Business Connectivity Market Review – Annexes 14 to 25

Review of competition in the provision of leased lines

Redacted for publication ✂

Draft Statement

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Contents

Annex 14

TI Trunk

Introduction

A14.1 As set out in section 5, we have decided that no operator has SMP in the provision of wholesale national TI trunk segments at all bandwidths in the UK. We have also decided that segments identified as regional trunk should be included in the market for low bandwidth TISBO services.

A14.2 This annex explains in more detail our conclusions on the location of trunk nodes that we use to set the boundary between TI trunk and terminating segments. We explain the basis for our conclusion that we should define this boundary on the same basis as identified in the March 2013 BCMR Statement. Declining volumes in the TI market mean there has been no material investment in interconnection by OCPs, and instead many OCPs have rationalised their own networks by reducing the number of points at which they interconnect with BT since the March 2013 BCMR Statement. As a result, we consider the market for TI trunk will not have changed materially since the last review in a way that would justify a change to the method we use to set the boundary between TI trunk and terminating segments.

A14.3 This annex also explains the basis for our decision to include, in the TI terminating segments market, segments defined as regional trunk in the March 2013 BCMR Statement. We explain that competitive conditions in the provision of circuits previously classified as regional trunk circuits and in the provision of terminating segments are sufficiently similar for both to be included in the TI terminating segments (TISBO) market. This is because both circuit types are relatively short-distance circuits enabling a CP to serve an end-user's premises by connecting it to the nearest BT node at which it has a point of handover. In addition, estimates of BT's service shares are consistent with competitive conditions for regional trunk segments being similar to those for terminating segments. As discussed in Section 5, we find BT to have SMP in the low bandwidth TISBO market including regional trunk segments.

A14.4 The structure of this annex is as follows: first, we describe trunk segments and some of the concepts used to define them in previous reviews; second, we summarise the proposals we made in the May 2015 BCMR Consultation and stakeholders' responses; and finally, we respond to stakeholders' responses to the consultation and set out our final conclusions.

Background on previous definitions

Trunk segments

A14.5 National trunk segments are the links between major centres of demand such as towns and cities. These links can support sufficient volumes of aggregated traffic to allow a number of OCPs to generate the economies of scale necessary for them to build competing trunk networks. In some circumstances, particularly over longer distances, these competing trunk networks can be used to supply leased lines. This means that a CP providing a retail TI service may still rely on BT to provide local connections (terminating segments) but it will be less reliant on BT to provide trunk segments between urban centres.

A14.6 As set out in the Explanatory Note to the EC Recommendation, these national trunk segments are presumed competitive and in a market not susceptible to regulation:

> "…[a] clear distinction between the terminating and trunk segment is important as the market for wholesale trunk segments of leased lines has been removed from the list of markets susceptible to *ex ante* regulation in the 2007 Recommendation. Nowadays, almost all Member States have deregulated this wholesale market for trunk segments. Therefore the presumption that trunk segments are replicable on a national scale remains valid. Consequently, NRAs should not revisit their analysis of trunk segments of leased lines where these have been previously found to be effectively competitive. This assumption does not exclude, however, that individual NRAs might find that certain trunk routes fulfil the three criteria and thus warrant *ex ante* regulation."[1]

A14.7 Accordingly, we found national trunk to be competitive in our last review. However, identifying national trunk segments in the BCMR is still an important step to establish the extent of the TI terminating segments market.

A14.8 For the reasons explained below, we also identify certain trunk segments that we call regional trunk. In 2013, regional trunk was defined as a separate market in which BT had SMP. We are therefore required to review this market again in this review.

We used TANs to identify the boundary between trunk and terminating segments

A14.9 In both the 2008 and BCMR 2013, to identify the boundary between trunk and terminating segment markets we identified so-called Trunk Aggregation Nodes (TANs).

A14.10 We observed that in large urban centres (like London, for example) BT has multiple major nodes. Other scale CPs also have a core of trunk routes between major urban centres (but to a lesser extent than BT). These CPs often interconnect with BT at least at one major exchange (and sometimes more than one exchange) in each major urban centre.

A14.11 For TI markets, we used some of BT's major nodes (67 Tier 1 nodes)[2] as the basis for defining TANs. We grouped some (but not all) of the 67 Tier 1 nodes into TANs. We identified 46 TANs for the TI market in the 2008 BCMR. We based our identification of the relevant TANs on an assessment of aggregation opportunities for CPs other than BT. Our reasoning was that other CPs would be unlikely to aggregate their traffic back to points of interconnect at each and every Tier 1 node (or at an equivalent point on their own network). Grouping Tier 1 nodes in one region into a common TAN meant that a CP only needed to interconnect with BT at

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[1] Explanatory Note to the EC Recommendation, page 49.

[2] BT's SDH network is split into a hierarchy of Tier 1, Tier 2 and Tier 3 nodes. There are fewer Tier 1 nodes (67) relative to Tier 2 and Tier 3 nodes.

any one of those nodes to aggregate traffic from its end-users throughout the region by using regulated terminating segments from BT.

A14.12 Taking as the starting point BT's Tier 1 nodes, we identified TI TANs by looking at two main pieces of information for TI services:

- the extent of interconnection by CPs;[3] and

- the number of circuits potentially served by a particular node and its proximity to another Tier 1 node.

A14.13 For example, in the Birmingham area there were two Tier 1 nodes close to each other. Based on the volume of traffic served in the Birmingham area and the close proximity of those nodes we grouped these nodes into the "Birmingham TAN". This was based on the notion that a reasonably sized CP would choose to interconnect with at least one Tier 1 node, but not necessarily both.

A14.14 In London, we identified more than one TAN reflecting the greater volume of traffic in the capital. Hence, even if some Tier 1 nodes were relatively close to each other, it would be likely that a reasonably sized CP would interconnect in more than one location in the capital. A TAN therefore represents a group of one or more of BT's Tier 1 network nodes.

A14.15 We considered that these TANs continued to be an appropriate basis to identify trunk segments in the March 2013 BCMR Statement.[4]

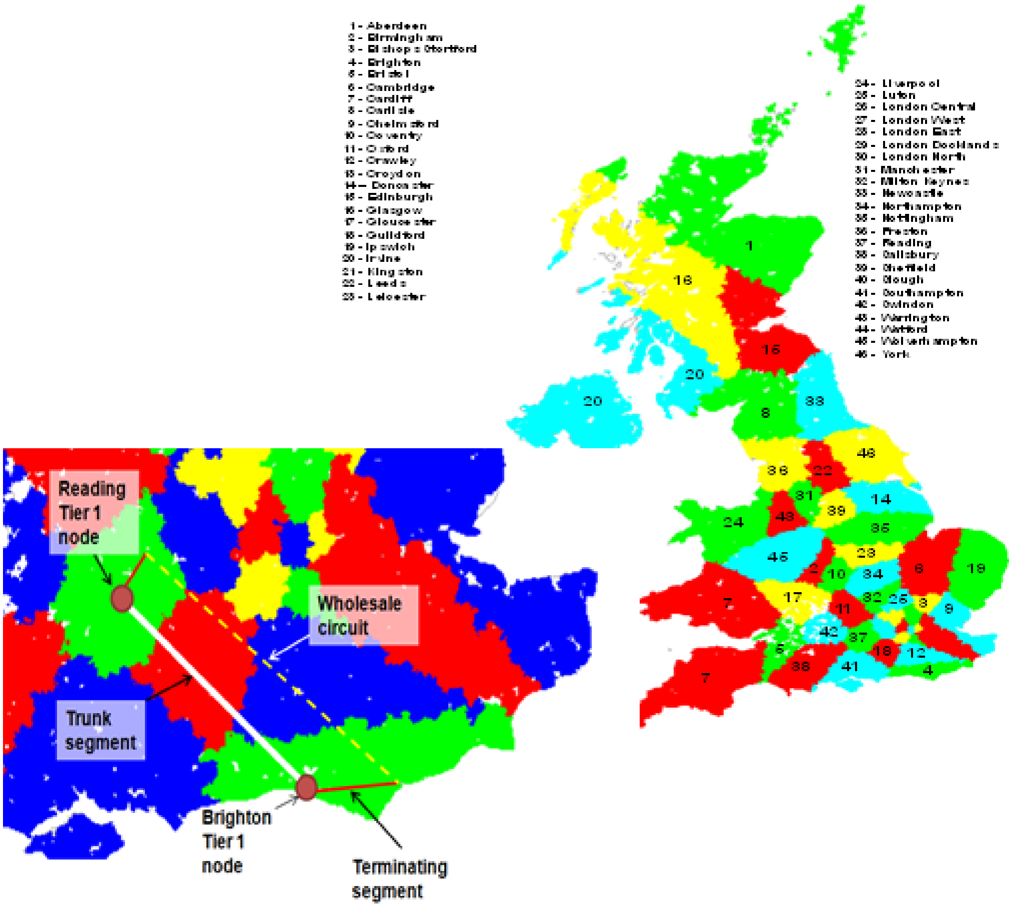
TI TANs had a 'catchment area'

A14.16 Although a TAN is a group of major network nodes, for each TI TAN we relied on the "catchment area" of each TAN to assess which circuits would require a trunk segment based on whether the circuit ends are in different catchments areas.

A14.17 Catchment areas were originally identified by BT for each of its Tier 1 nodes, so the TI TAN catchment areas represents all of the smaller exchanges and customer end-points that the major Tier 1 nodes are assumed to serve (as set out in Figure A14.1 below).

[3] Based on TI interconnection services known as point of handover links.
[4] 2013 BCMR Statement, Section 6.

Figure A14.1: Catchment areas and circuit routing assumptions



A14.18 In both the 2008 and BCMR 2013, we defined any circuit linking A and B-ends in different TAN catchment areas as containing a trunk segment. In our market definition for TI trunk, we also assumed that a circuit between catchment areas was routed via the Tier 1 nodes, even if actual routing on BT's network was different to this. For example, in the lower left of Figure A14.1 above, we show an OCP purchasing a wholesale circuit from BT between the Brighton catchment area (4) and the Reading catchment area (37). The wholesale circuit is represented by the yellow dotted line. As the circuit links different catchment areas, it would contain a trunk segment. For market definition purposes, the circuit is assumed to go via the Tier 1 nodes nearest to the circuit end points in each of the catchment areas.

Distinction between regional and national trunk

A14.19 We changed the TI trunk market definition in the BCMR 2013. This was because, in a number of cases, we found CPs were purchasing short distance circuits that were being classified as being in the TI trunk market because they happened to cross the boundary of adjacent TAN catchment areas (e.g. in Figure A14.1 an OCP might purchase a short distance link between the Brighton catchment area (4) and the Crawley catchment area (12)).

A14.20 A number of the circuits which OCPs purchased connected a customer end to a Point of Handover at a BT exchange nearby but in an adjacent TAN catchment area. Under the rules governing routing[5], such circuits were deemed to be routed via the Tier 1 nodes in the two TANs, thus notionally using a trunk segment. We were concerned that competitive conditions in the provision of these short distance circuits were more like those of a terminating segment. For these short distance circuits, BT tends to provide direct links from end-users' sites to CPs' network points of connection, including short distance links that happen to cross a TAN boundary.

A14.21 To avoid grouping circuits providing this local connectivity together with circuits that were more obviously trunk (i.e. competitive national routes such as London to Edinburgh, London to Manchester etc.) we segmented the trunk markets. We identified a market for 'regional trunk' routes between adjacent TANs and a market for 'national trunk' routes between non-adjacent TANs.

A14.22 We found BT to have SMP for the regional trunk and we deregulated the national trunk routes as we found national trunk to be competitive.

May 2015 BCMR Consultation

A14.23 In the May 2015 BCMR Consultation we explained why we proposed to identify the competitive national trunk routes on the same basis as the BCMR 2013. We also set out proposals to include regional trunk segments within the low bandwidth TISBO markets.

Market developments

A14.24 We explained that our assessment was set against the backdrop of significant declines in BT's sales of TI services (PPCs) since the 2013 BCMR Statement. We showed that further ongoing declines were forecast in relation to the TI trunk market. We further stated that the decline in the volume of PPCs was also reflected in BT's sales of interconnection services for TI services known as Points of Handover (PoH).

A14.25 We noted that significant declines in the volume of PPCs of different bandwidths are reflected in BT's forecasts of the different network components that make up a PPC including trunk segments (based on km of trunk sold) in Figure A14.2 below.

Figure A14.2: Forecast declines by TI network components

[✂]

Source: Ofcom May 2015 BCMR Consultation, based on BT forecasts.

