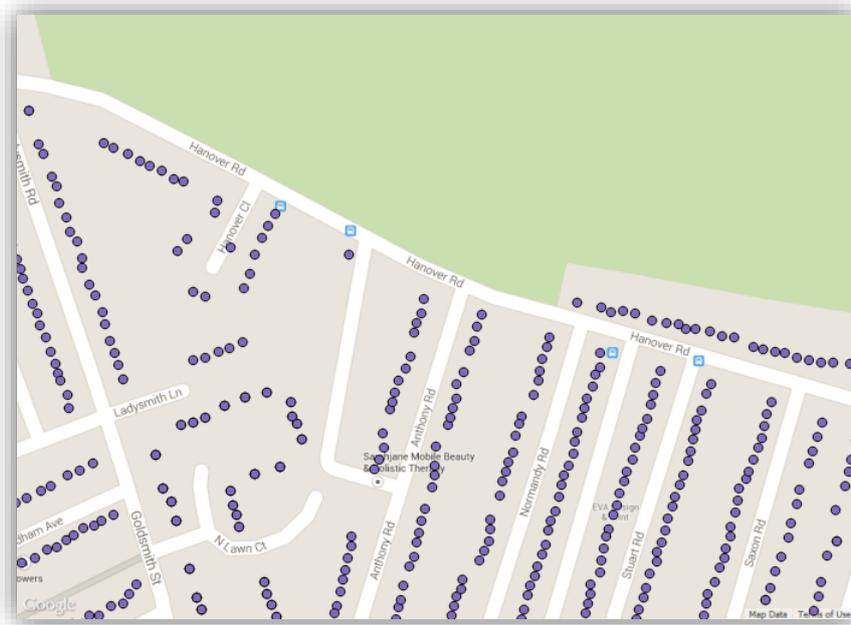
A1.3 The Royal Mail maintains the Postcode Address File (PAF) which contains details of all 29 million addresses in the UK. Each address is allocated a postcode unit (i.e. a full postcode), with up to approximately 100 unique addresses sharing the same postcode unit.

A1.4 The geography of a postcode is implied by reference to the underlying addresses. The area of a postcode unit is defined as being the area that contains all the addresses shared by that postcode. It doesn't matter where the boundary is drawn as long as it contains all the relevant addresses. Similarly, a postcode sector area is defined as the area containing all its constituent postcode units, and so on through the hierarchy. Therefore, there is no such thing as a 'correct' boundary for any of the postcode segments.

A1.5 Since the postcode system is designed to help deliver mail efficiently, it follows that the implied areas for postcode segments tend to be contiguous regions which do not overlap. However, postcodes are not created and managed with the consistency of these areas in mind, and so there are exceptions. In particular,

- Some large buildings will have more than one postcode unit (referred to as vertical streets), and on occasions these postcode units belong to different postcode sectors;
- Postcode sector areas can intersect one another, creating multiple regions for each sector;
- Some postcode units and sectors are non-geographic. These are usually for PO Box addresses. However, they are still geocoded with the coordinates of the relevant sorting office.

A1.6 To generate postcode boundaries, we start with the underlying addresses, i.e. each unique mail delivery point. Ordnance Survey produce data which contains a point location for each address. This will usually be at a point within the relevant building. Figure 11 below shows these locations for a small area in Exeter.



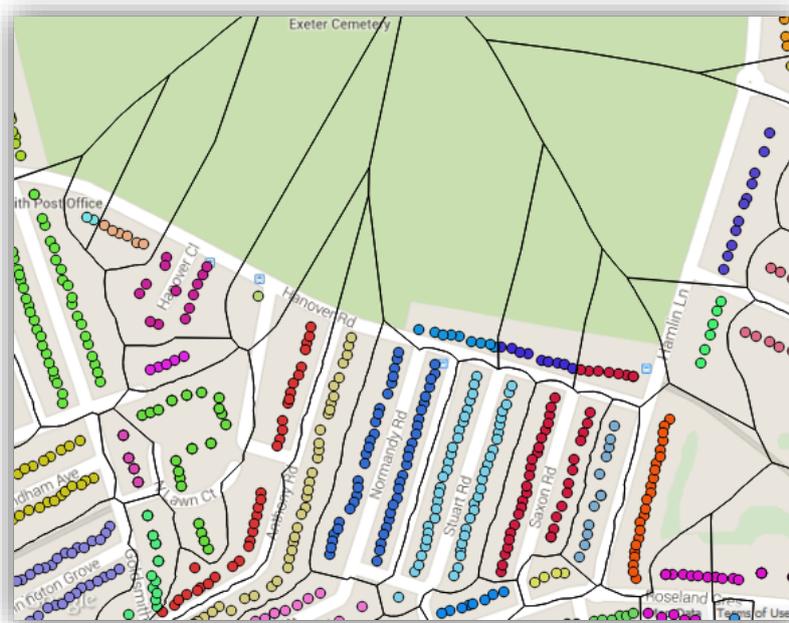
**Figure 11** A sample of address points in Exeter

