OFFICE OF COMMUNICATIONS

Disaggregated Markets

Leased Lines

Discussion Document

Publication date: **28 March 2006**

Closing Date for Responses: **8 June 2006**

Contents

Section 1

Summary

Introduction

1.1 This discussion document sets out various analyses that Ofcom has conducted in order to assess the extent to which there is evidence of geographic variations in competitive conditions in the various leased lines product markets in the UK. Leased lines are telecommunications products that are usually used by businesses. Unlike the telecommunications networks that residential customers generally use, which have shared capacity, leased lines offer end users dedicated transmission capacity. An example of an end-user that would use a network of leased lines could be a high street bank's network of cash machines or Camelot's network of Lotto terminals. Leased lines support the transmission of voice and of data and data transmission is symmetrical (i.e. upload speeds are the same as download speeds).

1.2 Leased lines are an important part of the UK's telecommunications infrastructure and it is important from a citizen perspective that end-users are able to access leased lines at competitive price levels and that incentives to innovate and improve customer service are increased.

1.3 The analysis presented in this document builds upon the analysis conducted in the leased lines market review (LLMR) published in May 2004 and also takes into account the relevant regulatory principles identified in Ofcom's strategic review of telecommunications, in particular the principle "to accommodate varying regulatory solutions for different products and, where appropriate, different geographies".

1.4 This discussion document does not address the question of the product market definitions for leased lines services, which were defined in the LLMR, nor does it seek to define the boundaries of any geographic markets that may exist. This document also does not assess whether there are any operators active in the market that may have significant market power (SMP) or assess the appropriate regulatory environment for the products in these markets.

1.5 In addition, this discussion document does not address the question of whether the Hull area constitutes a separate geographic market for the provision of leased lines services. The LLMR defined the Hull area as a separate market in the provision of retail leased lines services and wholesale symmetric broadband origination services on the basis of competitive conditions in the Hull area being significantly different from the rest of the UK. The question of whether the Hull area constitutes a separate geographic market in the leased lines products markets will be revisited in the next market review.

The LLMR

1.6 The LLMR defined six separate leased lines product markets, these being the markets for:

- retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s);
- wholesale low bandwidth traditional interface symmetric broadband origination (up to and including 8Mbit/s);

- wholesale high bandwidth traditional interface symmetric broadband origination (above 8Mbit/s up to and including 155Mbit/s);
- wholesale very high bandwidth traditional interface symmetric broadband origination (above 155Mbit/s);
- wholesale alternative interface symmetric broadband origination at all bandwidths; and
- wholesale trunk segments at all bandwidths.

1.7 For the first five of these, the LLMR defined the scope of the relevant geographic market as being the UK (excluding the Hull area) and the Hull area. For the wholesale trunk segments market, Ofcom defined the scope of the relevant geographic market as being the whole of the UK.

1.8 The geographic scope of the markets was defined primarily on the basis of behavioural characteristics of the markets, in particular, the presence of any common pricing constraints and also the extent to which buying patterns suggest that competitive conditions across geographic areas were linked. This approach was taken as a traditional SSNIP approach to geographic market definition, when applied to leased lines products, tends to result in very narrow markets, which at the limit for leased lines could result in individual leased lines being defined as separate markets. The LLMR also included an analysis of the extent to which there were variations in competitive conditions on a geographic basis. This analysis involved assessing the extent to which competitive conditions in different geographic areas were sufficiently homogeneous to be included in the same geographic market.

1.9 Ofcom carried out the analysis in two areas, the first being the areas bounded by the M25 and the second being Manchester, these being areas where Ofcom considered widespread competition to be most feasible. The conclusion of that analysis was that within these areas there would be a significant proportion of customers who would be captive to BT.

1.10 Ofcom found BT to have SMP, with the exception of the wholesale very high bandwidth traditional interface symmetric broadband origination market (TISBO), in each of the markets in the UK (excluding the Hull area), including the wholesale trunk market. Further, Ofcom found Kingston Communications to have SMP in the retail low bandwidth traditional interface leased lines market, the wholesale low bandwidth TISBO market, the wholesale high bandwidth TISBO market and the wholesale AISBO market.

1.11 As a result of these SMP findings a range of regulations were imposed on BT and Kingston in the markets in which they were found to have SMP.

Assessing geographic variations in competition

1.12 Ofcom has conducted a range of analysis in order to assess the extent to which there is evidence to suggest that competitive conditions vary on a geographic basis in the various leased lines markets in the UK. This analysis has involved Ofcom collecting data through consumer research, data from leased lines network operators and data from external published sources.

Consumer research data

1.13 Ofcom has used data from two sets of consumer research surveys to inform its assessment. The first research was conducted amongst large businesses[1] and the second amongst medium sized businesses[2].

Data from leased lines operators

1.14 Ofcom has sought to collect retail and wholesale data from leased line operators for each relevant leased line product provided in the UK. This involves around 600,000 retail leased lines and around 1 million customer end points (and considerably more wholesale components). Ofcom requested that the data be provided in such a way as to allow the geographic analysis to be conducted on a postal sector basis. Ofcom has also collected data from operators relating to their network points of presence. The data has allowed Ofcom to conduct various analyses of the extent to which different operators have the ability to provide leased lines services using their own networks, and of the extent to which different operators' shares of the provision of services varies by discrete geographic areas (postal sectors).

Statistical analysis

1.15 Ofcom has also been able to use the data provided by operators in combination with other publicly available data to assess the extent to which it is possible to group non-contiguous areas together into broader areas in which it could be expected that competitive conditions would be similar. This external data relates to factors that could be considered to be key drivers of demand for retail and wholesale leased lines products, namely data on business site density, household density and mobile base station density.

Geographic analysis of leased lines markets

1.16 Ofcom has focused its analysis in this discussion document on assessing variations in competitive conditions and behavioural factors, such as the existence of common pricing constraints and buying patterns, as opposed to conducting a SSNIP analysis, which, as noted above, tends to result in narrow geographic markets in the context of leased lines. The conclusions of Ofcom's analysis are mixed for the different product markets being considered, and can be summarised as follows:

- Retail low bandwidth traditional interface leased lines. There is little evidence of variations in competitive conditions in the provision of services in this market. However, BT's pricing policies could be indicative of there being a separate market in the central London zone.

- Wholesale low bandwidth TISBO. Again, there is little evidence of variations in competitive conditions in the provision of services in this market. However, BT's pricing policies could be indicative of the central London zone being a separate market.

- Wholesale high bandwidth TISBO. The analysis conducted of the geographic location of alternative operators' networks and the service shares on a postal sector basis indicates that it could be the case that there are significant variations in competitive conditions and that this could be reason to vary remedies within a

[1] Defined as having over 250 employees.
[2] Defined as having between 51 and 250 employees.

national market or to define separate local markets. Such a conclusion is also supported by BT's pricing policies, as BT prices these traditional circuits at a lower price in the central London zone both at the retail and at the wholesale level.

- Wholesale very high bandwidth TISBO. There are very few geographic areas where operators provide very high bandwidth traditional interface leased lines, either at the retail level or the wholesale level. The analysis could be suggestive of any variation in competitive conditions being very limited and that the relatively high value of these circuits makes entry generally economic.

- Wholesale AISBO. The analysis conducted of the geographic location of alternative operators' networks and the service shares on a postal sector basis indicates that it could be the case that there are significant variations in competitive conditions and that this could be reason to vary remedies within a national market or to define separate local markets. However, BT's pricing policy is to price these alternative interface circuits, at both the retail and wholesale level, on a national basis, suggesting the presence of a national common pricing constraint.

- Wholesale trunk segments. The analysis conducted of the geographic location of alternative operators' networks (in particular their connectivity with BT's Tier 1 nodes) and the service shares on a postal sector basis indicates that it could be the case that there are significant variations in competitive conditions on a route by route basis and that this could be reason to vary remedies within a national market or to define separate local markets. However, BT's pricing policy is to price wholesale trunk segments on a national basis, suggesting the presence of a national common pricing constraint.

1.17 Therefore, the strongest evidence for there being variations in competitive conditions on a geographic basis exists in the wholesale high bandwidth TISBO market and possibly also in the wholesale AISBO market and the wholesale trunk segments market. The evidence is such that it could be appropriate to either define local geographic markets for these products and then assess market power and apply remedies as necessary, or alternatively to vary remedies on a geographic basis, but within a national market.

Aggregation

1.18 The results of the assessment as summarised above raise questions about how different geographic areas should be grouped together for the purposes of imposing regulations. Is it necessary to have contiguous areas? Should "islands" of different competitive conditions be avoided? Is the postal sector the correct geographic unit from which to aggregate or would another unit, such as BT exchange areas or council authority boundaries be more appropriate? These are some questions on which Ofcom seeks stakeholders' views.

Varying remedies

1.19 It is possible that variations in competitive conditions within a market may be sufficient to warrant variations in remedies, by geographic area. As this discussion document does not define the geographic scope of the markets or conduct an SMP assessment in these markets, it is not possible for Ofcom to assess what an appropriate regulatory outcome may be. Nevertheless it is possible to consider how remedies could be varied going forward, if this is the appropriate outcome. Ofcom suggests how this issue could be approached and Ofcom seeks stakeholders' views.

Section 2

Introduction

Background

2.1 This discussion document sets out various analyses conducted by Ofcom of geographic variations in competition in leased lines markets in the UK. The analyses consider whether there is evidence to suggest that a future review of the leased lines markets might justifiably conclude that there are a number of separate geographic markets or that the regulation of leased lines should vary by geographic area. The analyses are conducted for each of the leased lines markets identified in the last market review.

2.2 There are three broad potential outcomes from the analysis:

- All or some of the product markets are national in scope (suggesting national remedies should be applied);
- All or some of the product markets are national in scope but there are variations in competition (such that local remedies may be appropriate, in recognition of any local characteristics that exist); or
- All or some of the product markets are local in scope (suggesting local remedies, if any, should be applied).

2.3 For those product markets where the conclusion of the analyses is that the evidence suggests that the product markets are national in scope but that there should be local remedies, or that the products markets are local in scope and there should be local remedies, this document considers potential different options for aggregating areas of similar competitive conditions. However, this document does not seek to define the boundary of revised geographic markets, assess operators' market power within those markets or consult on future remedies. These are issues that will be considered in future market review consultation documents as and when necessary and as such this discussion document does not propose any changes to the current regulatory arrangements in relation to leased lines services. However, this document does discuss different options for varying remedies within a national market, if such an approach is judged appropriate.

2.4 In carrying out this exercise Ofcom has taken full account of:

- the European Regulatory Framework; and
- Ofcom's Strategic Review of Telecommunications

2.5 The European Regulatory Framework sets out the framework in which Ofcom regulates the relevant communications markets in the UK, including leased lines. Ofcom's Strategic Review of Telecommunications sets out the principles Ofcom will use in formulating its regulatory approach.

The European Regulatory framework

2.6 Ofcom is obliged as the UK's National Regulatory Authority (NRA) to periodically review a core set of communications markets, as identified by the European

Commission. The goal of these reviews is to ensure that there is harmonisation in the way that European NRAs regulate these markets.

2.7 The market review process involves:

- defining relevant economic markets;
- assessing whether any operator has significant market power (SMP) within those markets i.e. whether they can act to an appreciable extent independently of competitors, customers and ultimately consumers in the markets identified (market share and barriers to entry are examples of key indicators of SMP); and
- imposing regulation or remedies to, amongst other things:
  - counteract any SMP identified; and
  - promote competition.

2.8 Remedies can take many forms, for example: obligations to supply, obligations not to unduly discriminate and the imposition of price controls.

2.9 The section sets out in more detail what is required at each stage of the market review process.

Market definition

2.10 The first step in the market review process is to define the relevant economic markets into which the various products and services being considered fall. There are two dimensions to the definition of a relevant market: the relevant products to be included in the same market and the geographic scope of the market. The definition of the product market is logically prior to the definition of the geographic market.

2.11 It is important to bear in mind that the market definition exercise is a means to an end and not an end in itself. That is, market definition is used to identify the relevant products against which to assess a firm's or a group of firms' market power in the market. This in turn informs the decision of whether to impose ex-ante regulations, on what products and in what areas to impose such regulations and the form of such regulations.

2.12 Market boundaries are determined by identifying constraints on the price-setting behaviour of firms. There are two main competitive constraints to consider: how far it is possible for customers to substitute other services for those in question (demand-side substitution); and how far suppliers could switch, or increase, production to supply the relevant products or services (supply-side substitution) following a price increase.

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

Product markets

2.14 As noted above, the HMT is a useful analytical tool used to define markets. The HMT considers a hypothetical scenario where there is only one supplier of the product in question. If the price of that product rose by a small but significant amount and was non-transitory, would a sufficient number of consumers of that product switch demand to other products to have the effect of rendering the relative price rise unprofitable? If they would, then those other products would be considered demand-side substitutes and would be considered to form part of the same relevant product market. The HMT also considers the effect of a relative price rise on supply-side substitution; would a relative price rise lead to entry within a short time (typically one year) into the provision of the service such to render the price rise unprofitable?

Geographic markets

2.15 The purpose of defining the geographic market is to determine an area in which the conditions of competition are similar of sufficiently homogeneous. The principles of demand-side and supply-side substitution also apply to the definition of the geographic scope of the relevant economic market. However, rather than considering alternative products, the analysis assesses the effect on demand of the relevant product in the geographic area being considered if there is a relative price change in a narrow geographic area. If the products in the relevant product market in other areas are sufficient substitutes, such as to render the price rise unprofitable then the geographic scope of the relevant market is widened to include these additional areas. Similar principles apply in relation to supply-side substitution.

2.16 Also relevant is paragraph 56 of the European Commission's Guidelines on market analysis and the assessment of market power, which states that in cases where there is a sufficient degree of variety in competitive conditions between areas (what a sufficient level might be is not specified), distinct local markets should be defined:

> "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."

2.17 Therefore, different geographic areas are found to be in the same relevant geographic markets to the extent that competitive conditions in different areas are sufficiently homogeneous.

Common pricing constraint

2.18 A third factor that is sometimes an additional consideration when defining the scope of product and geographic markets, in addition to demand-side and supply-side substitution, is whether there exist common pricing constraints across customers, services or areas such that they should be included within the same relevant market even if demand-side and supply-side substitution are not present. For example, it might be the case that a common pricing constraint exists where an operator or operators sets a uniform national price which results in the competitive pressure in one area being transmitted to other areas.

Chains of substitution

2.19 Both the product market and the geographic market can be affected by chains of substitution[3] which have the effect of broadening the relevant economic market. Because of the limitations associated with the use of demand-side and supply-side substitution when applied to leased lines markets (see paragraph 3.4) chains of substitution are likely to be of limited relevance.

SMP assessment

2.20 This part of the market review process assesses whether any operator within the relevant markets defined by the market definition exercise has significant market power (SMP). Under the Directives and section 78 of the Communications Act, SMP has been defined so that it is equivalent to the competition law concept of dominance. Article 14(2) of the Framework Directive states that:

> "An undertaking shall be deemed to have significant market power if, either individually or jointly with others, it enjoys a position equivalent to dominance, that is to say a position of economic strength affording it the power to behave to an appreciable extent independently of competitors, customers and ultimately consumers."

2.21 Further, Article 14(3) of the Framework Directive states that:

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

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

2.23 One useful indicator in assessing SMP is market share (either measured in volume of sales or revenues). There are, however, other indicators such as changes in market share over time, barriers to entry and exit (including sunk costs), economies of scale, scope and density and market concentration that could be relevant to take into account when assessing SMP within a market. One or more firms may be assessed as having SMP and different firms may have SMP in different geographic markets.

[3] A chain of substitution may exist for example where a customer would not travel from location A to location C to purchase a product and avoid a SSNIP, but would travel to location B. This may suggest that locations A and B are in the same geographic market but locations A is in a separate geographic market from location C. However, if there are customers in location B who would travel to location to C to purchase a product to avoid a SSNIP in location B, then this may suggest that locations B and C are in the same market. Because of a chain of substitution between locations A and B and locations B and C, locations A and C would be defined in the same geographic market.

Remedies

2.24 If any operator is found to have SMP in a particular economic market then Ofcom has to consider what regulation or remedies it should impose in order to address this SMP[4]. These are referred to as ex-ante regulations (in that they are imposed prior to particular behaviour) and can be designed to address potential anti-competitive behaviour, prevent exploitation of SMP e.g. price caps and/or to promote competition.

2.25 Although similar remedies can be imposed in multiple separate markets where Ofcom finds one or more operators to have SMP, each remedy is market specific. This means that if there are separate geographic markets there could potentially be different remedies in each of these markets.

The leased lines market review (LLMR)

2.26 In June 2004, Ofcom completed the Review of the retail leased lines, symmetric broadband origination and wholesale trunk segments markets ('Leased Lines Market Review' or 'LLMR'). This discussion document builds on work undertaken as part of that review.

Market definition in the LLMR

Product markets

2.27 Leased lines are fixed permanent telecommunications connections providing capacity between two points. The LLMR analysed these services at both the retail and the wholesale level.

2.28 At the retail level, the main distinguishing features of leased lines are that they:

- provide capacity dedicated to the user's exclusive use; and
- enable the user to send voice and data messages from one site to another.

2.29 Retail services may be either analogue or digital.

2.30 The LLMR also considered the underlying wholesale components of these retail services. Two categories of wholesale services were considered by the LLMR review: those relating to symmetric broadband origination and those relating to trunk segments. Within the first category, there are two sub-categories, namely traditional interface symmetric broadband origination ("TISBO") services and alternative interface symmetric broadband origination ("AISBO") services.

2.31 The LLMR identified the following product markets:

- retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s);
- wholesale low bandwidth TISBO (up to and including 8Mbit/s);
- wholesale high bandwidth TISBO (above 8Mbit/s up to and including 155Mbit/s);
- wholesale very high bandwidth TISBO (above 155Mbit/s);

[4] Article 8(2) of the Access Directive/ Section 87 of the Communications Act 2003

- wholesale AISBO at all bandwidths; and
- wholesale trunk segments at all bandwidths

Geographic markets

2.32 Once the relevant product markets had been defined, Ofcom analysed the geographic dimensions of these markets.

2.33 Ofcom considered various data and methodologies when defining the geographic scope of the relevant markets. First of all, Ofcom considered using a SSNIP analysis to define the geographic boundary. However, Ofcom concluded that such an analysis of demand-side and supply-side substitution would lead to the identification of a multitude of highly localised geographic markets because of limited demand-side and supply-side substitution opportunities. Ofcom concluded that because of this, such an approach is not practical or desirable. Given this, and consensus from BT and other communications providers, Ofcom considered other factors that could inform the geographic boundary of the relevant market.

2.34 The two key additional factors considered by Ofcom were:

- cluster markets (buying patterns) - in certain cases, products or areas may be considered to be in the same product or geographic market on the basis of a cluster market analysis if consumers purchase the relevant services as a bundle. This may mean that buyers are not solely concerned with the individual prices of particular products or in particular areas, but with the total price of the bundle. They could in practice purchase the product on a national basis; and
- common pricing constraints - i.e. areas in which a firm voluntarily offers its services at a geographically uniform price may constitute a single market.

2.35 Ofcom's assessment of these factors for each of the different type of product market reviewed in the LLMR is summarised in Table 1 below.

Table 1 – Criteria used in the LLMR for assessing geographic markets

Product market	SSNIP test	National buying patterns	National pricing constraint
Retail traditional interface	Proliferation of highly localised markets – impractical to analyse	Strongly suggests a national market	Suggests CLZ[5] and Hull area separate from the rest of the UK
TISBO		May suggest a national market	Inconclusive
Trunk segments			Suggests a national market
AISBO			Suggests a national market

2.36 The LLMR also considered the extent to which there were variations in competitive conditions on a geographic basis to inform the geographic boundary of the relevant

[5] CLZ is the Central London Zone, being the geographic area served by the 020 7 dialling code.

markets. This involved assessing the extent to which competitive conditions in different geographic areas were sufficiently homogeneous to be included in the same geographic market.

2.37 In informing this assessment, Ofcom carried out analysis for central London and for Manchester. Ofcom chose these areas as it expected these areas to be two of the areas in the UK where widespread competition would be most feasible. Ofcom assessed the extent to which alternative network operators would be able to provide leased lines services to businesses with greater than 250 employees, assuming an economic build distance of 300m.

2.38 This analysis showed that for London (defined as the areas lying within the M25) the central London zone (defined as the area served by the 020 7 area dialling code) and Manchester (the boundary being defined in reference to the M60) that there would be a significant proportion of customers who would be captive to BT.

2.39 The conclusion of the analysis in the LLMR was that national market definitions were appropriate given:

- the highly localised nature of competition in leased lines markets meant that there would be significant uncompetitive areas within any geographic areas that were declared to be broadly competitive in aggregate;
- the national buying patterns that existed, especially at the retail level; and
- the presence of a common pricing constraint, which was a material factor in trunk and AISBO markets.

2.40 Nevertheless, Ofcom recognised that the impact of regulation and market developments may cause there to be a different conclusion in a future review.

SMP assessment in the LLMR

2.41 On the basis of the markets defined in the LLMR and following an assessment of SMP indicators within those markets, BT was found to have SMP in the following markets:

- retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s) in the UK (excluding Kingston upon Hull);
- wholesale low bandwidth TISBO (up to and including 8Mbit/s) in the UK (excluding Kingston upon Hull);
- wholesale high bandwidth TISBO (above 8Mbit/s up to and including 155Mbit/s) in the UK (excluding Kingston upon Hull);
- wholesale AISBO at all bandwidths in the UK (excluding Kingston upon Hull); and
- wholesale trunk segments at all bandwidths in the whole of the UK (including Kingston upon Hull).

2.42 Kingston Communications was found to have SMP in the following markets:

- retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s) in Kingston upon Hull;

- wholesale low bandwidth TISBO (up to and including 8Mbit/s) in Kingston upon Hull;
- wholesale high bandwidth TISBO (above 8Mbit/s up to and including 155Mbit/s) in Kingston upon Hull; and
- wholesale AISBO at all bandwidths in Kingston upon Hull.

Remedies in the LLMR

2.43 As a result of these findings a range of SMP conditions were imposed on BT and Kingston in the markets in which they were found to have SMP (see Section 6).

2.44 The LLMR acknowledged that the question of geographic market definition in relation to the provision of leased lines services is a complex one which raises many economic and policy issues. Ofcom recognised that the issue would need to be reviewed as markets develop and in particular as the introduction of wholesale PPCs further impacted on the market. Ofcom stated its intention to conduct analysis relating to geographic markets across the sector in the context of its Strategic Review of Telecommunications.

Strategic Review of Telecommunications

2.45 Ofcom's Strategic Review of Telecommunications was the first wide-ranging analysis of the telecommunications sector for thirteen years and aimed to establish Ofcom's principles for the future regulation of the UK telecommunications industry. A particular focus was on developing the strategy through which Ofcom will promote competition, or take other regulatory action, to further the interests of consumers and citizens in the UK. The key outputs of the Review were the Phase 2 consultation document, issued on 18 November 2004 and a statement issued on 22 September 2005 setting out Ofcom's approach to future telecommunications regulation.

2.46 In the phase 2 consultation document[6], Ofcom set out seven key regulatory principles which it proposed should be used to guide its actions. The principle that is most relevant to the issues considered in this discussion document is the principle that varying regulatory solutions for different products and, where appropriate, different geographies should be accommodated.

2.47 Ofcom recognises that the development of remedies may vary according to the extent of competition within a market which has been defined as being national in scope. Such an approach could require setting remedies which allow some flexibility but at the same time would address the concerns that a complete removal of SMP obligations might entail. For example, within a national retail market, it may be appropriate to withdraw regulation in some geographic areas while relying on obligations on a national basis in the whole of the relevant wholesale market[7].

2.48 A number of respondents to the consultation on phase 2 of Ofcom's strategic review of telecommunications supported the idea of a separate consultation specifically on the issue of geographic regulation of telecommunications markets. Ofcom believes that it would be more constructive to consult on the implications of geographic

[6] "Strategic review of telecommunications: Phase 2 consultation document", Ofcom, 18 November 2004.
[7] Section 45 (10) of the Communications Act 2003 gives Ofcom the specific power to set different SMP conditions in relation to different parts of the UK.

regulation in relation to specific markets. This discussion document, therefore, focuses on the consequences of applying these principles in leased lines markets in particular.

Purpose of this discussion document

2.49 In this discussion document Ofcom assesses the evidence that there are significant geographic variations in competitive conditions in the various leased lines product markets and considers whether it could be appropriate to vary remedies on a geographic basis. This discussion document also considers the scope for concluding for the product markets identified in the LLMR that the scope of the geographic markets has changed and that competitive conditions are not sufficiently homogeneous to conclude that each product market is national, but suggests that a number of local markets should be defined.

2.50 Ofcom has focused on the product markets in which the LLMR found an operator to have SMP and to which remedies were applied. These product markets were:

- retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s), the "retail low bandwidth leased lines market";
- wholesale low bandwidth traditional interface symmetric broadband origination (TISBO) (up to and including 8Mbit/s), the "wholesale low bandwidth TISBO market";
- wholesale high bandwidth traditional interface symmetric broadband origination (above 8Mbit/s up to and including 155Mbit/s), the "wholesale high bandwidth TISBO market";
- wholesale alternative interface symmetric broadband origination at all bandwidths, the "wholesale AISBO market"; and
- wholesale trunk segments at all bandwidths, the "wholesale trunk segments market".

2.51 Ofcom has also considered the other product market, which was defined as being national in scope in the LLMR, and in which no operator was found to have SMP, namely the "wholesale very high bandwidth TISBO market". Ofcom has considered this no-SMP market in this discussion document on the basis that within this product market, competitive conditions may also vary geographically such that separate local markets could be defined or such that remedies could be varied within a national market[8].

2.52 Section 3 of this discussion document sets out Ofcom's methodology for assessing whether there are geographic variations in competitive conditions, describing the various work streams undertaken. Section 4 then sets out the results of Ofcom's analysis and Ofcom's views on geographic variations in competition in each of the relevant product markets on the basis of the analysis undertaken.

2.53 Section 5 goes on to discuss the issues associated with aggregating areas of sufficiently homogeneous competitive conditions. Section 6 discusses the scope and

[8] Although it would only be possible to vary remedies within a national market if an operator were found to have SMP in the national market.

options for varying remedies on a geographic basis within markets defined as national in scope, with Section 7 setting out the next steps.

2.54 Annex 1 of this discussion document sets out the process for responding to the various questions posed, with Annex 2 setting out Ofcom's consultation principles, Annex 3 being a cover sheet for responses and Annex 4 listing all of the questions posed in Sections 3 to 6 of the discussion document. Annex 5 summarises the findings of the consumer survey research relevant to the consideration of geographic variations in competition in leased lines. Annex 6 sets out the details of Ofcom's network reach analysis, with Annex 6 explaining the details of Ofcom's market analysis. Annex 8 presents the various statistical analyses that Ofcom has conducted. Annex 9 provides a glossary of terms used in this discussion document.

2.55 Ofcom has also published along side this discussion document the findings of the consumer research used in this discussion document. Ofcom will also publish in early April further details of its market analysis, providing information for the whole of the UK.

Section 3

Assessing geographic variations in competition

Introduction

3.1 This section describes the various work streams that Ofcom has undertaken in order to inform its assessment of the extent of geographic variations in competition in the various leased lines product markets defined in the LLMR and identified in the previous Section.

3.2 This Section sets out:

- Ofcom's approach to geographic market definition; and
- a description of the different types of analysis and data that Ofcom has used to inform its assessment of variations in competitive conditions on a geographic basis in the various leased lines product markets.

Geographic Market Definition

3.3 As noted in the previous section, geographic market definition is concerned with identifying discrete geographic areas in which competitive conditions are sufficiently homogeneous. A useful tool for informing this assessment is the HMT or SSNIP test, which involves assessing the extent to which it is possible for a hypothetical monopolist in the provision of a specific product in the area in question to profitably sustain a relative price rise.

3.4 This involves the analysis of demand-side and supply-side substitution. The LLMR stated that a traditional SSNIP analysis may, at the extreme, lead to separate geographic markets being defined for each individual leased line. However, with about 600,000 retail leased line circuits with around 1 million customer end points (and considerably more wholesale components) in the UK this approach would be wholly impractical, not only from a market definition perspective, but also from the perspective of assessing SMP and imposing and enforcing remedies. Therefore, given these practical difficulties, some level of aggregation is required.

3.5 A second approach is that used in the LLMR which assessed behavioural indicators of competition, looking at buying patterns, both at the retail level and at the wholesale level and looking at pricing behaviour to see whether there exists a common pricing constraint across geographic areas. A third approach is to look at supply conditions, that is, the number of operators having the ability to supply customers in a given area. As noted in the previous Section the LLMR included an analysis of operators' network build, focussing on two geographic areas: that bounded by the M25 and Manchester

3.6 In carrying out geographic analysis at a disaggregated level there are a number of different discrete geographic areas that can be used as the building block from which more aggregated areas can be identified. There are also a number of different ways in which the analysis of the leased lines markets in the UK can be aggregated from

looking at each leased line (and wholesale components) individually. Ofcom has considered a number of possibilities. These include:

- looking at the markets on an exchange by exchange basis;
- looking at the markets on an area code basis e.g. all exchanges serving 020 7 codes (central London) and 0121 (Birmingham) could be defined as being suitable for having varied remedies or being separate geographic markets;
- defining the appropriate areas as within an easily identifiable defined boundary, such as within the M25; and
- using postcode information.

3.7 Ofcom, considers that the most appropriate building block from which to collect data, conduct analysis and from which to aggregate is to use postcode information. This is for the following reasons:

- Most, if not all, operators know the postcode of the premises to which they provide services;
- Operators know the postcode of where they interconnect with other operators;
- Using postcode information allows flexibility to aggregate up to different postal measures, such as sectors, districts or areas;
- Using postcode information would allow Ofcom flexibility to aggregate different, geographically disparate geographic areas together;
- The more disaggregated the information the less the potential for 'black holes' i.e. the designation of SMP can reflect local variations in competition more closely, avoiding significant pockets of variations in competitive conditions within a broader geographic market. This is a particular problem of using areas such as dialling codes or the M25 as a boundary;
- This approach offers a greater degree of flexibility, increasing the ability to respond to changes in geographic variations in competitive conditions in future market reviews, to the extent that discrete areas can be added or taken away from geographic market boundaries or the areas where remedies are varied; and
- Using postcodes allows Ofcom to assess the extent to which operators have network presence at each end of a leased line.

3.8 Ofcom, in carrying out its assessment of the homogeneity of geographic competitive conditions in the leased lines markets has used postal sector data. Postal sectors are defined as the full postcode, minus the last two characters e.g. SE1 9.

Assessment of geographic variations in competition

3.9 Ofcom, in assessing the homogeneity of competitive conditions on a geographic basis has sought to assess the extent to which there are, or could be on a forward-looking basis, differing competitive conditions in different geographic areas for a given set of products, as identified in the product market definition exercise in the LLMR. Areas in which competitive conditions are sufficiently homogenous could be found to be in the same geographic market. These geographic areas need not be

contiguous and indeed could be expected to be geographically disjointed. This is because the definition of the relevant geographic market is not being defined in reference to demand-side and supply-side substitution, but in reference to the homogeneity of competitive conditions.

3.10 In those geographic areas where there are insufficient competitive constraints, appropriate regulation could then be implemented. Issues related to these questions of aggregating geographic areas into relevant markets are considered in Section 5 below.

3.11 In some respects, because this approach to market definition involves assessing variations in competitive conditions, the types of analysis used in this approach are similar to those which Ofcom would adopt when assessing SMP in a relevant economic market. The difference here though is that the competitive conditions for different products are assessed on a geographic basis to define the geographic market. Thereafter, once the relevant scope of the product market and geographic market has been identified, the relevant SMP analysis would be conducted.

3.12 The use of a consistent set of indicators to define the geographic scope of the market and in the analysis of SMP should help ensure that competitive conditions in a defined area are indeed broadly homogeneous and that the SMP finding is appropriate to the area as a whole. Therefore, this approach is likely to reduce the occurrence of "black holes"[9] in any SMP findings. If, at the aggregation stage (see Section 5) areas are grouped in such a way that competitive conditions are sufficiently homogeneous throughout the combined area, it is much more likely that, when the analysis of SMP and the need for remedies is performed using data for the combined area, its conclusions will be appropriate throughout the combined area as a whole.

3.13 In this context, it is useful to bear in mind the type of information that can be used to assess SMP in the various leased line markets when assessing the extent to which competitive conditions are homogeneous in different geographic areas. The Commission has identified a number of criteria that should be addressed when assessing whether an operator has SMP in a market. The main criteria that are relevant to the various leased lines markets and assessed in the LLMR are:

- Market shares;
- Control of infrastructure not easily duplicated;
- Economies of scale;
- Economies of scope;
- Vertical integration;
- Ease of market entry;
- Barriers to switching;

[9] "Black holes" being those small areas within a larger area where the incorrect conclusion on SMP is found e.g. no SMP is found in a broad area, but that area contains pockets of areas where there is indeed SMP or SMP is found in a broad area, but that area includes pockets of areas in which there are competitive constraints such that no SMP should have been found.

- Network reach.

3.14 For this discussion document Ofcom has focused on information on market shares[10], barriers to switching and network reach to assess the homogeneity of competitive conditions on a geographic basis. This is because these are the factors for which it has been possible to collect geographic data and the factors which are likely to be most relevant for assessing variations in competitive conditions on a geographic basis. This analysis has several strands, including the following:

- Consumer survey. This involves using data from consumer surveys (i.e. surveys of large businesses and of SMEs) to assess the extent to which consumers of retail leased lines buy bundles of leased line products across different geographic locations and their understanding of how prices vary on a geographic basis. This data can then be used in combination with empirical data from operators to assess the extent to which buying patterns could mean that the relevant geographic market is broader than local areas, for example if operators purchase services on a national basis.

- Supply-side analysis/ network reach analysis. This involves mapping the geographic reach of operators' networks to assess the extent to which for the various retail leased line product markets, the number of operators able to supply an area and hence exert a competitive constraint on BT, with its ubiquitous network, varies on a geographic basis.

- Market analysis. This involves analysing empirical data collected from operators in order to estimate the service share of each operator in each postal sector at both the wholesale and retail level in each of the product markets.

3.15 Ofcom does not believe that any of these work strands alone would yield sufficient information to allow a comprehensive consideration of the extent of any variations of competitive conditions on a geographic basis. However, together, the work strands allow Ofcom to achieve this.