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[5] For charging purposes, BT uses circuit routing rules to determine the proportions of the length of a circuit that are respectively trunk and terminating segments. These are logical routing rules that might be independent of the actual 'physical' routing of the circuit, which is a function of various network management issues such as available capacity etc. The proportion of a circuit that is trunk is based on the distance between Tier 1 nodes in different areas. BT uses these proportions to calculate the charges BT makes for wholesale TI circuits (PPCs) sold to third parties and to its own retail arm.

A14.26 The above figure suggested that BT's volumes of trunk reduced by nearly half over the period 2011/12 to 2013/14, and that this trend is expected to continue.

A14.27 We noted that the declining volumes in the TI market are also reflected in the services OCPs use to interconnect their own core networks with BT, known as Point of Handover (POH) services. We referred, for example, to BT's regulatory financial statements (RFS), where BT states that *"PoH has been impacted by customers rationalising their networks, i.e. reducing the number of sites and consequently points of handover, and instead increasing the bandwidth to remaining sites."* [6]

A14.28 We also presented data from BT's RFS on the significant decrease in volume of interconnection circuits (Table A14.1 below). We noted that the overall number of interconnections and sites is in decline (reflected in 3rd party POH volumes). At the same time, the volume of In Span Handover (ISH) interconnect services, which OCPs use to aggregate together multiple lower bandwidth TISBO circuits over a single higher capacity interconnect link, increased marginally from 497 to 526 between 2012 to 2013 and remained unchanged in 2014, reflecting the rationalisation of OCPs' networks.

Table A14.1: Point of Handover volumes

	Year			Units
	2012	2013	2014	
CSH connections	83	0	0	Connections
CSH rentals	376	369	363	Lines
ISH connections	1	0	0	Connections
ISH rentals	497	526	526	lines
3rd party POH rental 64 Kbit/s	12462	3865	3,096	local end
3rd party POH rental 2 Mbit/s non CLZ	49977	4889	4,175	local end
3rd party POH rental 2 Mbit/s CLZ + other	4909	678	611	local end
3rd party POH rental equipment	n/a	46152	33,798	local end
CSH connections	83	0	0	connections

Source: Ofcom 2015, based on BT RFS

[6] Page 106, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2013/CurrentCostFinancialStatements2013.pdf
Pages 72-74, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2014/Current_Cost_Financial_Statement_2014.pdf

A14.29 In addition to the significant decline in existing POH lines, we noted that there were only 84 new PoH connections in 2012 and none at all in 2013 and 2014.

A14.30 We considered that this evidence was consistent with BT's view in the RFS that OCPs were consolidating by *"reducing the number of sites"* and interconnect points with BT for TI trunk services.

A14.31 We noted that in response to our April 2014 BCMR Call for Inputs (CFI), BT had submitted two papers. One was an overall position paper on TI trunk and the second a critique by consultants SPC Network[7], whom BT had previously commissioned to review our analysis during the BCMR 2013. BT set out some objections to our analysis for the BCMR 2013, such as our service share calculations. It summarised its position with respect to TI trunk as follows:

> *"We have not developed yet further proposals for TI services regarding either the market boundaries or SMP designation given the life cycle of the products. However and without prejudice to our position, we believe regulation should be reduced should Ofcom wish to continue with its current approach into the next BCMR.*
>
> *In our view, a safeguard cap with no direct regulatory restrictions on competing below this price would enable fair competition but still allow for end-users to be protected from any danger of excessive pricing. The provision of TI services is in rapid decline with substitution to other networks where there is regulation already in place where BT is deemed by Ofcom to have market power."*

A14.32 We considered that BT's main concerns were about what it regards as the inappropriate application of our approach to TI trunk market definition to CI core conveyance. We discuss the definition of CI core in Annex 15.

A14.33 We noted that BT also submitted a new paper by SPC Networks which set out additional comments on Ofcom's 2013 BCMR Statement. We explained that we had not revisited SPC's arguments as the decline in TI volumes means they are now less relevant, as discussed further below.

We proposed not adding more TAN nodes

A14.34 We proposed to define national TI trunk based on the existing 46 TI TANs.[8]

A14.35 We proposed to use the same TI TAN areas as used in the 2013 BCMR Statement in light of the forecast ongoing decline in TI circuit volumes. We explained that, unlike CI core, CPs are not expanding the coverage of their TI trunk networks. We noted that declining volumes in the TI market have led to reductions in the extent of interconnection by CPs with BT for TI services.

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[7] "Report for BT group plc TI trunk - Market definition and assessment of market power: Response to Ofcom's BCMR Statement", SPC Network, 7 May 2014. http://stakeholders.ofcom.org.uk/binaries/telecoms/market-reviews/20140507_SPC_Network_BCMR_Statement_Response_TI_Trunk_May_2014.pdf

[8] This meant that any circuit between non-adjacent TAN areas would still be treated as including a trunk segment.

A14.36 We explained that the reason for these declines is that, as retail volumes decline in TI markets, it may become no longer cost effective for CPs to support extensive interconnection for TI services alone.[9] Indeed, we noted that certain operators have chosen to exit the TI market entirely and have sold their existing base of circuits to other CPs such as Vodafone. We noted BT's comments in the RFS referred to the decline in PoH services,[10] providing evidence of network rationalisation and the reduction in the number of sites and PoHs.

A14.37 We therefore considered that a change now to increase the number of TANs (and hence deregulate further) would be against the direction of travel within the market. We considered that, if anything, the evidence suggested that OCPs are actively reducing the number of interconnection points for TI services with no new PoH connections expected. We noted however that to the extent that at least some demand remains, the locations where demand for TI services is relatively more concentrated will not have changed. Hence, we considered there was merit in retaining our TAN definition, as it identifies at least one trunk node for most of the major urban centres in the UK.

Regional trunk circuits as part of the terminating segments market

A14.38 We proposed to include regional trunk circuits as part of the terminating segments market. We noted that in the 2013 BCMR Statement, our analysis suggested that regional trunk circuits faced similar competitive conditions to terminating segments. We observed that many circuits which included a regional trunk segment were relatively short distance circuits linking customer end-points to OCPs' interconnect points at a nearby BT exchange. In this context, the designation of circuits between adjacent TANs as including a trunk segment was often notional, and a product of where particular 'catchment area' boundaries were drawn. However, and in contrast to shorter distance circuits, it was clear that circuits between non-adjacent TANs in major urban centres would be more likely to be routed across OCPs' own competing trunk networks.

A14.39 In light of the fact that the competitive conditions for these shorter distance regional circuits and terminating segments are similar, we proposed, in the May 2015 BCMR Consultation, to include regional circuits within the terminating segments market, which is consistent with the approach of other European NRAs that have included only the most competitive routes within the core markets.[11]

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[9] We noted that interconnection typically involves renting space in a BT exchange and/or purchasing high capacity interconnection links from BT. Such on-going costs are only justified where there is sufficient traffic going over those links.

[10] In its RFS, BT stated that: *"PoH has been impacted by customers rationalising their networks, i.e. reducing the number of sites and consequently points of handover, and instead increasing the bandwidth to remaining sites."* Page 106, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2013/CurrentCostFinancialStatements2013.pdf

[11] We noted that a similar approach has been adopted by some European NRAs, for example in its last review of leased lines the Irish NRA, ComReg, explained: "It is clear that there are large parts of the core network where investment in alternative infrastructure has not occurred and where competitive products and services are unavailable. Where these (i.e. uncompetitive)

A14.40 We referred to the 2013 BCMR Statement, in which we had observed similar competitive conditions in both regional trunk and terminating segments reflecting the nature of these services and our overall SMP analysis. In particular, the factors underlying SMP in the provision of terminating segments would also apply to similar 'regional trunk' circuits (i.e. segments that happen to cross a TAN boundary). This is because the evidence shows that nationally OCPs are only able to supply a very small proportion of the local end infrastructure for TI low bandwidths on their own networks. This is the case even in geographic locations such as London where there is significant rival infrastructure. BT retains a very high share of the terminating segments markets in those locations.

A14.41 In the May 2015 BCMR Consultation, we considered that given there are similar competitive fundamentals between terminating and regional trunk segments, there is limited benefit (for market definition purposes) in considering them separately.

A14.42 We considered however that there is a clearer difference between 'terminating segments and regional trunk' (where we had found SMP) and national trunk (where we previously found no SMP). On this basis, we proposed to adopt a simplified approach whereby circuits between an end-user's site and a CP's PoH that cross an adjacent TAN boundary (previously regional trunk) would fall within the terminating segments market. We therefore no longer proposed to define a regional trunk market. We noted that the inclusion of regional trunk within the terminating segments markets would not change our SMP findings.

A14.43 We explained that the inclusion of regional trunk and terminating segments in the same product market did not remove regulatory obligations on BT. In particular, BT would still have obligations to provide non-discriminatory access and equivalence of outcomes.

A14.44 We asked stakeholders the following question:

Question 5.4: Do you agree with our approach to, and proposed product and geographic market definition for, wholesale TI trunk, including our proposal to treat 'regional trunk' segments as part of the TISBO market? If not, what alternative would you propose and why?

Stakeholders' responses

A14.45 There were few comments on our proposals. Vodafone agreed that the regional trunk segments will have competitive conditions that are the same as terminating segments. It considered that there would not be competitive harm from a single product market for both service elements. [✂] also concurred with our market definition / SMP findings but did not elaborate.

A14.46 BT disagreed with our proposal to include regional trunk in the terminating segments market. It argued that this continues an approach to market definition and

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supply conditions exist, [....] the services provided are regarded as being in the terminating segment market."

SMP analysis for TI trunk that BT has previously pointed out as flawed and not consistent with the EC Recommendation or with the approach of other NRAs.

A14.47 BT submitted that the regulation of trunk markets – first based around Tier 1 nodes and then on TANs – has been consistently misapplied since the first PPC Direction in the early 2000s. BT did not see any reason to treat TI trunk services differently to CI core, in which we had proposed to de-regulate based on OCPs' presence at exchanges. It thought it was important to apply a similar approach on the grounds of technology neutrality and consistency. BT did not agree with re-classifying regional trunk as a terminating segment without proper economic analysis addressing the issues raised in its economic papers.

A14.48 BT raised a number of key concerns:

- *CP interconnection is much more extensive:* BT highlighted SPC Network's analysis which showed a large number of BT nodes with OCPs' networks within reach. BT argued that Ofcom has put to one side these economic and empirical arguments, and had provided no evidence of BT holding SMP in regional trunk in 2016.

- *Boundaries of TANs are arbitrary and result in anomalies:* BT noted our argument that competitive conditions on short routes that happen to cross the boundary of a TAN would be similar to a terminating segment. However, BT argued that 'nearest neighbour connectivity' is entirely a function of where the boundary of 'catchment areas' had been drawn, which were arbitrary and ad-hoc in nature. Coverage in TANs varies enormously from small TANs to large TANs, which then generates a number of anomalies i.e. a circuit from Liverpool to Plymouth would be regional trunk; whereas Chelmsford to London would be national trunk.

- *Evidence on decline in number of points of handover is not evidence of fewer interconnection points by CPs:* BT also noted that Ofcom used the consolidation in the market as a reason why trunk would not be more competitive. BT argued however that the consolidation that has occurred is due to Vodafone acquiring rival networks. BT claimed that Vodafone has freely admitted it can compete effectively with BT outside of regulated TANs. BT further argued that the reduction in volumes of PoH merely reflects a reduction in the number of individual PPC interconnections purchased, not reductions in the number of interconnect locations. BT argued that there is limited need for CPs to reduce the numbers of interconnect locations, CPs do not have to buy space in BT exchanges, the cost of PoH equipment is sunk (paid for at the time when the first connection is made), and there are only small ongoing maintenance charges associated with PoH equipment.

- *Examples of trunk assessment by NRAs:* BT noted that Ofcom had referred to Comreg's approach which, like Ofcom's proposal, was to identify competitive and uncompetitive trunk and to include the latter in the terminating segments market. BT submitted however that Comreg's approach to identifying competitive and uncompetitive routes was based on the presence of other CPs' infrastructure at exchanges and was not dissimilar to the approach proposed by SPC Network.

Ofcom's conclusions

A14.49 As we have previously found BT to have SMP in the regional trunk market, we are required – in line with the EC Framework – to consider these services in this review. In relation to national trunk, although we have previously found this to be competitive, we review these segments to set a boundary for TI market(s). The identification of TI national trunk segments is intended to delineate TI terminating segments, with TI national trunk being competitive and therefore outside of the market.