- A1.7 Mail delivery points have no intrinsic geographic area, and so we have to create an area for each unique point location. As noted above, we can draw these boundaries anywhere as long as they contain the relevant address point. One technique used in GIS is to create what are known as Voronoi, or Thiessen, polygons for each of these locations. Any location inside one of these polygons is closer to its address point than to any of the other address points.
- A1.8 The following map shows the Voronoi polygons for the same set of addresses in Exeter.



**Figure 12** Voronoi polygons for a sample of address points in Exeter

A1.9 Lots of these addresses share postcodes. So we can now merge these individual address areas to create postcode unit areas, as shows below.



**Figure 13** Postcode unit areas based on Voronoi polygons of underlying address points

A1.10 The address points are coloured according to their postcode. The postcode unit areas are all valid in that each area contains all its constituent addresses. However, they are rather untidy and do not follow obvious boundaries such as roads, which a person would likely have used had they been asked to draw boundaries around sets of uniquely coloured dots. Therefore, the next stage that is often undertaken is to ‘clip’ these shapes to roads, rivers, and well defined administrative boundaries. This is a manual, and therefore subjective, process. The next diagram shows the results of this clipping exercise for the polygon dataset produced by Ordnance Survey<sup>47</sup>. The original Voronoi polygons are shown as a black dotted line, and the new polygons are the red lines.

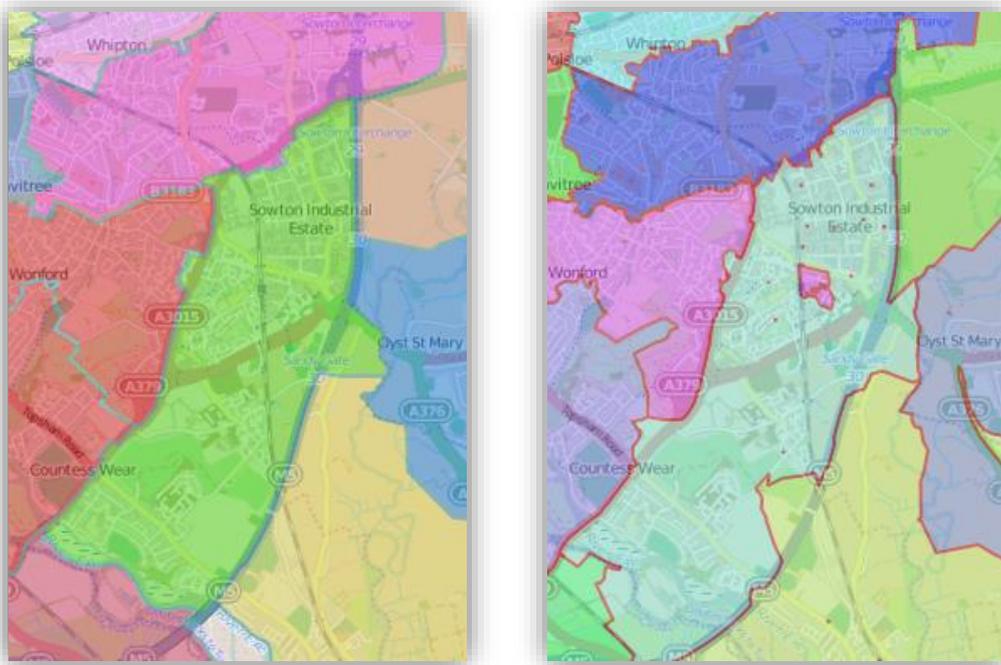


**Figure 14** A comparison of postcode unit areas produced

A1.11 The final step is to merge postcode unit areas into postcode segments. At this stage there may be some further manual adjustment to remove discontinuities in the resulting polygons<sup>48</sup>. Strictly speaking, this reduces the accuracy of the areas, but for most purposes this would be an appropriate compromise to produce contiguous postcode sector areas.