Consumer Survey

3.16 The first strand of Ofcom's work in this area has been an analysis of 'consumer' views on leased lines and geographic variations in competition. In the case of leased lines, end-users are generally-speaking large corporations[11] and medium sized businesses[12]. Ofcom surveyed nearly 500 large businesses and around 200 medium sized businesses in order to consider the geographic dimension to their buying patterns. A summary of the main conclusions that can be drawn from the consumer surveys in relation to geographic markets is set out in Annex 5 and both of the research reports are being published alongside this discussion document.

Network reach analysis

3.17 Ofcom's network reach analysis is focused at the wholesale level and assesses the opportunities for operators to compete with BT (in the UK excluding the Hull area) and Kingston (in the Hull area) at these levels.

[10] Although the information Ofcom has used is not strictly market shares as it is based on operators' shares of ends on a postal sector basis. Throughout this discussion document these are referred to as service shares.
[11] Those businesses with more than 250 employees.
[12] Those businesses with between 51 and 250 employees.

3.18 As part of the LLMR, Ofcom undertook a direct comparison of the network reach of a range of operators in major metropolitan areas. Using data purchased from Experian and network maps provided by operators, Ofcom plotted the fibre and duct networks of five of the largest competitors to BT against the locations of businesses with 250 or more employees. The 250 employee cut-off point was used since, based on discussions with industry, Ofcom is of the view that this is a reasonable proxy for the size of business that will be a potential customer of leased line services. It is also the case that the cost of a leased line is less likely to be justifiable in the case of smaller businesses.

3.19 This analysis was undertaken for the LLMR in 2004 and Ofcom has recently confirmed with the five relevant operators that their network fibre layouts have not changed significantly and as such the same results have been used for comparison with other recent findings which are based on data that Ofcom gathered specifically for this consultation.

3.20 Ofcom, for the purposes of this project has asked data from a larger number of operators than it had for the LLMR previously. The data that was submitted from the alternative network operators (Altnets) consisted of the following:

- A list of all points of presence (geographically located by means of their postcodes/addresses/coordinates) which play a significant role in Altnets' build/buy decisions; and
- Postcode information of the network points where they handover PPC traffic to/ from BT (points of handover), the type of interconnection and whether the node is a BT trunk node.

3.21 The data that was gathered from BT consisted of:

- An update of the traffic volume data for traffic passing through each of BT's SDH Tier 1 nodes; and
- BT's "T-codes"[13] for the entire UK.

3.22 The data gathered on operators' points of presence in relation to the provision of leased line services has allowed Ofcom to undertake a number of different analyses to assess the geographic reach of operators' networks. The details of this analysis are set out in Annex 6, but can be summarised as being:

- a count of operators' points of presence at postal sector level; and
- an assessment of the number of postal sectors whose large business sites are contestable by different numbers of operators, taking into account different assumptions about economic build distances.

3.23 In carrying out this analysis it is necessary for Ofcom to make a number of assumptions. The main assumptions relate to:

- the number of operators required in order to offer a sufficiently greater level of competitive constraint from those areas where there is no choice of operator; and

[13] BT's T-codes is a fibre flexibility point within its network and is usually located in a footway box.

- the distance that an operator would build from a PoP in order to provide services to a business site.

3.24 In order to illustrate the differences in competitive constraint that may exist, Ofcom's base case assumption on the first of these is that in the circumstances of leased lines markets there would need to be at least two additional operators (i.e. at least 3 operators) in an area in order to provide a sufficiently different constraint. On the second, in the network reach analysis conducted for the LLMR, Ofcom's analysis assumed that operators would be willing to extend their network by a distance of 300 metres from their fibre networks to serve a business customer, recognising that distances would vary on a case by case basis[14]. However, the additional analysis that Ofcom is conducting for this discussion document requires assumptions to be made about economic build distance from operators' points of presence, rather than from their fibre networks. In these circumstances, Ofcom believes that it is appropriate to assume longer build distances than would be the case if it was analysing the effect of extending an operator's fibre network as operators would in reality not be limited to extending their networks from the location of their points of presence. Ofcom has assumed, for its base case, an economic build distance of 500 metres, although again recognising that actual economic build distances will be affected by numerous factors and may vary be geographic location. A future market review ill need to consider what an appropriate build distance is and any conclusions would have to be made in light of this.

Market analysis

"Service" share analysis

3.25 As explained above, information on "service" shares may be useful for the purposes of identifying areas which enjoy homogeneous competitive conditions. However, it should be noted that these service shares are not market shares, but the proportion of leased lines services provided by each operator in each postal sector. Using this information, together with the other analysis considered in this discussion document, can be helpful in identifying those areas with sufficiently homogeneous conditions to conclude they are in the same geographic market. Once this exercise has been concluded and the precise scope of the relevant economic market defined, operators' market shares across the whole market can then be assessed as part of any assessment of SMP within the relevant markets.

3.26 In the LLMR, Ofcom used aggregated retail market share information to inform its assessment of SMP but was unable to present market share data at the wholesale level. Instead, in its analysis of the wholesale market, Ofcom had to rely on retail market share data as a proxy for market shares at the wholesale level. To inform the assessment of BT's wholesale market shares, Ofcom made assumptions, based on information received from BT, about the proportion of retail circuits (in addition to BT's own retail circuits) for which it provides wholesale inputs.

3.27 For the purposes of this discussion document, Ofcom wanted to analyse both retail and wholesale service share information. The first stage of this analysis, consistent with the approach taken in the LLMR, involved Ofcom analysing, on a postal sector basis, the data provided by operators separately for low bandwidth, high bandwidth

[14] The LLMR noted that network operators had suggested to Ofcom that they would typically be prepared to extend their networks by 20 to 100 metres in order to serve a new customer. However, due to practical issues around analysing the available data, the shortest distance that Ofcom could conduct the analysis was to assume a dig distance of 300 metres.

and very high bandwidth traditional interface retail circuits and for alternative interface retail circuits. Additionally, this stage also involved Ofcom analysing, for retail circuits, operators' shares of different trunk routes. These different analyses at the retail level could then be used as an input into the assessment of the extent to which competitive conditions vary on a geographic basis at the retail level, but additionally can also inform an assessment of the extent to which competitive conditions vary on a geographic basis at the wholesale level.

3.28 The second stage of the analysis was to conduct similar analysis at the wholesale level to that conducted at the retail level. This would involve assessing wholesale data provided by operators for low bandwidth, high bandwidth and very high bandwidth TISBO wholesale circuits, for AISBO wholesale circuits and for trunk wholesale circuits. Similar to the analysis conducted at the retail level, this analysis will inform an assessment of the extent to which competitive conditions vary on a geographic basis at the wholesale level.

3.29 Ofcom has attempted to gather this level of disaggregated information from operators. Ofcom always recognised that it would be challenging for operators to provide all of the data requested. A summary of the information requested by Ofcom is set out in Table 2.

Table 2 – Summary of information requested from operators

Information	Retail	Wholesale (symmetric broadband origination)	Wholesale (trunk segments)
Postcode location of each end or connection to trunk	Yes	Yes	Yes
Bandwidth	Yes	Yes	Yes
Analogue or digital	Yes	Yes	N/A
Traditional interface or alternative interface	Yes	Yes	N/A
Point of handover (if relevant)	N/A	Yes	Yes
Who buy from/ sell to	No	Yes	Yes
Closest BT tier 1 nodes	N/A	Yes	Yes

3.30 Despite the high response rate and levels of co-operation from operators there are a number of key concerns with the data provided by operators in response to the information requests, which impacts the reliability/ robustness of any conclusions that can be drawn from the analysis. These key concerns are:

- The data provided by operators is not always entirely consistent with the product market definitions specified by Ofcom in the LLMR. In particular, operators found it difficult to provide trunk information on the basis of the definitions in the LLMR.
- Not all circuits had sufficient postcode information and where this information has been provided it was not always accurate. This was particularly the case with older circuits where postcodes had changed/ no longer existed.

- In calculating operators' shares of leased lines services in each postal sector, Ofcom would normally use both volume and revenue information. However, it has not been possible to obtain revenue information, primarily because operators' billing data cannot be cross referenced back to circuit location information. As a result Ofcom has focused its analysis in this discussion document on volume information.

3.31 Nevertheless, the data made available from operators at the retail level has allowed Ofcom to conduct a detailed analysis of the retail level of the relevant leased lines markets. However, because of the data issues, as described above, in order to carry out this analysis, Ofcom has had to make a number of adjustments to the data provided by operators to ensure that the analysis is conducted on an as accurate as possible data set. A description of the analysis that Ofcom has conducted at the retail level and the adjustments that Ofcom has made to the data is set out in Annex 7 of this document.

3.32 While the wholesale markets data provided by BT was broadly comprehensive, the data provided by Altnets in relation to the request for wholesale data has been such that it has not been possible for Ofcom to conduct the analysis that it was originally intending to for these markets and which it has carried out at the retail level. Altnets have consistently informed Ofcom that the information that Ofcom requested is not routinely collected and as such to provide the data requested by Ofcom is not possible within the timeframes available. To provide comprehensive data of the sort requested by Ofcom for the wholesale level would require significant investment in data systems and take many months.

3.33 Despite the incomplete data set at the wholesale level, Ofcom has been able to carry out some additional analysis on the data available that could contribute to the assessment of variations of competitive conditions on a geographic basis at the wholesale level. The details of that analysis are also set out in Annex 7 of this document.

Statistical analysis

3.34 In addition to these service share analyses, Ofcom has also undertaken various statistical analyses. These statistical analyses have two main purposes. The first is to provide data that can be compared at a high level against the other analysis that has been carried out in order to perform a "sense-check" function. The second is to inform the aggregation of postal areas into discrete geographical areas which can be viewed as separate local geographic markets or into areas in which variations in competitive conditions are such that it could be appropriate to vary remedies

3.35 As noted above, in order to analyse the various leased lines markets to the level of granularity required, Ofcom has requested a considerable amount of data from BT and other operators relating to the retail leased lines services they provide and the wholesale elements underlying these services. For any individual leased line, these wholesale elements may be self-provided or purchased from another operator or a combination of the two.

3.36 Ofcom has devised regression models to inform an assessment of the extent to which it is possible to identify demand-side factors that can be used to explain variations in competitive conditions. By assessing the main drivers of leased lines demand and using this in conjunction with the data provided by operators, it could be possible to use regression analysis to identify those geographic areas where there is likely to be greater competitive pressures, due to operators building networks and providing services to end users.

3.37 These demand-side factors can then provide a basis for cluster analysis, which can be used to inform a possible method for aggregating postal sectors into markets (see Section 6). Ofcom has considered the main factors affecting the take-up of leased lines and used this information to predict where greater take-up of leased lines is likely and, therefore, the geographic areas where it could be expected there to be a greater level of competition. The regressions can then be used to identify, using the number of operators offering services, operators shares of service ends and a count of aggregate bandwidth in each postal sector as explanatory variables, those postal sectors in which there is likely to be a stronger competitive constraint and those in which competition is less likely to exist and any constraint would be weaker. Further explanation of these regressions is provided in Annex 8 of this document.

3.38 Prior to undertaking this exercise, Ofcom discussed this approach with a number of operators, including BT and UKCTA, as well as considering the availability of different data sets that could be used to explain competitive conditions in leased lines markets. These operators broadly supported Ofcom's proposed approach, but highlighted that although demand-side factors that have been identified are significant drivers of demand and hence network build, there other significant factors that affect operators' network build, but for which data sets are not available. The main drivers of leased lines demand identified by Ofcom are:

- Household densities: Although not directly offered to residential consumers, leased lines are used in the provision of broadband origination and content (such as video on demand) services to such customers. In particular LLU operators will use leased lines in the provision of LLU backhaul.

- Business site densities: Leased lines are a business product and all other things remaining equal, in general, the larger a business, the more likely it is to use leased lines services. Ofcom has therefore taken into account several possible measures of business densities per postal sector. The regression models considered, for each postal sector, the following variables:

    - Count of business sites[15] for those business types for which separate research suggests has a high spend on leased lines services;

    - Count of business sites for those business types for which separate research suggests has a medium spend on leased lines services;

    - Count of business sites for those business types for which separate research suggests has a low spend on leased lines services;

    - Count of all the business sites[16];

    - Ratio business per postal sector area; and

    - A prediction of expenditure on leased lines services, using as a source separate research on business spend on leased lines.

[15] Count of business sites is used, which when coupled with the postal sector coverage area data provides business density information.

[16] The presence of both number of businesses and number of high, low and medium-spend business risks collinearity. This is avoided in the cluster analysis by a factoring procedure known as principal component analysis and guarded against in the regression analysis by consideration of covariance matrices.

- Mobile phone radio base station density: Leased lines are used in the provision of mobile services (Radio Base Station backhaul) so the number of mobile masts in a particular postal sector may affect the provision of retail leased lines.

3.39 However, after conducting the regression analysis it has become apparent that the variables above for which there are data sets only explain between 40% and 60% in the variation of the values of the dependent variables that the regressions are seeking to explain. This means that although this approach in theory could be used to predict those geographic areas in which there could be expected to be a greater competitive constraint in the provision of leased lines services, further work would have to be conducted to identify and develop data sets for those explanatory variables that are not included in the current regression models. As such, Ofcom has not relied in this discussion document on the output of this work stream.

3.40 Ofcom also carried out cluster analysis to assist in assessing the extent to which competitive conditions in the various leased lines markets in the UK vary on a geographic basis. This cluster analysis could be particularly useful in informing appropriate aggregations of discrete geographic areas into geographic markets or into areas where remedies could be varied on a geographic basis. Again, further explanation of the cluster analysis that has been carried out is provided in Annex 8 of this document.

Question 1)	*Do respondents agree with the analytical framework adopted by Ofcom to assess geographic variations in competitive conditions in the various leased lines markets in the UK?*

Section 4

Geographic analysis of leased lines markets

Introduction

4.1 The focus of this discussion document is to consider whether there is evidence of geographic variations in competitive conditions such that there is reason to believe that there could be separate geographic markets, or that while competitive conditions are sufficiently homogeneous to define a single national market, there are nonetheless variations within that market such that Ofcom should vary remedies.

4.2 The previous section described briefly the various work streams Ofcom has undertaken in order to assess whether such variations in competitive conditions exist. This section sets out in broad terms the results of the analysis of each of the work streams and their implications for each of the product markets identified in the LLMR. These were:

- retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s);
- wholesale low bandwidth traditional interface symmetric broadband origination (up to and including 8Mbit/s);
- wholesale high bandwidth traditional interface symmetric broadband origination (above 8Mbit/s up to and including 155Mbit/s);
- wholesale very high bandwidth traditional interface symmetric broadband origination (above 155Mbit/s);
- wholesale alternative interface symmetric broadband origination at all bandwidths; and
- wholesale trunk segments at all bandwidths

Retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s)

4.3 The LLMR concluded that the retail low bandwidth traditional interface leased lines market was national (excluding the Hull area) and that this was based on national buying patterns where retail customers would buy these retail leased lines as a bundle, across geographic areas, such that buyers are concerned with the price of the bundle as a whole rather than being concerned with prices in different geographic areas. However, the LLMR also recognised that BT applied a distinct pricing scheme to the CLZ and that this pricing behaviour meant that it was unlikely that BT faced a national pricing constraint at the retail level.

4.4 Annexes 5 to 8 set out the details of the analysis that Ofcom has undertaken to inform its assessment of the extent to which competition varies on a geographic basis in the various leased lines markets listed above. As this part of this Section is considering the retail low bandwidth traditional interface leased lines market, the

analyses that are most informative of variations in competitive conditions on a geographic basis in the retail low bandwidth traditional interface market are:

- the retail service share analysis; and
- the consumer survey evidence.

4.5 Also relevant is a consideration of BT's pricing policies for retail low bandwidth traditional interface leased lines. However, the other analysis undertaken by Ofcom is more relevant to the consideration of variations in competitive conditions in the various wholesale markets.

Retail service share analysis

4.6 This analysis involves estimating operators' shares of service provision in each of the postal sectors in the UK for each of the markets defined in the LLMR to inform an assessment of the extent to which competitive conditions vary on a geographic basis. The retail market analysis was based on empirical data collected from BT and thirteen alternative network operators.

4.7 The retail data collected from operators totalled around 560,000 traditional interface retail leased line records and around 28,000 alternative interface retail leased line records.

Operators' shares of retail service ends

4.8 The number of retail customer ends served by each operator was aggregated to postal sector level to estimate operators' share of retail service ends on the basis of the operators' proportion of total service count, where the service count equated to the total number of customer end points served within each postal sector.

4.9 The two main types of retail leased lines services being sold by operators were considered:

- Point-to-point retail leased lines. These are point-to point leased lines, which provide dedicated capacity between two points.
- Retail network services. These are network services such that customers purchase dedicated capacity from a number of single points - such as geographically dispersed corporate sites - onto a service provider's core network. The individual single points can then have connectivity to all the other sites.

4.10 Both types of these retail services can be provided using traditional interface e.g. primarily SDH-based, or alternative interface e.g. primarily Ethernet-based technologies but as this section is considering the retail low bandwidth traditional interface leased lines market, only traditional interface circuits are taken into account in the analysis that follows.

4.11 A point-to-point retail leased line being used to connect two customer sites would contribute two end points to the total service count; a leased line used to connect a customer site to an operators' core network would contribute one end point to the total.

4.12 In addition, in order to account for the distribution of different bandwidths within a particular market, a second analysis was carried out that incorporated a revenue

weighting. To calculate the breakdown of operators' shares of 'weighted bandwidth' for each postal sector in the UK, it was necessary to develop a proxy for revenue weighting. This proxy was required because it was not possible to gather revenue information from operators in a format that would enable Ofcom to conduct an analysis on a geographic basis.

4.13 On the completion of this analysis, it is possible to pictorially represent any geographic variations in operators' service shares. Set out below in Figure 1 and Figure 2 is the output of this analysis for the City of London area and for the 020 7 dialling code area respectively (with boundaries being defined by the solid black lines).

Figure 1 – BT's service share on a postal sector basis in the retail traditional interface low bandwidth market in the City of London

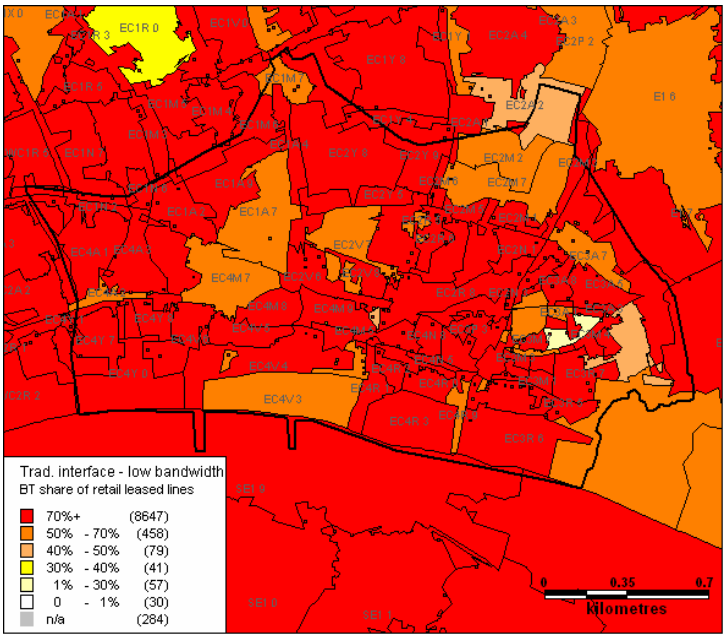
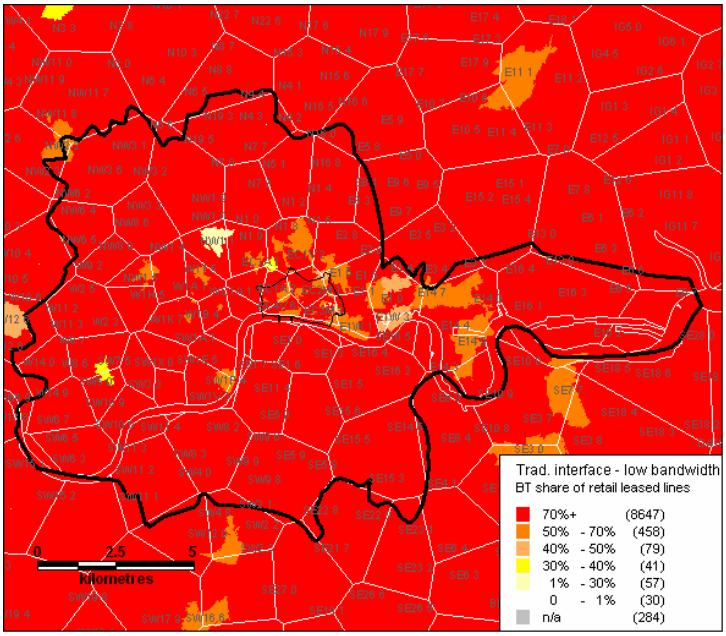


Figure 2 – BT's service share on a postal sector basis in the retail traditional interface low bandwidth market in the 020 7 dialling code area.



Note: the white lines on the map represent the approximate boundaries of BT's local serving exchanges. These are also shown in other maps below.

4.14 These Figures show that there is limited variation in BT's share of retail traditional interface low bandwidth leased line ends within the London area. This is consistent with the output of the analysis for the other areas of the UK. This analysis could support there being little geographic variation in the provision of retail low bandwidth traditional interface leased lines.

Consumer survey evidence

4.15 The consumer survey evidence found that there was limited use of multiple suppliers by large businesses (77% use a single supplier). Of the businesses that do use multiple suppliers, the research found that those buying low bandwidth leased lines were significantly less likely to use more than one supplier than those businesses buying high and very high bandwidth leased lines[17]. Where a business uses multiple leased lines suppliers, 46% use BT as one of the suppliers. Where a business uses only a single supplier 60% use BT, with the next highest single provider being used by 5% of businesses.

4.16 This consumer survey evidence could suggest that, except for the largest of the large businesses, buying patterns suggest that it is important for businesses to be able to source low bandwidth retail leased lines from a single supplier. This could support a conclusion that suppliers of leased lines face competitive conditions on a national, or at least a very broad, geographic basis at the retail level.

[17] That is to say that large business buying high bandwidth and very high bandwidth leased lines are more likely to use multiple suppliers.

BT's pricing policies

4.17 Information provided by BT shows that BT prices some of its retail low bandwidth traditional interface leased lines circuits at a discount in the CLZ. To the extent that there are any variations in competitive conditions within the CLZ area then any benefits to end users (in terms of reduced prices from BT in response to increased competitive pressures) will be spread across the whole of the CLZ area and be of benefit to all end users within that geographic area. This could suggest that there is a break in the geographic scope of the market such that the market is not UK-wide and could be defined by the CLZ boundary.

Wholesale low bandwidth traditional interface symmetric broadband origination

4.18 As with the retail market, the LLMR concluded that the wholesale low bandwidth TISBO market was national in scope. This conclusion was based on a number of factors, these being:

- There was limited scope for smaller operators to interconnect with each other, as opposed to BT and that retail circuits that consisted of wholesale inputs from three or more network operators may not be able to provide the same quality of service as circuits based on wholesale inputs provided by one or two operators, suggesting that national buying patterns at the retail level were a relevant consideration;

- BT's policy of charging a national price for low bandwidth TISBO circuits, even though the charge control arrangements that had been in place allowed for BT to vary its charges on a geographic basis, suggesting that a common pricing constraint across different geographic areas was present. However, Ofcom recognised that prior to the requirement on BT to offer wholesale PPCs, when BT used to sell retail circuits to alternative operators, these retail prices did vary by geography, specifically with lower charges in central London.

- In terms of assessing variations in competitive conditions, in the LLMR Ofcom used an analysis of operators' network reach in the London and Manchester areas, as described in Section 2 and concluded that if either of these areas were to be found to be competitive then there would be a high risk that within either area that there would be significant areas that would in fact be uncompetitive.

4.19 The analyses that Ofcom has conducted for this discussion document that are most relevant to an assessment of the extent of variations in competitive conditions on a geographic basis in the low bandwidth TISBO market are:

- The network reach analysis;

- The retail service share analysis; and

- The wholesale service share analysis.

4.20 Ofcom has also:

- qualitatively assessed the extent to which it remains the case that there is limited scope for alternative operators to interconnect with each other as opposed to BT; and

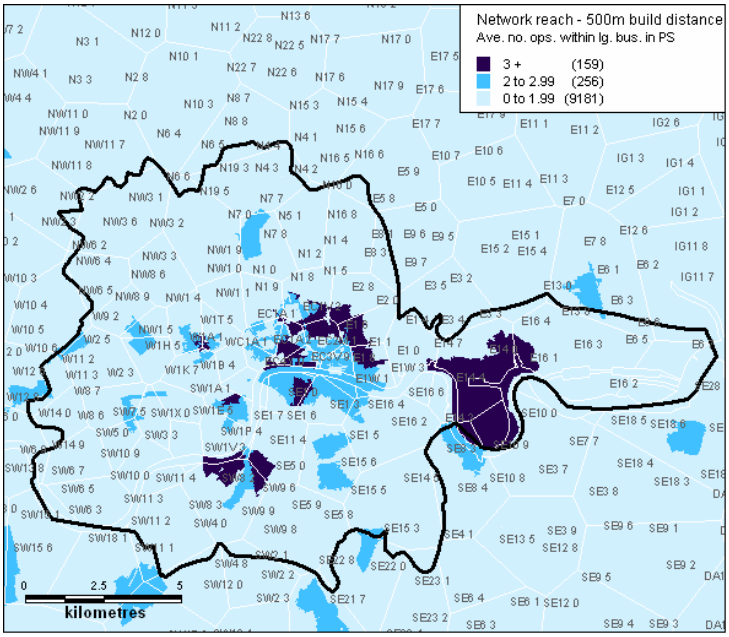
- considered BT's pricing policies.

Network reach analysis

4.21 The details of Ofcom's network reach analysis are set out in Annex 6. This analysis shows, at a postal sector level, the location of businesses that are likely to be customers of leased lines services and how many operators, in addition to BT are able to service those customers. This involves Ofcom making assumptions about the build distance at which it becomes economic for a network operator to provide services to a customer over its own network rather than purchasing a PPC from BT to serve that customer. These assumptions are explained in Section 3, with further details provided in Annex 6.

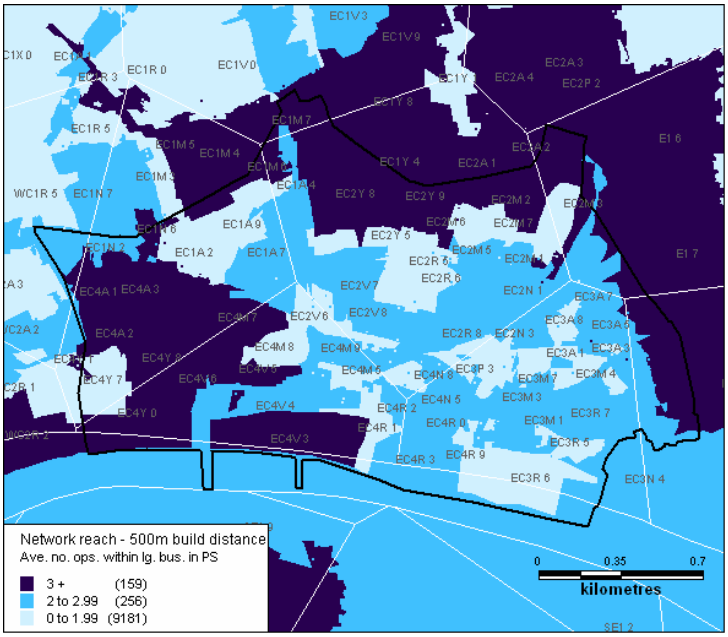
4.22 The analysis shows that, for the assumptions made, there are a number of postal sectors where there could be expected to be a greater constraint on pricing, compared to other geographic areas. Taking Ofcom's base case assumptions of there needing to be at least two operators (in addition to BT) with a point of presence, within 500m of a large business customer site, this results in there being 159 postal sectors within the UK, accounting for around 11% total weighted bandwidth[18] within the low bandwidth traditional interface retail leased lines market. This is shown for the CLZ and the City of London in Figures 3 and 4 below.

Figure 3 – Number of operators in the CLZ, assuming 500m build distance



[18] See Annex 7

Figure 4 – Number of operators in the City of London, assuming 500m build distance



4.23 Further to this analysis, which is based on analysing alternative operators' ability to provide services to large businesses within 500m of their points of presence, Ofcom, for the LLMR conducted an analysis of the ability of a limited number of alternative operators to provide services from their fibre networks. The focus of this analysis was the City of London and the CLZ. The results of this analysis are summarised in Table 3 below.

Table 3 – Proportion of business sites served assuming different build distances

	Build distance	Operator 1	Operator 2	Operator 3	Operator 4
City of London	50m	60%	67%	94%	96%
	90m	96%	87%	95%	97%
CLZ	300m	70%	57%	84%	87%

4.24 This analysis could be a basis on which all of the postal sectors within the City of London, together with each of the postal sectors in which there are 2 or more operators with a network presence, could be identified as having different competitive conditions such that there may be a case to warrant the variations of remedies within a broader market, or for defining a separate market.

Retail and wholesale service share analysis

4.25 As noted above, (paragraph 3.32) the data provided by Altnets in relation to Ofcom's request for wholesale data has been such that it has not been possible for Ofcom to conduct the analysis that it was originally intending for the wholesale low bandwidth TISBO market. Nevertheless, the retail service share analysis set out above can be used to inform a lower bound of BT's service shares at the wholesale level on a

postal sector basis. This retail analysis, when considered together with some additional share analysis based on data provided by BT, can be indicative of the extent to which there are variations in competitive conditions on a geographic basis at the wholesale level. The details of this additional analysis are set out in Annex 7. This analysis allows Ofcom to estimate an upper bound of BT's service shares, using information from all operators at the retail level, together with the information from BT provided for the wholesale level.

4.26 In estimating BT's wholesale leased line service share in this way, it is possible that the ratio of BT's wholesale shares to the total retail market, on a postal sector basis, will be greater than 1:1. This is because the wholesale inputs that are being used in the calculation can be used to supply a variety of downstream markets, and are not limited to the retail leased lines markets being considered in this document.

4.27 The variations in service shares on a geographic basis at the retail level, can be explained by two factors: Altents using capacity on their own networks; and Altnets purchasing capacity from BT, in the form of PPCs, and using these regulated wholesale inputs to compete in the downstream retail leased lines markets. Therefore, just because there may be variations at the retail level, this will not necessarily translate to there being variations at the wholesale level.

4.28 As shown above, there is very little variation in service shares at the retail level for retail low bandwidth traditional interface leased lines. Figures 5 and 6 below show the estimates of the upper bound of BT's service share for low bandwidth TISBO circuits, on a postal sector basis in the London area, first for the City of London and second for the CLZ. In these figures, the areas shown as black are those areas where the ratios of BT's wholesale circuits to the total retail market volume of circuits, on a postal sector basis, are greater than 1:1.

Figure 5 – Upper bound of BT's share of the wholesale low bandwidth TISBO market, by postal sector in the City of London

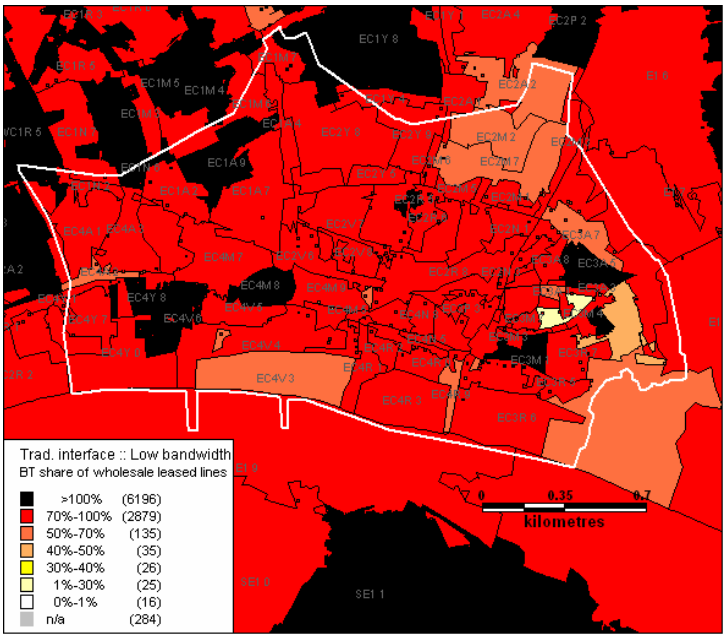
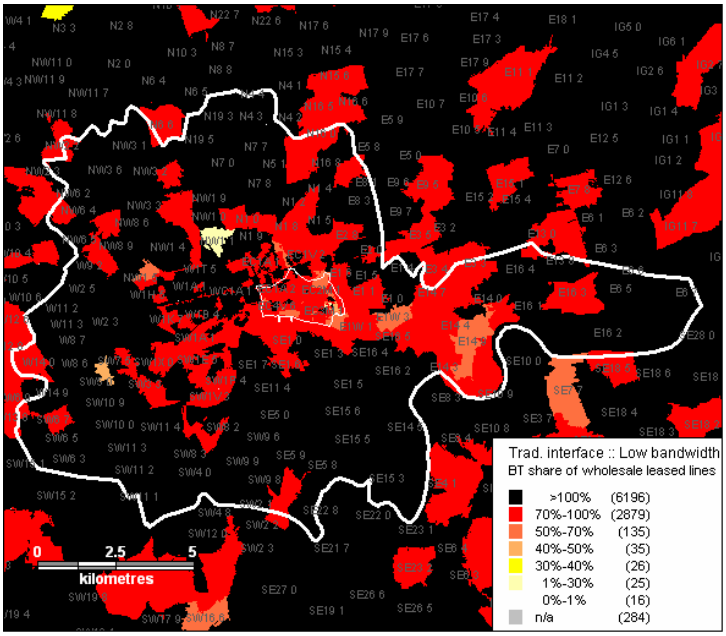


Figure 6 – Upper bound of BT's share of the wholesale low bandwidth TISBO market, by postal sector in the CLZ



4.29 These Figures show that at the wholesale level there are very few postal sectors where BT's wholesale service share is estimated to be below 70% and even fewer still where its share is estimated to be below 50%. This could be expected given BT's shares at the retail level and the fact that all of those retail circuits rely on BT wholesale inputs.

4.30 The network reach analysis above (paragraphs 4.21 to 4.24) shows that there are geographic areas where operators' networks could constrain BT such that there could be variations in competitive conditions on a geographic basis. However, the service share analysis of the low bandwidth traditional interface market does not appear to support a conclusion of there being significant variations in competitive conditions. This anomaly could be because alternative operators are in fact using their networks to compete in other markets[19] or because the potential for competition to develop in the provision of these services is not being reflected in actual service shares observed in the market.