A14.50 We explain below that competitive conditions in regional trunk and terminating segments are similar. Hence, given the purpose of our TI trunk definition, we include regional trunk in a single market with TI terminating segments. We also explain why we do not consider it is appropriate to expand the national trunk market.

Competitive conditions in regional trunk and terminating segments are very similar

A14.51 The concept of regional trunk segments arose from the TAN approach, discussed in the March 2013 BCMR Statement (Section 6, pp 355 to 449), and as explained in paragraphs A14.19 to A14.22 above. The TAN concept was primarily a way of capturing the scope for OCPs to compete for longer distance leased lines between major centres such as London and Birmingham. In other words, it was a way of identifying national trunk.[12] The TANs were intended to represent the key demand concentrations where we expected OCPs to locate core nodes. We noted that, within each TAN, a number of CPs had interconnection points with BT at most Tier 1 nodes.[13]

A14.52 Under the PPC routing rules, *any* circuit which crosses a TAN boundary is deemed to include a trunk segment (between Tier 1 nodes), but such use of a trunk segment between two Tier 1 nodes in adjacent catchment (TAN) areas is in a sense "notional".[14] This notional routing can be very different to the actual routing, which might be much more direct.[15] The main purpose of the notional routing is to enable the charges for BT's wholesale circuits to be calculated in a competitively neutral way which prevents discrimination between circuits sold to BT's competitors and those used by BT itself to provide retail leased lines.

A14.53 However, as stated above, we think that it is necessary to distinguish between national trunk circuits (between non–adjacent catchment areas) and regional trunk circuits (which cross a single boundary between adjacent areas), because competitive conditions between these national and regional trunk circuits are very different. "National trunk" circuits are "*the high volume routes where the potential for competition was likely to be relatively high."* By contrast, the scope for competition in "regional trunk" circuits is much more limited because "*they are relatively short-*

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[12] See for example, para 6.64.of the 2013 BCMR Statement.
[13] In the 2013 BCMR Statement, we examined the "presence" of two or more CPs in BT exchange locations based on information on purchases of Point of Handover interconnection products. We noted significant OCP 'presence' at Tier 1 node locations (based on proximity of 2 or more CPs to 49 of the 67 Tier 1 node locations). There were, nevertheless, additional exchanges at lower Tiers in BT's network with some operator presence (Tier 1.5, Tier 2 and Tier 3). Although we noted in a number of cases these additional nodes were in proximity to existing TANs. In any case, other evidence did not suggest we should rely on operator presence alone.
[14] 2013 BCMR Statement, para 6.35.
[15] BT itself also argued (2013 BCMR Statement para 6.165) that "circuits are rarely actually routed via a Tier 1 node".

distance circuits enabling a CP to serve an end-user's premises by connecting it to the nearest BT node at which it had a point of handover" and so "*many of these circuits shared the characteristics of terminating segments.*"[16]

A14.54 To illustrate the point further, it is useful to consider how competition to provide terminating segments would operate in the absence of TAN boundaries. Competitive conditions in markets for terminating segments are determined at the end-user's site, primarily by the number of operators with network in sufficiently close proximity to the site (which we capture in our network reach analysis). When TAN boundaries are superimposed, some of the connections to end-users' sites (those crossing a TAN boundary) may now appear (notionally) to require a trunk segment but, in reality, competitive conditions have not changed. Competition in the provision of these regional trunk circuits remains, as with those terminating segments, wholly within a TAN area, determined by competition at the end-user's site rather than by the number of networks able to provide aggregated conveyance capacity between core nodes.

A14.55 By contrast the aggregated connections between key urban centres are competitive (as reflected in our national trunk definition). Therefore, when we overlay TAN boundary rules and apply them to long distance circuits between major urban areas, these are likely to be routed via relevant trunk nodes and are likely to be competitive. In this way we can identify national trunk segments.

A14.56 Overall, we consider that in most cases there is likely to be little practical difference in competitive conditions between regional trunk and terminating segments. This is because a number of CPs are purchasing network segments between their customer sites and their PoPs that happen to cross the boundary of the TAN catchment areas. In this context, these segments are not fulfilling the role of national trunk. These types of circuits are likely to be directly routed, like a terminating segment.

A14.57 By contrast, 'national' trunk segments are likely to be routed via trunk nodes in major urban areas where OCPs have their own competing network.

Available empirical evidence does not suggest differences in competitive conditions between regional trunk and terminating segments

A14.58 As already explained, we think that competitive conditions in regional trunk segments, when supplied as part of a partial private circuit, are sufficiently similar to terminating segments in relation to competitive conditions to include them in the same market. This is not only for the reasons set out in paragraphs A14.51 to A14.57 above, but is supported by wider empirical evidence.

A14.59 We have calculated service shares with available data for different network segments. This is based on the following calculation steps:[17]

[16] We set out this reasoning in the 2013 BCMR Statement, paragraphs 6.70 - 6.71.
[17] Due to some necessary changes in the data we collected for this review, we have not been able to replicate fully the analysis we conducted in the 2013 BCMR Statement. The changes to the circuit information we gathered have been discussed extensively in our data consultation.

- We start with our cleaned dataset on each BT or OCP TI circuit (SDH/PDH only);
- Using postcodes for the A and B-ends, we then determine whether the circuit contains:
  - a terminating segment only (both postcode ends belong to the same TAN);
  - a terminating segment and regional trunk (postcode ends are in adjacent TANs)
  - a terminating segment and national trunk (postcode ends are in non-adjacent TANs)
- For circuits with missing postcode information, we allocate pro-rata across terminating, regional and national trunk where we have circuit end information.
- We then estimate BT's service shares for each segment (we do so under two scenarios: Scenario 1 where on-net and off-net circuits are included and Scenario 2 where only on-net circuits are included).[18]

A14.60 Our estimated service shares are shown in Table A14.2.

Table A14.2: High level estimates of BT service shares in different network segments

BT shares	Terminating only	Regional trunk segments	National trunk segments
Scenario 1: all circuits	86%	71%	42%
Scenario 2: on-net only	91%	80%	60%

Source: Ofcom 2016

A14.61 The above results show that there are significant differences between competitive conditions for national trunk and those for regional and terminating segments. BT's

http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-data-analysis/summary/BCMR_Data_Consultation.pdf
One of the main differences to the data available in the BCMR 2013 is that the current circuit information available does not allow us to distinguish between retail and wholesale sales. Therefore, it is difficult to compute the extent of self-supply associated with a retail circuit without understanding in detail underlying retail requirements and how that feeds into an operator's self-supply of purchase of TI services from BT or other operators.

[18] Note that the Scenario 2 estimates include only OCP circuits provided entirely on-net and exclude circuits which are provided partly on-net and partly off-net. They do not necessarily provide a "true" view of BT's share therefore.

share of national trunk is significantly lower in both scenarios than its shares of the other two segments, which are consistent with strong dominance, again in both scenarios.

A14.62 There are some caveats with the analysis, as a significant proportion (61%) of OCPs' data does not include location data for both circuit ends. Moreover, there are a number of complexities involved in computing trunk service shares.[19] However, the underlying pattern that emerges is consistent with previous service share calculations. For example, in the 2013 BCMR Statement, we noted:

"evidence on OCPs' purchasing behaviour…suggests that many OCPs:

- rely on BT to provide TI circuits that are either entirely within TAN catchment areas (TISBO) or between adjacent TANs; but
- have limited reliance on BT for national trunk."[20]

A14.63 In the 2013 BCMR Statement, we estimated BT's service shares to be 33% for national trunk and 88% for regional trunk (similar to BT's share of low bandwidth TISBO).[21]

A14.64 Therefore, our previous service share estimates and the available current evidence suggest that competitive conditions for regional trunk segments are similar to terminating segments.

BT's view that competitive trunk is wider than existing TANs

A14.65 BT has argued that our existing trunk definition still fails to capture far more significant competition for trunk beyond existing TAN locations. BT referred to Vodafone's response to the CFI in which, BT claims, Vodafone admitted it can compete effectively with BT outside of the deregulated national trunk market.

A14.66 BT noted that we had relied on operator presence to identify CI Core markets but applied a different approach for TI trunk. BT argued that we should adopt the same approach we used to assess CI core in the May 2015 BCMR Consultation. It argued we should define the boundary between terminating and (competitive) trunk segments on the basis of the presence of two or more CPs with interconnection (PoH) at a BT node. It submitted that other NRAs had adopted this approach.[22]

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[19] See for example Section 7, paragraphs 7.895 to 7.902 and Annex 5 paragraphs A5.183 to A5.224 of the 2013 BCMR Statement for a description of service share calculations.
[20] 2013 BCMR Statement, paragraph 6.147.
[21] 2013 BCMR Statement, paragraph 6.156.
[22] In the May 2015 BCMR Consultation, we noted the approach of other NRAs to competitive and non-competitive trunk segments. BT submitted that our approach was not consistent with other NRAs. It highlighted that Comreg's basis for identifying competitive trunk was based on the presence of rival infrastructure in major cities. However, we referred to the decision of Comreg in the BCMR simply to illustrate the point that it was reasonable to include any 'uncompetitive' trunk as part of the terminating segment market. Our proposal to include regional trunk in the terminating segments market is consistent with Comreg's approach.

A14.67 BT argued that the identification of trunk based on TANs is arbitrary and results in a number of anomalies.

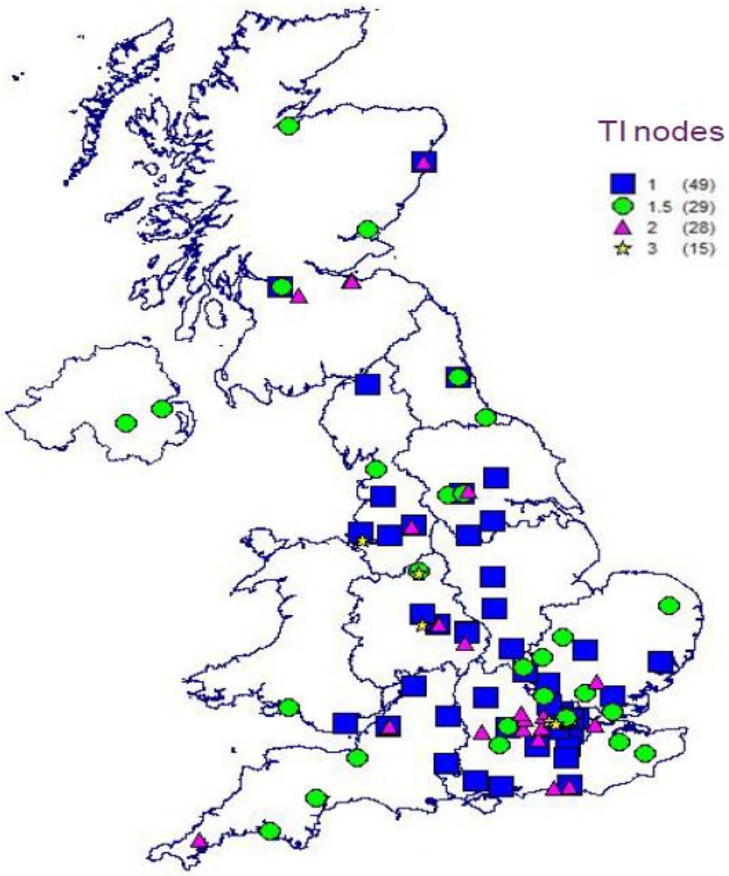
<u>More extensive competition beyond the existing TANs</u>

A14.68 For TI markets, we do not consider that wider evidence supports further de-regulation based on OCP presence alone. In the 2013 BCMR Statement, we examined in detail those BT exchange locations where CPs appeared to be present based on information on purchases of PoH interconnection products.

We conducted a detailed review of TANs in the March 2013 BCMR Statement

A14.69 Figure A14.3 (Figure 6.17 in the 2013 BCMR Statement) showed for example some of the other SDH nodes where OCPs had located.

Figure A14.3: OCP presence at different levels in the BT network



Source: Ofcom 2013 (based on BT data on OCP's Point of Handover purchases used in SPC's September 2012 report)

A14.70 Firstly, we found that a number of exchanges where OCPs were present were in the same location or very close to existing TANs. This made it unlikely that it would be appropriate to regard circuits between these locations as trunk segments. If two nodes are in close proximity, a CP may choose to locate only at one and not the other as either is sufficient for providing national trunk to more distant locations and there is insufficient traffic within the area to justify a PoH at both points.