<sup>47</sup> OS CodePoint with polygons: <http://www.ordnancesurvey.co.uk/business-and-government/products/code-point-with-polygons.html>

<sup>48</sup> For example, GeoLytix (<http://geolytix.co.uk/geodata/postal-boundaries>) produces a postcode sector boundary dataset, and notes that “[t]he methodology used [to create the dataset] places an emphasis on following ‘natural’ boundaries; avoiding, where possible, enclaves, exclaves (holes and islands) and split Sectors.”



**Figure 15** Comparison between Geolytix cleaned up postcode sectors (left), and those produced by merging OS CodePoint Polygons (right)

A1.12 In the left hand map showing postcode sector boundaries produced by Geolytix, the central postcode sector (EX2 7) differs from the right hand map, produced by simply merging the OS CodePoint polygons, in the following ways:

- The southern boundary follows the contours of the river;
- The eastern boundary follows the M5 motorway more closely (and in general the other boundaries follow roads more closely); and
- The island of postcodes from the sector EX2 5 shown in pink in the right hand diagram are ignored.

## Annex 2: Further consideration of postcode sectors

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### *Mutual exclusivity*

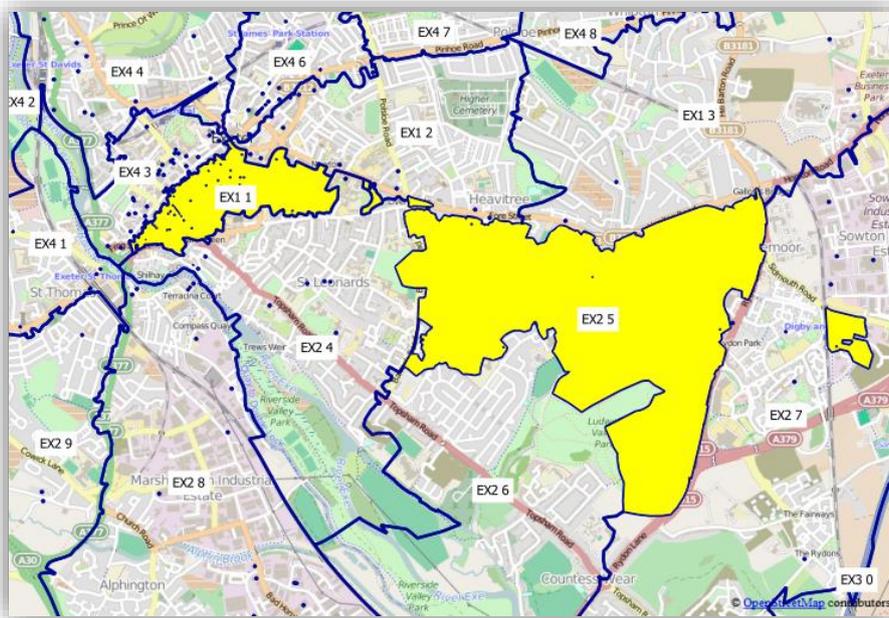
- A2.1 Postcode units and postcode sectors are not defined by reference to a geographic area, and therefore do not have inherent geographic dimensions. The Digimap service from the University of Edinburgh explains this clearly: “Postcodes are maintained by the Royal Mail and designed by them primarily for the efficient delivery of mail, not as a geospatial reference for spatial analysis or as boundaries to be used in thematic mapping.”<sup>49</sup>
- A2.2 Every address in the UK is uniquely associated with a single postcode. As such, *almost* every location is associated with a single postcode sector. However, there are exceptions where a single building such as a block of flats or a large office has more than one postcode. Given that postcode sectors are derived from postcodes, some buildings are associated with more than one postcode sector.
- A2.3 For example, within the OS sample dataset for Exeter<sup>50</sup>, there are 1,123 buildings which have more than one postcode. These are known as “Vertical Streets”. Of these, the vast majority of the relevant postcodes share the same postcode sector. However, 44 buildings have postcodes which come from different postcode sectors. That is, in respect of these buildings, the postcode sector does not create a mutually exclusive area: the location and area associated with the relevant buildings share two postcode sectors.
- A2.4 Clearly, this is a small minority of locations, but it serves to highlight the fact that postcode sectors are not well-defined geographic areas.
- A2.5 A more significant concern is that fact that postcode sector areas need not be contiguous. That is, a postcode sector area may be made up of two or more separate shapes, with the result that other postcode sectors then contain holes.