4.31 Nevertheless, it could be expected that over time operators may utilise their networks in order to compete in the retail and wholesale provision of low bandwidth leased lines. This is an issue that would be examined in any future leased lines market review.

Scope for alternative operators to interconnect with each other

4.32 As noted above, the LLMR considered the extent to which it was possible for alternative operators to interconnect with each other as opposed with BT and concluded that the scope for this was very limited. Ofcom's conclusion on this question was that there were not many points of interconnection between alternative operators which would be suitable for the interconnection of leased lines. This was both in absolute terms and relative to the number of potential points of

[19] These other markets could include the provision of higher bandwidth leased lines, business network solutions, switched voice or broadband.

interconnection between alternative operators and with BT. Ofcom reasoned that while this situation prevailed, the argument that operators require to purchase on a national basis would suggest that the wholesale market should be defined as national.

4.33 For the purposes of this discussion document, Ofcom has revisited this question. It appears to be the case that since the LLMR a greater number of operators have extended their networks in order to interconnect with BT at a greater number of BT's Tier 1 nodes. This could be so that operators can self-provide a greater proportion of their trunk transmission, even if they continue to rely on wholesale symmetric broadband origination products purchased from BT in those geographic areas where these operators do not have their own access networks.

4.34 This being the case, it is relevant to consider the extent that end users require that their retail products be provided by a single retail provider and/or the extent to which networks built up using the inputs of three or more network operators can provide the same quality of service as a network that is based on wholesale inputs provided by one or two operators.

4.35 Evidence from the large business survey shows that larger businesses (in employee terms) do purchase leased lines from multiple retail providers. The main reason given for using multiple leased lines providers is price, with businesses opting for the best available price available at the time the contract is negotiated. Larger businesses also stated that they could manage the risks of an operator going out of business by using multiple retail providers.

4.36 On the question of whether networks built up using the inputs of three or more network operators can provide the same quality of service as a network that is based on wholesale inputs provided by one or two operators, Ofcom has no information that indicates that the relevance of this issue has diminished since the LLMR.

4.37 Therefore, the evidence on whether there is scope for alternative operators to interconnect with each other is mixed. On one hand, since the conclusion of the LLMR there is greater scope for operators to interconnect with BT (and each other) at BT's Tier 1 nodes. In addition, the large business survey suggests that where this is not possible, it is feasible for businesses, in particular larger businesses, to purchase leased lines from multiple operators, although there is currently limited use of multiple suppliers by large businesses. This could mean that if there are local markets where BT does not have an obligation to provide wholesale inputs, alternative operators could either use their own or alternative operators' networks to provide retail services. To the extent that alternative operators cannot interconnect with each other in these areas then it may be that these operators would have to rely on negotiating with BT for access to their networks or these operators would not be able to compete in these areas – but other operators with network would.

4.38 However, on the other hand, for smaller businesses, it appears to be the case that they are more inclined to purchase all of their retail leased lines services from a single operator. This combined with the view that networks built up using the inputs of three or more network operators are not able to provide the same quality of service as a network that is based on wholesale inputs provided by one or two operators, may suggest that the relevant geographic market is national in scope.

BT's pricing policies

4.39 Information provided by BT shows that, as with its prices in the retail low bandwidth traditional interface leased lines market, it prices some of its low bandwidth TISBO products in the CLZ at a discount to the rest of the UK. Therefore, to the extent that there may be variations within the CLZ area, then any competitive response by BT to increased competition within any part of the CLZ will be spread across all of the wholesale low bandwidth TISBO circuits that it sells within the CLZ area and may not be spread to the rest of the UK. This could suggest that there is a break in the scope of the geographic markets and that the market is not UK-wide and could be defined by the CLZ boundary.

Wholesale high bandwidth traditional interface symmetric broadband origination

4.40 The LLMR concluded that the geographic scope of the high bandwidth TISBO market was national. This was based on a number of factors, these being:

- There was limited scope for smaller operators to interconnect with each other, as opposed to BT and that retail circuits that consisted of wholesale inputs from three or more network operators may not be able to provide the same quality of service as circuits based on wholesale inputs provided by one or two operators, suggesting that national buying patterns at the retail level was a relevant consideration;

- BT's policy of charging a national price for high bandwidth TISBO circuits, even though the charge control arrangements that had been in place allowed for BT to vary its charges on a geographic basis, suggesting that a common pricing constraint across different geographic areas was present. However, Ofcom recognised that prior to the requirement on BT to provide wholesale PPCs, when BT used to sell retail circuits to alternative operators, these retail prices did vary by geography, specifically with lower charges in central London.

- In terms of assessing variations in competitive conditions, in the LLMR Ofcom used an analysis of operators' network reach in the London and Manchester areas, as described in Section 2 and concluded that if either area was to be found to be competitive there was a high risk that within such areas there would be significant areas that would in fact be uncompetitive.

4.41 As with the wholesale low bandwidth TISBO market, the analyses that Ofcom has conducted for this discussion document that is most useful in assessing the extent of variations in competitive conditions on a geographic basis in the wholesale high bandwidth TISBO market are:

- The network reach analysis;

- The retail service share analysis; and

- The wholesale service share analysis.

4.42 Ofcom has also:

- qualitatively assessed the extent to which it remains the case that there is limited scope for alternative operators to interconnect with each other as opposed to BT; and

- considered BT's pricing policies.

Network reach analysis

4.43 As noted in Annex 6, the network reach analysis is not specific to individual markets, as it assesses the extent to which different operators are able to use their own networks to provide services to large business customers, within a specific geographic area. Therefore, the conclusions of the network reach analysis as summarised for the wholesale low bandwidth market are maintained here. That is, there are a number of postal sectors where there could be expected to be a greater constraint on pricing, compared to other geographic areas. Taking Ofcom's base case assumptions of there needing to be at least two operators (in addition to BT) with a point of presence, within 500m of a large business customer site, this results in there being 159 postal sectors within the UK accounting for around 19% of total weighted bandwidth within the high bandwidth traditional interface retail leased lines market. This could be a basis on which these postal sectors could be identified as having different competitive conditions such that there may be a case to warrant the variations of remedies within a broader market, or for defining a separate market.

4.44 However, as with the low bandwidth market, it is relevant to assess the extent to which operators' service shares (at the retail level and as far as possible, at the wholesale level) vary on a geographic basis, to inform the extent to which the availability of alternative operators' networks can act as a constraint.

Retail and wholesale service share analysis

4.45 As has been noted above, the data provided by operators relating to the services that they provide at the retail level is such that Ofcom is confident that its analysis of retail service shares is a broadly accurate representation of operators' presence in the market. In carrying out this analysis, the number of retail customer ends served by each operator was aggregated to postal sector level to estimate the operator share of ends on the basis of the operators' proportion of total service count, where the service count equated to the total number of customer end points served within each postal sector, with the two main types of retail leased lines services being sold by operators being point-to-point retail leased lines and retail network services[20]. Both types of these retail services can be provided using traditional interface e.g. primarily SDH-based, or alternative interface e.g. primarily Ethernet-based technologies.

4.46 In order to try and capture the distribution of different bandwidths within a particular market, analysis was also carried out using a proxy for revenues. Once this analysis had been completed, it was possible to pictorially represent any geographic variations in operators' service shares. Set out below in Figure 7 and Figure 8 is the output of this analysis for the City of London area and for the 020 7 dialling code area respectively (with boundaries being defined by the solid black lines).

[20] These are network services where customers purchase dedicated capacity from a number of single points (such as geographically dispersed corporate sites) onto a service provider's core network.

Figure 7 – BT's service share on a postal sector basis in the retail traditional interface high bandwidth market in the City of London

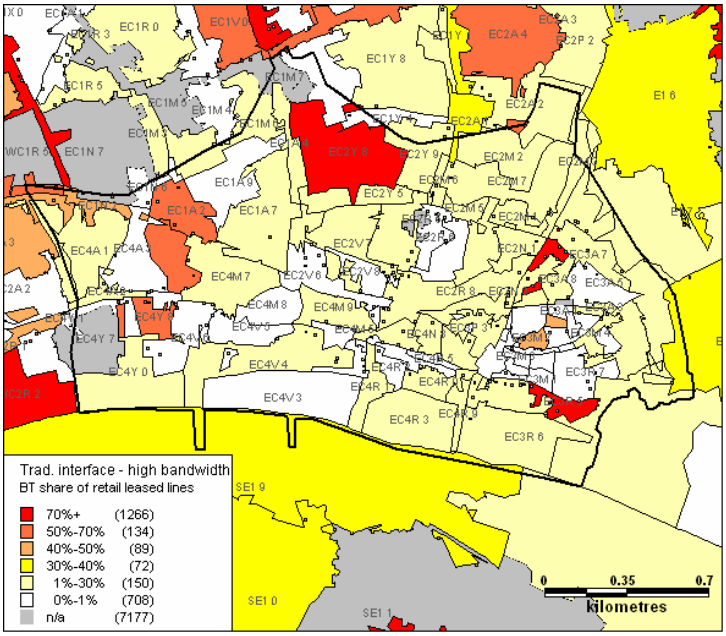
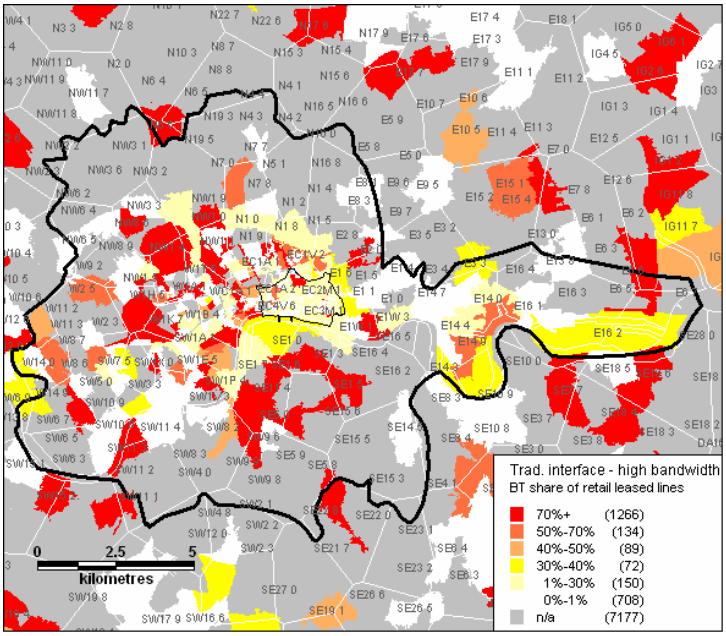


Figure 8 – BT's service share on a postal sector basis in the retail traditional interface high bandwidth market in the central London zone



4.47 These figures show that within the London area, there is significant variation in BT's share of leased lines ends on a postal sector basis. This pattern is repeated in other cities in the UK.

4.48 However, these maps relate to the provision of retail leased lines services. What is of interest here is the extent to which there are variations in service shares at the wholesale level. It could in fact be the case that the variations that are illustrated in Figures 7 and 8 are the result of alternative operators using PPC wholesale inputs

purchased from BT at the wholesale level and not using their own networks to support their provision of retail services. If this were to be the case then it could be argued that any geographic variation in competitive conditions at the wholesale level would be limited.

4.49 Therefore, it is helpful to try and understand the extent to which there are indeed variations in BT's shares at the wholesale level. As with this analysis in the wholesale low bandwidth TISBO market, because of the limited data that Ofcom has been able to collect from Altnets, it has not been possible for Ofcom to carry out the analysis at the wholesale level that it was originally intending to.

4.50 The retail analysis set out above can be used to inform a lower bound of BT's service shares at the wholesale level on a postal sector basis. It is also possible to carry out some additional analysis that allows Ofcom to estimate an upper bound of BT's service shares, using information from all operators at the retail level, together with the information from BT provided for the wholesale level. This approach adopts the same methodology as used for the low bandwidth TISBO market and explained in Annex 7. The results of this analysis for the City of London and for the central London zone are shown in Figures 9 and 10 below.

Figure 9 – Upper bound of BT's market share of the wholesale high bandwidth TISBO market, by postal sector in the City of London

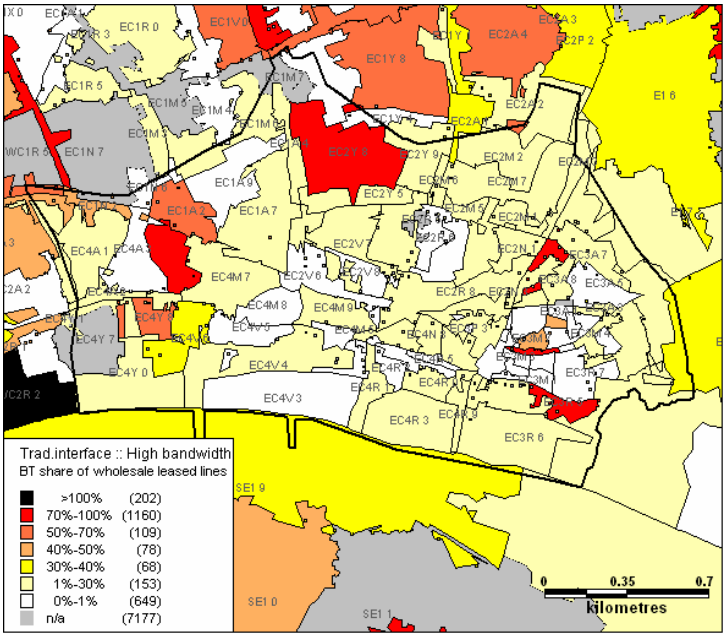
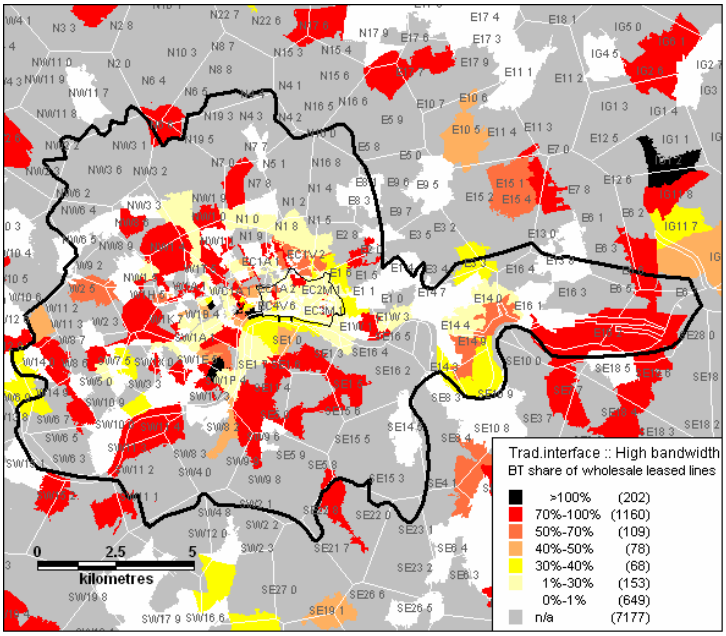


Figure 10 – Upper bound of BT's market share of the wholesale high bandwidth TISBO market, by postal sector in the central London zone



4.51 As with this analysis in the wholesale low bandwidth TISBO market, in estimating a BT's service share in this way, it is possible that the ratio of BT's wholesale shares to the total retail market, on a postal sector basis, will be greater than 1:1. This is because the wholesale inputs that are being used in the calculation can be used to supply a variety of downstream markets, and are not limited to the retail leased lines markets being considered in this document. However, unlike the wholesale low bandwidth TISBO market, there appears to be quite a wide variation, on a postal sector basis, in the estimate of BT's service share of the wholesale high bandwidth market. This may indicate that in these areas that alternative operators are utilising capacity on their own networks as wholesale inputs into the provision of retail leased lines (and other downstream services). In the areas where there are sufficient operators with networks, it may be the case that there is a greater constraint, such that it might suggest geographic variations in competitive conditions.

Scope for alternative operators to interconnect with each other

4.52 The same arguments that were made in the discussion of this issue under wholesale low bandwidth TISBO apply here. Therefore it is not clear whether the there is the ability for alternative operators to interconnect with each other, or whether purchasers of leased lines, in particular smaller businesses, would be able to purchase retail leased lines from multiple retail providers.

BT's pricing policies

4.53 At the retail and the wholesale level, BT varies its prices for the provision of wholesale high bandwidth TISBO circuits, by offering a discount on those leased lines in the CLZ. This could suggest that there is no national common pricing constraint and that local markets exist and that the boundary of this local market could be the CLZ.

Wholesale very high bandwidth traditional interface symmetric broadband origination

4.54 The LLMR concluded that the geographic scope of the wholesale very high bandwidth TISBO market was national. This was based on the same reasoning as that for the high bandwidth TISBO market, these being:

- There was limited scope for smaller operators to interconnect with each other and that retail circuits that consisted of wholesale inputs from three or more network operators may not be able to provide the same quality of service as circuits based on wholesale inputs provided by one or two operators;
- BT's policy of charging a national price for very high bandwidth TISBO circuits, even though the charge control arrangements that had been in place allowed for BT to vary its charges on a geographic basis. Again, Ofcom recognised that prior to the requirement on BT to provide regulated wholesale PPCs, BT used to vary on a geographic basis the prices at which it sold retail circuits to alternative operators.
- In terms of assessing variations in competitive conditions, in the LLMR Ofcom used an analysis of operators' network reach in the London and Manchester areas, as described in Section 2 and concluded that if an area was to be found to be competitive there was a high risk that within such areas there would be significant areas that would in fact be uncompetitive.

4.55 As with the wholesale low bandwidth and high bandwidth TISBO markets, the analysis that Ofcom has conducted for this discussion document that is most informative for an assessment of the extent of variations in competitive conditions on a geographic basis in the wholesale very high bandwidth TISBO market are:

- The network reach analysis;
- The retail service share analysis; and
- The wholesale service share analysis.

4.56 Ofcom has also:

- qualitatively assessed the extent to which it remains the case that there is limited scope for alternative operators to interconnect with each other as opposed to BT; and
- considered BT's pricing policies

Network reach analysis

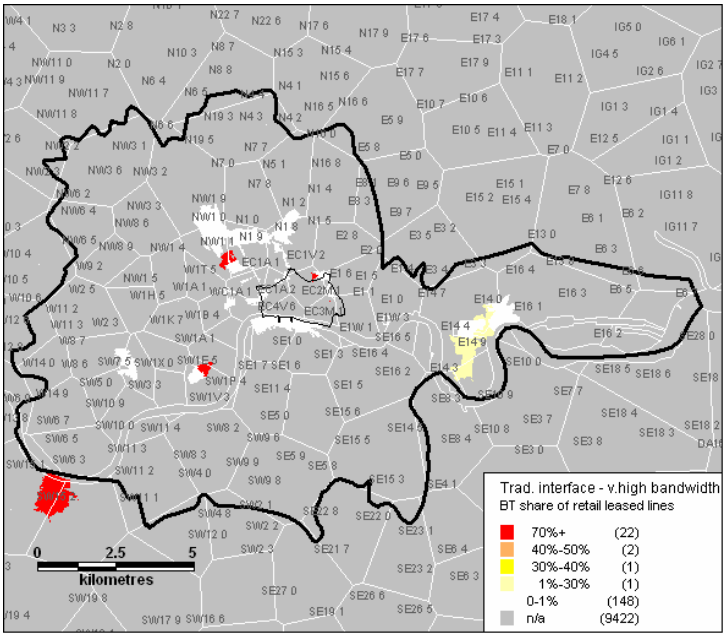
4.57 As noted in Annex 6, the network reach analysis is not specific to individual markets, as it assess the extent to which different operators are able to use their own networks to provide services to large business customers, within a specific geographic area. Therefore, the conclusions of the network reach analysis as summarised for the wholesale low bandwidth market are maintained here. That is, there are a number of postal sectors where there could be expected to be a greater constraint on pricing, compared to other geographic areas. However, to assess the extent to which there exists geographic variations in any constraint in the context of the very high bandwidth TISBO market, it is useful to consider operators' retail and wholesale service shares on a postal sector basis.

Retail and wholesale service shares

4.58 As with the other TISBO markets above, it is useful to begin with a consideration of the service shares at the retail level and then go on to consider whether there are variations at the wholesale level. At the retail level, the information that Ofcom obtained from operators indicates that there around 380 very high bandwidth traditional interface retail leased lines in the UK and that these circuits have their ends in around 170 postal sectors.

4.59 Figure 11 below shows BT's share of very high bandwidth retail leased lines ends for the central London zone area, being the area served by the 020 7 dialling code and signified by the boundary line.

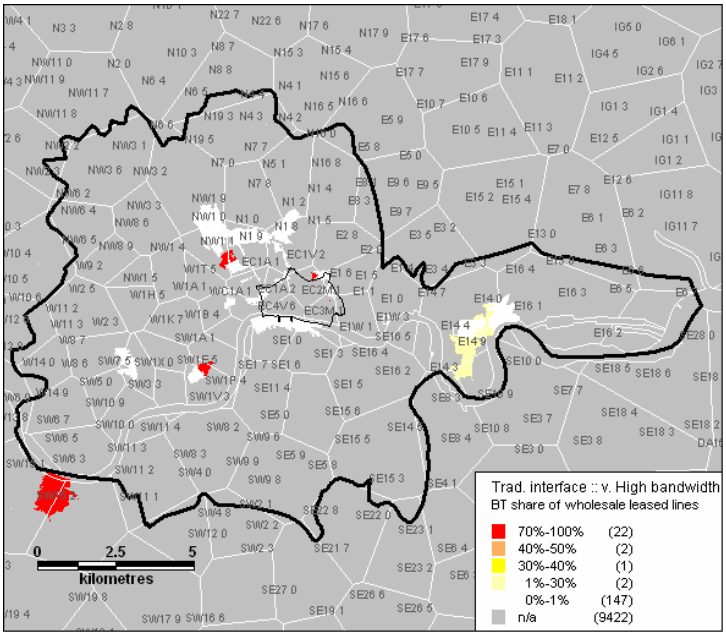
Figure 11 - BT's service share on a postal sector basis in the retail traditional interface very high bandwidth market in the central London zone



4.60 This Figure shows that in the London area there are relatively few postal sectors where there are any operators that provide very high bandwidth traditional interface retail leased lines. Moreover, there are very few areas where BT's service share is over 50% and where it is over 50% there are only one or two leased lines ends within these postal sectors and it happens to be the case that BT is the provider of those circuits.

4.61 As with the low bandwidth and high bandwidth traditional interface retail leased lines data above, it has also been possible to estimate the BT's service share at the wholesale level. Doing this allows Ofcom to assess the extent to which any variations at the retail level are the result of operators purchasing wholesale very high bandwidth inputs from BT, or whether these are provided by alternative operators through utilising their own networks. It is important to bear in mind that currently there are no regulatory obligations on BT in respect of the provision of wholesale very high bandwidth TISBO products. This means that BT does not have to provide alternative operators with PPCs in this market. The results of Ofcom's analysis at the wholesale level for the central London zone are shown in Figure 12.

Figure 12 – BT's market share of the wholesale very high bandwidth TISBO market, by postal sector in the central London zone



4.62 Figures 12 could be taken to show that any variation in competitive conditions is very limited and as such there may be little scope to define local markets in the provision of services with the wholesale very high bandwidth TISBO market.

Scope for alternative operators to interconnect with each other

4.63 The same arguments that were made in the discussion of this issue under wholesale low bandwidth TISBO apply here. Therefore it is not clear whether the there is the ability for alternative operators to interconnect with each other, or whether purchasers of leased lines, in particular smaller businesses, would be able to purchase retail leased lines from multiple retail providers.

BT's pricing policies

4.64 As with the provision of retail and wholesale high bandwidth traditional interface circuits, BT varies its prices for the provision of very high bandwidth traditional interface circuits by offering a discount on those leased lines in the CLZ. This could suggest that there is no national common pricing constraint and that local markets exist and that the boundary of a local market could be the CLZ.

Wholesale alternative interface symmetric broadband origination at all bandwidths

4.65 As noted above, the LLMR concluded that there was no bandwidth distinction that separated the product market for the provision of wholesale AISBO circuits. In terms of the scope of the geographic boundary of the market, again, the LLMR concluded that the relevant market was national in scope. The main reasons for this conclusion were:

- There was limited scope for smaller operators to interconnect with each other, as opposed to BT and that retail circuits that consisted of wholesale inputs from three

or more network operators may not be able to provide the same quality of service as circuits based on wholesale inputs provided by one or two operators, suggesting that national buying patterns at the retail level was a relevant consideration.

- BT's policy of charging a national price for its retail alternative interface products, including no variations within London. BT had taken such pricing decisions absent any regulatory obligations as prior to the LLMR there was no regulation in force for the provision of alternative interface products. This suggested to Ofcom that a common pricing constraint may exist. However, Ofcom recognised that alternative interface products were a relatively new product and as the market developed BT's pricing structure may change in the future.

- In terms of assessing variations in competitive conditions, in the LLMR Ofcom used the network reach analysis applied to London and Manchester as described above in Section 2. Ofcom concluded that if an area was to be found to be competitive there was a high risk that within such areas there would be significant areas that would in fact be uncompetitive.

4.66 The analysis that Ofcom has conducted for this discussion document that is relevant to the consideration of whether there are variations in competitive conditions such that this suggests that remedies within a national market could be varied or indeed whether separate markets should be defined is:

- The network reach analysis;

- The retail service share analysis; and

- The wholesale service share analysis.

4.67 Ofcom has also:

- qualitatively assessed the extent to which it remains the case that there is limited scope for alternative operators to interconnect with each other as opposed to BT; and

- considered BT's pricing policies.

Network reach analysis

4.68 As has been noted above, the network reach analysis is not market specific as an operator's network is not limited to servicing an individual market. Networks can be used to support activities in a number of markets, across different service offerings. However, by analysing operators' networks it is possible to identify those areas where operators would be able to use their own networks to impose a constraint on their competitors.

4.69 As noted under the discussion of the wholesale low bandwidth TISBO market, the network reach analysis that Ofcom has conducted for this discussion document seeks to assess the extent to which businesses that are likely to be purchasers of retail leased lines services are capable of being serviced by operators in addition to BT. As explained above, this analysis shows that there are a number of postal sectors where there could be expected to be a greater constraint on pricing compared with other postal sectors. Taking Ofcom's base case assumptions of there needing to be at least two operators (in addition to BT) with a point of presence, within 500m of a large business customer site, this results in there being 159 postal

sectors within the UK accounting for around 9% of total weighted bandwidth within the alternative interface retail leased lines market. This could be a basis on which these postal sectors could be identified as having different competitive conditions such that there may be a case to warrant the variations of remedies within a broader market, or for defining a separate market.

4.70 However, as networks can be used to service multiple downstream markets, it is also relevant to assess any evidence of variations in competitive conditions within the specific markets being considered.

Retail and wholesale service share analysis

4.71 As with the other markets considered in this discussion document, Ofcom considers that the retail data collected from operators has allowed it to build up a useful picture of the geographic areas in which different operators provide alternative interface retail leased lines products to their customers. This allows Ofcom to analyse the extent to which operators' service shares vary on a geographic basis by postal sector, which could be indicative of variations in competitive conditions at the retail level in the provision of these retail services.

4.72 As with the other markets discussed above, Figures 13 and 14 below show the extent to which BT's service shares vary by postal sector, first in the City of London and then the central London zone.

Figure 13 – BT's service share on a postal sector basis in the retail alternative interface market in the City of London

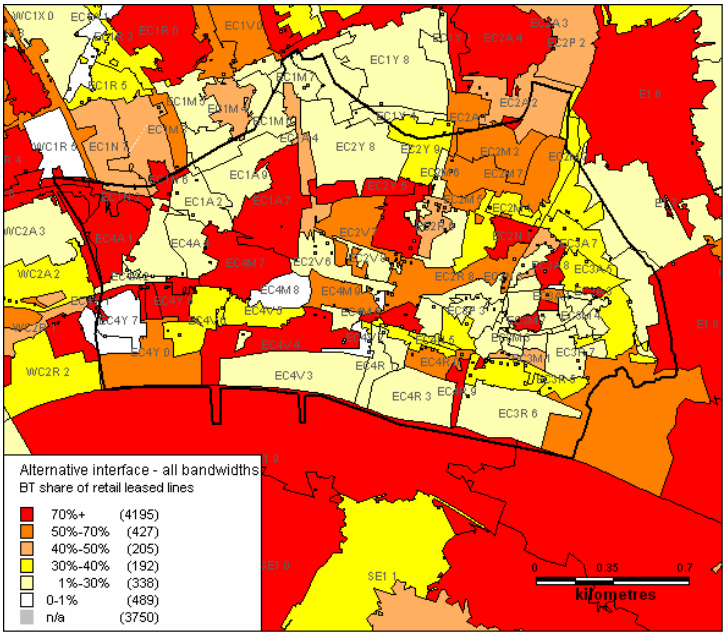
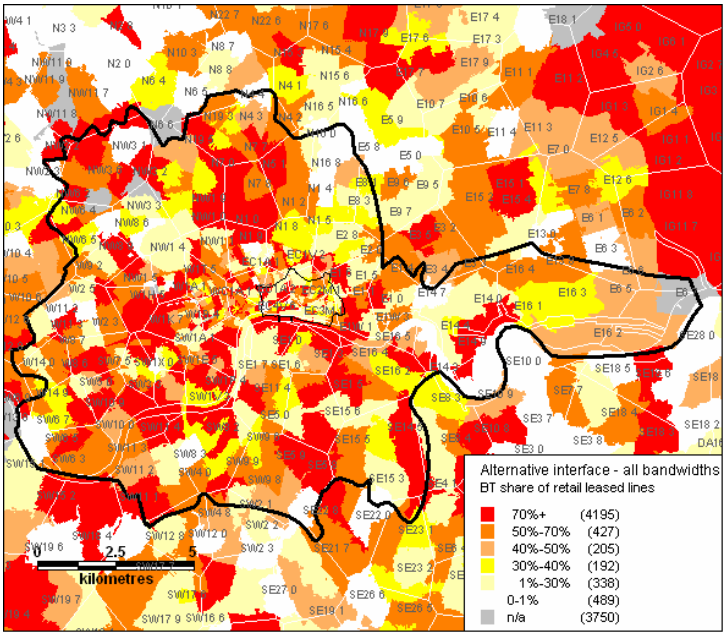


Figure 14 – BT's service share on a postal sector basis in the retail alternative interface market in the central London zone



4.73 Figures 13 and 14 above indicate that there are variations in BT's share of the provision if retail alternative interface leased lines at a postal sector level, within the City of London, within the central London zone and more widely across other parts of the UK.

4.74 As with the other leased lines markets analysed above, it is important to bear in mind that this analysis relates to the provision of retail leased lines services. Similar to the markets for low bandwidth and high bandwidth traditional interface leased lines, BT has regulatory obligations to provide wholesale inputs for alternative interface circuits. These wholesale inputs are AISBO circuits. This means that the output of this retail analysis could be the result of operators using these wholesale inputs from BT to support their retail alternative interface service offerings, rather than using their own networks to support the provision of these services. Therefore it is important to assess as much as possible the extent to which there is any evidence that operators' service shares at the wholesale level vary on a geographic basis.

4.75 As with the other markets assessed in this discussion document, because of the limitation in the data available from Altnets in response to Ofcom's information requests, it has not been possible to calculate operators' service shares at the wholesale level. However, using the methodology set out above for the other markets, which uses data provided by BT, it has been possible for Ofcom to estimate an upper bound of BT's share of the provision of wholesale AISBO circuits.

4.76 As noted above, in estimating a BT's service share in this way, it is possible that the ratio of BT's wholesale shares to the total retail market, on a postal sector basis, will be greater than 1:1. This is because the wholesale inputs that are being used in the calculation can be used to supply a variety of downstream markets, and are not limited to the retail leased lines markets being considered in this document. Ofcom's estimate of BT's share of wholesale AISBO circuits on a postal sector basis in the City of London and the central London zone are set out in Figures 15 and 16 below.

Figure 15 – BT's service share on a postal sector basis in the wholesale AISBO market in the City of London

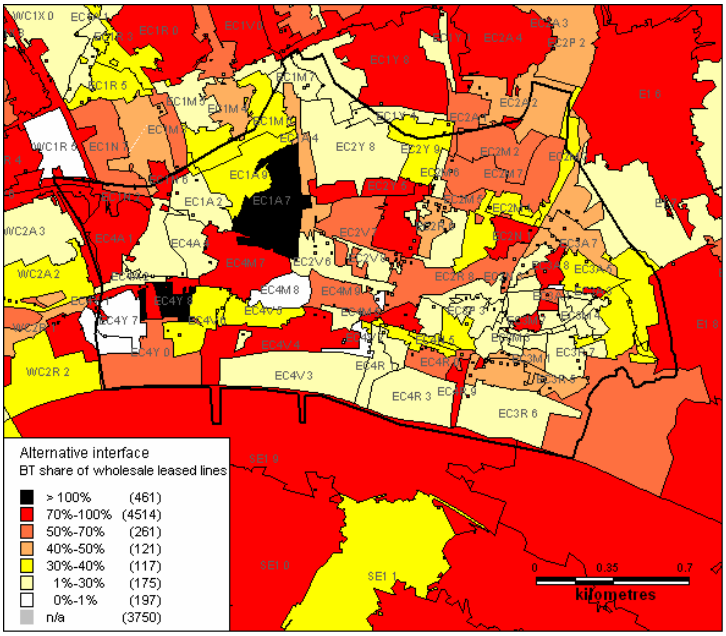
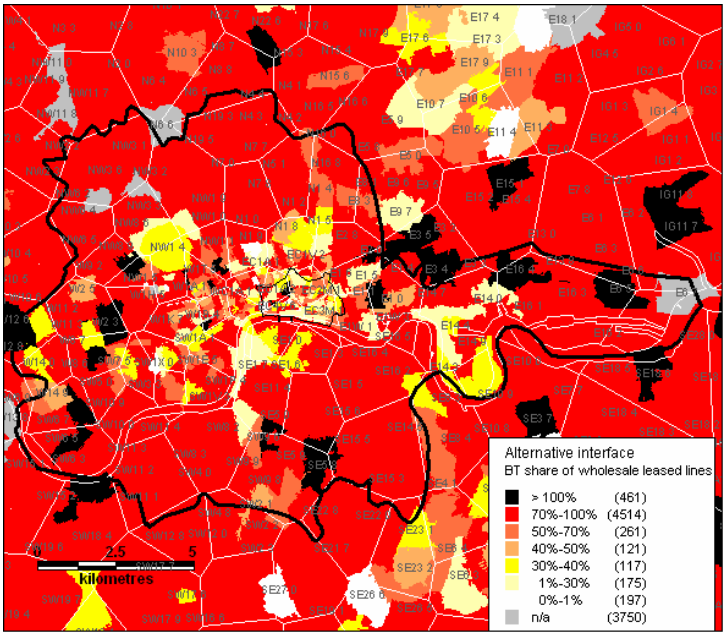


Figure 16 – BT's service share on a postal sector basis in the wholesale AISBO market in the central London zone



4.77 These Figures, when compared with Figures 13 and14 above appear to show that there continues to be a large degree of variation in BT's service share within the City of London, but when the geographic area is expanded to the central London zone, the variation in BT's shares is much diminished. This could indicate that in the City of London alternative operators are utilising capacity on their own networks to provide wholesale inputs into their retail alternative interface products, but in the central London zone these operators become much more dependent on the wholesale AISBO products provided by BT. Therefore, this analysis could suggest that there

are variations in competitive conditions in the provision of wholesale AISBO circuits such that this may suggest that remedies in this market be varied by geography or that separate geographic markets be defined.