A14.71 We also noted that there was significant OCP 'presence' at Tier 1 node locations (OCPs were located close to 49 of the 67 Tier 1 node locations). Although there were also some exchanges at lower Tiers in BT's network (Tier 1.5, Tier 2 and Tier 3)[23] with an apparent CP presence, we considered that it would not be appropriate to regard these as trunk nodes on this basis alone.[24]

A14.72 To investigate this further, we conducted various detailed analyses in the BCMR 2013. These showed that the set of nodes where two or more OCPs were present did not always coincide with the boundary of the effectively competitive trunk market.[25] In particular, we presented evidence that CPs relied on BT for a significant number of wholesale TI services (PPCs) beyond the smaller BT exchanges where there was OCP presence.

A14.73 We considered that CPs' purchases of POH services were an indicator of presence at a node, but did not show the strength of the potential competitive constraint. For example:

- not all POHs were enabled to support different technologies. For example, an OCP might have interconnected to support PDH circuits but not SDH;
- not all POHs were connected to CPs' national trunk networks;
- the fact that an OCP is purchasing a POH at a BT node did not mean that that OCP has sufficient spare capacity (or efficient POHs) that it could then use to compete with BT; and
- OCPs' networks were not as extensive as BT's, so OCPs were also less able to provide resilience (e.g. two diverse paths) from each exchange location where they were purchasing a POH.

A14.74 We were also concerned about the cost and practicality of interconnection for a CP relying on third parties for trunk segments. We observed that it was not necessarily the case that a healthy merchant market existed at all BT exchanges where there was a degree of operator presence. These points suggested that even those OCPs purchasing POH at a node might also be reliant on BT for additional circuits at that location in order to reach other parts of the UK (and not only for access circuits). In addition, even if OCPs purchasing a POH had sufficient "presence" to self-supply any circuits requiring trunk from that location, there was no guarantee that OCPs would sell circuits to their rivals.

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[23] Broadly speaking Tier 2 nodes sit on SDH-rings in regional large towns and Tier 3 on regional medium towns with a number of additional nodes below this level.
[24] See the 2013 BCMR Statement, paragraph 6.268. Indeed, we have re-examined the data and we do not find evidence of significant changes since 2013. In fact, we estimate that there has been a reduction in the number of PoH locations with competitor CPs.
[25] SPC, in a paper submitted by BT, argued that the presence of two OCPs within 500m of a BT exchange was an appropriate criterion for defining this boundary. SPC's proposals are discussed in paragraphs 6.224 – 6.234 of the 2013 BCMR Statement.

A14.75 Indeed, BT's response to the CFI also seems to show that there is not always a good correlation between OCPs' presence and PPC purchases.[26] In the submission, SPC Network provided a case study of an OCP's PPC purchases and the BT exchanges where it was buying PoH. This particular OCP was purchasing PPCs that connected a number of end-user ends to a main POH near Heathrow Airport (red and blue lines). However, the OCP in question also had a number of other PoH locations (green dots).

Figure A14.4: SPC Network analysis

[✄]

A14.76 Figure A14.4 showed that in a number of cases the operator has purchased long distance PPCs from BT even though it potentially has local PoH interconnects at BT exchanges. In theory it would be more efficient to use these local PoHs to reduce the length of the PPCs purchased. SPC Networks submitted that the most likely explanation is that these circuits were routed to Heathrow as this was most efficient at the time the PPC was first purchased. Through time other PoHs may have been added, but the OCP in question did not re-route existing circuits to the new nearest PoH because the re-arrangement would have added to costs and caused disruption to the end-user.

A14.77 However, it also serves to show that OCPs will still rely on BT for a significant number of circuits beyond locations where they have a PoH. Further, as the market declines and TI customers may consider migration to CISBO or other services, it seems unlikely that OCPs will re-arrange their existing purchases of TI circuits from BT to the nearest PoH, particularly given the low value of TISBO circuits (which are now mainly of 2Mbit/s capacity). Hence we consider it would be inappropriate to rely solely on PoH interconnection as the basis for identifying a competitive TI trunk market.

Market developments point to low investment and consolidation in TI Trunk

A14.78 As discussed in paragraphs, A14.24 to 14.31 above, the market context discussed in the May 2015 BCMR Consultation shows significant ongoing decline of volumes in the TI market. This is reflected in the large reductions in the volume of PoH services CPs use to interconnect their own core networks with BT. This evidence is consistent with OCPs consolidating and reducing the number of interconnect points with BT for TI trunk services.

A14.79 BT has argued that there are alternative explanations (i.e. the reduction in PoHs is not necessarily driven by the reduced scale of rival trunk networks). BT explained that most PPCs have an accompanying PoH circuit, hence when a PPC is ceased so is its PoH circuit. BT argued that there has been a negligible reduction in the number of PoH locations.

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[26] "Report for BT group plc TI trunk - Market definition and assessment of market power: Response to Ofcom's BCMR Statement", SPC Network, 7 May 2014. http://stakeholders.ofcom.org.uk/binaries/telecoms/market-reviews/20140507_SPC_Network_BCMR_Statement_Response_TI_Trunk_May_2014.pdf

A14.80 We agree that not all of the decline in PoH volumes can be interpreted as OCPs reducing the number of interconnection points with BT. However, it is clear from the above data in Table A14.1 that the extent of PoH interconnect has not increased as there have been no new PoH connections. Indeed, in BT's RFS it observed that CPs were reducing and consolidating the number of sites. The 'direction of travel' arguments are consistent with industry consolidation of the number of interconnect points. Only Vodafone, which supports our proposals for the trunk market in its response to the May 2015 BCMR Consultation, appears to have retained the extent of its core network to support TI services. We consider that, given the further expected significant declines in the TI market, ongoing rationalisation will be inevitable. This does not support BT's view that the competitive TI trunk segment has expanded since the last review.

A14.81 BT made reference to comments made by Vodafone in its response to the CFI, but we do not consider they provide support for further de-regulation of TI trunk. Vodafone was in fact expressing concerns about BT's dominance in the provision of Ethernet and NGA services in the context of the case for a regulated dark fibre remedy, which it supported.

A14.82 Indeed, Vodafone highlighted that a key benefit of TI regulation was that it only required interconnection at a limited set of 69 nodes to achieve a parallel cost base to BT (see footnote 18 in Vodafone's response to the CFI). Vodafone contrasted this to the much greater extent of interconnection required to achieve cost parity in the provision of Ethernet, which it said had hampered competition. The 69 nodes Vodafone refers to here are BT's Tier 1 nodes, which are the points we have used to identify TANs. Hence, Vodafone's point seems supportive of PPC regulation to date and does not argue for more extensive de-regulation of trunk circuits. This view is consistent with Vodafone's support for our proposals for trunk in the May 2015 BCMR Consultation.

A14.83 In any case, even if Vodafone has interconnected at many more locations, we would want to see evidence of other significant operators present at BT exchanges to justify deregulation. Moreover, we would also require evidence that this presence has impacted on competition for TI trunk, which, as suggested above, is not apparent from the available evidence.

A14.84 We do not consider it appropriate to identify an expanded TI trunk based on OCPs' presence alone, for the reasons set out in 2013. There is no reason to consider that any developments since the last review will have materially changed competitive conditions in TI trunk such that OCPs' presence is now a more appropriate indicator of reliance on BT than we have previously found it to be. In particular, we do not consider OCPs will have invested in deeper interconnection or even in re-routing traffic through existing interconnects given declining volumes and low value in the TI market. Therefore, the reasons we previously identified as to why OCPs' presence is not a meaningful indicator of reliance on BT are likely to continue to apply. As a result, we consider the basis on which we previously identified the boundary for TI trunk is likely to remain the most appropriate means of distinguishing effectively competitive segments from segments where CPs remain reliant on BT, and retain this boundary accordingly.

Differences in the CI and TI markets merit different approaches

A14.85 We have adopted a different approach in the CI Core market reflecting the different market conditions in CI compared with TI. In particular, we have seen evidence of material investment in interconnection in the CI market, which means that it is appropriate to revisit the extent of the competitive core. In doing so, we need to define criteria for identifying potentially competitive exchanges outside of the existing CI core.

A14.86 As we discuss in Annex 15 on CI Core, our approach to identifying these potentially competitive exchanges relies on operator presence as a guide to competitive conditions, along with wider evidence where available. Before applying this criterion, we considered in detail whether OCP presence was a useful guide to identifying constraints on BT in the provision of CI Core services and concluded that it was. At the same time, it was also necessary to consider what minimum number of OCPs could be regarded as indicating the boundary of the CI core market.

A14.87 In the case of TI trunk, we have found in the past that proposals to rely on the presence of a minimum number of OCPs alone did not yield a sufficiently reliable indicator of competitive conditions to use to define the TI trunk market. Moreover, the direction of travel in the TI market does not suggest there is likely to have been a material expansion in the extent of the competitive trunk segment, so we consider there is no need to revisit the boundary previously defined in the way there is in CI Core.

We consider our TAN approach is a practical means to identify TI trunk segments

A14.88 BT argued that the identification of trunk based on TANs is arbitrary and results in a number of anomalies.

A14.89 As discussed above, it is necessary to distinguish between trunk segments (which are competitive) and terminating segments (which are not). We identified TANs as a practical means of doing this, given that there is not a clear and definitive boundary between the two segments, and given that it is not possible to identify in advance, and assess the competitive conditions for, every hypothetical circuit route that may be provided. Given this, it is inevitable that, however it is drawn, a boundary that is practical for regulatory purposes may give rise to some anomalies. Nevertheless, we consider the TAN rules we apply are proportionate and appropriate and in practice we do not consider that any anomalies are likely to be material.

A14.90 It is worth recalling that in first identifying TANs for our trunk market definition in the 2007/8 Review, we started with catchment areas based around BT's Tier 1 nodes. These catchment areas for Tier 1 nodes were an established feature of TI markets and familiar to CPs operating in TI markets.[27] Tier 1 nodes are found in each of the main urban centres and they map broadly onto where OCPs have interconnected as discussed above (see for example Figure A14.3). In this sense they provide a reasonable way to identify competitive national trunk services between major population centres.

[27] The precise boundaries of Tier 1 catchment areas were based on BT's parenting of locations in the UK to each of its 67 Tier 1 nodes. In this respect, the catchment areas were and remain established areas used for charging purposes to segment PPCs into trunk and terminating segments. It is important in this context to recall that the PPC charging mechanism was one of the main methods used to secure equivalence of outputs given that BT consumes (internally) end-to-end TI circuits whereas OCPs can only purchase one end (hence the term partial private circuit).

A14.91 BT argues that our definition of regional trunk based on adjacent TAN catchment areas fails a 'common sense' test on the grounds that circuits of similar lengths are treated differently (it cites Liverpool to Plymouth and Chelmsford to London as both regional trunk, but with very different circuit lengths). We think that it can be entirely appropriate to treat circuits of the same distance differently. For example, a low bandwidth circuit to a rural location may have never justified investment in trunk capacity. By contrast, a similar length competitive trunk between, say, central London and Reading would attract more competition.[28]

A14.92 BT also provides examples of anomalies in the TAN rules, such as circuits that span bodies of water (the Bristol Channel etc.) or very long distance circuits (Plymouth to Liverpool) that are treated as regional trunk.

A14.93 We recognise that in a limited number of cases some circuits that BT sells look, on the face of it, at odds with the rationale for the proposed market definition. For example, BT referred to a single PPC it sells between Plymouth and Liverpool. But the weight we attach to this issue depends on the materiality of the alleged anomalies. The analysis we undertook in the March 2013 BCMR Statement suggested that most circuits between adjacent TANs were in fact relatively short distance circuits as we might expect.[29]

A14.94 We could in principle conduct a fairly detailed exercise of re-drawing the boundaries of each catchment area to avoid potential anomalies (e.g. avoiding the parenting of a location to a node across a body of water, introducing distance based rules). However, this would add additional complexity to what is intended to be a practical way to determine the scope of the competitive trunk market. In many cases, if we were to draw the boundary marginally differently, we consider that the overall results of our analysis of competitive conditions would remain unchanged. Furthermore, any rule we adopted would still be unlikely to rule out all anomalies.

A14.95 Overall, we continue to consider our TAN approach is a practical means to identify TI trunk segments. We do not consider it appropriate or proportionate to attempt to conduct a circuit by circuit analysis of national trunk.

Ofcom's conclusions

A14.96 We continue to define a national TI trunk market including segments between (non-adjacent) TI TANs. The available evidence does not suggest competition has changed given network consolidation in the TI market.