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[http://digimap.edina.ac.uk/webhelp/os/data\\_information/os\\_products/supporting/codepoint\\_guidance.htm](http://digimap.edina.ac.uk/webhelp/os/data_information/os_products/supporting/codepoint_guidance.htm)

<sup>50</sup> Vertical streets data is not generally freely published, but the OS provide a small sample of data for Exeter.



**Figure 16** An example of non-contiguous postcode sectors in Exeter

A2.6 Figure 16 shows the example of two non-contiguous postcode sectors in Exeter: EX1 1 and EX2 5. In both cases there is a primary area where most of the relevant postcodes reside. However, there are also a small number of postcodes in a nearby area surrounded by postcodes from a different sector.

A2.7 This is not particularly unusual, and merely reflects the fact that postcodes are created and organised to help Royal Mail deliver post rather than to create consistent, non-overlapping areas for mapping purposes.

#### *Clear and stable boundaries*

A2.8 Postcode sectors do not have unambiguous boundaries. As explained in annex 1, the boundaries are synthetic – created to contain address delivery points which share the same postcode sector. Any boundary which contains the relevant delivery points would be valid. Different organisations will create different boundaries based on the same underlying address and postcode data.

A2.9 These boundaries also change over time due to changes in the underlying postcodes and addresses. There are a number of reasons for these changes:

- Postcodes come in and out of service due to the construction and demolition of buildings;

- Royal mail will reorganise existing postcode allocations to ensure efficient delivery (for example if a new sorting office is built), and also occasionally in response to customer demand<sup>51</sup>.
- New postcode sectors are introduced to create additional postcode capacity, for example, to accommodate new developments.

A2.10 Although the introduction of new postcode sectors is relatively rare, postcode sector boundaries change more often due to the more frequent changes to the postcodes within existing sectors.

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<sup>51</sup> Apparently, people can get quite worked up about their postcode sector.

<http://www.standard.co.uk/news/london/postcode-war-as-hounslow-residents-fight-for-richmond-address-9095158.html>; <http://www.bbc.co.uk/news/magazine-26367320>

## Annex 3: Non-geographic postcode sectors in the WECLA

A3.1 The following table lists the non-geographic postcode sectors present in the WECLA as defined in Schedule 1 of the BCMR Statement 2013. The data comes from Royal Mail's file of non-geographic postcode sectors.<sup>52</sup>

Sector	Type	Company / Delivery Office / Post Town	Geographic area covered by delivery office
E14 1	PO Box	Poplar (Docklands) London	E14
E77 1	Large user	NatWest, LONDON E	E1 Sector 8
E98 1	Large user	News International, LONDON E	E1W Sector 2
EC1A 1	Large user	All Royal Mail Offices, LONDON EC1	EC1
EC2P 2	PO Box	East Central London EC2	EC2
EC2P 2	Large user	PO Boxes & some Large Users in LONDON EC (in the old District EC2) EC2 (AMNRVY)	EC2
EC3P 3	PO Box	East Central London EC3	EC3
EC3P 3	Large user	PO Boxes & some Large Users in LONDON EC (in the old District EC3) EC3 (AMNRVY)	EC3
SL1 0	PO Box	Slough Slough SL1 - SL2	SL1-SL2
SW95 9	Large user	Mail Opening for DWP, Nine Elms Lane, LONDON	All London Areas (inc HA)
TW3 9	PO Box	Hounslow Hounslow	TW3 – TW6
UB18 7	Large user	Spring International	UB2 Sector 5
UB18 9	Large user	Spring International	UB2 Sector 5
UB8 9	PO Box	Uxbridge West Drayton, Uxbridge	UB7 - UB11
W12 6	Large user	BBC TV, Blue Peter & other BBC Competitions, LONDON	W12 Sector 7
W1A 1	Large user	PO Boxes & Admail Codes in LONDON W1	W1
W1A 3	Large user	PO Boxes & Admail Codes in LONDON W1	W1
W1A 9	Large user	PO Boxes & Admail Codes in LONDON W1	W1
W5 9	PO Box	Ealing London	W5
W6 6	PO Box	Hammersmith London	W6
W8 9	PO Box	Kensington London	W8

<sup>52</sup> [http://www.royalmail.com/sites/default/files/12jan\\_current\\_non-geos-original\\_0.pdf](http://www.royalmail.com/sites/default/files/12jan_current_non-geos-original_0.pdf)