Scope for alternative operators to interconnect with each other

4.78 The same arguments that were made in the discussion of this issue under wholesale low bandwidth TISBO apply here. Therefore it is not clear whether there is the ability for alternative operators to interconnect with each other, or whether purchasers of leased lines, in particular smaller businesses, would be able to purchase retail leased lines from multiple retail providers.

BT's pricing policies

4.79 BT does not vary its prices for the provision of alternative interface circuits on a geographic basis. For each bandwidth, BT has a single national price, both at the retail level and at the wholesale level. This could suggest that there is a national common pricing constraint present, indicating a national market.

Wholesale trunk segments at all bandwidths

4.80 As with the retail low bandwidth traditional interface markets and the various wholesale symmetric broadband originations discussed above, the LLMR concluded that the relevant geographic market for the provision of wholesale trunk segments was national in scope. The main reasons for this conclusion were:

- There was limited scope for smaller operators to interconnect with each other, as opposed to BT and that retail circuits that consisted of wholesale inputs from three or more network operators may not be able to provide the same quality of service as circuits based on wholesale inputs provided by one or two operators, suggesting that national buying patterns at the retail level was a relevant consideration.

- Despite there being no regulatory obligations on BT requiring nationally averaged prices, BT priced trunk segments on a national basis rather than setting route-by-route charges.

4.81 The analysis that has been conducted for this discussion document that is most informative for an assessment of the extent to which there are geographic variations in competitive conditions on a geographic basis in the provision of trunk segments is:

- The network reach analysis.

- The "retail trunk" service share analysis; and

- The wholesale trunk service share analysis.

4.82 Ofcom has also:

- qualitatively assessed the extent to which it remains the case that there is limited scope for alternative operators to interconnect with each other as opposed to BT; and

- considered BT's pricing policies.

Network reach analysis

4.83 The network reach analysis in considering geographic variations in competitive conditions in the provision of wholesale trunk segments is slightly different to the analysis undertaken when assessing geographic variations in competition in the various symmetric broadband origination markets analysed above. In the context of wholesale trunk segments, the key area of interest is the extent to which different operators can compete in the provision of trunk services between different UK locations. It is important to bear in mind at this point the product market definition for trunk segments in the LLMR. The LLMR defined the breakpoint between trunk segments and symmetric broadband origination as being specified as BT's Tier 1 nodes, but making clear that the relevant markets also include the equivalent on other communications providers networks.

4.84 By analysing the geographic location of operator's networks, this can be informative of the extent to which alternative operators can self provide trunk transmission between different locations. However, Ofcom only has information on the geographic location of alternative operator's point of presence and not actual network routing. Therefore, it is necessary for Ofcom to make some assumptions as to the extent to which operators can self-provide trunk transmission between their network points of presence. The main assumptions, as for the network reach analysis for the symmetric broadband origination markets above are in respect of :

- the number of operators that there are required to be in order to offer a sufficiently different constraint from those areas where there is no choice of operator; and

- the distance that an operator would build from a PoP in order to provide services to a business site.

4.85 Ofcom's base case assumption on the first of these, consistent with the approach taken for the symmetric broadband origination markets, in that there would need to be at least two additional operators (i.e. at least 3 operators) with the capacity to interconnect at a Tier 1 node in order to provide a sufficiently different constraint. On the second, Ofcom believes that it is reasonable to assume that the economic build distance in order to interconnect with BT at its Tier 1 nodes will be greater than the economic build distance for providing services to businesses. This is due to the significant economies of scale that can be achieved through aggregating traffic at such nodes. Ofcom has used for its base case assumption an economic build distance of 1km. However, Ofcom believes that this is a relatively conservative assumption, especially for Tier 1 nodes that carry a significant volume of traffic.

4.86 This analysis shows that out of a total of 2211 trunk routes that have different parent Tier 1 nodes at the A end and at the B end, assuming an economic build distance of 1km for an alternative operator to interconnect with BT at its Tier 1 nodes, there are 345 trunk routes at which there are connected two or more alternative operators at both ends, accounting for 15.6% of trunk routes. If the assumption about the economic build distance to interconnect with BT at its Tier 1 nodes is increased to 5km the number of trunk routes at which there are connected two or more alternative operators at both ends, increases to 1625, accounting for 73.5% of trunk routes. Further details are shown in Table 4 below.

Table 4 – Number of alternative operators with a network point of presence at both ends of the trunk route

	No. of trunk routes		Cumulative number of trunk routes		% of trunk routes		Cumulative % of trunk routes	
	1km	5km	1km	5km	1km	5km	1km	5km
5 or more	1	530	1	530	0.0	24.0	0.0	24.0
4	7	253	8	783	0.3	11.4	0.4	35.4
3	76	376	84	1159	3.4	17.0	3.8	52.4
2	261	466	345	1625	11.8	21.1	15.6	73.5
1	504	313	849	1938	22.8	14.2	38.4	87.7
0	1362	273	2211	2211	61.6	12.3	100	100

Retail and wholesale service share analysis

4.87 Retail service shares analysis in the trunk segments markets is in some senses a hypothetical construct as it is not possible for customers (either businesses, telecommunications aggregators/resellers or network operators) to purchase a retail trunk segment. Nonetheless, it is possible to identify the trunk route of each retail leased line[21] and identify the retailer of that "retail" trunk segment. Ofcom believes that although this analysis is a hypothetical construct it can nonetheless be informative of the extent to which it could be the case that there is a variation in competitive conditions at the wholesale level. If the analysis shows that there is variation in service shares on a route by route basis at the retail level and the network reach analysis shows that on certain routes there are operators with network at both ends of the routes, then this could indicate that these routes have different competitive conditions from other routes.

4.88 Figure 17 below shows BT's share of retail trunk segments on each of the 2211 trunk routes in the UK. As can be seen from the matrix, there are some routes where BT's share of trunk routes is below 50%. An interesting observation from Figure 17 is that many of the trunk routes on which BT's market share is lowest are intra-London routes. This may reflect that many of the alternative operators' customers are located in the London area and that these customers are purchasing retail network services rather than end-to-end retail leased lines and as such these operators are selling relatively short circuits from the customer premise to their core network node. Because of the concentration of BT Tier 1 nodes within the London area this shows that these alternative operators have a large share of intra-London retail trunk traffic. This could suggest there being a stronger competitive constraint in intra-London routes, compared to other routes within the UK.

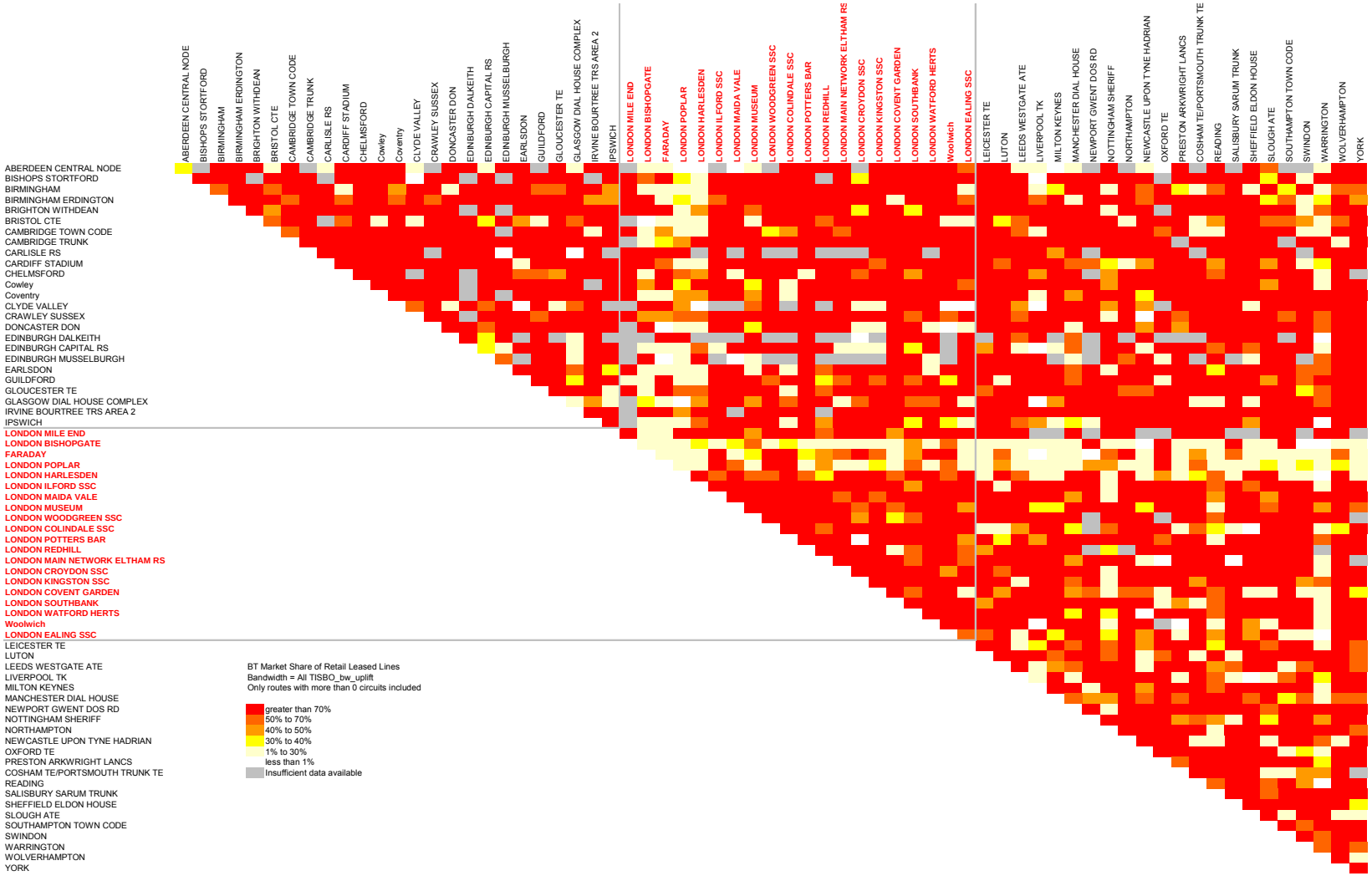
4.89 Nevertheless, it can be seen from Figure 17 that there are other routes which may or may not include a London Tier 1 node for which BT's share of retail trunk segments

[21] Although noting that the trunk route in this context is not the actual physical routing of a circuit but the route from the parent BT Tier 1 node at the A end to the parent BT Tier 1 node at the B end.

is low, which may indicate that in these areas there a stronger competitive constraint than those areas where BT's share is higher.

4.90 As with the wholesale symmetric broadband origination markets discussed above, the question that we are interested in answering here is the extent to which there exist variations in competitive conditions at the wholesale level. It could be the case that the variations in retail service shares that are evident at the retail level are due to the provision of regulated wholesale trunk inputs by BT and that network operators do not have the ability to use their own networks to compete in the provision of these wholesale services.

Figure 17 – BT's share of retail trunk segments by route



4.91 As with the other wholesale markets assessed in this document, it has not been possible for Ofcom to carry out the analysis of the wholesale trunk market that it was originally intending to. This is because the data provided by Altnets at the wholesale level is not comprehensive enough to be confident of the output of such analysis. However, it has been possible to estimate BT's share of the wholesale trunk segments market using information provided by BT to Ofcom. As with the other markets assessed in this way and discussed above, it is possible that the ratio of BT's wholesale shares to the total retail market, on some trunk routes will be greater than 1:1. This is by virtue of the fact that the wholesale trunk segments that BT sells to other networks operators can be used in the provision of non-retail leased lines services.

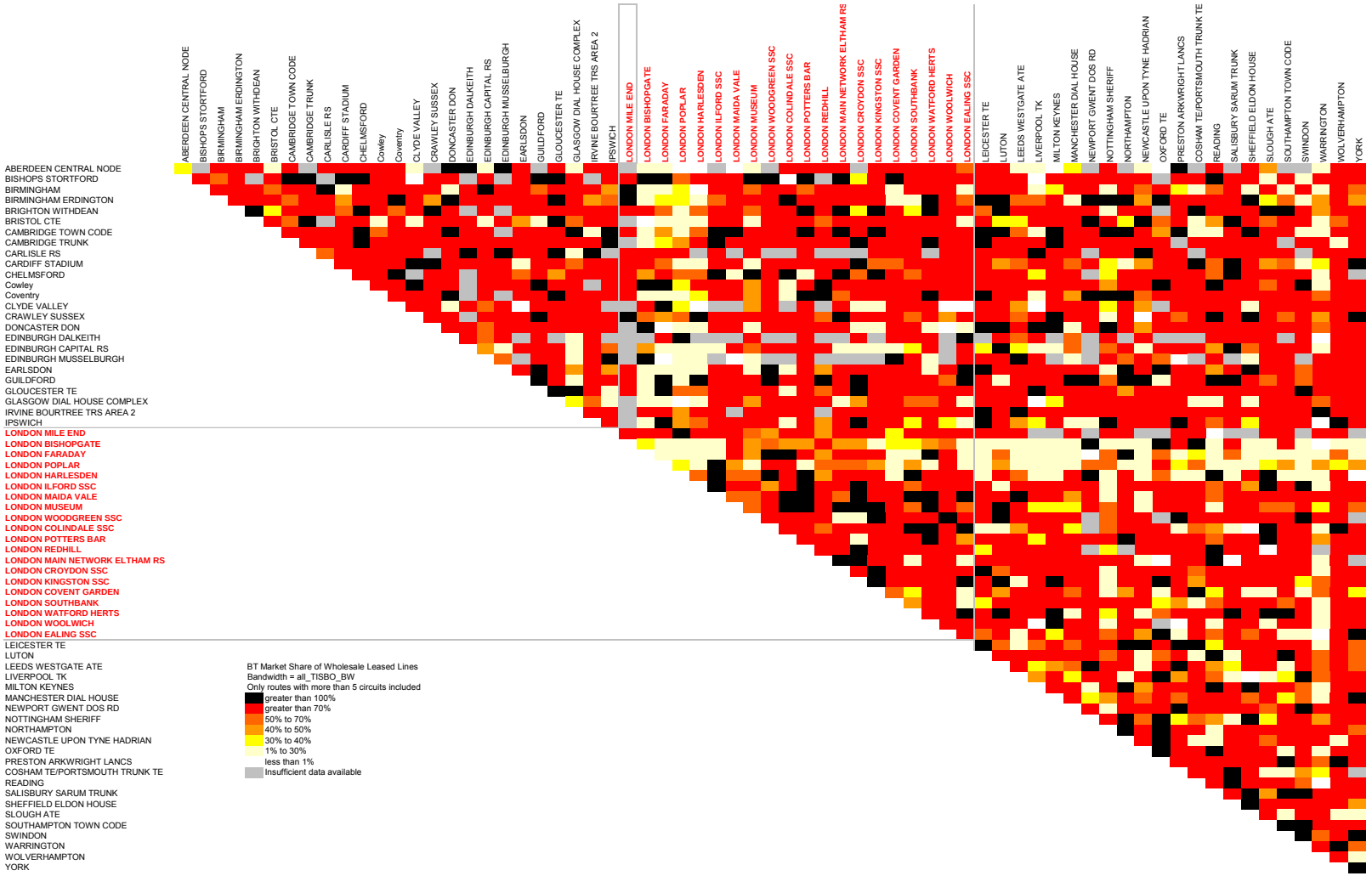
4.92 Figure 18 below repeats the analysis in Figure 17 above, but does this using the wholesale trunk data provided by BT and provides an upper bound estimate of BT's service share in the provision of wholesale trunk segments.

4.93 Figure 18 shows that at the wholesale level, there remains a number of trunk routes where BT's service share is relatively low, falling below 50%. This shows that it could be the case that there is a variation in the competitive constraint present on certain routes, compared to other routes.

4.94 It is also possible to combine this analysis with the trunk network reach analysis set out above to assess whether there is a strong correlation between those trunk routes where there is a lower BT share and those trunk routes where alternative operators have a network presence at each end of the route. Ofcom has conducted this analysis using the network reach data assuming both a 1km and a 5km economic build distance.

4.95 This analysis shows that as the number of operators with a network presence at both ends of a trunk route increases, BT's share of trunk segments decreases. However, the fit of the correlation is not particularly strong. Part of the reason for this could be the quality of the data received from the alternative network operators and the associated data uplift required (see Annex 7).

Figure 18 – BT's share of wholesale trunk segments by route



Scope for alternative operators to interconnect with each other

4.96 The same arguments that were made in the discussion of this issue under wholesale low bandwidth TISBO apply here. Therefore it is not clear whether the there is the ability for alternative operators to interconnect with each other, or whether purchasers of leased lines, in particular smaller businesses, would be able to purchase retail leased lines from multiple retail providers.

BT's pricing policies

4.97 BT does not vary its prices for the provision of wholesale trunk segments on a geographic basis. For each bandwidth, BT has a single national price. This could suggest that there is a national common pricing constraint present, indicating a national market.

Conclusions of analysis

4.98 As set out above, Ofcom has conducted a variety of analyses to help inform whether there is evidence to suggest that competitive conditions vary on a geographic basis in the various leased lines markets in the UK, such that there could be reasons to vary remedies within a national market or to define separate local markets. The conclusions of the analysis are mixed for the different product markets being considered, but can be summarised as follows:

- Retail low bandwidth traditional interface leased lines. There is little evidence of variations in competitive conditions in the provision of services in this market. However, BT's pricing policies could be indicative of there being local markets.

- Wholesale low bandwidth TISBO. Again, there is little evidence of variations in competitive conditions in the provision of services in this market. However, BT's pricing policies could be indicative of there being local markets.

- Wholesale high bandwidth TISBO. The analysis conducted of the geographic location of alternative operators' networks and the service shares on a postal sector basis indicates that it could be the case that there are significant variations in competitive conditions and that this could be reason to vary remedies within a national market or to define separate local markets. Such a conclusion is also supported by BT's pricing policies where BT prices these traditional circuits at a lower price in the central London zone both at the retail and at the wholesale level.

- Wholesale very high bandwidth TISBO. There are very few geographic areas where operators provide very high bandwidth traditional interface leased lines, either at the retail level or the wholesale level. The analysis could be suggestive of any variation in competitive conditions being very limited and that the relatively high value of these circuits makes entry generally economic.

- Wholesale AISBO. The analysis conducted of the geographic location of alternative operators' networks and the service shares on a postal sector basis indicates that it could be the case that there are significant variations in competitive conditions and that this could be reason to vary remedies within a national market or to define separate local markets. However, BT's pricing policy is to price these alternative interface circuits, at both the retail and wholesale level, on a national basis, suggesting the presence of a national common pricing constraint.

- Wholesale trunk segments. The analysis conducted of the geographic location of alternative operators' networks (in particular their connectivity with BT's Tier 1 nodes) and the service shares on a postal sector basis indicates that it could be the case that there are significant variations in competitive conditions on a route by route basis and that this could be reason to vary remedies within a national market or to define separate local markets. However, BT's pricing policy is to price wholesale trunk segments on a national basis, suggesting the presence of a national common pricing constraint.

4.99 The results of the analyses presented in this discussion document represent an initial view on this question and further analysis will be required, particularly in those markets where there is evidence of significant variations in competitive conditions. This further analysis will be instructive as to the precise boundary in which it could be appropriate to either vary remedies within a national market or to define local markets.

4.100 The next two Sections of this discussion document consider for those markets where the evidence is strongest in suggesting that there could be geographic variations in competitive conditions, issues around aggregating geographic areas and ways in which remedies within markets could be varied. The markets considered are:

- Wholesale high bandwidth TISBO;
- Wholesale AISBO; and
- Wholesale trunk segments.

Question 2)	*Do respondents agree that supply-side factors are a significant indicator of geographic variations in competitive constraints within leased lines markets in the UK?*

Question 3)	*Do respondents agree that the evidence of geographic variations in competitive conditions is greatest for wholesale high bandwidth TISBO, wholesale AISBO and wholesale trunk segments?*

Section 5

Aggregation Issues

Introduction

5.1 The purpose of this section is to consider how geographic areas with similar competitive conditions might be aggregated, either for the purpose of defining markets at a sub-national level, or for the purpose of varying regulatory remedies within a single geographic market. The issues involved are discussed first in general terms, before their application to specific leased lines markets is examined.

5.2 The market analysis focuses on the wholesale markets for high bandwidth TISBO and AISBO, as the evidence indicates that competitive conditions do vary significantly within these markets, and there is clearly a need for some degree of aggregation. Aggregation issues do not arise for trunk segments, as it would be feasible to define individual routes as being in separate markets.

5.3 In addition, we have not considered aggregation issues in relation to the retail low bandwidth traditional interface leased lines market, or the wholesale low bandwidth TISBO market because, as discussed in Section 4, the evidence does not point to the existence of significant geographical variations in competitive conditions within these markets.

General Issues

5.4 It may first be useful to recap on the overall approach which has been taken to the geographic market analysis:

- SSNIP analysis: this involves the analysis of demand side and supply-side substitutability, based on the SSNIP test and the HMT;
- Pricing constraints and buying patterns: this looks at whether the geographic coverage of a market might be extended by the existence of common pricing constraints, or by the purchasing behaviour of end-users; and
- Competitive conditions: this looks at the extent to which other indicators of competitive conditions vary by geography, and whether different geographic areas should be grouped together on this basis, either to define relevant markets for regulatory purposes, or to consider the scope for varying remedies within a market.

5.5 Section 4 looked at the first three of these in the context of leased lines. This Section on aggregation looks at the possibility of grouping together those areas where there are similar competitive conditions and also considers whether there are other practical factors which might justify some modification or approximation of the geographic groupings which emerge from the previous analysis e.g. to yield areas that might be more readily understood by consumers and providers, or for which cost and revenue information might be more readily available.

Aggregation based on competitive conditions

5.6 In Section 3 above, Ofcom identified a range of factors which should be taken into account when assessing whether competitive conditions in different areas are similar. Ofcom's analysis of this issue has three main elements:

- statistical analysis: techniques such as regression and cluster analysis can be used to explain and predict the scope for competition in different areas;
- the number of suppliers who currently have a presence in the area; and
- service shares.

5.7 Each of these elements of the analysis could be used as approaches for aggregating areas into markets.

Statistical analysis

5.8 The first approach involves identifying demographic and other characteristics that are likely to influence the level or intensity of demand in a given area, and the extent of competitive market entry. The explanatory variables used in this analysis could be factors affecting either demand (such as population or business density) or supply (such as topographic conditions). Statistical techniques such as regression analysis and cluster analysis can be used to assess the extent to which the chosen indicators are capable of explaining actual variations in competition - it is important to have some empirical evidence for the explanatory power of the selected variables, if they are to be used with any confidence. Areas can then be grouped together, based on the predicted level of competition.

5.9 The main attraction of the this approach is that it involves stepping back from existing market conditions, and can therefore:

- provide a more stable basis for grouping areas together; and
- reflect factors which are likely to drive the future development of competition, rather than simply reflecting the past and present.

5.10 In Ofcom's view, these are potentially important advantages which mean that, where appropriate indicators can be identified and subject to data availability, this approach is likely in some cases to be the most appropriate option.

Network presence

5.11 The second approach would be to group together areas based on the number of suppliers with a presence in the area, which could be used to serve customers. This will reflect supply-side conditions relevant to the market under consideration, which can be assessed using information on network reach. Information of this kind has already been discussed in Section 4 above.

5.12 The main advantage of using this approach is that it would reflect, in a direct way, the extent to which customers in a given area are likely to have choice of suppliers. Possible disadvantages are that:

- the extent of supplier networks could change quite frequently, suggesting a need for frequent updates of the market analysis;
- it would only capture the current position, and would not reflect any plans or prospects for network expansion; and
- if regulation were to be based on network reach, this could provide a disincentive for competitors to extend their networks into currently non-competitive areas.

5.13 For these reasons, an approach based on the number of suppliers may in some cases be less appropriate than one based on underlying drivers of demand and competition.

Service shares

5.14 The third approach is to group areas together on the basis of service shares (that is an operator's share of leased line ends within an area). Our analysis of service shares has been carried out at the postal sector level. Although individual postal sectors may be small, they may in many cases be large enough to satisfy the SSNIP conditions for a separate market, which provides some justification for regarding service shares as a potentially useful indicator of local competitive conditions.

5.15 Nevertheless, Ofcom has some concerns about an approach based on service shares, as it may focus too much on the outcome of the competitive process, rather than on the underlying drivers of the potential for competition. As a result, it might lead to conclusions about market dominance that are unjustified and unstable over time. For example, the award of a single contract after a competitive tendering process could result in a high market share for the winning provider in a particular area. It would clearly be wrong in these circumstances to infer that the provider had a dominant position in that area, just as it would be wrong to change the identity of the "dominant" provider each time the contract changed hands.

5.16 In the light of these factors, Ofcom does not believe that service shares should be the primary basis for grouping areas together. This does not mean, however, that service share information is irrelevant. It can still provide a useful cross-check on groupings obtained by other means, to ensure that differences between the expected level of competition and the observed outcome can be accounted for.

Practical considerations

5.17 Whichever approach is used in the first stage of the analysis, it is likely to produce an untidy 'patchwork quilt' of areas, made up of groupings which have been classified according to their competitive conditions. In the present case, the analysis is based on postal sectors, of which there are 9,598 in the UK. This raises a number of practical issues.

5.18 The first issue is that services such as wholesale leased lines will in most cases be used to link locations in different postal sectors. It is therefore necessary to decide how a leased line between a competitive and a non-competitive area should be treated.

5.19 It is useful to recall that market definition, is a means to an end, with the end in the context of geographic market definition being the identification of the relevant geographic area within which to assess a firm's or a group of firms' market power, which in turn informs decisions about the necessity to impose ex-ante regulations. In the current context, the main concern is with wholesale TISBO and AISBO products which link a customer's premises to a BT PoC. For these products, Ofcom's view is that the location of the customer's premises should be the determining factor when it comes to deciding on the applicability of regulatory remedies because the location of a premise (relative to competing networks) is a key determinant of the choice of leased lines supplier to that premise.

5.20 The second issue is that the first stage of analysis is likely to group together a number of non-contiguous areas, which may be hundreds of miles apart. In some

ways it would seem to be counter-intuitive to define such a collection of postal sectors as a single market. In Ofcom's view, however, the non-contiguous nature of such groupings should not prevent them being referred to as a single market for regulatory purposes, linked together by the similarity of their competitive conditions. Such an approach would be consistent with the EC guidelines for analysis of markets and SMP, and could provide a practical basis for regulation.

5.21 A third issue, related to the second, is that the boundaries between markets are likely to be untidy, and that larger areas within one market are likely to be interspersed with smaller 'islands' in another. There are at least two reasons why this could matter:

- Firstly, it could be confusing for customers if regulatory provisions vary on the basis of geographic market definitions which have little or no meaning from their point of view. Ofcom would welcome views from interested parties as to whether this would be a significant factor; and

- Secondly, the costs and difficulties of ensuring compliance with regulatory provisions may be considerable if market definitions are based on geographically untidy groupings of areas. The most obvious difficulties concern the availability – or lack of it – of cost and revenue information at a disaggregated geographic level. In the course of preparing this discussion document, Ofcom invited BT to comment on this issue. In response, BT expressed a preference for an approach based on aggregations of BT exchange areas. This is the lowest level at which accounting information is collected with BT. This possibility is considered further below, in the context of the high bandwidth TISBO and AISBO markets.

5.22 If the issues associated with aggregation prove to be significant, consideration could be given to the use of some simpler, established geographic areas, which were introduced for another purpose but which might nonetheless broadly reflect variations in competition. Options could include:

- administrative boundaries such as the City of London or Greater Manchester, which would be more familiar to customers;

- groupings of BT exchange areas, for which accounting information might be more readily available; or

- other more readily understood areas such as 'within the M25'.

5.23 We give further consideration to some of these options below.

Application to leased lines

5.24 Ofcom has looked at how the approaches described above might be applied in the case of leased lines. The basic building block used in the analysis is the postal sector. As explained in Section 3, analysis at the postal sector level provides an appropriate balance between practicality and precision, for the purposes of statistical analysis.

5.25 The findings are set out below for:

- statistical analysis - aggregation based on the results of regression and cluster analysis;

- aggregation based on supplier numbers; and

- possible use of other area definitions

Statistical analysis

5.26 Ofcom has carried out regression and cluster analysis, to shed light on the factors which may explain variations on competitive conditions in the markets for leased lines. The results of the analysis are described in Annex X.

5.27 The regression analysis was aimed at identifying factors which could explain variations by postal sector in:

- the number of providers supplying retail circuits;
- the total number of circuits provided (weighted by bandwidth); and
- BT's retail market share.

5.28 The results of the regression analysis are of limited value in the present context because it was not possible to obtain statistically significant results for the two product categories of most interest to us, namely high bandwidth TISBOs and AISBOs.

5.29 However, the results do show that the number of providers present in a postal sector can be largely explained in terms of the following independent variables:

- the number of businesses with 200+ employees;
- household density;
- the number of mobile masts;
- the number of houses;
- the area covered by the postal sector; and
- expected expenditure levels on leased lines (based on other survey results for business customers)

5.30 The purpose of the cluster analysis was to group postal sectors together on the basis of demographic factors which are likely to influence the extent of competition in the market for leased lines. The analysis led to the identification of the ten clusters listed in Table 5.

Table 5 - Results of the cluster analysis

	Cluster number	Number in each cluster	% in cluster	Description
City Centre	1	848	8.8%	Lots of high and medium spend companies Average number of base stations and households Centre of a city/large town
City Core	2	237	2.5%	High number of high and medium spend companies Below average number of households but above average household density High number of base stations
Suburbia	3	894	9.3%	High number of medium and low spend businesses Average household density and number of households Above average number of base stations Suburbia
Town Centre	4	1270	13.2%	Average number of households but high population density High numbers of low and medium-spend companies Average number of base stations Small town
Rural Area	5	1081	11.2%	Rural area Below average number of business, households and base stations
Industrial Area	7	643	6.7%	Low population density, Industrial Area
Mixed Use	8	1649	17.2%	Mixed residential area Low levels of business but average masts
Average Area	9	1452	15.1%	Average area (matches average across population)
Residential Area	10	1105	11.5%	Residential area High household density but low levels of business
Business district[22]	12	41	0.4%	Area of London – very low residential, but not high business

5.31 These clusters were driven by the number of businesses, the number of mobile masts and household density of the postal sectors; that is, by three of the variables which were found in the regression analysis to have a significant influence on the number of retail providers. There is in this sense a consistency between the findings of the regression analysis and the cluster analysis.

5.32 Tables 6 and 7 below show how the number of providers varies within and between clusters, for retail high bandwidth traditional interface leased lines and retail

[22] This is a subset of cluster 5 – see Annex 8.

alternative interface leased lines. Ofcom's observations on these results are as follows:

- For retail high bandwidth traditional interface circuits, a significant proportion of the postal sectors in all clusters apart from Business District have no providers at all, indicating that there are no customers for these products. The proportion of postal sectors with two or more operators only exceeds 8% in three clusters, namely Business District (57%), City Core (41%) and City Centre (20%). The proportion with three or more operators is lower still, at 37% in Business District, 18% in City Core, 7% in City Centre and 3% or less in other clusters.

- For retail alternative interface circuits, the level of retail competition appears to be somewhat greater. The proportion of postal sectors with two (three) or more operators is 90% (29%) in Business District, 59% (24%) in City Core, 37% (9%) in City Centre and 32% (7%) or less in the remaining clusters.

Table 6 – The number of retail high bandwidth traditional interface leased lines providers, by cluster

Number of retail high retail high bandwidth traditional interface operators by cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	**27%**	**48%**	**69%**	5%	**62%**	**75%**	**80%**	**85%**	**86%**	**90%**	**75%**
1	**31%**	**33%**	**23%**	**37%**	**29%**	**19%**	**17%**	**12%**	**11%**	**9%**	**19%**
2	**23%**	**13%**	**5%**	**22%**	**6%**	4%	2%	2%	2%	1%	4%
3	11%	5%	2%	**32%**	2%	1%	0%	1%	1%	0%	2%
4	5%	2%	1%	5%	1%	1%	0%	0%	0%	0%	1%
5	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Over 5	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Table 7 – The number of retail alternative interface providers, by cluster

Number of retail alternative interface operators by cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	6%	**10%**	**18%**	0%	**20%**	**58%**	**27%**	**57%**	**50%**	**78%**	**38%**
1	**36%**	**52%**	**50%**	**10%**	**52%**	**34%**	**49%**	**38%**	**39%**	**21%**	**41%**
2	**35%**	**28%**	**25%**	**61%**	**23%**	**6%**	**22%**	4%	**6%**	2%	**16%**
3	**13%**	8%	6%	**24%**	5%	2%	2%	1%	2%	0%	3%
4	7%	1%	1%	5%	1%	0%	1%	0%	0%	0%	1%
5	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Over 5	1%	0%	0%	0%	0%	0%	0%	0%	05	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

5.33 Care is needed when interpreting these results. It is important to note in particular, that this analysis is based on the number of retail providers who currently provide circuits, and that the number of providers at the wholesale level may be significantly lower. The analysis of network reach, as discussed below, is likely to be a better indicator of the potential for competition in the related wholesale markets.

5.34 Stakeholder views are invited on the significance and potential value of the regression and cluster analysis in assessing geographic variations in competitive conditions in the markets for leased lines.

Number of Suppliers

5.35 This analysis is potentially relevant to the wholesale markets for both TISBO and AISBO. It involved using the information on the network reach of the various providers to determine the average number of providers serving the businesses within each postal sector.