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[28] BT advanced the same arguments, with the same examples, in the BCMR 2013 - see paragraphs 6.107 and 6.174 – 6.183 of the 2013 BCMR Statement.

[29] In the 2013 BCMR, we looked at the TI circuits that BT sells that have ends in each of the catchment areas for the Liverpool and Cardiff/Newport TANs to understand its example of anomalies better. In general, our analysis showed that many of the circuits sold are relatively short distance circuits that cross the boundary between one TAN and another and which would be correctly described as regional trunk (similar to a terminating segment). There were a few (anomalous) longer distance circuits, but the number of circuits that fell within this category was small. Indeed, we suggested that the lack of longer distance regional trunk in this example may have reflected the fact that CPs were able to self-supply some circuits but relied on BT for circuits where there was a significant regional trunk component.

A14.97 We include non-competitive ‘regional trunk’ circuits in the terminating segments market. Consequently, we do not distinguish between ‘regional’ and ‘local’ circuits as in the March 2013 BCMR Statement (‘regional trunk’ and ‘TISBO’ services). We consider that both segment types face similar competitive conditions.

A14.98 Hence, our finding that BT has SMP in the low bandwidth TISBO market (as discussed in Section 5) will include those segments previously defined as regional trunk.

Annex 15

CI core

Introduction

A15.1 Identifying core segments in the BCMR is an important step in establishing the extent of the CI terminating segments market, as these core segments are presumed to be competitive, and therefore to be outside the market. In Section 4, we summarised our decision on the boundary between terminating segments and core conveyance networks for CI services. In this annex we set out our analysis in more detail.

A15.2 Our decisions are as follows:

- Core conveyance between the 56 Trunk Aggregation Nodes (TANs) as defined in the March 2013 BCMR Statement remains outside the market for terminating segments.[30]

- We identify an additional 34 BT exchanges (listed at the end of this annex) as CI core nodes. We refer to these additional nodes as 'New Competitive Exchanges' (NCEs).

- Our identification of the NCEs is based primarily on an assessment of CP presence at BT exchanges, but we have considered other competitive indicators. We have also considered evidence about the ability of the main infrastructure providers to supply competitive core at these exchanges.

- We have considered in our analysis whether the NCEs should be grouped together into TANs.[31] We conclude that there is not a strong case for grouping the additional 34 NCEs, as there is likely to be sufficient competitive conveyance between the NCEs or between the NCEs and the 56 TANs. Such conveyance is therefore outside the market for terminating segments.

- We have also identified 63 data centres (DCs) (listed at the end of this Annex) that appear to be used as core network nodes by multiple CPs. We define these DCs as core nodes which means that connectivity between such DCs will not be subject to regulation.

- As with NCEs, links between DCs, between DCs and NCEs and between DCs and TANs are outside the market for terminating segments.

A15.3 Below we set out the analysis that underpins these conclusions, which is divided into three parts. First, we set out our background on how we have regulated core

[30] We identified TANs in past BCMRs. They represent groups of one or more of BT's main exchanges known as OHPs and are located in urban centres (see below for a further explanation).
[31] This affects regulation as BT would not be required to provide core conveyance between exchanges in different TANs, but would still be required to provide circuits between exchanges within the same TAN.

services in the past. We then discuss our analysis of BT exchanges followed by DCs. For the discussion of BT exchanges and DCs, we summarise our May 2015 BCMR Consultation proposals and stakeholders' responses and then explain our further analysis in light of further information we have gathered and in response to stakeholders' comments. At the end of this annex, we provide a complete list of the BT exchanges and DC locations that make up the CI core.

Background

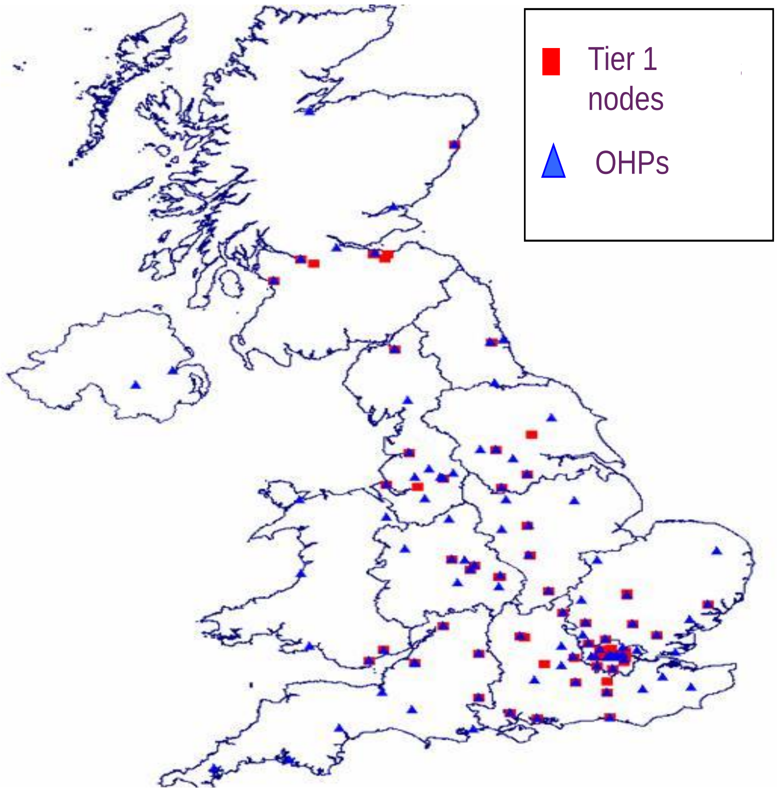
Market analysis for core conveyance in previous reviews

A15.4 Several infrastructure providers in the UK have high capacity core infrastructure allowing them to provide connectivity between major urban locations and network hubs. We refer to these high capacity connections as "core conveyance" or "trunk" services. BT has previously been found not to have market power in the provision of core conveyance. These core network links are distinguished from terminating segments, which are the links from customer sites to the core networks. In this part of the annex we provide a description of how we have previously drawn the boundary between core networks (which are likely to be competitive) and terminating segments (which are often not competitive).

A15.5 In previous reviews we defined the CI core market (at that time referred to as AI core) using an approach similar, but not identical, to that used for TI Trunk markets (as discussed in Annex 14). This reflected some differences in the development of AI and TI markets.

A15.6 For AI markets, BT's fibre access network was separated from its core through the identification of major nodes in its network called Openreach Handover Points (OHPs). The locations of these OHPs and of BT's main TI Trunk nodes (Tier 1 nodes) are illustrated below.

Figure A15.1: BT's main network node locations



Source: BCMR 2008

A15.7 There are 106 OHPs located around the UK typically in the main urban centres. We observed that large urban centres (like London) have multiple OHPs.[32] Circuits from these OHPs that go deeper into the network (i.e. to the end-users) are terminating segments (comprising access and backhaul segments). Openreach's various wholesale leased line access and backhaul products, which it provides to other CPs, including BT's downstream divisions, are classed as terminating segments.

A15.8 Recognising that other larger CPs also have a core of trunk routes between major urban centres (but to a lesser extent than BT) we identified and grouped some (but not all) of BT's 106 OHPs into Trunk Aggregation Nodes (TANs).

A15.9 The identification of the TANs was a feature of the 2008 and 2013 BCMR Statements and was based on an assessment of opportunities for CPs other than BT to aggregate traffic from customers using (at that time) AI services. The logic underlying the grouping of OHPs into TANs was that other CPs would be unlikely to aggregate their traffic back to points of interconnect at each and every one of BT's 106 OHPs (or their own equivalent network nodes).

A15.10 We designated 56 UK TANs mainly centred on UK cities. We concluded that, given the extent to which demand was concentrated at particular OHPs, BT's competitors could reasonably be expected to interconnect with BT in at least one exchange in

[32] We note that BT has another OHP in the Shetland Islands taking the total to 107 OHPs across the whole of the UK.

the 56 TANs, and would then only need to rely on BT for wholesale services in order to aggregate traffic from deeper in the network (i.e. from end-user sites) back to exchanges located in each of the 56 TANs.

A15.11 The definition of TANs enabled us to identify (for regulatory purposes) a non-CP-specific competitive 'core'. Circuits sold between OHPs that belonged to different TANs were classified as part of the competitive AI core. Other AI circuits, including those between OHPs within the same TAN, were classified as terminating segments.

A15.12 This was reflected in our regulatory remedies that required BT to provide AISBO terminating segments between any two points in the UK (excluding the Hull area and subject to any technical limits) but did not require BT to provide circuits between OHPs in different TANs (as these are deemed to be core segments). The regulation applied to AI services did not rely on the identification of TAN catchment areas, unlike the case for TI trunk segments.[33]

Assessment of BT exchanges

May 2015 BCMR Consultation proposals

<u>We reviewed whether the core had become more competitive</u>

A15.13 In our May 2015 BCMR Consultation, we referred to the latest EC Recommendation, which considers core or trunk segments to be competitive and not susceptible to *ex ante* regulation:

> "…[a] clear distinction between the terminating and trunk segment is important as the market for wholesale trunk segments of leased lines has been removed from the list of markets susceptible to *ex ante* regulation in the 2007 Recommendation. Nowadays, almost all Member States have deregulated this wholesale market for trunk segments. Therefore the presumption that trunk segments are replicable on a national scale remains valid. Consequently, NRAs should not revisit their analysis of trunk segments of leased lines."

A15.14 We considered that, in principle, the EC Recommendation suggests that NRAs should not revisit their analysis of core networks. However, we thought there were reasons to believe that the competitive core part of the network had expanded since the BCMR 2013. We referred to evidence, as set out in our market context section, on the emergence of DCs that are used by CPs as network hubs. These are points on CP networks where core network fibre and equipment is located and interconnection with other operators can (in principle) take place.

[33] The reason why TAN catchment areas are used to identify TI trunk services relates to the different regulatory approaches adopted for TI and AI markets. In particular, we regulate BT's wholesale TISBO services (PPCs) on the basis of 'equivalence of outcomes' (EOO) rather than the approach adopted for AISBO services - 'equivalent of inputs'. In order to achieve 'EOO', BT's TISBO services are subject to the 'PPC pricing' rule, which attempts to make the TI services which BT consumes internally as 'equivalent' as possible to the PPCs that external customers can purchase from BT. For a further discussion, see paragraphs 6.36 to 6.39 of the 2013 BCMR Statement.

A15.15 We also explained that BT had submitted evidence that CPs now generally interconnect at BT exchanges and points deeper (closer to the end-user) in its network than at the time of the BCMR 2013 AI core market definition. We therefore considered whether, given the specifics of the UK market, we should widen the scope of the competitive CI core market in light of market developments.

Key criteria in identifying candidate competitive exchanges

A15.16 In our May 2015 BCMR Consultation, we proposed that core conveyance between the 56 TANs (based on 85 OHPs) as listed in the March 2013 BCMR Statement remained competitive. We explained that as we did not find SMP in relation to core conveyance in 2013, we were not required to reassess this market. Moreover, we referred to the Explanatory Note to the EC Recommendation, which explicitly states that “NRAs should not revisit their analysis of trunk segments of leased lines”. We considered that this approach is consistent with our view that the competitive core is not likely to have contracted and may have expanded, and also maintains regulatory stability.

A15.17 However, we explained that we still needed to consider the extent of the CI core, to ensure that the markets for terminating segments are defined correctly. We therefore also considered whether additional exchanges should be included within the CI core.

CPs’ presence at BT exchanges

A15.18 We discussed BT’s proposal[34] that our analysis of core networks should take into account CPs’ presence at other lower tier BT exchanges, not only its OHPs. Specifically, BT proposed that we include in the competitive core network any exchange at which two or more CPs other than BT were present. BT asserted that this would be sufficient to ensure that core conveyance from such an exchange would be competitive.

A15.19 BT suggested that we could identify the number of operators present at an exchange by counting the number of CPs purchasing interconnect products from BT at that location. The logic is that if a CP is purchasing an interconnection product from BT at a particular exchange then it must be handing a BT terminating segment over to its own network (or that of a third party).

A15.20 For Ethernet services, BT provided data on two interconnect products:

- *External Cablelinks:* these are fibre connections that run from equipment at the exchange end of a terminating segment to a chamber outside of the BT exchange building;
- *Bulk Transport Link (BTL):* this service is used to handover multiple wavelengths on a single link.[35]

[34] BT response to Call for Inputs dated 15 July 2014.
[35] BTL is typically used where a CP purchases BT’s EBD, a backhaul product.