5.36 Features of the analysis were as follows:

- for each location belonging to a business employing more than 250 people, we determined the number of providers with a point of presence within a given distance of that location. The 250 employee cut-off was chosen to pick up those business premises likely to be large enough to be in the market for a leased line;
- the distances used were 250m, 500m and 1000m. These distances were chosen to reflect the distances which suppliers might be prepared to build out their networks, in order to connect new leased line customers. It is recognised that a supplier is likely to be prepared to build out over a longer distance for a customer wanting multiple and/ or higher bandwidth leased lines, as the prospective revenues would in these cases be higher.
- for each postal sector, the average number of providers was then calculated. In this calculation, each business location was weighted according to the number of employees working there.

5.37 Illustrative results are shown in Figures 19 to 22. These maps are for the Central London Zone and the City of London. Figures 19 and 20 are based on a build-out distance of 500m, whereas Figures 21 and 22 assume a build-out distance of 250m. The maps categorise postal sectors into three categories – those in which the average number of suppliers is less than 2, those in which it is between 2 and 3, and those in which it is more than 3.

Figure 19 – Number of operators in the CLZ, with 500m build-out

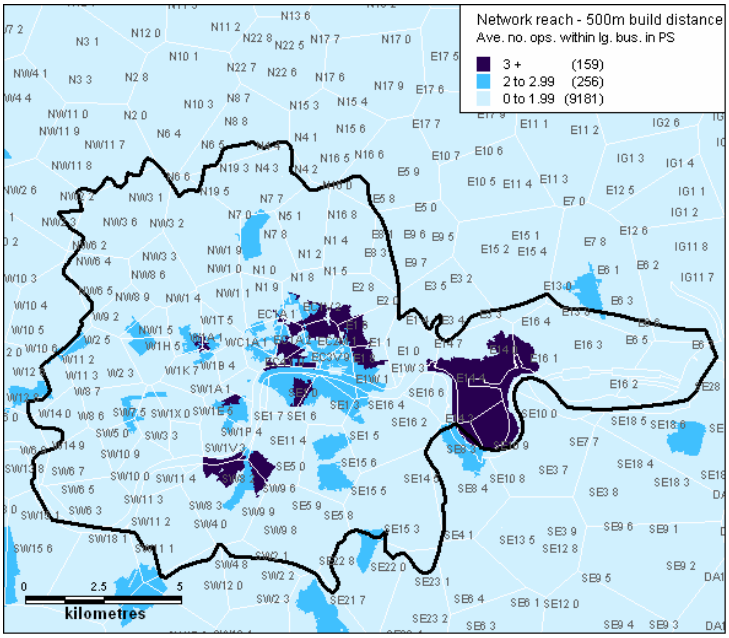


Figure 20: Number of operators in the City of London, with 500m build-out

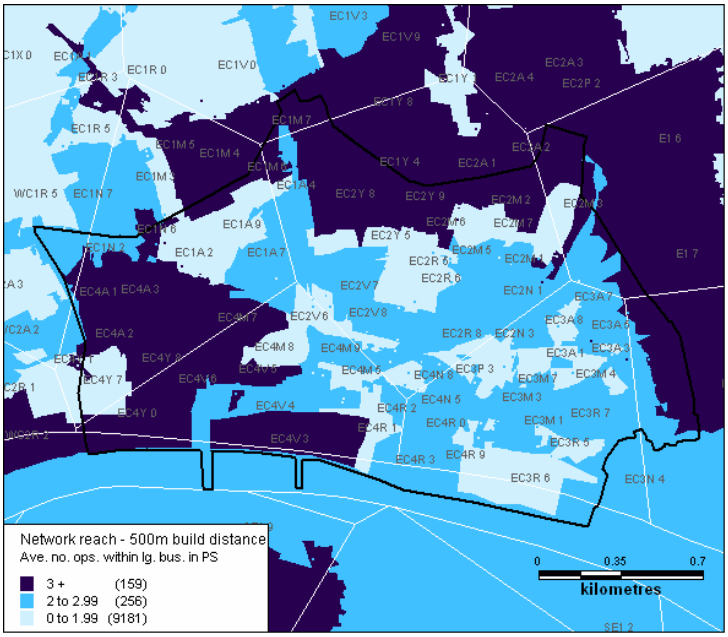


Figure 21 – Number of operators, CLZ, based on 250m build-out

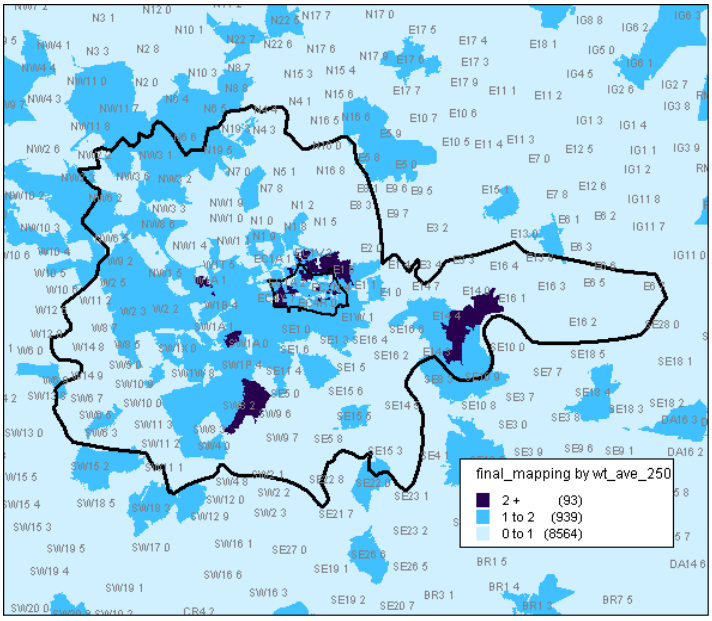
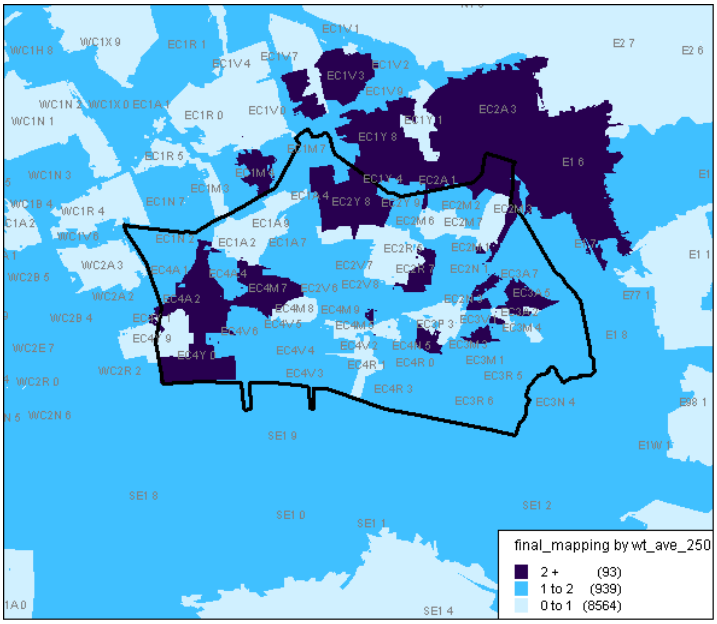


Figure 22 – Number of operators, City of London, based on 250m build-out



Tables 8 to 10 below summarise this analysis for the UK, the CLZ and the City of London respectively.

Table 8 – Analysis of operator numbers in the UK

UK (9598 PS)	**250m**	**500m**
Number of postal sectors with 2+ suppliers	93	415
Proportion of total retail circuits within above postal sectors:		
- High bandwidth traditional interface leased lines	14%	32%
- Alternative interface leased lines	5%	17%
Number of postal sectors with 3+ suppliers	20	159
Proportion of total retail circuits within above postal sectors:		
- High bandwidth traditional interface leased lines	4%	19%
- Alternative interface leased lines	1%	8%

Table 9 – Analysis of operator numbers in the CLZ

CLZ (454 PS)	250m	500m
Number of postal sectors with 2+ suppliers	37	128
Proportion of total retail circuits within above postal sectors:		
- High bandwidth traditional interface leased lines	33%	68%
- Alternative interface leased lines	18%	49%
Number of postal sectors with 3+ suppliers	5	49
Proportion of total retail circuits within above postal sectors:		
- High bandwidth traditional interface leased lines	9%	43%
- Alternative interface leased lines	5%	25%

Table 10 – Analysis of operator numbers in the City of London

UK (9598 PS)	250m	500m
Number of postal sectors with 2+ suppliers	17	62
Proportion of total retail circuits within above postal sectors:		
- High bandwidth traditional interface leased lines	14%	76%
- Alternative interface leased lines	20%	73%
Number of postal sectors with 3+ suppliers	0	21
Proportion of total retail circuits within above postal sectors:		
- High bandwidth traditional interface leased lines	0	23%
- Alternative interface leased lines	0	24%

5.38 Table 8 shows that at a national level, only 20 postal sectors out of 9598 have three or more operators, based on a build out distance of 250m. The number rises to 415 for two or more suppliers and a build-out distance of 500m. These 415 postal sectors account, respectively, for 32 and 17% of the retail high bandwidth traditional interface and alternative interface leased lines sold in the UK.

5.39 Looking at the CLZ, Table 9 shows that a third of the retail traditional interface circuit ends are located in postal sectors served by two or more providers, based on a build distance of 250m and that this proportion rises to two-thirds with a build distance of 500m. The proportions are somewhat lower for retail alternative interface circuit ends, at around a fifth and a half respectively, but are still significant.

5.40 The proportion of circuits covered falls to under 10% for both circuit categories if the criteria are tightened to 3+ providers and a build distance of 250m

5.41 Within the City of London, Table 10 shows that there are no postal sectors with 3 or more suppliers at a build distance of 250m. However, with a build distance of 500m, around a quarter of businesses are within postal sectors having 3 or more suppliers and around three quarters are in sectors with 2 or more suppliers. The pattern is similar for high bandwidth traditional interface and alternative interface circuits.

5.42 It can also be seen from the maps that the more competitive areas quite often form non-contiguous 'islands': as expected, they do not conform neatly to any established or recognisable boundaries.

5.43 Figures 23 below shows that the number of multi-supplier areas is more limited in the next six largest UK cities, by population. With a build-out distance of 500m, there are only a handful of postal sectors with 2 or more suppliers and hardly any with more than 3.

Figure 23 – Number of operators, major cities outside London

Figure 23a – Birmingham

500m build-out

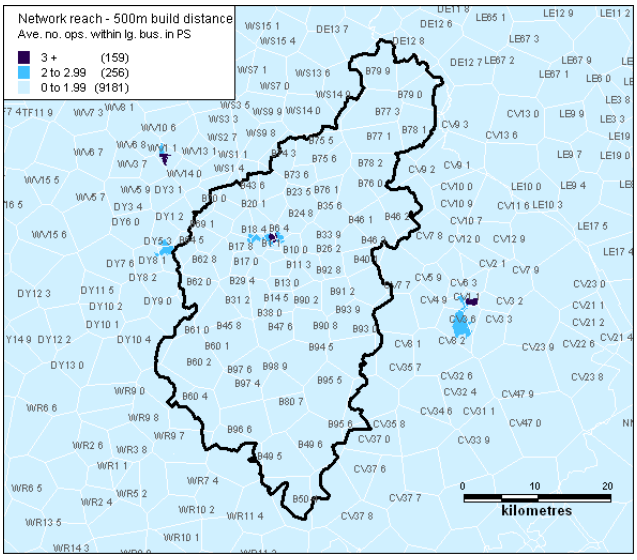


Figure 23b – Glasgow

500m build-out

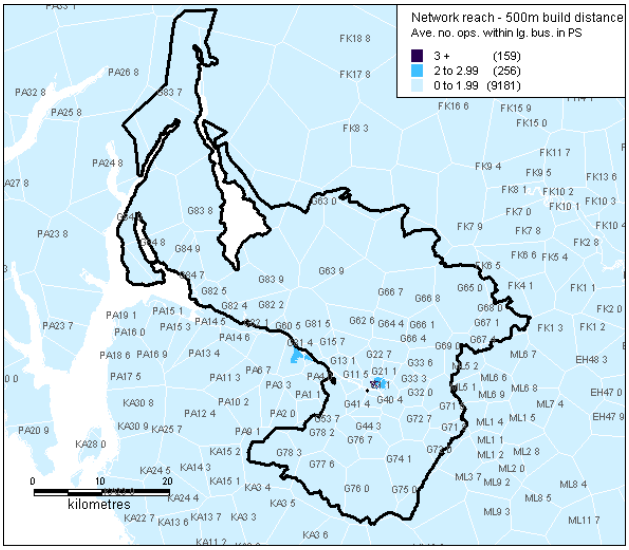


Figure 23c – Liverpool

500m build-out

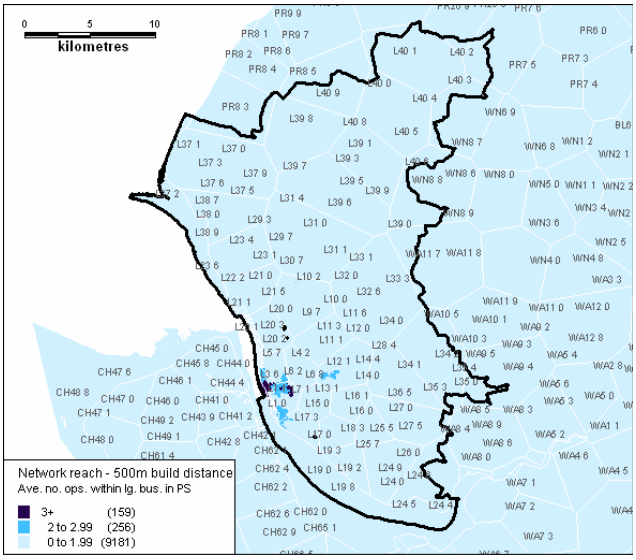


Figure 23d – Leeds

500m build-out

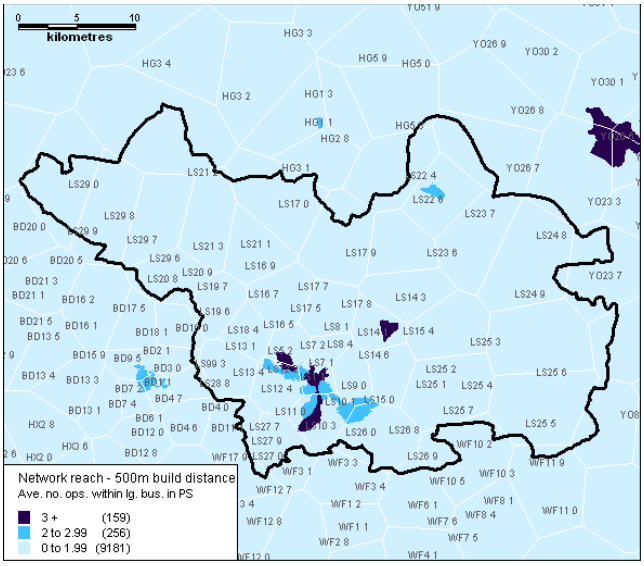
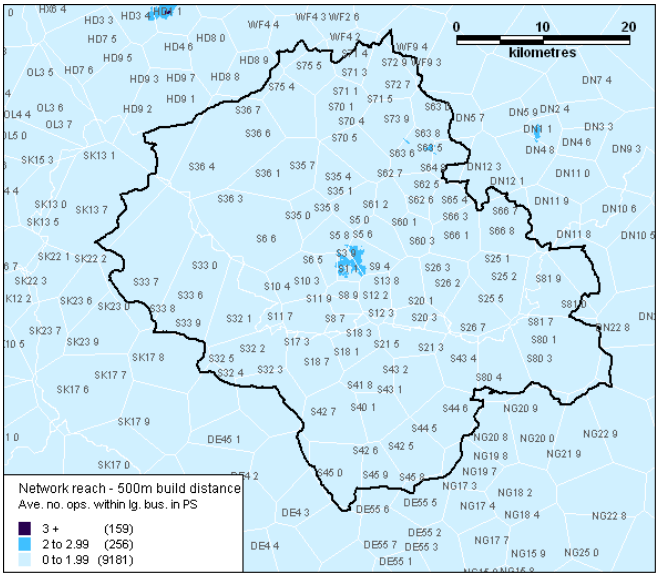


Figure 23e – Sheffield

500m build-out



5.44 Stakeholder views are invited on the significance and potential value of this kind of analysis in grouping areas for regulatory purposes, and on the parameters that should used when carrying it out, including:

- the 250 employee cut-off;
- the build-out distances; and
- the number of suppliers required for there to be different competitive conditions.

Other area definitions

5.45 As discussed above, there may be a case for using area boundaries which have already been established for another purpose, when defining geographic markets at the sub-national level. Such areas would ideally be a reasonable approximation of those suggested by the analysis of competitive conditions, while bringing other benefits in terms of being more readily understood by customers and/or easier to apply from a regulatory standpoint.

5.46 Ofcom has looked at the following possibilities:

- the City of London;
- the 020 calling area for London (i.e. the Central London Zone); and
- BT exchange area boundaries, for London and other major centres.

5.47 The City of London and the CLZ 020 7 dialling area boundary are shown on Figures 1 to 16 and 19 to 22. It is apparent from those figures that there is little correlation between these boundaries and the competitive conditions in the various postal sectors, as reflected in the analysis of supplier numbers and the cluster analysis. In Ofcom's view, they are unlikely to provide a good basis for the definition of sub-national markets for leased lines.

5.48 In Figures 19 to 23 Ofcom has superimposed BT's exchange area boundaries. The rationale for considering the use of exchange area boundaries is that accounting information for BT's services is more readily available at an exchange area level than it is by postal sector. It might therefore be more practical, both for BT and for Ofcom, if regulatory measures were to be applied using geographic boundaries which correspond to exchange area boundaries. As noted above, BT has expressed a strong preference for an approach based on its exchange areas, arguing that alternative methods would be very difficult to apply.

5.49 As perhaps would be expected, the maps indicate that the extent of the correlation between competitive conditions, analysed by postal sector, and BT's exchange area boundaries is quite low. Nevertheless, Ofcom does not rule out an approach based on exchange area boundaries, as this may prove to be the only practicable option.

5.50 Stakeholders are invited to comment on the potential value of using BT's exchange area boundaries, or other area definitions, either to define sub-national markets for leased lines, or for possible use in varying regulatory remedies within an existing market.

Question 4)	*Has Ofcom correctly identified the main issues involved in the aggregation of geographic areas?*
Question 5)	*How much weight should be attached to the results of statistical analysis, when considering how areas should be aggregated together for regulatory purposes?*
Question 6)	*How much weight should be attached to the analysis of supplier numbers and network reach, when aggregating geographic areas for regulatory purposes?*

Question 7)	*What assumptions should be used when carrying out such an analysis for leased lines, particularly with regard to business size, build-out distances and the number of suppliers required for effective competition?*

Question 8)	*Should the area groupings derived from the analysis of competitive conditions be approximated for practical reasons (e.g. to take account of the availability of accounting data) and, if so, how?*

Section 6

Scope for varying remedies within a national market

Introduction

6.1 As noted in Section 2, the EC guidelines on market analysis and SMP indicate that competitive conditions need not be perfectly homogeneous within a geographic market. It is possible that, within an area, competitive conditions may be sufficiently homogeneous to justify the definition of a single market, but sufficiently different to warrant the variation of remedies (i.e. SMP conditions) which are already in place. This section considers this possibility, with reference to the markets for leased lines.

6.2 The analysis focuses on the wholesale markets for high bandwidth TISBO, AISBO and trunk segments. We have not looked in detail at the retail market for low bandwidth leased lines and the wholesale market for low bandwidth TISBO. That is primarily because of the evidence referred to in Section 4 above, which does not point to there being significant variations in competitive conditions within these markets. In addition, the scope for varying remedies within the retail market for low bandwidth leased lines is severely constrained by the provisions of the Universal Service Directive, which require a minimum set of remedies to be applied where SMP has been found to exist in this market.

6.3 Ofcom does not consider that it has gathered sufficient evidence to reach a firm conclusion about whether variations in competitive conditions are sufficient to warrant the introduction of variable remedies within the markets considered below. We do not therefore put forward firm proposals for the introduction of such remedies. Additionally, in order for any SMP conditions to be set, modified of revoked the test in section 86 of the Communications Act 2003 must be satisfied i.e. that there has not been a material change in the market identified since a condition was set or last modified.

6.4 The main purpose of the analysis is to consider, if variable remedies were to be introduced, what they might look like. Ofcom's view is that it is likely to be easier for stakeholders to comment on the possibility of variable remedies, if they are given an indication of what this could mean in practice.

6.5 An attraction of variable remedies is that they would open up the possibility of a phased approach to deregulation. Where the level of competition grows more quickly in some parts of a market than in others, SMP conditions could be reduced in the more competitive areas, as a prelude to full deregulation.

Wholesale high bandwidth TISBO

6.6 BT is currently subject to nine SMP Conditions and three Directions in the wholesale market for high bandwidth TISBO. These are as follows:

Conditions:

- **GG1 - Requirement to provide network access on reasonable request.** This is a general obligation to provide access as soon as reasonably practicable and on fair and reasonable terms and conditions and charges.

- **GG2 – Requirement not to unduly discriminate.** This is a requirement on the dominant provider not to discriminate against a competitor in relation to matters connected with network access, in a manner likely to restrict or distort competition.

- **GG3 – Basis of charges.** This Condition requires the dominant provider to secure, and be able to demonstrate that charges for network access are reasonably derived from the long run incremental costs of provision, and allowing for an appropriate mark-up for the recovery of common costs including an appropriate return on capital employed. It also requires the provider to maintain (i) a cost accounting system, which can be used to determine whether the charge control and cost-orientation requirements are being met, and (ii) accounting separation, for use in the investigation of possible claims of undue discrimination.

- **GG4 – Charge control.** This Condition provides for the regulation of charges for network access. Annex A of the Statement lists maximum charges for the products, which were to be applicable in the event that BT breached its voluntary undertaking on charges. This Condition was modified by a Notification published by Ofcom on 30 September 2004, which imposed an RPI-X% price cap on BT's charges for PPC terminating segments[23].

- **GG5 – Requirement to publish a reference offer.** This Condition obliges BT to publish a reference offer and sets out in some detail what it should contain.

- **GG6 – Requirement to notify charges and terms and conditions.** This Condition requires BT to publish charges, terms and conditions and to give 90/28 days written notice of any changes for existing/new Network Access respectively. It also specifies the sort of information that should be included in an Access Charge Change Notice.

- **GG7 – Quality of service.** Requires BT publish QoS information for Network Access, as directed by Ofcom.

- **GG8 – Requirement to notify technical information.** Requires BT to provide reasonable advance notice (not less than 90 days), of changes to technical characteristics, technical standards or points of Network Access.

- **GG9 – Requests for new Network Access.** Requires BT to publish reasonable guidelines in relation to requests for new Network Access, and sets out time limits for this process.

Directions set out in Annex E of the Statement:

6.7 **Direction under Condition GG1** – Requires BT to provide PPCs in accordance with the terms specified, which relate to migrations, forecasts, service level agreements, compensation payments, requisite periods, repair provisions etc. Also requires BT to offer LLU backhaul services within a reasonable period and on reasonable terms.

[23] Partial Private Circuits Charge Control, Final Statement, 30 September 2004, Annex A.

6.8 **Direction under Condition GG3** – Requires BT to provide PPCs in accordance with the terms specified, which relate to charges for failed migration orders, equipment re-use etc. It also requires that charges for LLU backhaul are consistent with charges for those elements which are common to PPCs and LLU backhaul services.

6.9 **Direction under Condition GG7** – Requires BT to publish on a quarterly basis a range of performance indicators for its provision of PPCs to third parties, such as performance with respect to Committed Delivery Dates, Requisite Period etc.

6.10 The majority of these Conditions and Directions are concerned with the non-price terms of access. Their purpose is to ensure that the dominant provider is not able to use its dominance in the wholesale market for high bandwidth TISBO to distort competition in the downstream retail market – they are aimed at ensuring that there is a 'level playing field' in the downstream market. This is achieved by requiring the dominant provider to supply wholesale products to its retail competitors on terms and conditions that are not discriminating to those on which it supplies those products to its own retail business. The following Conditions and Directions are designed primarily to achieve this objective:

- GG1 – Network access. Plus associated Direction.
- GG2 – No undue discrimination
- GG5 – Requirement to publish a reference offer
- GG6 – Requirement to notify charges and terms and conditions
- GG7 – Quality of service. Plus associated Direction.
- GG8 – Requirement to notify technical information
- GG9 – Requests for new Network Access

6.11 These provisions are aimed at providing what was referred to in the Telecoms Strategic Review as Equivalence of Outcome.

6.12 As part of BT's Enterprise Act Undertakings, BT is required to provide:

- TILLAPS and TILLBPS to any Communications Provider within a reasonable time of a request. These products are to be provided by Openreach, (BT's new Access Services business), and may be used by alternative network operators to assemble their own PPCs, in order to compete against BT in the wholesale TISBO market (Section 5.5 of the Undertakings); and
- sufficient transparency to enable alternative network operators to understand any differences between the matters BT is required to list in its PPC Reference Offer and the comparable products it supplies to itself. (Section 4.1.1 of the Undertakings).

6.13 These Undertakings support the current approach to the provision of Network Access in the wholesale TISBO market, based on Equivalence of Outcome.

6.14 The extent to which the equivalent set of remedies in the low bandwidth TISBO market enables competitors to replicate BT's products in the downstream retail

market is currently the subject of a separate Ofcom consultation[24]. Specifically, that consultation is considering whether the requirements related to low bandwidth PPC terminating segments support replicability in the retail low bandwidth traditional interface leased lines market in the UK excluding Hull. A Statement setting out Ofcom's findings is due to be published shortly.

6.15 In relation to the wholesale high bandwidth TISBO market, Ofcom does not consider that there would be a good case for varying remedies which are designed to ensure a level playing field in the downstream market, because of geographic variations in upstream competitive conditions. The fact that some degree of upstream competition exists in a particular geographic area does not reduce the need to ensure a level playing field in the downstream market. As long as SMP continues to be present in the upstream market, there is a risk that relaxation of the relevant remedies would inhibit the growth of downstream competition. This in turn could restrict the growth of competition in the upstream market, as retail competitors would be less well placed to invest in upstream facilities of their own – with a smaller retail customer base, the case for building out their own networks would inevitably be weaker.

6.16 The position is somewhat different in relation to the remaining two Conditions and the associated Direction, namely:

- GG3 – Basis of charges. Plus associated Direction; and
- GG4 – Charge control.

6.17 These provisions are concerned with the price of access, and their purpose is twofold. Firstly, they are designed to support fair competition in downstream retail markets. Secondly, they are designed to benefit end-users by ensuring that the dominant provider does not use its dominance to raise wholesale prices to levels in excess of those that would prevail in an effectively competitive market.

6.18 In Ofcom's view, there may be a case for relaxing these remedies within a market, as competition develops. This is because there is a risk that, as the scope for competition increases, the charge control and the cost orientation obligation could have an adverse effect on investment and market entry by other wholesale providers. Such a situation is unlikely to be in the longer term interests of consumers.

6.19 In the light of these arguments, Ofcom has identified the following options for consideration:

- **Option 1: Remove the charge control.** Under this option, the charge controls would no longer be applicable in the more competitive geographic areas within the market, but the cost orientation Condition and the associated Direction would continue to apply. It would still be necessary for BT to be able to demonstrate that its charges were reasonably related to the costs of provision, but the much more specific restrictions imposed by the charge control would cease to apply.
- **Option 2: Remove the charge control and the cost orientation requirement.** Under this option, Conditions GG3 and GG4 (except for the provisions relating to accounting separation, which would be retained in order to help ensure that it was possible to monitor compliance with the no undue discrimination condition), and the associated Direction, would no longer be applicable in those geographic areas designated as having more competitive market conditions. BT would not longer be

[24] "Regulation of Business Retail Markets", Ofcom, September 2005

required to ensure that its charges were reasonably related to cost. Ofcom may also want to consider whether Condition GG1 would require modification to remove the requirement on BT to ensure that its charges for Network Access were fair and reasonable. The accounting separation requirement would be retained, to support the no undue discrimination requirement, which would still prohibit undue price discrimination.

6.20 Under either of these options, BT would of course continue to be subject to the requirements of the Competition Act.

6.21 Ofcom recognises that it is difficult to assess the relative merits of Options 1 and 2, except in the context of specific proposals regarding the geographic areas within which they might be applied. We have not yet reached the stage at which such proposals can be formulated, as they would depend on the answers to a number of the other questions raised in this discussion document. Ofcom would nevertheless welcome any views which stakeholders may have on the desirability of varying remedies within the wholesale high bandwidth TISBO market, in the way described by Options 1, 2 and 3.

AISBO

6.22 In the LLMR, Ofcom imposed the following SMP Conditions on BT as a result of its analysis of the AISBO market:

- **HH1 – Requirement to provide Network Access on reasonable request.** This is a general obligation to provide access as soon as reasonably practicable and on fair and reasonable terms and conditions and charges.

- **HH2 – Requirement not to unduly discriminate.** This is a requirement not to discriminate against a competitor in relation to matters connected with network access, in a manner likely to restrict or distort competition.

- **HH3 – Basis of charges.** This Condition requires the dominant provider to secure, and be able to demonstrate that charges for network access are reasonably derived from the long run incremental costs of provision, and allowing for an appropriate mark-up for the recovery of common costs including an appropriate return on capital employed. It also requires the provider to maintain (i) a cost accounting system, which can be used to determine whether the cost-orientation obligation is being adhered to, and (ii) accounting separation, for use in the investigation of possible claims of undue discrimination.

- **HH4 – Requirement to publish a reference offer.** This Condition obliges BT to publish a reference offer and sets out in some detail what it should contain.

- **HH5 – Requirement to notify charges and terms and conditions.** This Condition requires BT to publish charges, terms and conditions and to give 90/28 days written notice of any changes for existing/new Network Access respectively. It also specifies the sort of information that should be included in an Access Charge Change Notice.

- **HH6 – Quality of service.** Requires BT publish QoS information for Network Access, as directed by Ofcom.

- **HH7 – Requirement to notify technical information.** Requires BT to provide reasonable advance notice (not less than 90 days), of changes to technical characteristics, technical standards or points of Network Access.

- **HH8 – Requests for new Network Access.** Requires BT to publish reasonable guidelines in relation to requests for new Network Access, and sets out time limits for this process.

6.23 BT is also required to comply with the following Directions:

- **Direction under Condition HH1** – Requires BT to offer LLU backhaul services within a reasonable period and on reasonable terms.

- **Direction under Condition HH3** – Requires BT to ensure that charges for LLU backhaul are consistent with charges for those elements which are common to PPCs and LLU backhaul services.

6.24 The obligations set out in these Conditions and Directions are similar to those applied in the wholesale high bandwidth TISBO market, except that that there is no charge control for AISBO products, and the Directions are much less specific about the terms and conditions that should apply, and about the publication of performance indicators.

6.25 In the LLMR, Ofcom decided not to impose a charge control in the AISBO market, because the market was at an early stage in its development, and it was considered desirable to allow time for the cost orientation requirement to have an effect, before determining whether a charge control was necessary.

6.26 Under the Enterprise Act Undertakings, BT is required to provide the following AISBO products on the basis of Equivalence of Inputs (Section 3.1.1 of the Undertakings):

- Wholesale Extension Services (WES)

- Backhaul Extension Services (BES).

6.27 These services must be ready for service by September 30, 2006.

6.28 In addition, BT is required to provide the following products on an EOI basis from Openreach (Section 3.1.2 of the Undertakings):

- Wholesale Extension Services Access Products;

- Wholesale Extension Services Backhaul Products; and

- Wholesale End-to-End Ethernet Services.

6.29 Other CPs will be able to use the first two of these products to assemble their own WESs, in order to compete with BT in the AISBO market. The third of these products is itself a wholesale AISBO product. All of these products are designed to support a level playing field in the downstream market.

6.30 In Ofcom's view, the same considerations apply when considering the case for varying AISBO remedies by geographic area within a market, as were discussed above in relation to high bandwidth TISBOs. The main difference is that, as there is

no AISBO charge control, the option of disapplying it does not of course arise. Ofcom has therefore defined one option for consideration in the AISBO market, namely:

- **Option A1: Remove the cost orientation requirement.** Under this option, Condition HH3 would no longer be applicable in those geographic areas within the national market which have designated as being more competitive. Accounting separation requirements would be retained, in order to help ensure that it was possible to monitor investigate compliance with the no undue discrimination requirement, which would still prohibit undue price discrimination. Ofcom may also want to consider whether Condition GG1 would require modification to remove the requirement on BT to ensure that its charges for Network Access were fair and reasonable. The requirements of the Competition Act would of course continue to apply.

6.31 Ofcom would welcome stakeholder views on this option.

Wholesale trunk segments

6.32 BT is currently subject to the following SMP Conditions in the market for wholesale trunk segments:

- **H1 – Requirement to provide Network Access on reasonable request.** This is a general obligation to provide access as soon as reasonably practicable and on fair and reasonable terms and conditions and charges.

- **H2 – Requirement not to unduly discriminate.** This is a requirement not to discriminate unduly against a competitor in relation to matters connected with network access.

- **H3 – Basis of charges.** This Condition requires the dominant provider to secure, and be able to demonstrate that charges for network access are reasonably derived from the long run incremental costs of provision, and allowing for an appropriate mark-up for the recovery of common costs including an appropriate return on capital employed. It also requires the provider to maintain (i) a cost accounting system, which can be used to determine whether the cost-orientation obligation is being adhered to, and (ii) accounting separation, for use in the investigation of possible claims of undue discrimination.

- **H4 – Requirement to publish a reference offer.** This Condition obliges BT to publish a reference offer and sets out in some detail what it should contain.

- **H5 – Requirement to notify charges and terms and conditions.** This Condition requires BT to publish charges, terms and conditions and to give written notice of any changes for new or existing Network Access on the same day as the changes come into effect. It also specifies the sort of information that should be included in an Access Charge Change Notice.

- **H6 – Quality of service.** Requires BT publish QoS information for Network Access, as directed by Ofcom.

- **H7 – Requirement to notify technical information.** Requires BT to provide reasonable advance notice (not less than 90 days), of changes to technical characteristics, technical standards or points of Network Access.

- **H8 – Requests for new Network Access.** Requires BT to publish reasonable guidelines in relation to requests for new Network Access, and sets out time limits for this process

6.33 BT is also subject to the following Directions in this market:

- **Direction under Condition H1** – Requires BT to provide PPCs which include trunk segments in accordance with the terms specified, which relate to migrations, forecasts, service level agreements, compensation payments, requisite periods, repair provisions etc. BT is also required to offer LLU backhaul services within a reasonable period and on reasonable terms.