A15.21 Using BT's data on OCPs' interconnect purchases at BT exchanges, we found that there were 1,320 BT exchanges with at least one CP purchasing interconnection products and at 740 exchanges there were two or more CPs.

A15.22 In conducting this analysis, we found that 33 CPs purchase external Cablelinks. They included major infrastructure operators such as Vodafone and Virgin, but also a number of smaller operators such as Hyperoptic and seemingly location-specific ones such as Lancaster University.

A15.23 We identified two issues that arise from this analysis:

- *Interconnect purchases by non-infrastructure players:* some of the operators purchasing interconnect services do not have their own core infrastructure. These operators may not impose a competitive constraint on BT's core conveyance services from the location of the interconnection. For example, we know that [✂] is reliant on third party supply for a significant proportion of its network requirements. Therefore, the 'presence' of [✂] purchasing interconnection from BT at an exchange will very likely mean it will hand over traffic onto a third party provider's network. Given this, interpreting [✂] interconnect purchases as evidence of core competition would overstate the strength of the competitive constraint imposed by that operator.

- *Interconnect purchases by smaller operators:* some of the very small and/or localised operators (e.g. Lancaster University) are unlikely to compete to any significant extent in the provision of core conveyance services. Even if they have their own infrastructure, the scope for them to provide national core/trunk solutions is limited.

A15.24 In light of the above concerns we proposed to count purchases of interconnect products only by OCPs with significant on-net supply of core conveyance.[36]

Number of competitors needed to establish candidate competitive nodes

A15.25 We did not consider that on its own the presence of two OCPs would be sufficient to indicate effective competition.

A15.26 The number of competitors was an issue discussed in detail in the BCMR 2013 Statement (see paragraphs 6.250 to 6.262). In particular, we did not consider that the 'presence' of two or more OCPs was sufficient on its own to establish a competitive core. Indeed, consistent with the approach advocated in the BEREC guidelines on market definition[37], we noted that it is usually necessary to consider a wider set of criteria in order to identify separate markets.

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[36] Defined as: Vodafone, Virgin, Colt, Gamma, Interoute, KCOM, Level 3, Neos and Zayo. Interconnect purchases by the following companies were excluded: Carillion Construction, Convergence Group Solutions, Daisy, Edge Telecom, Eircom, Excell Business Systems, Exponential E, Hyperoptic, Intechnology, Internet Technology Products, Kenton Research, Lancaster University, Networking People Northwest, Novosco, One Connect, Orange, Service Direct Newco, Sky, TalkTalk, Thales, Updata, Venus Business Communications, Viatel and Zen.

[37] Updated BEREC Common Position dated 5 June 2014: http://berec.europa.eu/eng/document_register/subject_matter/berec/regulatory_best_practices/comm

A15.27 We considered that an OCP with presence at a BT exchange may not always translate into a strong enough competitive constraint on BT.[38] Limitations on the ability of an OCP to compete might include the costs of interconnection or capacity constraints. There are also potential issues related to the fact that OCPs do not have as extensive a network as BT. For instance, OCPs may be less able to provide resilience (e.g. two diverse paths) from each exchange location where they are 'present'. Further, 'presence' at an exchange does not guarantee that an OCP is able to provide core conveyance from that location across the UK. For example, during the BCMR 2013, CWW (now Vodafone) told us that some of its Points of Handover (POH) for TI services did not actually all sit on its core network.[39]

A15.28 For this reason, as part of the consultation process, we noted that we would ask CPs directly if they have any similar concerns over their ability to provide competing core networks in relation to the competitive exchanges we identified.

Additional checks of CPs' 'presence'

A15.29 We also noted the need to ensure that not only are at least two CPs 'present', but – further – that at least two of these CPs have their own infrastructure at the exchange. We proposed a second criterion, pending further information, which considered whether a CP actually has network within 200 metres of an exchange. We thought this would be stronger evidence that the CP is purchasing interconnection to its own network rather than to a third party CP's, and to ensure that a CP counted as present would be likely to have a material and sustainable impact on competition.

A15.30 We noted that it was not possible to consider BT's service share of core conveyance because CPs do not routinely collect the necessary data. However, we also noted that we would be seeking additional relevant evidence from CPs on their presence and ability to provide competitive core at each BT exchange as part of the consultation process.

A15.31 In light of the analysis on interconnect product purchases and the 200m criteria, we identified an initial list of 96 'candidate competitive exchanges' (CCEs). This provided our preliminary view of the refined trunk segment.

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on_approaches_positions/4439-berec-common-position-on-geographic-aspects-of-market-analysis-definition-and-remedies

[38] A more detailed discussion of the limitations of 'presence' as an indicator of competition in backhaul (in the context of TI services, though largely also relevant to AI services) can be found in 6.278 to 6.294 of the 2013 BCMR statement http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Sections6-7.pdf

[39] 6.283 of the 2013 BCMR statement http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Sections6-7.pdf

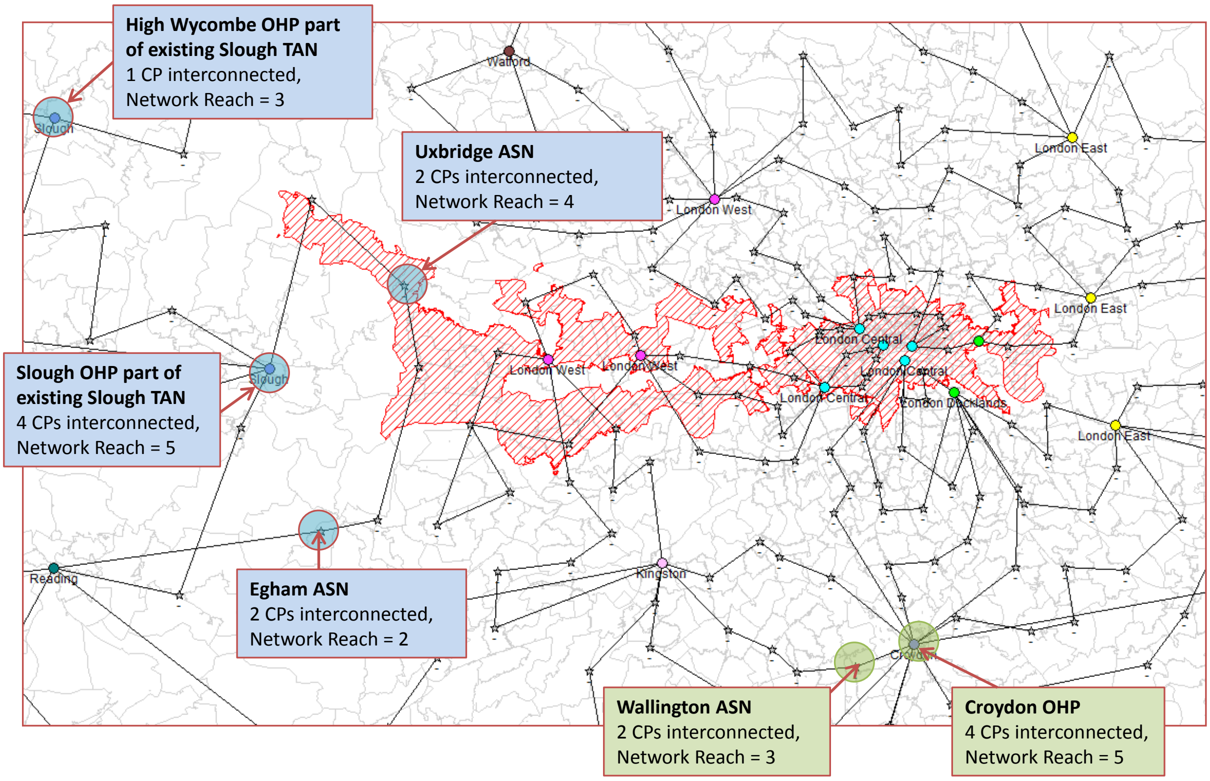
Mapping of additional candidate nodes to existing TAN locations

A15.32 A specific issue related to the identification of the proposed additional candidate competitive exchanges[40] was whether we should treat circuits between nodes in close proximity as core segments.

A15.33 We noted that the current TANs were formed by grouping together a number of BT OHPs which were in close proximity to each other (e.g. the Slough TAN was formed from the High Wycombe and Slough OHPs). This was because an OCP serving customers in a given area (for example, the Slough TAN area) might be expected to have one point of interconnection (POI) in that area but would not be likely to have a POI at other BT OHPs in the same TAN area (for example, an OCP would not be expected to interconnect at High Wycombe as well as at Slough).

A15.34 Indeed, Figure A15.2 below showed only one OCP interconnected in the High Wycombe OHP and four OCPs at the Slough OHP. The OCPs located at each of BT's OHPs were different (i.e. the OCP at the High Wycombe node [✂] is not the same as the other four OCPs at the Slough OHP).

Figure A15.2: Example of TAN groupings



Source: Ofcom May 2015 BCMR Consultation.

A15.35 We noted that BT was still required to provide OCPs with backhaul between OHPs in the same TAN (i.e. a circuit between the Slough and High Wycombe TAN would

[40] We noted that as the TAN grouping rule reflected CPs' specific needs for interconnection with BT at its exchanges we did not apply it to DCs. Instead we proposed to treat each DC as a new TAN.

be part of a terminating segment). So, for example, the CP in High Wycombe [✂] would be able to purchase from BT a circuit between the Slough OHP and the High Wycombe OHP on regulated terms. However, a circuit from High Wycombe or Slough to any other TAN (e.g. Reading) would be classified as a core segment.

A15.36 We considered whether each of the newly defined CCEs should be defined as a separate core node in its own right or whether we should group nodes in close proximity together, including with existing TANs. We proposed to group some of the CCEs in close proximity either together or with existing TANs.

A15.37 We considered that this approach was generally consistent with the original rationale for TANs. For example, we were concerned that the CCEs were 'lower tier' exchanges on BT's exchanges. We noted that there would be a general tendency for there to be fewer CPs and more limited aggregation opportunities at lower levels in the network. This may make it less likely that an OCP will have a POI there as well as at an OHP in the vicinity.

A15.38 We noted, for example, that at the Uxbridge and Egham exchanges the same two large operators [✂] – which we referred to as OCP 1 and 2 – are apparently 'present'. If each CCE were treated as a separate TAN then this would imply that there would no longer be a requirement for Openreach to provide a circuit between Egham and Slough where an OCP may have existing interconnection. For OCP1 and OCP2, we stated that this is potentially not a concern as they have interconnected in the Egham and Uxbridge exchanges and apparently have network in the locality.

A15.39 We considered that the concern may arise, however, for a third OCP3 that currently interconnects in the Slough OHP and can no longer obtain a circuit between Egham and Slough which it previously purchased from BT on regulated terms. We noted that over relatively short distances and with limited circuit volumes from Egham to Slough, it would be unlikely to be economic to rely on OCP1 or OCP2 to provide 'core' between these locations. There would be inefficiencies for OCP3 associated with:

- handover of an access circuit from Openreach in Egham to OCP 1's or OCP 2's core network;
- conveyance of the circuit from Egham to Slough on that rival core network; and
- handover of the circuit to OCP3's own core network in Slough.

A15.40 We noted that at the lower tier exchange (Egham), no OCP other than OCP1 and 2 purchases interconnect products to hand over circuits to a non-BT core network.[41]

A15.41 On the basis of the above reasoning, we considered that there was a case for grouping new exchanges into existing TANs, as over short distances and with

[41] We also referred to a similar situation for another potential TAN grouping, this time for the Wallington ASN and the existing Croydon TAN. Again, the same two large OCPs (OCP1 and OCP2) were present at the lower tier Wallington exchange but most interconnection that did occur by other CPs with BT was at the Croydon OHP.

relatively low volumes of circuits there would still be limited scope for smaller players to rely on rivals to BT, such as OCP1 and 2. This would reflect the general tendency for there to be fewer CPs and more limited aggregation opportunities at lower levels in the network.

A15.42 Following our detailed analysis we identified 18 TANs in addition to the existing 56, taking the total to 74 TANs (see paragraphs A20.87 to A20.95 of the BCMR May 2015 BCMR Consultation).

Summary of consultation proposals

A15.43 Based on the application of the above criteria, in addition to existing TAN exchanges, we proposed to identify 18 new TANs that consisted of 96 new Candidate Competitive Exchanges (CCEs). 17 of the 96 CCEs were in the London area (CLA or LP).

A15.44 We proposed that links both between the candidate TANs and with existing TANs would form part of the competitive CI core and would therefore fall outside the CISBO market. These links would not be regulated.

A15.45 We noted however that there were some limitations on the data available to us. In particular, in light of data limitations, we inferred CPs' presence in CI core markets on the basis of the proximity of their networks to BT exchanges at which they purchase interconnection products.

A15.46 We said that we would ask each CP to review the information we have compiled on their presence at BT exchanges (and DCs discussed in paragraphs A15.125 to A15.164 below). This was with a view to understanding their capability to self-supply core conveyance and/or provide core connectivity to third parties.

A15.47 We asked the following questions for consultation:

Question 4.5: Do you agree with our approach to product and geographic market definition for wholesale CI core conveyance services and do you agree with our proposed market definitions for wholesale CI core? If not what alternative would you propose and why?

Question 4.6: Do you consider that our list of candidate competitive exchange and data centre locations is correct?

Question 4.7: Are there any reasons you consider data centre connectivity or connectivity between additional candidate nodes would not be competitive?

Stakeholders' responses

A15.48 Most stakeholders agreed with our general approach to identifying candidate competitive exchanges, but some had reservations about the scope of BT exchanges we identified as competitive. Virgin and BT were broadly supportive of our approach but believed that a number of additional exchanges should be added to the competitive core. BT argued we should not group the additional CCEs into TANs – and should therefore not regulate these "intra-TAN" routes - as individual exchanges at each end of the "intra-TAN" route would meet the same threshold for deregulation as routes between exchanges in different TANs.

A15.49 Six Degrees agreed that analysis of use of Cablelink was a necessary and appropriate indicator of CPs' presence. It believed that we should verify that where alternative CPs have connected to an exchange that they are able to provide competitive backhaul services into that location. Six Degrees explained that its experience has been that CPs had provisioned interconnection at a number of exchanges solely for internal backhaul purposes and are not able to provide backhaul for other CPs. It suggested we should use a smaller list of "truly competitive" exchanges for this review.

A15.50 Vodafone considered that the competitive core could be smaller and the criterion for choosing competitive core sites should be based on where large major core providers are proven to be connected.

A15.51 [✂] agreed that there was a competitive national backhaul market, but said that, as the market was highly dynamic, we should think about how we might react to changes during the market review.

Analysis of BT exchanges

A15.52 BT argued that the method we used to identify CPs' presence at an exchange may understate the number of competitive nodes as:

- we had excluded Cablelink services bought by non-infrastructure owning CPs such as TalkTalk and Sky. BT noted that a CP such as Virgin that owns the infrastructure could be 'present' due to its supply of core/backhaul to TalkTalk and/or Sky, but Virgin does not need to buy a Cablelink product from Openreach.[42]

- alternative legacy interconnect services used by some operators could be used instead of Cablelink in some locations. It gave an example of 'In-building interconnect' purchased by Vodafone.

A15.53 BT also commented that the 200 metre rule Ofcom had applied to check if CPs' Cablelink purchases were likely to be associated with use of their own networks was not necessary. BT considered that we should instead check with OCPs their use of Cablelinks to confirm that they had core network at the exchange. BT also questioned the use of 200 metres rather than longer distance assumptions given the impact this would have on the number of exchanges included.

A15.54 Vodafone noted that we had not considered why CPs were not connecting at locations where they have network nearby. It considered that we should only designate as competitive actually connected sites, and should exclude those that are not connected but within 200 metres as, unless we knew why there was no connection, it should be presumed that such a connection was uneconomic. It also noted that expected price reductions under the LLCC would make it less likely that CPs would dig as far as 200 metres in future. Vodafone also submitted that we should assure ourselves that the locations to be deregulated actually have the

[42] BT referred to an example where a CP apparently had network and a footway box directly outside a BT exchange building but it was not buying Cablelink (Virgin at the Ashford Exchange).

capacity for the external Cablelinks (which a CP would need in order to interconnect) to be ordered.

TAN groupings

A15.55 BT disagreed with grouping CCEs together to create additional TANs. BT considered that there was no logical reason for circuits between exchanges in the same TAN to be regulated if they meet the same threshold for deregulation as circuits between different TANs. It was concerned that this leads to artificial incentives for investment in competitive infrastructure; and will distort the efficient design and evolution of BT and other existing competitive core infrastructure.

A15.56 BT submitted that major CPs were present at all 181 nodes identified and buy virtually no circuits from Openreach between them. BT noted that of the remaining CPs, only one currently buys [✂] ‘intra-TAN’ circuits and all the remaining CPs buy no more than [✂] circuits in total across the UK.

A15.57 BT’s view was that Ofcom was continuing to oblige BT to provide regulated and potentially subsidised services to smaller OCPs with less extensive footprints, but who operate in competition with larger OCPs who have invested. BT considered a more appropriate approach to create a level playing field would be to identify all the competitive exchanges without grouping them into TANs. BT considered that we could apply transitional measures to address any short term challenges arising from de-regulation.

A15.58 BT questioned the examples we had used (in the Slough area) to support TAN groupings. For instance at the Slough TAN, which under our grouping proposals would include four exchanges – Slough (OHP), High Wycombe (OHP), Egham (ASN) and Uxbridge (ASN) – our proposals would require BT to provide an intra-TAN link between High Wycombe and Egham of 25km. BT noted that a much shorter circuit[43] from Egham (that we proposed to be part of the Slough TAN) to Bracknell (an existing OHP in the Reading TAN) would be a de-regulated core connection.

A15.59 BT asserted that at least two CPs [✂] have presence at all four Slough TAN exchanges.[44] BT submitted that the reason Ofcom gave to justify the grouping all of the exchanges in the Slough area was that a third CP may need to connect a customer site in Egham to its own core network in Slough. BT did not consider this justified the regulation of connections between all four sites.

A15.60 BT also questioned our statement in the May 2015 BCMR Consultation that: “It is revealing that, at the lower tier exchange (Egham), no OCP other than OCP1 and 2 purchases interconnect products to handover circuits to a non-BT core network.” [45]

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[43] We estimate a ‘crow flies’ distance of approximately 14km.

[44] It noted that although only one CP is deemed present at High Wycombe, [✂ ✂].

[45] BT did not consider this statement was correct as the Cablelink purchase data shows that [✂] at Egham and therefore connect to a non-BT core network. The same situation is true of the second example Ofcom uses of Wallington, where again [✂] purchase Cablelink and therefore use an alternative to BT for their onward connectivity.

A15.61 BT argued that the proposed TAN groups were significantly more extensive than the original groups. For example, the majority of SDH Tier 1 groups were groups of nodes in major cities. Many of the groupings now cover multiple discrete areas (e.g. Ofcom's illustration of a TAN grouping to the West of London and the Leeds TAN). In relation to the latter, whereas previously Ofcom had grouped Leeds and Bradford together (14km apart) the new proposal added a further six exchanges to this TAN, all of which have both Virgin and Vodafone present, but where some are up to 40km apart.[46]

A15.62 BT also argued that there are differences in definitions with the Undertakings, which make interpretation of EOI very difficult, if not impossible. In BT's view, intra-TAN circuits should not be subject to EOI obligations.[47]

Ofcom's response to stakeholder comments and further analysis

We retain the existing 56 TANs as part of the CI Core

A15.63 We consider that core conveyance between the 56 TANs as defined in the March 2013 BCMR Statement remains competitive. This approach is consistent with our view that (i) the competitive core is not likely to have contracted and may have expanded, (ii) maintaining regulatory stability is important, and (iii) this is consistent with the EC Recommendation that "NRAs should not revisit their analysis of trunk segments of leased lines."

A15.64 The remainder of this sub-section therefore focuses on conclusions over expanded competitive CI core.

Competitive assessment of core conveyance between BT's exchanges

A15.65 As explained above, in the May 2015 BCMR Consultation, our identification of candidate competitive exchanges - based on the number of competitors present - was only a proxy for competitive conditions at a particular exchange given the data limitations (as discussed in A15.21-A15.23 above). We anticipated that we would need to undertake further analysis to confirm operators' presence at BT exchanges.

A15.66 Therefore, following publication of the May 2015 BCMR Consultation, we sent an information request to the Principal Core Operators (PCOs)[48], as well as to Sky and TalkTalk as major purchasers of backhaul from OCPs, to understand the purpose of interconnection at each BT exchange. In particular, we wanted to confirm that the CPs we had counted as present had their own core network at those locations and

[46] BT noted that one of the exchanges grouped within the new Leeds TAN is on the extreme edge of our distance limit of 15km. It claims this has the consequence that two of the eight sites are 40km apart; they both have the same two CPs present and there are multiple exchanges between these locations with multiple CPs present - but the link between them is still regulated.
[47] BT also stated that there were some detailed corrections needed to the BT Exchange nodes listed in the draft legal instrument schedules. We have considered BT's comments in our remedies assessment.
[48] Principal Core Operators (PCOs) are a subset of CPs that have substantial core infrastructure and the capacity to provide wholesale leased lines to other OCPs. These include Virgin, Vodafone, Interoute, KCom, Zayo, Verizon, Neos, Level 3 and Colt.

were not reliant on third party supply. As part of this process, we also asked CPs to identify any other BT exchanges where they had core network presence. We also invited CPs to comment as part of the consultation process about the extent of competition at the candidate core nodes we identified.[49]

Indirect interconnection purchases may provide additional constraints in some areas

A15.67 In the May 2015 BCMR Consultation, we proposed to exclude from our analysis Sky and TalkTalk's purchases of interconnect services. This was on the basis that these operators generally do not have national backhaul and core infrastructure of their own. However, our further analysis of Sky and TalkTalk's purchases reveals that they may purchase an interconnect product at a BT exchange and then use a third party PCOs' network, such as Virgin, for backhaul/core from that BT exchange.

A15.68 We recognise that there may be locations where we have not already counted a particular PCO as present, but where it is nevertheless supplying services to TalkTalk or Sky. In principle, the PCO selling services to TalkTalk or Sky could provide an additional constraint, as the PCO's sales suggest some capability to provide a rival wholesale backhaul service to BT. Note that the PCOs' presence in this case would only be 'counted' by its 'indirect' interconnection at a BT exchange (i.e. by virtue of its supply of services to TalkTalk or Sky, who are the direct purchasers of the interconnect service from BT).

A15.69 To investigate this further, we requested data from CPs and analysed it to see if including these operators' purchases of backhaul from third parties at BT exchanges would make a material difference to our results. Our further analysis confirmed that Sky and TalkTalk purchases do alter our view on the extent of PCOs' presence. Furthermore, the analysis confirmed that PCOs are present with their own core networks at the majority of CCEs we had identified in the May 2015 BCMR Consultation.

A15.70 In summary, our analysis of the data from our formal information request resulted in the following differences in operator presence relative to our May 2015 BCMR Consultation:

- At [✂] exchanges, either Sky and/or TalkTalk are purchasing from a PCO that we had not previously counted as present (i.e. the PCO does not already have a direct interconnection at those BT exchanges).

- At a number of the 96 CCEs identified in the May 2015 BCMR Consultation, Vodafone is purchasing external Cablelink but relies on Virgin for backhaul at those locations.[50] This would suggest no longer counting Vodafone as present at

[49] We asked Vodafone about the legacy interconnect services BT referred to in its response (IBIs). Vodafone confirmed that it could not use these services to provide CI Core.
[50] Based on our updated information, we found that at a total of [✂] of the 96 CCEs, Vodafone purchases cable link but is reliant on Virgin.

these exchanges (where Virgin has already been counted as present), which would reduce the number of competitive exchanges.[51]

- CPs stated they were present at some exchanges which we had not previously counted.

Constraints from indirect PCO presence may be weaker

A15.71 Whilst we recognise PCOs with an 'indirect' presence (via sales to other providers) may be able to offer a rival backhaul service to BT in some circumstances, we have concerns that this type of presence may provide less of a constraint than an operator directly purchasing interconnect services at an exchange.