- **Direction under Condition H3** – Requires BT to provide PPCs in accordance with the terms specified, which relate to charges for failed migration orders, equipment re-use etc. It also requires that charges for LLU backhaul are consistent with charges for those elements which are common to PPCs and LLU backhaul services.

- **Direction under Condition H6** – Requires BT to publish on a quarterly basis a range of performance indicators for its provision of PPCs to third parties, such as performance with respect to Committed Delivery Dates, Requisite Period etc.

6.34 These obligations differ from those for the high bandwidth TISBO and AISBO markets in the following significant respects:

- in contrast to the high bandwidth TISBO market, the provision of trunk segments is not subject to a charge control; and

- BT is only required to give same-day notification of changes in terms and conditions, rather than 90 days and 28 days for existing and new services respectively.

6.35 These differences reflect the view taken in the LLMR that there was a better prospect of competition in the trunk market than in the TISBO and AISBO markets. In framing the remedies, Ofcom sought to strike a balance between the need to prevent excessive pricing and the desire to promote competition. The cost orientation requirement was considered appropriate, in preference to a reliance on the Competition Act, because it would give the SMP provider less latitude and provide greater certainty for access customers. (para. 8.42)

6.36 In Ofcom's view, the considerations set out above in relation to the high bandwidth TISBO market are also relevant to the market for trunk segments. Ofcom does not consider that it would be appropriate to vary by geography non-price remedies, within the existing national market, as their sole purpose is to provide a level playing field for downstream competition.

6.37 In relation to the cost orientation requirement, Ofcom is also doubtful that any geographic variation of the current obligation is likely to be appropriate in the near term, within the context of the existing national market. This is because:

- There is currently some uncertainty over the relationship between the prices and costs of BT's trunk segment services. Ofcom recently carried out an own-initiative investigation of BT's charges for PPC trunk services. During the course of the investigation Ofcom identified a number of concerns relating to the accounting treatment of PPC trunk segments. These concerns primarily related to the way that

core transmission costs are split between PPC wholesale trunk segments (which fall into the wholesale trunk segments market and are regulated through basis of charges Condition H3), and PPC terminating segments (which fall into the TISBO markets, and are regulated through the PPC terminating segments charge control for low and high bandwidths). A further concern was that the derivation of reported revenues for PPC wholesale trunk segments may not have been consistent with the methodology used by BT for third party billing. Before the investigation was closed in December 2005, Ofcom obtained a clear commitment from BT and agreed a project plan and timetable to prepare the data needed to quatify and correct the accounting problems identified. This work is ongoing. Until it has been completed, Ofcom does not believe it would be appropriate to consider relaxing the existing remedy within the context of a national market.

Question 9)	*Should Ofcom consider reducing the remedies applied in the wholesale market for high bandwidth TISBOs in the way described by Options 1 or 2?*

Question 10)	*Should Ofcom consider reducing the remedies applied in the wholesale market for AISBOs in the way described by Option A1?*

Question 11)	*Do stakeholders agree that, for the present, SMP remedies should not be varied by geography within the national market for trunk segments?*

Section 7

Next Steps

Introduction

7.1 This section sets out the next steps for considering the issues around an assessment of variations in competitive conditions on a geographic basis in the various leased lines markets in the UK.

Responses to this discussion document

7.2 Ofcom has requested that interested stakeholders provide responses to the questions asked in this discussion document by 8 June 2006. Prior to that date, Ofcom is willing to discuss its analysis and potential implications with interested stakeholders.

7.3 Subsequent to receiving the responses to the questions asked in this discussion document, Ofcom will consider fully the responses and issues raised by stakeholders. This will inform the next steps, which will be either:

- to consult on proposals to vary on a geographic basis the current remedies as concluded in the 2004 market review, with these remedies being varied within the current product and geographic market definitions;
- to formally initiate a further review of the leased lines markets in the UK, which will involve re-assessing the product and geographic market definitions, assessing whether there are any operators that have SMP in any of the markets as defined and considering what remedies, if any would be appropriate to address any SMP found; or
- to leave in place the regulatory position reached in the 2004 LLMR, with a view to conducting a future review of the leased lines markets when appropriate.

Annex 1

Responding to this discussion document

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made by **5pm on 8 June 2006.**

A1.2 Ofcom strongly prefers to receive responses as e-mail attachments, in Microsoft Word format, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 2), among other things to indicate whether or not there are confidentiality issues. The cover sheet can be downloaded from the 'Consultations' section of our website.

A1.3 Please can you send your response to first leasedlines@ofcom.org.uk.

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

Colin Garland
Floor 4
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7783 4109

A1.5 Note that we do not need a hard copy in addition to an electronic version. Also note that Ofcom will not routinely acknowledge receipt of responses.

A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 3. It would also help if you can explain why you hold your views, and how Ofcom's proposals would impact on you.

Further information

A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Colin Garland on 020 7783 4182.

Confidentiality

A1.8 Ofcom thinks it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt (when respondents confirm on their response cover sheer that this is acceptable).

A1.9 All comments will be treated as non-confidential unless respondents specify that part or all of the response is confidential and should not be disclosed. Please place any confidential parts of a response in a separate annex, so that non-confidential parts may be published along with the respondent's identity.

A1.10 Ofcom reserves its power to disclose any information it receives where this is required to facilitate the carrying out of its statutory functions. Ofcom will exercise due regard to the confidentiality of information supplied.

A1.11 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use, to meet its legal requirements. Ofcom's approach on intellectual property rights is explained further on its website, at www.ofcom.org.uk/about_ofcom/gov_accountability/disclaimer.

Next steps

A1.12 The next steps for considering the issues in this discussion document are set out in Section 7.

A1.13 Please note that you can register to get automatic notifications of when Ofcom documents are published, at http://www.ofcom.org.uk/static/subscribe/select_list.htm.

Ofcom's consultation processes

A1.14 Ofcom is keen to make responding to consultations easy, and has published some consultation principles (see Annex 2) which it seeks to follow, including on the length of consultations.

A1.15 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk. We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, whose views are less likely to be obtained in a formal consultation.

A1.16 If you would like to discuss these issues, or Ofcom's consultation processes more generally, you can alternatively contact Vicki Nash, Director, Scotland, who is Ofcom's consultation champion:

Vicki Nash
Ofcom (Scotland)
Sutherland House
149 St. Vincent Street
Glasgow G2 5NW
Tel: 0141 229 7401
Fax: 0141 229 7433
E-mail: vicki.nash@ofcom.org.uk

Annex 2

Ofcom's consultation principles

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

Before the consultation

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

During the consultation

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

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

A2.5 We will normally allow ten weeks for responses to consultations on issues of general interest.

A2.6 There will be a person within Ofcom who will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. This individual (who we call the consultation champion) will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why. This may be because a particular issue is urgent. If we need to reduce the amount of time we have set aside for a consultation, we will let those concerned know beforehand that this is a 'red flag consultation' which needs their urgent attention.

After the consultation

A2.8 We will look at each response carefully and with an open mind. We will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation response cover sheet

A3.1 In the interests of transparency, we will publish all consultation responses in full on our website, www.ofcom.org.uk, unless a respondent specifies that all or part of their response is confidential. We will also refer to the contents of a response when explaining our decision, without disclosing the specific information that you wish to remain confidential.

A3.2 We have produced a cover sheet for responses (see below) and would be very grateful if you could send one with your response. This will speed up our processing of responses, and help to maintain confidentiality by allowing you to state very clearly what you don't want to be published. We will keep your completed cover sheets confidential.

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

A3.4 We strongly prefer to receive responses in the form of a Microsoft Word attachment to an email. Our website therefore includes an electronic copy of this cover sheet, which you can download from the 'Consultations' section of our website.

A3.5 Please put any confidential parts of your response in a separate annex to your response, so that they are clearly identified. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

What do you want Ofcom to keep confidential?

Nothing	☐	Name/contact details/job title	☐
Whole response	☐	Organisation	☐
Part of the response	☐	If there is no separate annex, which parts?	

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

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response. It can be published in full on Ofcom's website, unless otherwise specified on this cover sheet, and I authorise Ofcom to make use of the information in this response to meet its legal requirements. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

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

Name

Signed (if hard copy)

Annex 4

Questions

A4.1 Sections 3 to 6 of this discussion document have set out Ofcom's assessment of geographic variations in competitive conditions in the leased lines markets in the UK. Ofcom has asked for stakeholders to respond to a number of questions related to its analysis. These are:

Question 1)	*Do respondents agree with the analytical framework adopted by Ofcom to assess geographic variations in competitive conditions in the various leased lines markets in the UK?*
Question 2)	*Do respondents agree that supply-side factors are a significant indicator of geographic variations in competitive constraints within leased lines markets in the UK?*
Question 3)	*Do respondents agree that the evidence of geographic variations in competitive conditions is greatest for wholesale high bandwidth TISBO, wholesale AISBO and wholesale trunk segments?*
Question 4)	*Has Ofcom correctly identified the main issues involved in the aggregation of geographic areas?*
Question 5)	*How much weight should be attached to the results of statistical analysis, when considering how areas should be aggregated together for regulatory purposes?*
Question 6)	*How much weight should be attached to the analysis of supplier numbers and network reach, when aggregating geographic areas for regulatory purposes?*
Question 7)	*What assumptions should be used when carrying out such an analysis for leased lines, particularly with regard to business size, build-out distances and the number of suppliers required for effective competition?*
Question 8)	*Should the area groupings derived from the analysis of competitive conditions be approximated for practical reasons (e.g. to take account of the availability of accounting data) and, if so, how?*
Question 9)	*Should Ofcom consider reducing the remedies applied in the wholesale market for high bandwidth TISBOs in the way described by Options 1 or 2?*
Question 10)	*Should Ofcom consider reducing the remedies applied in the wholesale market for AISBOs in the way described by Option A1?*
Question 11)	*Do stakeholders agree that, for the present, SMP remedies should not be varied by geography within the national market for trunk segments?*

Annex 5

Consumer Survey Information

Introduction

A5.1 As noted in Section 3, Ofcom has commissioned two separate pieces of consumer (business) research. The first was a study amongst large businesses[25] in the UK and the second a study into the use of leased lines amongst medium sized businesses[26] in the UK. The objective of these pieces of research was broader than the context of the focus of this discussion document i.e. the geographic dimension of competition in the provision of leased lines, as they included questions relating to product market definition as well as attitudinal questions.

A5.2 The large business survey was more detailed than the medium-sized business survey as Ofcom has a better understanding of the larger business markets and was therefore able to pose more detailed questions, particularly in relation to the geographic dimension of competition to these businesses. However, the medium business survey contains fewer findings that are directly related to the question of the geographic dimension of competition, but is nonetheless useful as contextual evidence to better understand how competition takes place in the leased lines markets.

A5.3 This section only summarises the research findings relevant to the geographic dimension of competition and therefore focuses on the large business survey. The full research reports for both pieces of research have been published separately on Ofcom's website.

A5.4 The areas of research that are relevant to this discussion document are:

- The use of single or multiple leased lines suppliers; and
- Perceptions of regional price differentials.

Use of single or multiple leased lines suppliers

A5.5 The large business survey found that 77% of businesses use a single supplier for leased lines and that smaller businesses are more likely to use a single supplier (43% have between 250 and 499 employees and 34% have 5 or fewer sites). The survey also found that those businesses with more than 500 employees are more likely to use more than one leased line supplier than those businesses with between 250 and 499 employees (45% and 31% respectively). Further, the study found that large businesses using leased lines with bandwidths greater than 8Mbit/s are significantly more likely than businesses using lower bandwidths to use more than one supplier (56% and 44% respectively).

A5.6 The main reason given for using a single supplier relate to the ease of managing a single supplier and the ability to negotiate discounts. Historic business decisions also impact on the decision to use a single supplier. The main reason given for using multiple leased lines suppliers was the supplier offering the best available price at the time. A further important reason was the additional security available from having more than one supplier, in case one of the suppliers lets them down.

[25] Defined as businesses with over 250 employees.
[26] Defined as businesses between 51 and 250 employees.

This latter reason was more likely to be a concern for those larger spending businesses.

Perceptions of regional price differentials

A5.7 Perceptions of regional price variations are mixed. Of the large businesses surveyed, 20% perceive there being regional price differentials, 47% believe that they do not vary, while 34% are unsure. Further, businesses with sites spread across the UK are most likely to perceive that prices vary by geography (30%).

Annex 6

Network Reach Analysis

Introduction

A6.1 As set out in Section 3 and explained in more detail in Section 4, Ofcom has carried out an analysis of leased lines network operators' networks in order to assess the extent to which these operators can use their own networks to provide services, either at the retail, or at the wholesale level. This network reach analysis can be used to inform an assessment of the extent to which the provision of leased lines services in different geographic areas is contestable. This analysis is a way of capturing the extent to which supply-side competitive constraints could lead to geographic variations in competition. This Annex explains the network reach analysis that Ofcom has carried out.

Data used

A6.2 Ofcom, to inform its analysis, has used a variety of data collected from network operators. The first set of data is data collected by Ofcom for the LLMR. Ofcom, for the LLMR plotted, in the London area, the fibre and duct networks of five of the largest competitors to BT against the location of business sites with over 250 employees. This cut-off point was used as this size business, is in general a reasonable proxy for the size of business that will be a potential customer of leased lines services. It is also the case that the cost of a leased line is less likely to be justifiable in the case of smaller businesses. Ofcom, as part of its data gathering for the analysis undertaken for this discussion document has confirmed with the relevant network operators that their network layouts have not changed significantly and as such the same results have been used in conjunction with other recent findings which are based on the analysis of data that Ofcom gathered specifically for the current assessment of variations in competitive conditions on a geographic basis.

A6.3 The second set of data is data from each of the alternative network operators and from BT. The data from the alternative network operators consisted of data on their network points of presence (geographically located by means of their postcodes/ addresses/ co-ordinates) and postcode information of the network points where these alternative operators handover PPC traffic to /from BT (points of handover). The data from BT consisted of an update of the traffic volume data passing through each of BT's Tier 1 nodes and BT's flexibility points for the whole of the UK.

Overview of analysis

LLMR analysis

A6.4 The analysis conducted for the LLMR plotted the fibre maps of four network operators against the geographic location of large business sites in the City of London and the CLZ. This analysis showed that if each of the alternative network operators was willing to build up to 100 metres from the current location of their fibre and duct networks, then all large sites within the City of London could be served by at least one alternative operator. In order for large business sites within the CLZ to be served by at least one alternative operator, the build distance would need to be increased to 300 metres.

A6.5 The analysis was also conducted for the City of London using build distances of 50 metres and 90 metres. The results of this analysis are shown in Table A1.

Table A1 – Proportion of business sites served assuming different build distances

	Build distance	Operator 1	Operator 2	Operator 3	Operator 4
City of London	50m	60%	67%	94%	96%
	90m	96%	87%	95%	97%
CLZ	300m	70%	57%	84%	87%

A6.6 This analysis shows that assuming relatively short build distances from a network operator's fibre and duct networks, that within the City of London, the vast majority of large businesses are able to be served by each of the alternative operators used in the analysis. As could be expected, as the geographic area analysed is expanded beyond the City of London, the build distance has to be increased in order for it to be possible for the alternative operators analysed to be able to provide services to a significant proportion of end users.

Network reach analysis

A6.7 The network reach analysis involved two main parts:

- For each postal sector, a count of operators' points of presence; and
- An assessment for each postal sector of the number of large business sites that are contestable by different numbers of operators, taking into account different assumptions about economic build distances.

Count of operators' points of presence

A6.8 This part of the network reach analysis used geo-analysis software to plot each of the alternative operators' points of presence to calculate the sum of points of presence in each postal sector. This information gives some sense of the geographic variations in competitive conditions that could exist as the areas of greater concentration of operators' points of presence are likely to generate a stronger competitive constraint than those areas where there is less concentration or there are no alternative operators present.

A6.9 However, such analysis does not convey the full picture of geographic variations in competitive conditions. This is because an operator's point of presence is not limited to providing services to end users located within a single postal sector. It could be the case, depending on the size of the postal sector, the distribution of large business around a point of presence and assumptions about the economic build distance, that an operator would in fact be able to provide services to end users in a number of different neighbouring postal sectors. In order to capture this effect, further analysis is required.

Contestability analysis

A6.10 This analysis involves plotting geographically all of the large business sites (including satellite sites) in the UK and then comparing this with the geographic location of network operators' points of presence. From this information it is possible, after making a number of assumptions, to calculate the average number of operators that are able to offer services to end users in each postal sector. The main assumptions that need to be made relate to:

- The number of operators to offer a sufficiently greater level of competitive constraint from those areas where there is no choice of operator; and
- The distance that an operator would build from a point of presence in order to provide services to a business site.

A6.11 In order to illustrate the differences in competitive constraint that may exist, Ofcom's base case assumption on the first of these is that in the circumstances of leased lines markets there would need to be at least two additional operators (i.e. at least 3 operators) in an area in order to provide a sufficiently different competitive constraint.

A6.12 On the second assumption that is to be made, in the network reach analysis conducted for the LLMR, Ofcom's analysis assumed that operators would be willing to extend their network by a distance of 300m to serve a business customer, recognising that distances would vary on a case by case basis[27]. However, the additional analysis that Ofcom is conducting for this discussion document requires assumptions to be made about economic build distance from operators' points of presence, rather than from their fibre networks.

A6.13 In these circumstances, Ofcom believes that it is appropriate to assume longer build distances than would be the case if it was analysing the effect of extending an operator's network. This is because operators are not generally limited to extending their networks from the location of their points of presence. Ofcom has assumed, for its base case, an economic build distance of 500m, although again recognising that actual economic build distances will be affected by numerous factors and may differ by geographic location. In light of this uncertainty, Ofcom has also conducted sensitivity analysis assuming economic build distances of 250m and 1km.

A6.14 Figures A1 and A2 below show the results of the contestability analysis for the CLZ and for the City of London. This shows that assuming an economic build distance of 500m and a constraint of at least two alternative operators, there appears to be a greater competitive constrain in an area around the City of London and in the Docklands area of east London.

[27] The LLMR noted that network operators had suggested to Ofcom that they would typically be prepared to extend their networks by 20 to 100 metres in order to serve a new customer. However, due to practical issues around analysing the available data, the shortest distance that Ofcom could conduct the analysis was to assume a dig distance of 300 metres.

Figure A1 – Number of operators in the CLZ, assuming 500m build distance

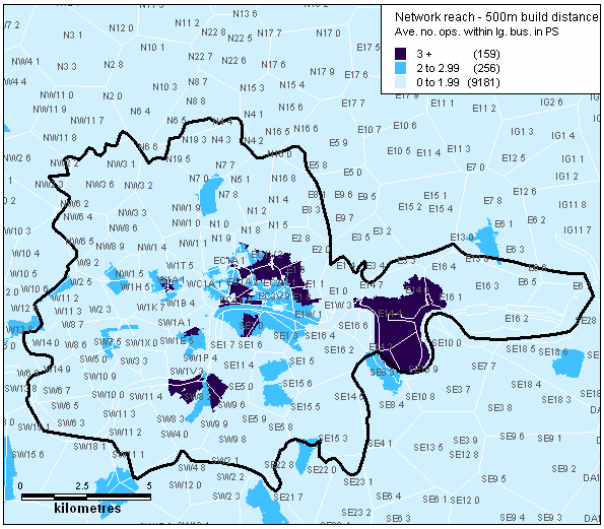
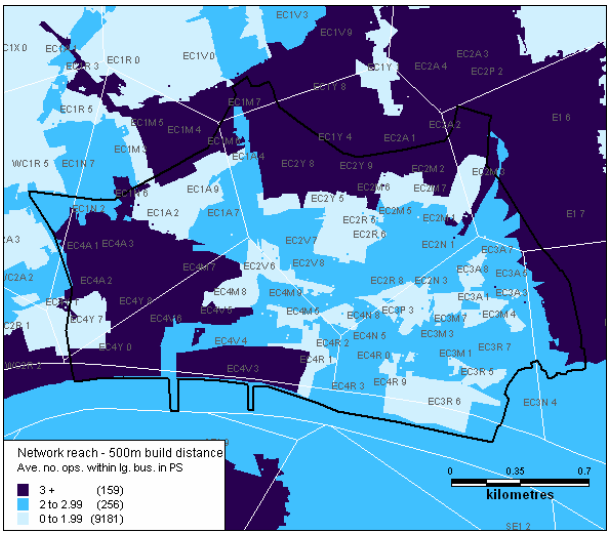


Figure A2 – Number of operators in the City of London, assuming 500m build distance



A6.15 One potentially surprising result from this analysis is that a significant number of postal sectors within the City of London appear to show that on average, businesses located within these postal sectors are able to be provided by leased lines services by less than two alternative operators. This is because the locations of many of the operators' points of presence are outside of the City of London. However, as set out above, the analysis conducted for the LLMR found that even assuming relatively short build distances, within the City of London, the vast majority of large businesses are able to be served by each of the alternative operators used in the analysis.

A6.16 These two sets of analysis taken together could indicate that an area including the City of London and an area around the Docklands area of east London could be subject to a greater competitive constraint than other geographic areas of London.

A6.17 Ofcom has also conducted this analysis for other cities in the UK. The pattern for these other cities is similar to the pattern observable in London, with there being a greater concentration of operators' points of presence in the centres of these cities.

However, the geographic coverage of any greater constraint that may exist is more limited, covering a fewer number of postal sectors, than is the case in London. The results of the analysis, assuming a build distance of 500m is shown for the next five largest cities in the UK, based on population, in Figures A3 to A7 below for Birmingham, Glasgow, Liverpool, Leeds and Sheffield.

Figure A3 – Number of operators in the Birmingham, assuming 500m build distance

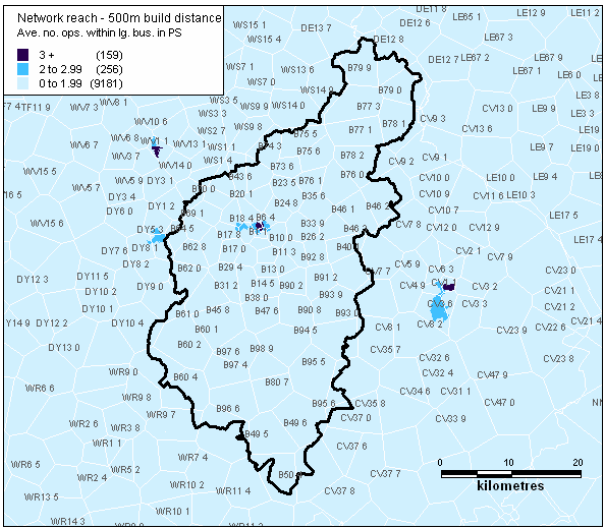


Figure A4 – Number of operators in the Glasgow, assuming 500m build distance

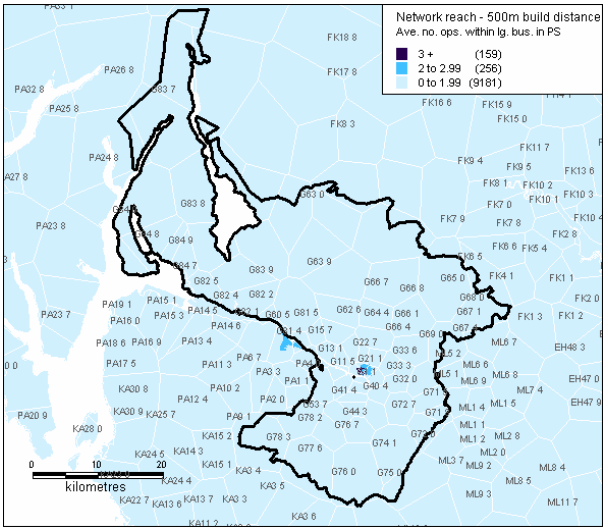


Figure A5 – Number of operators in the Liverpool, assuming 500m build distance

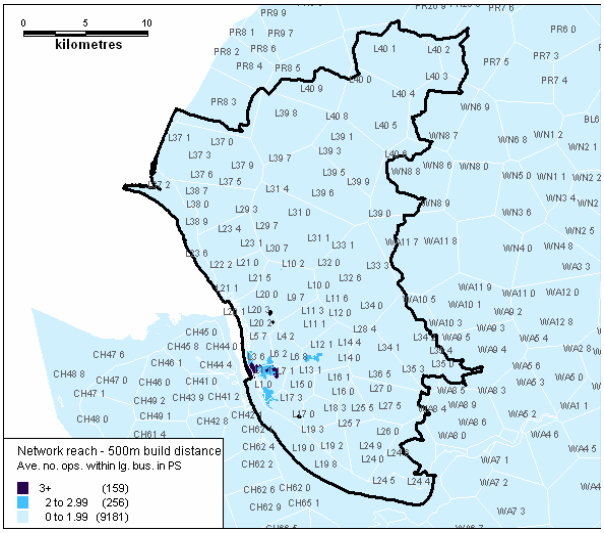


Figure A6 – Number of operators in the Leeds, assuming 500m build distance

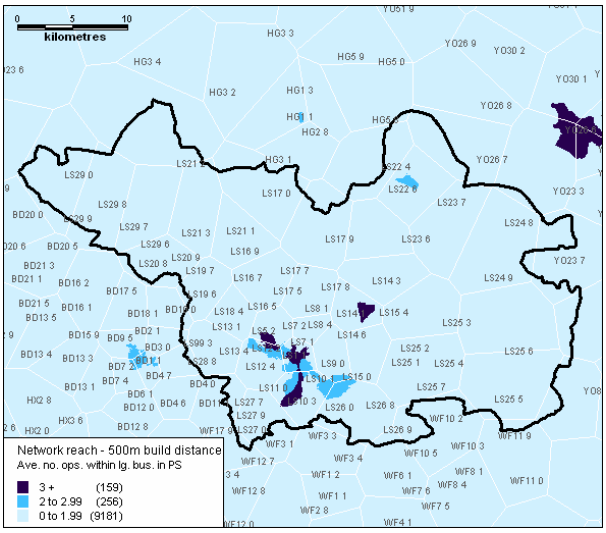
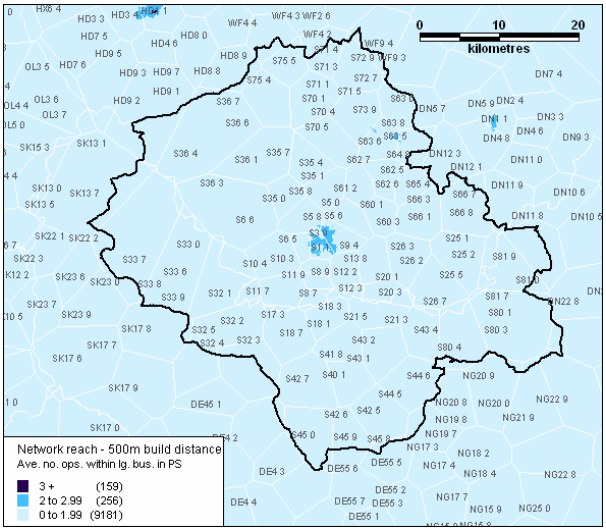


Figure A7 – Number of operators in the Sheffield, assuming 500m build distance



Annex 7

Market Analysis

Introduction

A7.1 As set out in Section 3, Ofcom has carried out market analysis to inform its assessment of the extent to which competitive conditions in the various leased lines markets in the UK vary on a geographic basis. The analysis of data collected from operators has allowed Ofcom to estimate the proportion of leased lines services provided by each operator in each postal sector for each leased line market defined in the LLMR.

Retail service share analysis

A7.2 The retail market analysis was based on empirical data collected from BT and thirteen alternative network operators. The retail market data collected from the operators included approximately 560,000 traditional interface retail leased line records and approximately 28,000 alternative interface retail leased line records, plus around 16,500 records that were subsequently judged to have been outside the leased line markets defined by Ofcom[28].

A7.3 The service share analysis at the retail level consisted of two parts: the retail service share analysis at postal sector level; and the retail trunk segments analysis.

A7.4 There were two outputs of the retail service share analysis:

- The detailed breakdown of operators' shares of 'retail service ends' for each postal sector in the UK. The key measurement was the 'retail service end', which equates to a customer end point (i.e. customer site) served within a given leased line market.
- The detailed breakdown of operators' shares of 'weighted bandwidth' for each postal sector in the UK. The key measurement was the 'weighted bandwidth', which is the result of applying a proxy for revenue weighting to each retail service end, dependent on the value of the service bandwidth.

A7.5 The two main types of retail leased lines services being sold by operators were considered:

- Point-to-point retail leased lines. which provide dedicated capacity between two points.
- Retail network services, which are services that enable customers to purchase dedicated capacity from a number of single points - such as geographically dispersed corporate sites - onto a service provider's core network. The individual single points then have connectivity to all the other customer sites.

A7.6 Both these types of retail services can be provided using traditional interface e.g. primarily SDH-based, or alternative interface e.g. primarily Ethernet-based technologies.

[28] These included those circuits that are used to support PSTN telephone circuits, ISDN circuits, Dark fibre services and SDSL.

A7.7 A point-to-point retail leased line being used to connect two customer sites would contribute two customer end-points to the total service ends count; a leased line used to connect a customer site to an operator's core network would contribute one end-point to the total.

A7.8 In order to account for the distribution of different bandwidths within a particular market, a second analysis was carried out that incorporated a revenue weighting. To calculate the breakdown of operators' shares of 'weighted bandwidth' for each postal sector in the UK, it was necessary to develop a proxy for revenue weighting. This proxy was required because it was not possible to gather revenue information from operators in a format that would enable Ofcom to conduct an analysis on a geographic basis.

A7.9 The proxy for revenue weighting took the form of a 'weighted bandwidth' figure, which was applied to each circuit during the first step of the analysis. The underlying assumptions for the weighted bandwidth figures are set out below. These weightings are based on the Commission's recommendation on retail leased lines prices and are shown in Table A2 below.

Table A2 – bandwidth ranges and weighting factors

RANGE	WEIGHTING FACTOR
Range 1 (>0 <=0.064Mbps)	1
Range 2 (>0.064 <=0.512Mbps)	1
Range 3 (>0.512 <=1.5Mbps)	4
Range 4 (>1.5 <=2.5Mbps)	4
Range 5 (>2.5 <=8.2Mbps)	4
Range 6 (>8.2 <=40Mbps)	18
Range 7 (>40 <=50Mbps)	18
Range 8 (>50 <=110Mbps)	22
Range 9 (>110 <=160Mbps)	26
Range 10 (>160 <=623Mbps)	50
Range 11 (>623 <=15000Mbps)	50

A7.10 The methodology to estimate operators' shares for both retail service ends and weighted bandwidth for each leased line market consisted of four steps:

a) Data cleansing & normalisation

b) Aggregation by postal sector

c) Data uplift

d) Calculation of BT's share of the market by postal sector.

A7.11 The four steps are described in turn below.

Step 1: Data cleansing & normalisation

A7.12 Although Ofcom's information requests to operators were alike, the way in which operators capture and store their data is not consistent between operators, and therefore the first step in the market analysis was to manipulate the raw data received into a structure suitable for Ofcom's intended analysis. The data cleansing and normalisation comprised six sub-tasks which together ensured that the data received was presented in a consistent format:

- Removal of circuits of a type not included within the Ofcom market definition for leased lines.
- Transfer of any circuits sold to the 13 Altnets to the wholesale section of the operators' responses, to avoid any double counting that might have occurred for leased lines sold between operators and then re-sold as part of a leased line service to an end-user.
- Postcode corrections to remedy the common detectable errors made when recording postcode data where automated batch processing techniques could be used.
- Bandwidth categorizing and weighting. All bandwidth dimensions provided by operators were converted to a common format, expressed in Mbit/s, and the bandwidth range of each circuit calculated according to the bounds defined in Table A2. Each range had an associated weighting factor, referred to as the 'weighted bandwidth' of the circuit and calculated as set out above.
- Circuit end-point analysis to identify the non-customer end-points so that these could be excluded from the service share calculations. The definition of leased line services specifies two possible types of end-point: network end and customer end. Where operators had not provided data on the type of end-point being served, any network end-points were identified using data for operator network points-of-presence (PoPs): These Datacentres and Telehouses, e.g. Telehouse in London Docklands, and Telecity in London and Manchester; the operators' core network data; and BT's points of interconnect.
- Extraction of the postal sector from the postcode data. As noted in Section 3, Ofcom opted to aggregate at the postal sector level when conducting its geographic analysis. When defining the boundaries of separate geographic markets, the intention would be to aggregate these postal sectors into larger geographic areas. There are 9596 postal sectors within the UK. The following list indicates the relative size of each postal measure:
  - Postcode (SE1 9HA): about 1.6 million
  - Postal Sector (SE1 9) : 9596
  - Postal District (SE1): 2889
  - Postal Area (SE): 121

Step 2: Aggregation by postal sector

A7.13 For each operator, the sum of retail service ends and the combined weighted bandwidth of the circuits, as described in A7.4, were calculated for each postal sector, for each market. As set out in Section 3, the markets relevant to this retail market analysis were:

- Retail low bandwidth traditional interface leased lines (up to and including 8Mbit/s);
- Retail high bandwidth traditional interface leased lines (above 8Mbit/s up to and including 155 Mbit/s);
- Retail very high bandwidth traditional interface leased lines (above 155Mbit/s);
- Retail alternative interface leased lines at all bandwidths.

A7.14 The relationship between each end of a leased line (referred to as the A-end and the B-end) was not maintained for the retail service share analysis, where only the geographic data relating to discrete customer ends was required, and not the geographic data relating to the distance or route taken between the two ends of a line.

Step 3: Data uplift

A7.15 Approximately 3% of the customer ends supplied by operators had inaccurate or missing data for its bandwidth and/or its postal sector. The purpose of the uplift exercise was to create a proxy for this missing data.

A7.16 An uplift factor for each operator in each market was applied to the output data from Step 2 to align this with the known number of end points for each operator in each market calculated in Step 1 of the analysis. This adjustment distributed those end points where the geographic location was unknown in proportion with the geographic distribution of the distribution of those circuits where the location was known.

A7.17 Although the overall uplift required was relatively small in terms of the national market, Ofcom recognises that there could be pockets of locations where the accuracy of market size and subsequent market share calculations could have been compromised as a result of applying uplift in this manner. These uplift errors could be significant at individual postal sector level in certain areas, but the impact of the errors decreases as these postal sectors are aggregated into larger areas, and is outweighed by the improved overall accuracy by applying the data uplift.

Step 5: Calculation of BT service shares

A7.18 The BT share of the retail leased line services, both in terms of service ends and the aggregate weighted bandwidth, in each postal sector was calculated. This data was used to map geographical variations in shares across the UK for each of the retail markets.

Wholesale service share analysis

A7.19 Ofcom's intention when it devised the information requests sent to operators was to conduct a service share analysis for each of the relevant wholesale markets similar to that conducted for the relevant markets at the retail level and described above. However, as explained in Section 3, the wholesale data received from Altnets in

response to the information requests has been such that it has not been possible to conduct the analysis as originally envisaged.

A7.20 Nevertheless, the data provided BT relating to the wholesale markets has been such that it has been possible to conduct an analysis of the wholesale markets. As noted above, in the provision of traditional interface products, there are two types of wholesale input, symmetric broadband origination (TISBO and AISBO) and trunk. Using the data provided by BT in response to the information request, Ofcom has been able to carry out the analysis as set out below.

A7.21 This analysis of the TISBO and AISBO wholesale markets used the data available from BT to derive BT's wholesale leased line service end points at postal sector level. The subset of this data for those wholesale circuits sold to Altnets was then identified. The wholesale data was compared against the results of the retail service share analysis (end points by postal sector) to derive an approximate 'upper bound' on BT's share of wholesale leased line service end points at postal sector level.

A7.22 However, this analysis is complicated by the fact that leased lines wholesale inputs (PPCs) can be used in the provision of a wide variety of downstream products, only one of which is leased lines. Examples of other downstream markets that can be supported by wholesale leased line elements include retail voice VPNs, PSTN telephone circuits and IP VPNs.

Total wholesale market end-points = Total retail market end-points + other relevant downstream end-points

A7.23 Without this complication, there would be a direct relationship between the wholesale markets and the retail markets, such that:

Total wholesale market end-points = Total retail market end-points

A7.24 However, because of the complication set out above, the wholesale analysis that has been conducted by Ofcom provides an 'upper bound' proxy for BT's wholesale market share in each of the wholesale leased lines markets rather than an estimate of BT's absolute share in each postal sector. As shown in Figure X, this 'upper bound' for the combined wholesale markets would be greater than 100% of the assumed wholesale leased lines market at a national level.

A7.25 In addition, there are a number of other assumptions that Ofcom has had to make in order to provide meaningful outputs from this analysis. These further assumptions are that:

- The wholesale leased line component segments are either self-provided or purchased from BT. The wholesale data provided by Altnets has not been considered as it was not possible to gather sufficient wholesale information from the suppliers.
- Altnets are not using wholesale high bandwidth leased lines to provide low bandwidth retail services.

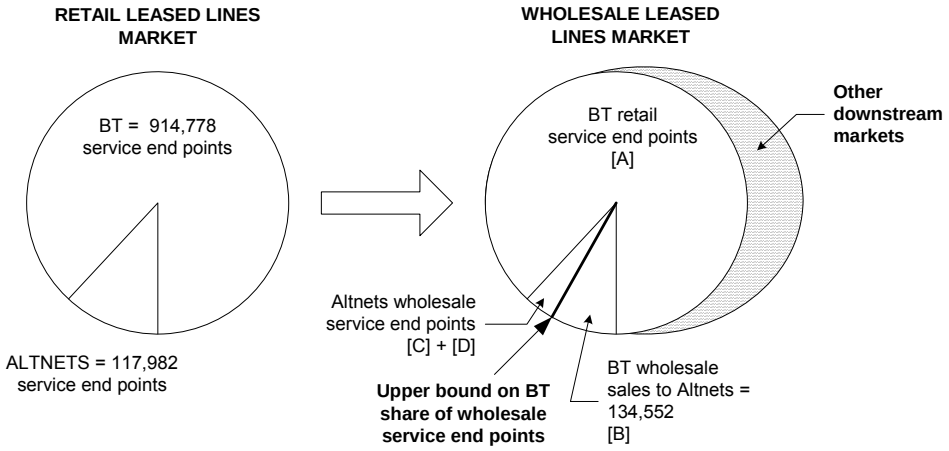
A7.26 The entire market can be seen as the sum of the following components:

Total Mkt = BT to BT + BT to Altnets + Altnet self-provide + Altnet to Altnet

(A) (B) (C) (D)

A7.27 As illustrated in the methodology diagram, Figure A8 below, the components (A) and (B) were based on BT's wholesale TISBO and wholesale AISBO data. The components (C) and (D) are unknown; (D) has been set to zero in line with the above assumption; a proxy for (C) was not developed, therefore BT's wholesale share has been presented as an 'upper bound'.

Figure A8 – Wholesale service share analysis methodology



Methodology

A7.28 The methodology to estimate the 'upper bound' proxy for BT's wholesale market share in each of the wholesale leased lines consisted of four steps:

- Data cleansing & normalisation
- Aggregation by postal sector
- Uplift
- Calculation of BT's share of the market by postal sector

A7.29 Each of these steps is described in turn below.

Step 1: Data cleansing & normalisation

A7.30 It was necessary for Ofcom to manipulate the raw data received from BT into a structure suitable for Ofcom's intended analysis. The data cleansing and normalisation comprised five sub-tasks:

- Transfer of circuits sold to operators other than the 13 Altnets identified for the purposes of this analysis, from the wholesale data set to the retail data set.
- Postcode corrections to remedy the common detectable errors made when recording postcode data, where automated batch processing techniques could be used.

- Bandwidth categorisation and weighting. The bandwidth range of each circuit was calculated according to the bounds defined in Table A2. Each range had an associated weighting factor, referred to as the 'weighted bandwidth' of the circuit.
- Circuit end point analysis to identify the non-customer end points so that these could be excluded from the calculations. Non-customer end points were identified from data supplied by BT on the location of their points of presence. It was necessary to exclude the network ends to allow a direct comparison with the retail analysis results, the rationale of which was based on the consideration of only customer end points,
- Extraction of the postal sector from the postcode data. As noted in Section 3, and for the retail market share analysis, Ofcom opted to aggregate at the postal sector level when conducting its geographic analysis.

A7.31 The completion of these five tasks for BT's wholesale data ensured that the data received was presented on a consistent basis.

Step 2: Aggregation by postal sector

A7.32 The sum of BT wholesale customer end points and the combined weighted bandwidth of the parent circuits were calculated for each postal sector, for each market:

- Traditional interface - low, high and very high bandwidth; and
- Alternative interface – all bandwidths).

Step 3: Uplift calculations

A7.33 As with the retail analysis, an uplift factor was applied to the output data from Step 2 to align this with the known number of end points in each market calculated in Step 1 of the analysis.

Step 4: Calculation of BT's service share by postal sector

A7.34 The output data from Step 3 (the volume of BT wholesale end points and the associated weighted bandwidth by postal sector) was combined with the equivalent BT data at the retail level to give an estimate for BT's share of the wholesale market.

Results

A7.35 The results of this analysis show that for many postal sectors, BT has a share of greater than 100%. In the low bandwidth market, 7,355 of the 9,596 postal sectors have a BT share greater than 100%. These results confirm that PPCs are used by operators to support downstream markets in addition to retail leased lines markets.

A7.36 However, for the high bandwidth TISBO and for the AISBO markets, while there are a large number of postal sectors that show a BT share of greater than 100% (1,185 and 3,777 respectively) there remains, consistent with the analysis conducted at the retail level, a significant variation in BT's share of wholesale circuits on geographic basis, by postal sector in these product markets. Indeed for both the high bandwidth TISBO market and the AISBO market there are around 300 postal sectors (although not necessarily the same postal sectors) where BT's share is between 1% and 40%.

Retail trunk segments analysis

A7.37 PPC trunk segments were defined as a distinct wholesale market in the LLMR. The breakpoint between wholesale trunk segments and wholesale symmetric broadband origination segments was specified in the LLMR as being BT's Tier 1 nodes, with the LLMR noting that the relevant market includes the equivalent of other communications providers' networks. The aim of the retail trunk analysis was to produce an illustration of operators' shares at the retail level of trunk for leased line services.

A7.38 Stand-alone retail trunk circuits are not a service available to third parties and as such these do not form a separate relevant economic market. Nonetheless it is instructive to the assessment of the extent to which competitive conditions vary on a geographic basis to assess the extent to which there is variation in operators' shares of the provision of retail trunk circuits (albeit that these retail trunk circuits are provided as part of a larger point-to-point retail leased line or retail network service). Given that stand-alone retail trunk circuits are not a service available to third parties the retail market data available from operators could be used as the sole input for this part of the analysis.

A7.39 The data supplied by BT to Ofcom identifies 67 BT Tier 1 nodes, of which 20 are located in London. This results in 2,211 possible trunk routes. Approximately 200 of these trunk routes are intra-city trunk routes i.e. where both parent Tier 1 nodes of a circuit are located in the same city.

A7.40 To derive the most likely trunk route for each leased line circuit, the nearest serving BT T1 node was identified. This data for the serving T1 node was supplied by BT and some Altnets, but derived using coordinate data for leased line end points for the majority of the Altnets' circuits.

A7.41 Those retail leased lines whose two end points both have the same parent BT Tier 1 node, by definition (as trunk is defined as transmission between BT's Tier 1 nodes) do not use any trunk and as such for the purposes of this part of the analysis are identified as not containing a retail trunk element. Although in practice, these circuits might be physically routed through Tier 1 (or alternative) nodes. Those retail leased lines that have different parent BT Tier nodes for both end points of the circuit would, for the purposes of this analysis, be identified as using a retail trunk element.

A7.42 Ofcom developed a model to estimate the total circuit count, the total bandwidth and the BT share of circuits and bandwidth on each of the 2,211 possible trunk routes and the 67 cases where there are no trunk segments i.e. both ends of the circuit share a Tier 1 node. The inputs to the model are the co-ordinate data for both ends of each retail leased line.

Uplift

A7.43 As with the analysis of operators' shares of retail service ends described in A7.6 to A7.8 above, there was a percentage of data loss due to incorrect or missing postcode data supplied by operators for the leased line ends. Therefore it was necessary to apply an uplift to the circuit count and total bandwidths to remedy the shortfall in the output number of end points when compared to the known number of end points,

A7.44 Unlike the analysis of operators' shares of ends of retail circuits, the relationship between the end points of a leased line had to be maintained. The analysis would only be successful for those lines where the postcodes for both ends of the leased line was supplied and could be matched to the Ofcom postcode database. In addition, an exact match on the postcode was required, whereas the service share analysis required a match only at postal sector level.

A7.45 This higher level of granularity resulted in fewer successful matches from the data provided by operators, resulting in much higher uplift factors being necessary for the trunk analysis. The average and median uplift percentages applied across the operators are set out in Table A3 below[29].

Table A3 – Retail trunk segment uplift

	Traditional interface leased lines	Alternative interface leased lines
Total circuit count	556,236	27,975
No postcode data	79,157 (14%)	2,723 (10%)
Average uplift applied to each operator's dataset	26%	28%
Median uplift applied to each operator's dataset	22%	15%

Output

A7.46 The BT service share was derived for each of the trunk routes in terms of (i) the share of circuit count and (ii) the share of bandwidth on each route. The model could also be adjusted to show the results for only the routes that carried a specified minimum number of circuits. The results of this analysis are shown in Figure 17 in Section 4.

Wholesale trunk segment analysis

A7.47 The wholesale trunk segment analysis consisted of:

- An analysis of BT's share of each trunk route, similar to the retail trunk route analysis. As would be expected in view of the wholesale market share analysis, the ratio of BT's wholesale shares to the total retail market is greater than 1:1. The results matrix for this analysis is illustrated in Figure 18 in Section 4 of this document.
- An analysis of BT wholesale circuits to determine the proportion that use trunk, and for each T1 node, the percentage of circuits to or from the node that have a trunk segment.

[29] Excluding one outlier: an operator whose relatively high level of uplift was applied to a very small number of service end points.

- Analysis of the wholesale circuits sold by BT to the 13 Altnets identified by Ofcom for the purposes of the analysis in this discussion document, to determine the percentage of circuits to or from that node that have a trunk segment.

Output

A7.48 The overall results are set out in Table A4 below, which shows the breakdown by circuit type for the proportion of wholesale circuits that use trunk. Results are presented for all wholesale circuits and a subset of these results, the BT sales to alternative network operators (OCPs/ Altnets). The two sets of results follow a similar pattern. For TISBO circuits, the digital circuits are more likely to have a wholesale trunk segment than analogue circuits. The majority (approximately two thirds) of AISBO circuits do not have a trunk segment which is probably a reflection of the distance limitations associated with alternative interface circuits.

A7.49 Figure A9 below shows the proportion of TISBO and AISBO circuits originating or terminating at each of BT's 67 Tier 1 nodes that have a trunk segment. Each of the Tier 1 nodes has been colour-coded according to their level of trunk-use. Table A5 summarises on a national basis the percentage of Tier 1 nodes within each trunk-use category.

Table A4 – Overall trunk segment analysis results: proportion of each wholesale circuit type using a trunk segment

	All wholesale circuits		**BT sales to OCPs**	
Circuit type	No trunk	With trunk	No trunk	With trunk
TISBO - analogue	65%	35%	67%	33%
TISBO - digital	47%	53%	48%	52%
All TISBO	55%	45%	50%	50%
AISBO	67%	33%	64%	36%
All circuits	55%	45%	50%	50%

Figure A9 – Percentage of circuits to/from each BT Tier 1 node that have a trunk segment for TISBO and AISBO

BT Tier 1 node	All TISBO ccts - All wholesale	All TISBO ccts - BT sales to OCPs
ABERDEEN CENTRAL NODE	25%	40%
BISHOPS STORTFORD	65%	87%
BIRMINGHAM	63%	67%
BIRMINGHAM ERDINGTON	72%	86%
BRIGHTON WITHDEAN	44%	58%
BRISTOL CTE	47%	49%
CAMBRIDGE TOWN CODE	47%	61%
CAMBRIDGE TRUNK	83%	92%
CARLISLE RS	30%	54%
CARDIFF STADIUM	28%	34%
CHELMSFORD	51%	76%
Cowley	72%	84%
Coventry	68%	79%
CLYDE VALLEY	59%	79%
CRAWLEY SUSSEX	55%	74%
DONCASTER DON	55%	68%
EDINBURGH DALKEITH	67%	88%
EDINBURGH CAPITAL RS	46%	52%
EDINBURGH MUSSELBURGH	53%	83%
EARLSDON	74%	84%
GUILDFORD	62%	72%
GLOUCESTER TE	50%	72%
GLASGOW DIAL HOUSE COMPLEX	43%	41%
IRVINE BOURTREE TRS AREA 2	19%	36%
IPSWICH	37%	42%
LONDON MILE END	86%	76%
LONDON BISHOPGATE	81%	89%
LONDON FARADAY	77%	91%
LONDON POPLAR	92%	93%
LONDON HARLESDEN	84%	91%
LONDON ILFORD SSC	64%	71%
LONDON MAIDA VALE	77%	87%
LONDON MUSEUM	73%	86%
LONDON WOODGREEN SSC	75%	70%
LONDON COLINDALE SSC	78%	85%
LONDON POTTERS BAR	75%	94%
LONDON REDHILL	84%	94%
LONDON MAIN NETWORK ELTHAM RS	66%	77%
LONDON CROYDON SSC	66%	68%
LONDON KINGSTON SSC	70%	86%
LONDON COVENT GARDEN	71%	92%
LONDON SOUTHBANK	78%	83%
LONDON WATFORD HERTS	70%	80%
LONDON WOOLWICH	74%	71%
LONDON EALING SSC	77%	81%
LEICESTER TE	52%	53%
LUTON	67%	66%
LEEDS WESTGATE ATE	41%	36%
LIVERPOOL TK	40%	43%
MILTON KEYNES	64%	67%
MANCHESTER DIAL HOUSE	42%	41%
NEWPORT GWENT DOS RD	52%	83%
NOTTINGHAM SHERIFF	42%	41%
NORTHAMPTON	57%	56%
NEWCASTLE UPON TYNE HADRIAN	22%	3%
OXFORD TE	60%	77%
PRESTON ARKWRIGHT LANCS	39%	49%
COSHAM TE/PORTSMOUTH TRUNK TE	49%	59%
READING	59%	61%
SALISBURY SARUM TRUNK	52%	78%
SHEFFIELD ELDON HOUSE	47%	47%
SLOUGH ATE	70%	72%
SOUTHAMPTON TOWN CODE	53%	63%
SWINDON	56%	57%
WARRINGTON	59%	69%
WOLVERHAMPTON	50%	64%
YORK	45%	50%

BT Tier 1 node	AISBO - All wholesale	AISBO - BT sales to OCPs
ABERDEEN CENTRAL NODE	1%	0%
BISHOPS STORTFORD	46%	100%
BIRMINGHAM	30%	31%
BIRMINGHAM ERDINGTON	31%	80%
BRIGHTON WITHDEAN	15%	14%
BRISTOL CTE	13%	16%
CAMBRIDGE TOWN CODE	13%	0%
CAMBRIDGE TRUNK	54%	
CARLISLE RS	3%	11%
CARDIFF STADIUM	2%	10%
CHELMSFORD	18%	50%
Cowley	58%	100%
Coventry	31%	36%
CLYDE VALLEY	14%	42%
CRAWLEY SUSSEX	26%	67%
DONCASTER DON	24%	17%
EDINBURGH DALKEITH	44%	50%
EDINBURGH CAPITAL RS	18%	15%
EDINBURGH MUSSELBURGH	31%	50%
EARLSDON	54%	27%
GUILDFORD	34%	31%
GLOUCESTER TE	18%	22%
GLASGOW DIAL HOUSE COMPLEX	8%	7%
IRVINE BOURTREE TRS AREA 2	1%	0%
IPSWICH	2%	0%
LONDON MILE END	77%	71%
LONDON BISHOPGATE	84%	91%
LONDON FARADAY	80%	87%
LONDON POPLAR	79%	71%
LONDON HARLESDEN	71%	71%
LONDON ILFORD SSC	37%	43%
LONDON MAIDA VALE	78%	81%
LONDON MUSEUM	76%	78%
LONDON WOODGREEN SSC	48%	46%
LONDON COLINDALE SSC	67%	67%
LONDON POTTERS BAR	58%	100%
LONDON REDHILL	63%	83%
LONDON MAIN NETWORK ELTHAM RS	60%	64%
LONDON CROYDON SSC	44%	43%
LONDON KINGSTON SSC	68%	67%
LONDON COVENT GARDEN	80%	96%
LONDON SOUTHBANK	62%	42%
LONDON WATFORD HERTS	40%	66%
LONDON WOOLWICH	52%	49%
LONDON EALING SSC	67%	63%
LEICESTER TE	10%	8%
LUTON	32%	38%
LEEDS WESTGATE ATE	4%	2%
LIVERPOOL TK	4%	2%
MILTON KEYNES	11%	8%
MANCHESTER DIAL HOUSE	3%	4%
NEWPORT GWENT DOS RD	5%	0%
NOTTINGHAM SHERIFF	8%	0%
NORTHAMPTON	6%	0%
NEWCASTLE UPON TYNE HADRIAN	1%	0%
OXFORD TE	32%	50%
PRESTON ARKWRIGHT LANCS	6%	6%
COSHAM TE/PORTSMOUTH TRUNK TE	14%	57%
READING	15%	9%
SALISBURY SARUM TRUNK	29%	0%
SHEFFIELD ELDON HOUSE	10%	3%
SLOUGH ATE	41%	25%
SOUTHAMPTON TOWN CODE	21%	50%
SWINDON	9%	57%
WARRINGTON	31%	24%
WOLVERHAMPTON	23%	50%
YORK	5%	1%

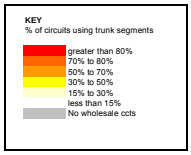


Table A5 – BT Tier 1 nodes: percentage of circuits to/from each node that have a trunk segment

Band (% of circuits to/from the T1 node using trunk segments)	Percentage of BT Tier 1 nodes within each trunk-use category			
	All BT wholesale circuits		BT wholesale circuits sold to OCPs	
	ALL TISBO	AISBO	ALL TISBO	AISBO
80% +	9%	3%	33%	12%
70% to 80%	21%	9%	21%	7%
50% to 70%	42%	16%	27%	21%
30% to 50%	22%	22%	18%	15%
15% to 30%	6%	13%	0%	10%
less than 15%	0%	36%	1%	33%
no circuits	0%	0%	0%	1%

A7.50 A number of cities (Birmingham, Cambridge, Edinburgh and London) have more than one Tier 1 node. In order to understand how these intra-city trunk routes were affecting the results presented above, Ofcom has aggregated the Tier 1 nodes within those cities. Table A6 and Figure A10 below illustrate the results of this analysis. Aggregating Tier 1 nodes in this way has the effect of reducing the proportion of circuits that contain a trunk segment, indicating that a significant proportion of trunk segments are intra-city trunk segments. This effect is most noticeable within London.

A7.51 This analysis could indicate that for those Tier 1 nodes within the higher trunk-use categories these areas might the locations where the Altnets have a relatively poor network reach. Similarly the Tier 1 nodes where there is low trunk use, this analysis could indicate that in these locations Altnets have a good network reach. However, it is worth noting that for some key locations, for example Birmingham (53%), Cambridge (55%), Glasgow (41%), Manchester (41%) and Sheffield (47%) these are nevertheless showing a high level of wholesale trunk segment use for TISBO circuits.

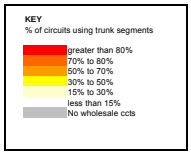
Table A6 – Inter-city routes: percentage of circuits to/from Tier 1 nodes that have a trunk segment

Band (% of circuits to/from the T1 node using trunk segments)	Percentage of BT Tier 1 locations within each trunk-use category			
	All BT wholesale circuits		BT wholesale circuits sold to OCPs	
	ALL TISBO	AISBO	ALL TISBO	AISBO
80% +	0%	0%	9%	5%
70% to 80%	7%	0%	20%	0%
50% to 70%	48%	5%	36%	16%
30% to 50%	34%	16%	30%	9%
15% to 30%	11%	20%	2%	16%
less than 15%	0%	59%	2%	55%
no circuits	0%	0%	0%	0%

Figure A10 – Inter-city trunk usage: Percentage of circuits to/from each BT Tier 1 location that have a trunk segment for TISBO and AISBO

BT Tier 1 node	All TISBO ccts - All wholesale	All TISBO ccts - BT sales to OCPs
ABERDEEN	25%	40%
BISHOPS STORTFORD	65%	87%
BIRMINGHAM	53%	53%
BRIGHTON	44%	58%
BRISTOL	47%	49%
CAMBRIDGE	44%	55%
CARLISLE	30%	54%
CARDIFF	28%	34%
CHELMSFORD	51%	76%
COWLEY	72%	84%
COVENTRY	68%	79%
CLYDE VALLEY	59%	79%
CRAWLEY	55%	74%
DONCASTER	55%	68%
EDINBURGH	32%	35%
EARLSDON	74%	84%
GUILDFORD	62%	72%
GLOUCESTER	50%	72%
GLASGOW	43%	41%
IRVINE	19%	36%
IPSWICH	37%	42%
LONDON	20%	25%
LEICESTER	52%	53%
LUTON	67%	66%
LEEDS	41%	36%
LIVERPOOL	40%	43%
MILTON KEYNES	64%	67%
MANCHESTER	42%	41%
NEWPORT	52%	83%
NOTTINGHAM	42%	41%
NORTHAMPTON	57%	56%
NEWCASTLE	22%	3%
OXFORD	60%	77%
PRESTON	39%	49%
PORTSMOUTH	49%	59%
READING	59%	61%
SALISBURY	52%	78%
SHEFFIELD	47%	47%
SLOUGH ATE	70%	72%
SOUTHAMPTON	53%	63%
SWINDON	56%	57%
WARRINGTON	59%	69%
WOLVERHAMPTON	50%	64%
YORK	45%	50%

BT Tier 1 node	AISBO - All wholesale	AISBO - BT sales to OCPs
ABERDEEN	1%	0%
BISHOPS STORTFORD	46%	100%
BIRMINGHAM	23%	27%
BRIGHTON	15%	14%
BRISTOL	13%	16%
CAMBRIDGE	7%	0%
CARLISLE	3%	11%
CARDIFF	2%	10%
CHELMSFORD	18%	50%
COWLEY	58%	100%
COVENTRY	31%	36%
CLYDE VALLEY	14%	42%
CRAWLEY	26%	67%
DONCASTER	24%	17%
EDINBURGH	5%	3%
EARLSDON	54%	27%
GUILDFORD	34%	31%
GLOUCESTER	18%	22%
GLASGOW	8%	7%
IRVINE	1%	0%
IPSWICH	2%	0%
LONDON	5%	2%
LEICESTER	10%	8%
LUTON	32%	38%
LEEDS	4%	2%
LIVERPOOL	4%	2%
MILTON KEYNES	11%	8%
MANCHESTER	3%	4%
NEWPORT	5%	0%
NOTTINGHAM	8%	0%
NORTHAMPTON	6%	0%
NEWCASTLE	1%	0%
OXFORD	32%	50%
PRESTON	6%	6%
PORTSMOUTH	14%	57%
READING	15%	9%
SALISBURY	29%	0%
SHEFFIELD	10%	3%
SLOUGH ATE	41%	25%
SOUTHAMPTON	21%	50%
SWINDON	9%	57%
WARRINGTON	31%	24%
WOLVERHAMPTON	23%	50%
YORK	5%	1%



Annex 8

Statistical Analysis

Introduction

A8.1 The retail leased lines data used in the statistical analysis was consistent with the market definitions set out in the LLMR and was split into four categories:

- Traditional interface low bandwidth retail leased lines;
- Traditional interface high bandwidth retail leased lines;
- Traditional interface very high bandwidth retail leased lines; and
- Alternative interface retail leased lines.

A8.2 This annex sets out the various statistical analysis that Ofcom has conducted to asses the extent to which there is evidence of variations in competition on a geographic basis in the provision of leased lines in the UK

Variations in provision of leased line services by postal sector: Variables Used

A8.3 The purpose of this analysis was to identify the key demographic variables which explain postal sector variations in:

- The overall number of leased line operators;
- The number of leased line operators, by product type;
- Amount of leased line capacity by product type; and
- BT's service share.

A8.4 The analysis was undertaken in two parts:

- Cluster Analysis – exploration of current state of leased lines market across a range of demographic variables.
- Regression analysis – relationship between demographic variables and the number of companies, bandwidth and BT's market share.

A8.5 The variables used were common to both parts of the analysis and were taken from a range of sources:

- MailerMap and Marker Map. These identify, for the entire UK, postal sector, postal code and postal area boundaries. They also provide census information on:
  - Size of postal sector in km2;
  - Number of households in each postal sector (2001 Census);
  - Household density – number of households per km2; and
  - Number of organisations with a business postcode – not available in Northern Ireland.
- The Experian Business Site data. This collates information on businesses from a range of sources – Companies House, business directories, credit references and

SOHO references – which enables it to estimate the number of businesses in a postal sector by SIC classification and cost. This was combined with the final data source to model the resulting variables.

- A business spend model from Schema. This was commissioned by Ofcom in 2004. Its purpose was to model the spend of companies, by Standard Industry Code (SIC) classification and size, on telecommunication services including leased lines. This does not include micro businesses (10 or fewer employees). This is because it was hard to capture these companies as they are not required to register with "Companies House" in England and Wales. Also the Schema model suggests companies of this size do not purchase leased lines. This provides information on:
  - Numbers of business with any spend on leased lines
  - Business density – number of business per km2;
  - Count of businesses with over 200 employees.
  - The number of businesses in a postal sector,
  - The number of businesses which have a high spend on leased line services;
  - The number of businesses which have a medium spend on leased line services;
  - The number of businesses which have a low spend on leased line services; and
  - The amount of leased line income which it would be possible to extract from companies in the following size bands: 11 – 19, 20 – 49, 50 – 199, 200 – 499 and over 500 employees.

Cluster Analysis

Methodology

A8.6 The first part of the analysis was to identify those postal sectors which were similar in terms of their demographic features, as listed above. This was achieved using a process known as "cluster analysis". This repeatedly groups and regroups postal sectors until the differences between postal sectors in a group are as small as possible and the differences between groups are as large as possible.

A8.7 The exact method used to create the clusters was "K-mean cluster analysis". This requires the selection of a number of clusters (e.g. 6). The computer programme then selects six values as starting points, which are either based on the distribution of the first demographic variable to be used in the model. This first demographic variable to be used in the model is chosen because it is the one which most differentiates postal sectors.

A8.8 The most appropriate starting value is chosen by running graphical, cross-tabular and hierarchical cluster analysis to see which variables most differentiate the variables and into how many groups. Numbers about these selected chosen starting points are then tested to identify the starting value which segments the postal areas into clusters which are large enough to analyse but which are not so large as to suggest that important differences are being missed.

A8.9 Each case is then considered in sequence and allocated to the group with the most similar starting value. As the next variable is entered, the values, used to group the

clusters, are recalculated. This process is repeated until the addition of new variables does not cause the clusters to change.

A8.10 The choice of the initial number of clusters is based on analysis of the data, through charting the data and running exploratory techniques. The resulting clusters can be confirmed by using a technique called "discriminant analysis" which takes the six clusters and shows to what extent they can be explained by a set of variables. If the discriminant analysis cannot closely replicate the clusters this indicates that there is either a problem in the dataset or in the clustering process.

A8.11 One complicating aspect of the cluster analysis was the fact that many of the explanatory variables being used are in fact correlated such that they move together. This effect makes it difficult to isolate the impact of each individual variable. This correlation effect was removed by "factorising" the data (principal component analysis)[30]. It is then possible to treat the combined group as a single, independent variable. When grouped together, the explanatory variables gave five "factors" – grouped variables – which were used to run the analysis.

A8.12 Once the clustering process had been run and checked, "discriminant analysis" was used to identify the key original explanatory variables. This allows each cluster to be profiled in terms of its demographics, so that the type of area represented by each cluster can be understood. Due to the nature of some of the variables, it was necessary to create ranges of data rather than looking at each individual value, e.g. postal sectors with between 1 and 625 households were grouped together These are set out in Appendix B.

A8.13 Once the clusters are drawn, it is possible to explore the current situation of the leased line market by type of area. This enables us to see if competition is limited to particular demographic types of postal sector and if there is only demand for particular products in certain types of postal sectors.

A8.14 The resulting nine clusters were used to see how number of operators, bandwidth and BT's market share varies between areas. The clusters are explained below and the results are given in Appendix A.

Results

A8.15 The clusters are outlined in Table A7 below.

[30] Principal component analysis involves a statistical analysis that reduces a number of (possibly) correlated variables into a (smaller) number of uncorrelated variables. The first principal component accounts for as much of the variability in the data as possible, and each succeeding component accounts for as much of the remaining variability as possible.

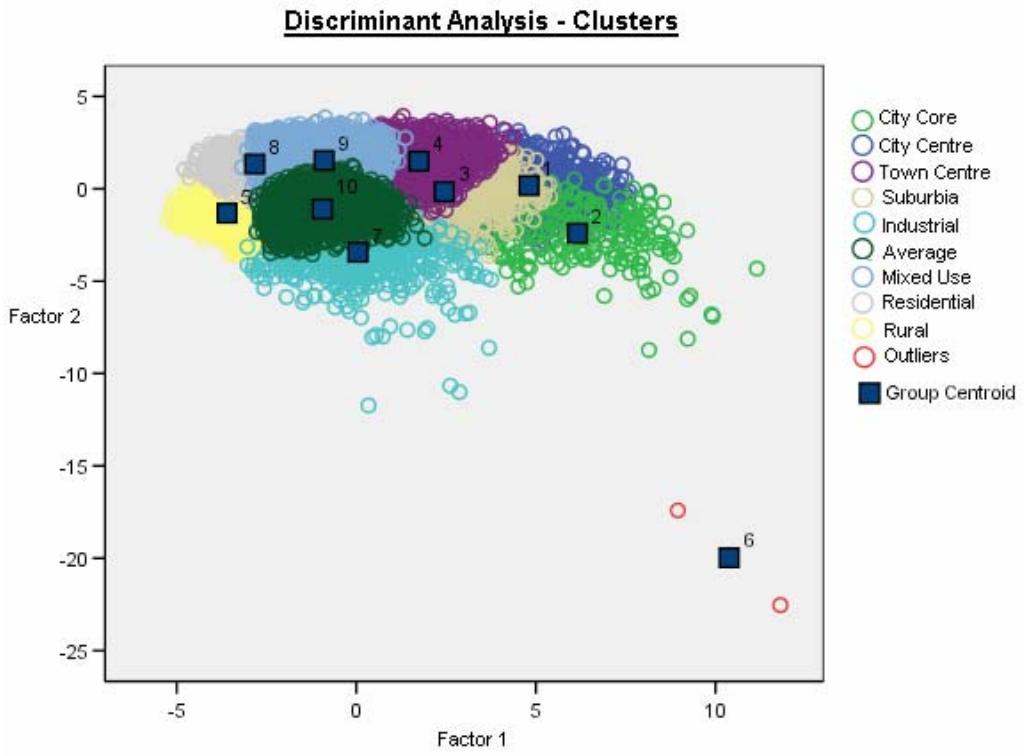
Table A7 – Summary of cluster analysis results

	Cluster number	Number in each cluster	% in cluster	Description
City Centre	1	848	8.8%	Lots of high and medium spend companies Average number of base stations and households Centre of a city/large town
City Core	2	237	2.5%	High number of high and medium spend companies Below average number of households but above average household density High number of base stations
Suburbia	3	894	9.3%	High number of medium and low spend businesses Average household density and number of households Above average number of base stations Suburbia
Town Centre	4	1270	13.2%	Average number of households but high population density High numbers of low and medium-spend companies Average number of base stations Small town
Rural Area	5	1081	11.2%	Rural area Below average number of business, households and base stations
Industrial Area	7	643	6.7%	Low population density, Industrial Area
Mixed Use	8	1649	17.2%	Mixed residential area Low levels of business but average masts
Average Area	9	1452	15.1%	Average area (matches average across population)
Residential Area	10	1105	11.5%	Residential area High household density but low levels of business
Business district[31]	12	41	0.4%	Area of London – very low residential, but not high business

[31] This is a subset of cluster 5 – see paragraph 6.4 below.

A8.16 Figure A11below shows the cluster identified by the discriminant analysis. In a similar way to the factoring process above, discriminant analysis identifies combined variables which best explain the clusters. The first two factors identified are combinations of household density, number of businesses and mobile masts. These two factors explain almost 80% of the variation between clusters.

Figure A11 – Illustration of the results of Ofcom's discriminant analysis



A8.17 As well as these clusters, there are two outliers and 378 missing cases where there was insufficient market information[32]. The outliers and missing cases account for 4% of the 9595 UK postal sectors. A large proportion of these missing cases (235 or 62% of them) are in Northern Ireland. This is because census data relating to the number of businesses was collected differently and was not present in the data set.

A8.18 Another issue with the clusters is that some of the postal sectors in Central London are classed as rural by the analysis. This issue is unique to Central London and often occurs in this type of analysis. This is because very small numbers of people live in the City of London. The 41 instances where this has occurred have been separated out and treated as a separate cluster. This separate cluster has been labelled "Business District" and is cluster number 12. As this is a known occurrence, this treatment is appropriate. But to do likewise with other areas, such as Central Manchester, would be to leave the model open to charges of subjectivity.

A8.19 The results of the cluster analysis suggest that three clusters (these being clusters 1, 2 and 12 from Table A7 above) account for the majority of postal sectors where

[32] Where for these postal sectors there was at least one explanatory variable that did not have any observations.

competitors to BT are present. These clusters represent city centres and account for over 10% of UK postal sectors. City centres/ city cores are the only areas where 5 or more competing operators can be found. Additionally cluster 12 can be identified as being where there are competitors to BT.

Regression Analysis

Methodology

A8.20 The second stage of the model is to quantify the importance of each of these variables. The objective of this model was to enable the prediction of how many operators or capacity could be expected in any particular postal sector, if some of the demographic variables change.

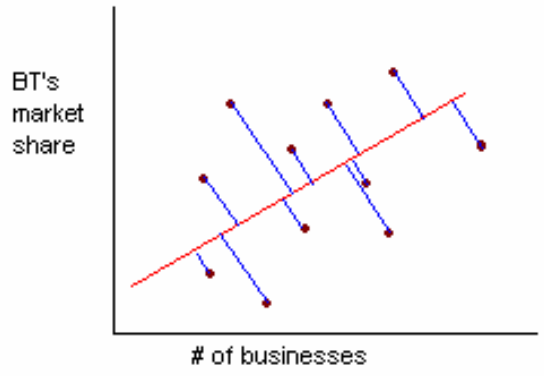
A8.21 This model is distinct from the cluster analysis and the results are unrelated. However, they should suggest similar results as they are based on similar demographic data.

A8.22 In this analysis, the variable giving the number of businesses from the Census is excluded to allow a prediction to be made about Northern Ireland postal sectors, ignoring any special conditions that might hold there.

A8.23 Regression analysis works out how much of a dependent variable (in this instance, number of operators, capacity or service share) can be explained by a group of explanatory variables (the demographics). Almost all regression models include a variable called a constant (□) which represents the base case. A regression model with only one explanatory variable and no constant is equivalent to a correlation.

A8.24 It is important to mention that the regression analysis was carried out using weighted bandwidth data, as described in Annex 7. Figure A11 below shows an illustrative scatter diagram of market share and number of business. The red line shows a regression model, which is explaining market share in terms of businesses. It was chosen as the model which gave the "best fit" between the plotted points. The blue lines show the part of the variation in the data which cannot be explained by the model. They are often called the error □. The difference between the true value for any postal sector and the one predicted by the model is known as the residual.

Figure A12 – Illustrative diagram of regression of market share and number of businesses



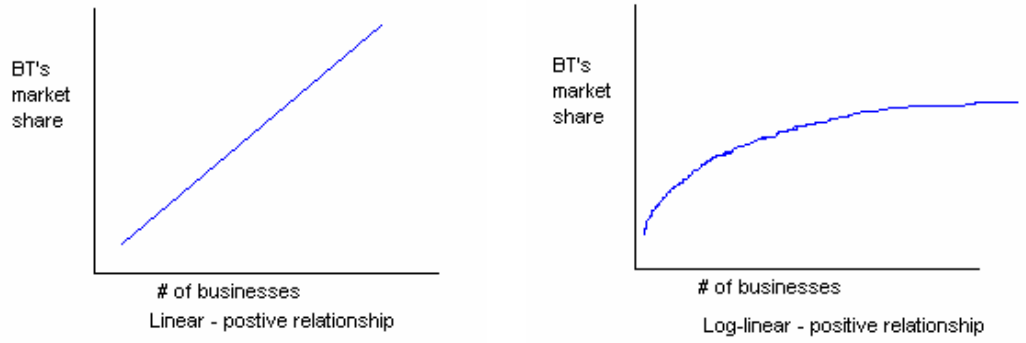
A8.25 Most models include more than one explanatory variable and it is hard to give a pictorial representation of these.

Results

A8.26 Originally, the intention was to create separate models explaining BT's market share, the number of operators and the level of capacity for each of the four product markets. This would have been 12 regressions in all. However, due to data issues, it was not possible to fit models for BT's market share or for retail very high bandwidth traditional interface leased lines. Additionally, although models for capacity in the retail high bandwidth traditional interface and retail alternative interface leased lines were fitted, reliance should not be placed on these for reasons explained below. This means that only five models are presented below.

A8.27 Of the five models, where results will be given, three take what is known as a linear functional form and the other two a log linear (also known as a semi-log) functional form. This means that when the dependent (market share, capacity, or operators) is graphed against the explanatory demographics, the graph indicates a particular type of relationship (see Figure 13 below). This is important as this determines how the model is interpreted.

Figure A13 – Examples of different functional forms



A8.28 A linear relationship means that y (number of operators) increases by β if the number of x (business in postal sector) increases by 1 while a log linear relationship means that y (number of operators) increases by $\beta\%$ if the number of x (business in postal sector) increases by 1

A8.29 The three models that take a linear relationship are number of operators, overall and by high-capacity traditional and alternative leased line product types.

A8.30 Models of this type have the form: $y = \alpha + \beta x + \varepsilon$. . α is the constant: the number of operators which can be assumed to be present if nothing else is known about the postal sector. β is the amount y increases if x is increased by 1. ε is the residual: the amount of variation between postal sectors which the model cannot explain. So, if the model is y = 2 + 0.25x, an area with 40 businesses will have 12 operators.

A8.31 The two models which take a log linear functional form are the number of operators offering retail low bandwidth traditional interface leased lines and the amount of retail low bandwidth traditional interface bandwidth.

A8.32 Models of this type have the form: $y = e^{(\alpha+\beta x+\varepsilon)}$. This can be rewritten in a linear form as $\ln(y) = \alpha + \beta x + \varepsilon$. α is equal to ln(y) or e^{α}. This is the base case: the number of operators that can be assumed to be present if nothing else is known about the postal sector. β is the % change in the base case that occurs if x is increased by 1. ε is the residual and is the amount of variation between postal sectors which cannot be explained by the model.

A8.33 It should be noted that the amount of variation explained by the different models for the number of operators, the number of operators supplying retail low bandwidth traditional interface leased lines and the bandwidth of retail low bandwidth traditional interface leased lines is between 43% and 62%. While the models explaining number of operators offering retail high bandwidth traditional interface and retail alternative interface leased lines are about 30%.

A8.34 The cluster analysis provides an interpretation of the lower explanatory power of the models for retail high bandwidth traditional interface and retail alternative interface leased lines. The greater the number of operators who offer a particular service, the easier it is to distinguish between those postal sectors with differing numbers of operators. However, as the number of operators offering a particular service falls across all possible sectors, it is harder to explain why one postal sector has one operator and another has two. There is less diversity to explain.

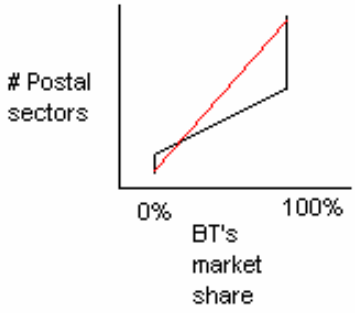
A8.35 For the retail low bandwidth traditional interface leased lines, it is possible to have between zero and eight operators in a postal sector. This is a wide range and allows distinctions to be drawn in demographic terms. For the retail high bandwidth traditional interface and retail alternative interface leased lines, over 95% of postal sectors have three or less operators. This makes it harder to distinguish between operator numbers in a postal sector on demographic variables.

A8.36 The results for all five of these models are given in Appendix D below, with instructions on how to interpret the results tables given in Appendix C.

Explanation of the exclusion of the BT service share model

A8.37 The reason for excluding BT's service share was due to the form the data took. Figure A14 below gives an illustration of this. Some postal sectors do not have BT present, some have both BT and other companies but the majority have only BT. This presence of BT only dominates the model and leads to the red line being fitted. This is an inaccurate representation of the underlying model as the kink in the curve is not represented in the "best fit" line.

Figure A14 – Stylised illustration of the form of BT's service share data

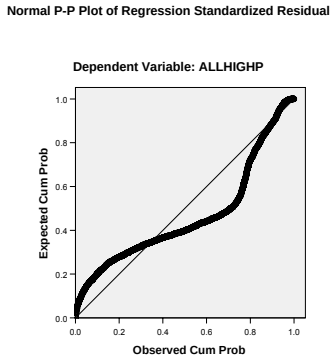


A8.38 To represent the service share curves properly would require that three separate models be fitted: one to explain why BT is not present in a postal sector, another to explain why only BT is present and the last to explain variation in BT's service share when both BT and other operators are present. This would be very complicated and offer results which would be difficult to interpret. For this reason, service share has not been modelled.

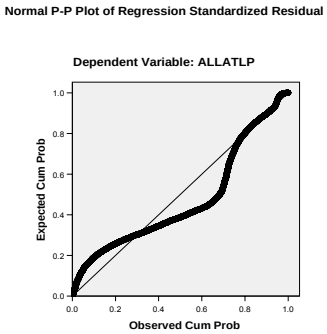
Explanation of the exclusion of the high bandwidth operator and the alternative interface operator models

A8.39 The reason for excluding the retail high bandwidth traditional interface and the alternative interface operators models is to do with the amount of variation a model explains. Not all the variation between postal sectors in terms of bandwidth will be explained by the model. As well as predicting a reasonable amount of the variation (more than 30%) a model also has to be "well-behaved". This means that it cannot either under-estimate or over-estimate the number of postal sectors in a consistent way. If this happens, it is known as "bias in the residuals" and indicates the presence of a unknown variable which is affecting the model. Unless that variable can be identified and adjusted for, the model will consistently predict values below or above what it should.

Figure A15 – Bias in the residuals for retail high-bandwidth traditional interface leased lines and retail alternative interface leased lines



Retail high bandwidth traditional interface leased lines



Retail alternative interface leased lines

A8.40 Figure A15 above show that the results for the high-capacity traditional and alternative leased lines are generally under-estimating the number of operators in the postal sector. If the residuals were not biased, then the heavy black lines would be straight or show very minor deviation.

Explanation of the exclusion of the very high bandwidth leased lines model

A8.41 The reason for excluding very-high capacity leased lines is more straight-forward. There are very few of these circuits in the country and they are only offered in 170 postal sectors. This proved too small a sample to analyse and give robust results.

Summary

A8.42 The regression and cluster analysis can be seen to be supporting one another. The profile of the clusters was dependent on household density, number of business and mobile masts. These features are mentioned in all the regression equations.

A8.43 Perhaps unsurprisingly, the broad conclusion that can be drawn from this analysis is that leased lines operators are most likely to be present in areas which are urban, which have a lot of businesses and which require leased lines for mobile masts. The main difference by different product market is the presence of different size of companies. Operators offering retail low bandwidth traditional interface leased lines are more likely to be present in a postal sector that contains medium-sized companies. Operators, offering retail high bandwidth traditional interface leased lines are likely to be present in an area with a mixture of small and large companies while those offering retail alternative interface leased lines are present in areas with large businesses.

Appendix A: Results of Cluster Analysis

Number of Operators by Cluster

Number of Operators by Cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	0%	0%	0%	0%	0%	0%	0%	0%	7%	**15%**	3%
1	0%	1%	6%	0%	4%	0%	**28%**	**34%**	**48%**	**53%**	**25%**
2	2%	5%	**18%**	0%	**17%**	**23%**	**35%**	**34%**	**26%**	**19%**	**24%**
3	7%	13%	**28%**	2%	**25%**	**36%**	**21%**	**19%**	**10%**	7%	**18%**
4	11%	**17%**	**23%**	**20%**	**25%**	**21%**	10%	7%	4%	3%	12%
5	**14%**	**22%**	13%	**24%**	14%	10%	4%	3%	3%	1%	8%
6	**18%**	**15%**	6%	**20%**	8%	5%	1%	2%	1%	1%	5%
7	**17%**	14%	3%	**27%**	4%	2%	1%	1%	2%	0%	3%
8	11%	7%	2%	5%	2%	2%	0%	1%	0%	0%	2%
9	8%	5%	1%	2%	0%	1%	0%	1%	0%	0%	1%
10	6%	2%	0%	0%	0%	1%	0%	0%	0%	0%	0%
Over 10	6%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

A8.44 This table shows the distribution of operators by clusters. Where 5% or more of a cluster's postal sector have a particular number of operators, then that cell is red. If it is one of three most common numbers of operators, then it will be in bold.

A8.45 It can be seen that city centres, including Business District, have the highest numbers of operators, usually 4 or above. Town centres, suburbia and industrial areas have the next highest levels with between 2 and 5 operators. About 50% of residential and rural areas and 30% of mixed use and average areas have only operator, usually BT.

BT's service share by Cluster

BT's service share in retail low bandwidth traditional interface leased lines by cluster											
Cluster/ MS	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0 – 1%	0%	0%	0%	0%	0%	0%	0%	0%	2%	1%	0%
1.1 – 30%	0%	1%	0%	0%	0%	1%	1%	0%	1%	1%	1%
30.1 – 40%	0%	1%	1%	2%	0%	0%	0%	0%	1%	1%	0%
40.1 - 50%	1%	1%	1%	0%	1%	0%	1%	0%	2%	1%	1%
50.1 – 70%	**7%**	**6%**	**5%**	**15%**	4%	3%	4%	4%	**7%**	**6%**	**5%**
Over 70%	**92%**	**92%**	**93%**	**83%**	**95%**	**96%**	**96%**	**95%**	**88%**	**89%**	**93%**
Base	237	848	1270	41	894	643	1649	1451	1013	902	8950

A8.46 BT's has over 50% service share in almost all postal sectors. The only exceptions are several postal sectors, in rural and residential areas, where BT has less than 30% service share. This is likely to be because there are few leased lines ends within these postal sectors and these are being supplied by an alternative operator.

Cluster/ MS	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0 – 1%	**14%**	**20%**	**33%**	**44%**	**24%**	**22%**	**43%**	**25%**	**45%**	**43%**	**29%**
1.1 – 30%	**12%**	**7%**	5%	**44%**	3%	8%	2%	6%	5%	1%	6%
30.1 – 40%	8%	5%	2%	0%	2%	1%	2%	2%	3%	2%	3%
40.1 - 50%	6%	5%	4%	3%	4%	3%	2%	3%	2%	2%	4%
50.1 – 70%	**12%**	**8%**	**6%**	5%	6%	2%	3%	4%	4%	4%	6%
Over 70%	**49%**	**54%**	**50%**	5%	**62%**	**65%**	**47%**	**61%**	**40%**	**49%**	**53%**
Base	174	443	384	39	339	158	328	217	150	107	2340

A8.47 It can be seen that although BT has a significant service share in over 53% of postal sectors, alternative operators have high service shares in 30% of postal sectors, especially business district, rural and residential areas. BT retains highest share in large business centres, suburbia and average areas.

BT's service share in retail very high bandwidth traditional interface leased lines by cluster											
Cluster/ MS	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0 – 1%	**91%**	**89%**	**81%**	**100%**	**78%**	**83%**	**83%**	**71%**	**100%**	**100%**	85%
1.1 – 30%	**5%**	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
30.1 – 40%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%
40.1 - 50%	0%	0%	3%	0%	0%	8%	0%	0%	0%	0%	1%
50.1 – 70%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Over 70%	**5%**	**11%**	**16%**	0%	**22%**	**8%**	0%	**17%**	0%	0%	12%
Base	22	46	32	1	18	12	23	7	4	5	170

A8.48 BT appears to have little service share in the provision of this product.

BT's service share in retail alternative interface leased lines by cluster											
Cluster/ MS	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0 – 1%	1%	2%	6%	7%	**6%**	**9%**	**15%**	**7%**	**14%**	**13%**	**8%**
1.1 – 30%	5%	4%	**9%**	**46%**	5%	3%	**8%**	3%	4%	3%	6%
30.1 – 40%	5%	2%	4%	**15%**	4%	1%	5%	1%	4%	0%	3%
40.1 - 50%	4%	4%	4%	7%	5%	1%	5%	1%	2%	0%	4%
50.1 – 70%	**15%**	**11%**	**9%**	7%	**9%**	**5%**	7%	3%	**5%**	3%	**7%**
Over 70%	**70%**	**77%**	**68%**	**17%**	**73%**	**81%**	**62%**	**85%**	**71%**	**81%**	**72%**
Base	224	766	1039	41	717	272	1208	628	553	241	5690

A8.49 BT has over 70% service share in postal sectors where this product is provided. It has lowest service share in postal sectors in industrial, rural and residential areas.

Bandwidth by Cluster

Total bandwidth in retail low bandwidth traditional interface leased lines by cluster											
Cluster/ BW (units)	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0 – 10	0%	0%	0%	0%	0%	1%	3%	2%	**35%**	**42%**	10%
10.1 - 25	0%	0%	1%	0%	0%	3%	13%	12%	**24%**	**26%**	11%
25.1 - 40	0%	0%	2%	0%	1%	10%	**16%**	**19%**	**13%**	**14%**	10%
40.1 – 55	0%	1%	6%	2%	3%	**13%**	**16%**	**17%**	7%	7%	9%
55.1 – 75	1%	1%	10%	0%	8%	**17%**	**16%**	**17%**	6%	3%	10%
75.1 – 105	2%	3%	**17%**	**10%**	14%	**21%**	14%	13%	5%	2%	11%
105.1 – 145	4%	8%	**19%**	5%	**18%**	12%	9%	8%	3%	2%	10%
145.1 – 215	**5%**	**15%**	**21%**	5%	**25%**	10%	7%	5%	3%	1%	10%
215.1 – 405	**22%**	**33%**	15%	**17%**	**20%**	7%	5%	3%	2%	2%	10%
Over 405	**68%**	**39%**	8%	**61%**	11%	7%	2%	4%	1%	2%	10%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Total bandwidth in retail high bandwidth traditional interface leased lines by cluster											
Cluster/ BW (units)	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	**27%**	**48%**	**69%**	5%	**62%**	**75%**	**80%**	**85%**	**86%**	**90%**	**75%**
1 – 25	11%	12%	**8%**	2%	**10%**	**6%**	**6%**	**5%**	3%	3%	**6%**
25.1 – 35	3%	3%	5%	5%	5%	4%	**6%**	**6%**	4%	2%	4%
35.1 – 60	**16%**	**13%**	**7%**	**7%**	**11%**	**5%**	4%	4%	2%	2%	**6%**
60.1 – 130	15%	12%	5%	**17%**	6%	4%	3%	2%	2%	1%	4%
Over 130	**28%**	**13%**	5%	**63%**	6%	**5%**	2%	2%	2%	0%	**5%**
Base	237	848	1270	41	894	643	1649	1452	1105	1073	9217

Total bandwidth in retail very high bandwidth traditional interface leased lines cluster											
Cluster/ BW (units)	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	91%	95%	98%	98%	98%	98%	99%	100%	100%	100%	98%
1 – 100	6%	4%	2%	0%	1%	1%	1%	0%	0%	0%	1%
101 -200	2%	1%	1%	2%	1%	1%	0%	0%	0%	0%	0%
201 – 300	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
301 - 400	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Total bandwidth in retail alternative interface leased lines by cluster											
Cluster/ BW (units)	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	6%	10%	**18%**	0%	**20%**	**58%**	**27%**	**57%**	**50%**	**78%**	**38%**
1 – 25	5%	6%	11%	2%	12%	**15%**	**14%**	**13%**	**15%**	**11%**	**12%**
26 – 45	5%	9%	11%	0%	9%	**7%**	8%	9%	10%	4%	8%
46 – 80	5%	12%	13%	**5%**	13%	6%	**15%**	**10%**	**11%**	3%	10%
81 – 130	**9%**	**16%**	14%	2%	**16%**	5%	13%	6%	5%	2%	10%
131 - 250	**22%**	**18%**	**17%**	**15%**	**15%**	4%	**14%**	3%	4%	2%	10%
Over 250	**49%**	**29%**	**16%**	**76%**	**15%**	5%	9%	3%	5%	1%	11%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Operators by Cluster and Product Type

Number of retail low bandwidth traditional interface operators by cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	0%	0%	0%	0%	0%	0%	0%	0%	8%	**16%**	3%
1	0%	1%	6%	2%	5%	**24%**	**32%**	**33%**	**47%**	**53%**	**26%**
2	4%	6%	**20%**	2%	**19%**	**34%**	**33%**	**32%**	**24%**	**19%**	**24%**
3	8%	12%	**28%**	5%	**27%**	**20%**	**20%**	**20%**	**11%**	7%	**18%**
4	11%	**20%**	**21%**	**22%**	**22%**	11%	10%	8%	5%	3%	12%
5	**22%**	**21%**	14%	**24%**	15%	5%	4%	3%	2%	2%	8%
6	**16%**	**17%**	5%	15%	6%	3%	1%	2%	1%	1%	4%
7	**14%**	13%	4%	**20%**	4%	2%	0%	1%	1%	0%	3%
8	11%	7%	2%	7%	2%	1%	0%	1%	0%	0%	2%
9	8%	2%	1%	2%	0%	0%	0%	0%	0%	0%	1%
10	4%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Over 10	2%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Number of retail high retail high bandwidth traditional interface operators by cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	**27%**	**48%**	**69%**	5%	**62%**	**75%**	**80%**	**85%**	**86%**	**90%**	**75%**
1	**31%**	**33%**	**23%**	**37%**	**29%**	**19%**	**17%**	**12%**	**11%**	**9%**	**19%**
2	**23%**	**13%**	**5%**	**22%**	**6%**	4%	2%	2%	2%	1%	4%
3	11%	5%	2%	**32%**	2%	1%	0%	1%	1%	0%	2%
4	5%	2%	1%	5%	1%	1%	0%	0%	0%	0%	1%
5	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Over 5	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Number of retail very high bandwidth traditional interface operators by cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	99%	99%	99%	100%	100%	100%	1005	100%	100%	100%	100%
1	1%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Number of retail alternative interface operators by cluster											
Cluster/ Operator	City Core	City Centre	Town Centre	Business District	Suburbia	Industrial	Mixed	Average	Residential	Rural	All
0	6%	**10%**	**18%**	0%	**20%**	**58%**	**27%**	**57%**	**50%**	**78%**	**38%**
1	**36%**	**52%**	**50%**	**10%**	**52%**	**34%**	**49%**	**38%**	**39%**	**21%**	**41%**
2	**35%**	**28%**	**25%**	**61%**	**23%**	**6%**	**22%**	4%	**6%**	2%	**16%**
3	**13%**	8%	6%	**24%**	5%	2%	2%	1%	2%	0%	3%
4	7%	1%	1%	5%	1%	0%	1%	0%	0%	0%	1%
5	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Over 5	1%	0%	0%	0%	0%	0%	0%	0%	05	0%	0%
Base	237	848	1270	41	894	643	1649	1452	1105	1076	9217

Appendix B: List of banded variables used in Ofcom's cluster analysis

Total Number of Households

Category	Number of Households in category	% of postal sectors in category
0	0	1.9%
1	1 – 625	10%
2	626 -1335	10%
3	1336 – 1865	10%
4	1866 – 2310	10%
5	2311 – 2730	10%
6	2731 - 3165	10%
7	3166 – 3600	10%
8	3601 - 4135	10%
9	4136 – 4870	10%
10	Over 4871	8%

Organisations (PAF data)

Category	Number of organisations by post code in category	% of postal sectors in category
0	0	0.2%
1	1 - 30	9%
2	31 - 60	11%
3	61 – 85	11%
4	86 – 105	9%
5	106 – 130	11%
6	131 – 155	10%
7	156 – 185	9%
8	186 – 230	10%
9	231 – 305	10%
10	Over 306	10%

Missing: 235 postal sectors

Household Density (Households/postal sector area

Category	Household Density in category	% of postal sectors in category
0	0	1.9%
1	1 - 20	9%
2	21 - 50	10%
3	51-120	10%
4	121 - 300	10%
5	301 – 600	10%
6	601 – 950	10%
7	951 – 1350	11%
8	1351 – 1800	9%
9	1801 – 2555	10%
10	Over 2556	9%

Business (Total number of businesses)

Category	Number of businesses in category	% of postal sectors in category				
		All Business	High-spend	Medium-spend	Low-spend	Large-spend
0	0	1.7%	2.8%	3.6%	18.3%	50.1%
1	1-10	8.3%	22.4%	23.5%	76.2%	49.6%
2	11-20	10.5%	27.7%	24.1%	5.1%	0.3%
3	21-30	12.7%	19.1%	15.9%	0.4%	*
4	31-40	12.2%	11.2%	10.3%	0.1%	*
5	41-50	10.6%	6.7%	6.7%		
6	51-60	8.3%	3.7%	4.3%		
7	61-70	6.5%	2.4%	3.3%		
8	71-80	5.9%	1.3%	2.2%		
9	81-90	4.7%	0.9%	1.6%		
10	91-100	3.6%	0.7%	1.1%		
11	101 – 125	5.7%	1.0%	2.8%		
12	126 – 150	3.5%				
13	151 – 175	2.1%		0.6%		
14	176 – 200	1.5%	0.2%			
15	201 – 250	1.4%				
16	251 – 300	0.6%				
17	301 – 350	0.2%				
18	>350	0.1%				

Notes:

Low-spend companies are few in number due to exclusion of companies with 1 – 5 employees which represent approximately 89% of the UK enterprises (ONS .

* value above 0% but less than 0.5%.

Appendix C: How to Read A Regression Results Table

A8.50 An example of the results table is given below with an explanation of how to interpret it.

Dependent variable – functional form

	β	x_1	x_2	x_3	x_4	x_5
β		β_1	β_2	β_3	β_4	β_5
(s.e)	(0.0X)	(0.0X0)	0.000	(0.00X)	(0.000)	(0.000)
T-score	XX.X	XX.X	XX.X	XX.X	XX.X	XX.X
$R^2_{(adj)}$		XX.X%		DW		1.5

A8.51 As an example, this is a model with five dependent variables and a constant. The title of the model tells you what is being explained (capacity or number of operators) and the functional form explains how to interpret the results.

A8.52 In a linear model, α is the estimate of the number of operators in a postal sector about which nothing else is known. To estimate the number of operators present in a particular postal sector, multiple the value of x by the associated β for all the xs, add the results together and add to α. This will give the number of operators likely to be present in that postal sector.

A8.53 In a log linear model, α is the $\ln(y_o)$. To calculate the likely number of operators present in a postal sector about which there is no other information, take the exponential of α. If more is known about the postal sector, multiply the value for each x by the associated β and increase α by the resulting percentage.

A8.54 x_{1to4} are the explanatory demographic variables and their associated $\beta_{1to\,4}$ are given in the row below. β is either the change in the number of operators or the % change in e^{α}, depending on form.

A8.55 As β and α are estimated values, it is not possible to state them with total precision. If hypothetically, the exercise is rerun with a subset of the postal sectors then different values may result. However, in 95% of such reruns, the value of β and α will lie between α or β +/- 1.96 times the associated standard error.

A8.56 One of the most important figures in the table is the $R^2_{(adj).}$ This shows the amount of variation in number of operators or capacity between postal sectors which can be explained by the model. A good model should have at least 60%. However, a value of less than this does not invalidate the α and β values. These values quantify how much a change in the associated explanatory variables change the number of operators or capacity. Rather, it indicates that an important variable or variables are missing.

A8.57 The T-score provides a way of ranking the explanatory demographic variables, according to their importance in the model. T-scores are used to test whether we can be sure that the β score is significantly different from 0 and that the associated explanatory variable truly affects the number of operators or capacity. The higher the t-score the more reassurance there is that this is a true effect. Only significant variables will be included in the model and then only as long as they contribute to the explanatory power of the model.

Appendix D: Results of Regression Analysis

A8.58 The following linear regressions have been subject to testing to ensure i) goodness of fit ii) model robustness and iii) correct functional specification. The tests used have tested:

- For bias;
- For colinearity between variables;
- To ensure best fit of the models ; and
- To ensure "best model".

A8.59 It is recognised that there may be models which offer a better fit but such models are more complex and do not offer enough increased explanatory power to offset the increase in complexity and the resulting difficulty in interpreting the relationship between the variables.

Table 1: Linear model - Number Of Operators

	α	Number 200+ employees	Revenue 50-99 employees	Number Mobile Masts	Revenue 20-49 employees	Household Density	Revenue 11-19 employees	Number Houses	Revenue 100-199 employees	PS Area
β	1.422	0.242	1.22E-005	0.07	1.48E-005	1.36E-004	9.49E-006	-7.0E-005	2.47E-006	-0.002
(s.e)	(0.032)	(0.010)	0.000	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
T-score	44.77	24.79	24.31	16.67	15.35	12.22	11.51	-7.68	7.61	-7.42
$R^2_{(adj)}$	55.5%						DW	1.69		

Table 2: Log-linear model - Number Of Operators providing retail low bandwidth traditional interface leased lines

	α	Number 200+ Employees	Revenue 50-99 Employees	All Business	Number Mobile Masts	Household Density	Revenue 100-199 Employees	Revenue 20-49 employees	PS Area
β	0.355	0.063	2.59E-006	0.003	0.017	3.29E-005	6.63E-007	2.12E-006	-3.15E-005
(s.e)	(0.010)	(0.04)	(0.000)	(0.000)	(0.002)	(0.000)	(0.0000	(0.000)	(0.0000
T-score	36.70	17.29	13.77	13.64	10.76	8.19	5.67	5.138	-4.06
$R^2_{(adj)}$	43.2%						DW	1.74	

Table 3: Log-linear model - Number of ends of retail low bandwidth traditional interface leased lines

	α	Number Operators	Number Mobile Masts	Number Houses	Number High-spend Business	Number Med-spend Business
β	2.255	0.360	0.061	1.21E-004	0.008	0.006
(s.e)	(0.023)	(0.006)	(0.002)	(0.000)	(0.001)	(0.000)
T-score	97.33	61.03	24.94	20.67	15.73	14.37
$R^2_{(adj)}$	62.2%			DW	1.57	

Table 4: Log-linear model - Number of ends of retail high bandwidth traditional interface leased lines

	α	Number Operators	Number High-spend Business	Revenue 6-10 Employees	Revenue 11-19 Employees	Revenue 500+ Employees	Number Med-spend Business	Revenue 100-199 Employees	Number Mobile Masts	Revenue 200-499 Employees	Revenue 50-99 Employees	Area (PS)
β	3.192	0.194	-0.012	6.86E-005	5.13E-006	3.44E-007	-0.004	1.01E-006	0.015	3.24E-007	1.25E-006	-0.001
(s.e)	(0.048)	(0.010)	(0.002)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.005)	(0.000)	(0.000)	(0.001)
T-score	67.11	18.65	-7.26	6.84	6.60	6.43	-6.42	4.27	3.21	2.55	2.51	-2.07
$R^2_{(adj)}$	29.2%						DW	1.66				

NB: Although all these variables are significant at 95%, the last three in this model are not significant at 99%.

Table 5: Log-linear model - Number of ends of retail alternative interface leased lines

	α	Number Operators	Household Density	Number High-spend Business	Revenue 500+ Employees	Area (PS)	All Business	Number Med-spend Business	Revenue 200-499 Employees	Revenue 6-10 Employees	Revenue 50-99 Employees
β	3.44	0.185	1.03E-004	0.026	3.26E-007	-0.003	-0.018	0.016	6.12-007	-3.8E-005	1.1E-006
(s.e)	(0.032)	(0.008)	(0.000)	(0.003)	(0.000)	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)
T-score	109.24	22.41	10.80	9.02	6.69	-6.64	-6.45	5.42	5.40	-4.53	3.08
$R^2_{(adj)}$	30.0%						DW	1.50			

NB: Some of the value for β take the form 1.5E-00X. This is known as engineering notation and is used to present very small data. 1.5E-007 is equivalent to 0.00000015. The conversion can be done by placing one zero less than the end figure in the 00X (in this case 6) after the decimal point but before the 1.5.

Annex 9

Glossary

Alternative interface symmetric broadband origination (AISBO)

A form of symmetric broadband origination service providing symmetric capacity between two sites, generally using an Ethernet IEEE 802.3 interface.

Bandwidth

The physical characteristic of a telecommunications system that indicates the speed at which information can be transferred. In analogue systems, it is measured in cycles per second (Hertz) and in digital systems in bits per second (Bit/s).

kbit/s

kilobits per second. A measure of speed of transfer of digital information.

Leased line

A permanently connected communications link between two premises dedicated to the customers' exclusive use.

Mbit/s

Megabits per second. A measure of speed of transfer of digital information.

Partial Private Circuit (PPC)

A generic term used to describe a category of private circuits that terminate at a point of connection between two communications providers' networks. It is therefore the provision of transparent transmission capacity between a customer's premises and a point of connection between the two communications providers' networks. It may also be termed a part leased line.

Plesiochronous Digital Hierarchy (PDH)

An older method of digital transmission used before SDH which requires each stream to be multiplexed or demultiplexed at each network layer and does not allow for the addition or removal of individual streams from larger assemblies.

Point of Connection (POC)

A point where one communications provider interconnects with another communications provider for the purposes of connecting their networks to 3rd party customers in order to provide services to those end customers.

Point of Presence (PoP)

A geographic location from which a communications offer a service to end users.

SSNIP

Small but Significant Non-transitory Increase in Price, usually considered to be 5 to 10 per cent, which is part of the hypothetical monopolist test used in market definition analysis.

Synchronous Digital Hierarchy (SDH)

A method of digital transmission where transmission streams are packed in such a way to allow simple multiplexing and demultiplexing and the addition or removal of individual streams from larger assemblies.

Symmetric broadband origination (SBO)

A symmetric broadband origination service provides symmetric capacity from a customer's premises to an appropriate point of aggregation, generally referred to as a node, in the network hierarchy. In this context, a "customer" refers to any public electronic communications network provider or end user.

Symmetric Digital Subscriber Line (SDSL)

A technology that allows the use of a copper line to send an equal quantity of data (e.g. a television picture) in both directions.

Tier 1

A tier in BT's SDH network that denotes a network of nodes covering areas of high population. These nodes are connected by very high capacity line systems and denote the BT trunk network.

Traditional interface symmetric broadband origination (TISBO)

A form of symmetric broadband origination service providing symmetric capacity from a customer's premises to an appropriate point of aggregation in the network hierarchy, using a CCITT G703 interface.