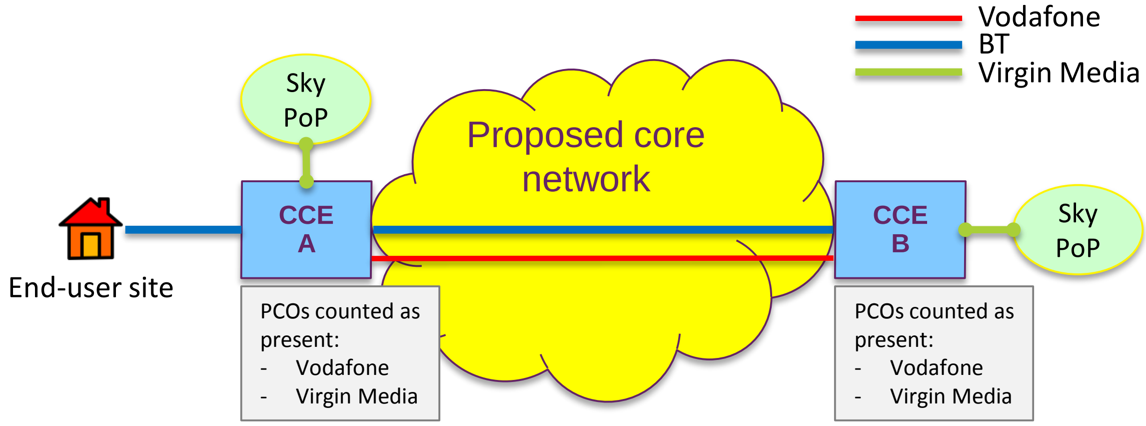
A15.72 In particular, we are concerned that PCOs may lack the network and/or capacity to provide wholesale core services at such locations. This was a point raised by Vodafone in its response, which highlighted some possible reasons why operators such as Virgin or Vodafone might not be interconnected directly at such an exchange. Vodafone explained that it could be related to the cost of build, the absence of available interconnect products, or a lack of capacity to support core conveyance from that exchange. Vodafone did not provide evidence of the materiality of this issue, though it is likely to vary by exchange and operator. However, Vodafone's comment does indicate the potential for barriers to competition to exist at exchanges where PCOs do not have direct connections. We therefore look in more detail at the potential strength of these constraints below.

A15.73 One example of where we consider the constraint from a PCO's 'indirect' presence would be more limited is where the operator is present at an exchange only for the purpose of providing a single LLU backhaul circuit to an LLU operator's POP. [52] Figure A15.3 below illustrates this using an example in which Virgin is present at an exchange (CCE A) but only for the purpose of providing a single LLU backhaul circuit to Sky's PoP.

[51] Apart from Vodafone, we did not find any other Principal Core Operator was reliant on another Principal Core Operator.

[52] LLU backhaul is discussed in Annex 8. Some respondents to the May 2015 BCMR Consultation argued that LLU backhaul provision in general is not competitive, for example, because of national purchasing requirements. Our view is that it can be competitive where a sufficient number of CPs are able to compete, consistent with our approach to identifying the CI core set out here.

Figure A15.3: Example of a limited constraint from ‘indirect’ presence



Source: Ofcom 2016

A15.74 In this stylised example, we find two operators apparently present at both CCE A and CCE B (Virgin and Vodafone). Vodafone self-supplies the red route between the two CCEs to a customer end (which it supplies using a regulated terminating segment from BT (the blue line from CCE A to the end-user site); and Sky buys the green routes from Virgin specifically to connect to Sky PoPs near each exchange. Virgin’s provision of these circuits to Sky is very route-specific and could potentially be over quite a short route distance. As a result, there is no guarantee that Virgin would have the network or capacity to supply conveyance to other CPs between CCE A and CCE B or to other core nodes. This is in contrast to the direct presence of Vodafone, who would be far more likely to have the ability to offer a backhaul service to third parties between the two exchanges. As a result, we consider there are some circumstances in which the constraint from indirect PCO presence could be significantly weaker than from direct interconnection.

A15.75 Moreover, the evidence we have seen suggests the indirect presence may be used to provide backhaul to a single PoP at a material number of exchanges. After analysing the circuits Sky purchased from Virgin to CCEs, we found [✁] purchased by Sky are going to another CCE. [✁]

A15.76 An additional consideration with the inclusion of Sky or TalkTalk purchases is that, if Virgin does not have its own Cablelink or direct interconnection at the BT exchange, Virgin would not be able to sell immediately to another third party. In these circumstances, any competitive constraint Virgin might be able to exert on BT could be more limited.

A15.77 Overall, we conclude it is appropriate to include OCPs such as Sky and TalkTalk in identifying effectively competitive exchanges as we recognise that in some cases the PCO interconnecting indirectly through them may be able to provide a rival backhaul service to BT. However, there are reasons we consider this will not always be the case and our analysis of circuit data suggests this could be true at a material proportion of exchanges where a PCO is indirectly connected. As a result, we take into account the weaker constraint these OCPs may exert in some exchanges when defining our criteria for effectively competitive exchanges.

The criteria for identifying competitive exchanges

A15.78 We consider an exchange will be effectively competitive where there is a sufficient degree of interconnection that CPs need not be reliant on BT for backhaul services.

As some CPs will need to contract with multiple providers to obtain a resilient solution, this requires a minimum of two rival backhaul services are potentially available for an exchange to be found competitive.[53]

A15.79 In the May 2015 BCMR Consultation, we identified candidate competitive exchanges based on information on exchanges where at least two OCPs were purchasing Cablelink. Underlying these criteria was the assumption that all of the OCPs we had identified as present at a particular exchange would have the ability and incentive to provide a rival wholesale backhaul service to BT. If this were the case, it would mean that even CPs seeking a resilient solution would have an alternative to BT at all exchanges.

A15.80 However, we had reservations over whether presence would necessarily translate into competitive constraint on BT in this way and invited comment from OCPs on whether the exchanges we had identified with these criteria were effectively competitive. We now look at whether criteria we set out in May 2015 BCMR Consultation remain appropriate both in light of responses received and our expanded definition of operators' presence.

A15.81 Six Degrees expressed concerns over the extent to which operators' presence translates into core competition. Six Degrees' experience was that not all OCPs 'self-supplying' their own core will always provide to third parties. We consider that, in general, competition between vertically integrated operators may be fully effective and sales to third parties are not a necessary condition for a market to be competitive. However, given some stakeholders' comments about potential limitations on PCOs' ability to provide a rival backhaul service (such as capacity constraints) we think an absence of supply to third-parties may be more of a concern, as it could indicate that the connection in question cannot be used to provide a rival backhaul service to BT.

A15.82 In light of both stakeholder comments and our own assessment of the potentially weaker constraint from indirect PCO presence, we consider that the number of rival backhaul services available at a particular exchange may not follow directly from the number of PCOs connected (directly or indirectly) to that exchange. Instead, the number of PCOs present could overstate the number of rival backhaul services available in a material proportion of cases. As a result, we consider that using a threshold of two PCOs to identify effectively competitive exchanges could result in extending the CI core too widely.

A15.83 We note that we would be particularly concerned about extending the core too widely in this way given that deregulating exchanges from which conveyance is not

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[53] We note that it may be possible at some exchanges that a single supplier could provide physically diverse routes. However, the ability of PCOs to provide multiple physically separated links from a BT exchange may be limited by the cost of deploying separate core network routes to achieve that diversity. In addition, the need to purchase interconnect links from BT may limit the degree to which physical links into a BT exchange building are physically separate. As a result, many CPs requiring a resilient solution are likely to have to contract with multiple suppliers. We also note that resilience is not merely a hypothetical concern. For example, [✂] Therefore, there is evidence for resilience concerns, which suggests that more than two OCPs may need to be present for fully effective competition. Four OCPs would be needed to allow competition from two non-overlapping pairs of primary and back-up suppliers.

in fact competitive could have adverse effects in other markets. In particular, LLU backhaul is a necessary input to support competition in the important downstream broadband markets, and the evidence we have seen suggests that LLU operators still rely on BT for backhaul to a significant extent.

A15.84 To investigate this concern further, we looked at how reliant purchasers of backhaul are on BT at exchanges where at least two PCOs (excluding BT) were present, adopting the new expanded definition of operator presence above. The idea behind this analysis was that if it led to the identification of exchanges where at least two OCPs were capable of providing a rival backhaul service to BT, we would expect to see relatively low reliance on BT at these exchanges. This is because, even where backhaul purchasers needed to contract with two OCPs for resilience reasons, they would still have an alternative to BT. On the other hand, if we found that backhaul purchasers remained heavily reliant on BT, it could suggest that PCO presence was over-stating the competitive constraints on BT.

A15.85 We identified 407 such exchanges using this criterion. We observed the routes going to/from these exchanges and which CP was providing the route (BT, Virgin, Vodafone etc.). We relied on circuit data from Sky and TalkTalk as they are among the most significant purchasers of backhaul.

A15.86 We found:

- Sky solely relied on BT for circuits at [✂] of the 407 exchanges; for TalkTalk this figure was [✂]; and
- at [✂]of the 407 exchanges, BT was the only supplier of circuits for both Sky and TalkTalk

A15.87 In addition, we found that the CP providing a circuit to, for example, Sky, is not always the same as the CP supplying TalkTalk. At [✂] of the 407 exchanges Virgin was supplying either Sky or TalkTalk but not supplying both.

A15.88 The above analysis only focuses on the purchasing behaviour of Sky and TalkTalk, which will represent only a proportion of total core connectivity (albeit an important one). Nevertheless, the evidence shows that at the 407 exchanges where two PCOs are apparently 'present', purchasers such as Sky and TalkTalk are still heavily reliant on BT.

A15.89 In contrast, we find much lower reliance on BT by Sky and TalkTalk at exchanges where there at least three PCOs are present.

A15.90 For the BT plus three PCO exchanges, we found:

- of the 34 BT plus three exchanges, Sky solely relied on BT for circuits at [✂] of exchanges; for TalkTalk this figure was [✂].
- at [✂] of BT plus three exchanges, BT was the only supplier of circuits for both Sky and TalkTalk.

A15.91 This analysis suggests a criterion based on two PCOs would be likely to over-state the extent of the competitive core, although it does not necessarily mean that a criterion based on three PCOs would be sufficient.

A15.92 To investigate this issue of the appropriate threshold further, we looked at the number of PCOs present in the existing CI core. Our rationale for this was that we consider the existing CI core to be effectively competitive, and therefore consider the number of PCOs present at these exchanges to provide a useful guide to an appropriate choice of threshold.

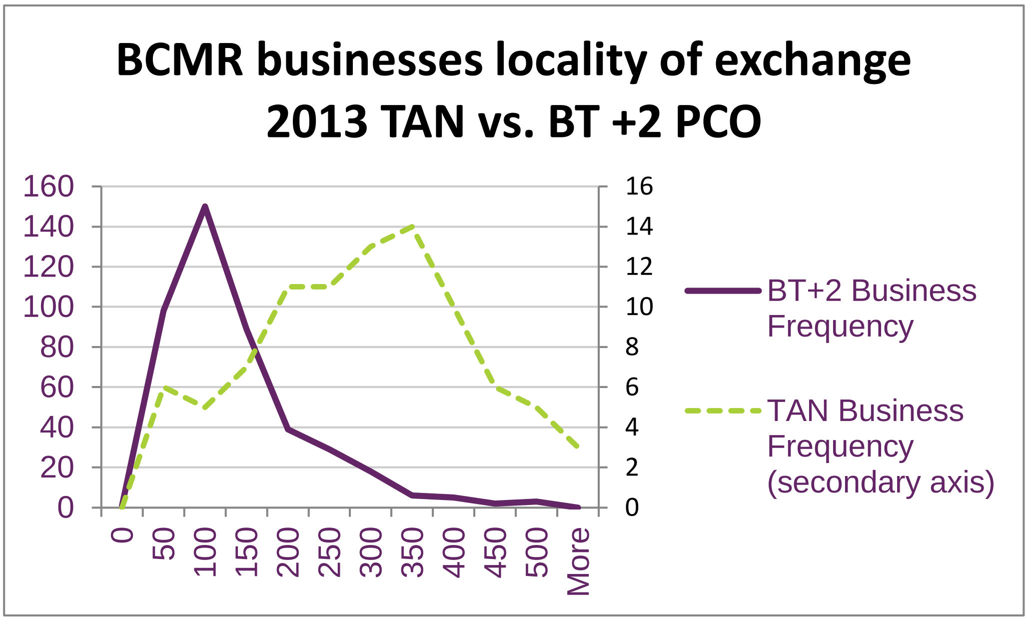
A15.93 We found that, on average, there were only two PCOs (in addition to BT) present at OHPs but three at TANs. This contrasts to one PCO on average across all exchanges.[54] This analysis suggests that applying a criterion based on a minimum of three PCOs is likely to identify exchanges where competitive conditions are similar to the existing CI core, and are therefore effectively competitive.

A15.94 As a further check, we looked at how the exchanges identified by applying this criterion compared to the existing CI core in relation to business concentration. Overall, we would expect that the most competitive exchanges would be in the main areas where businesses are concentrated, and so consider proximity to concentrations of business sites a useful indicator of competitive conditions.

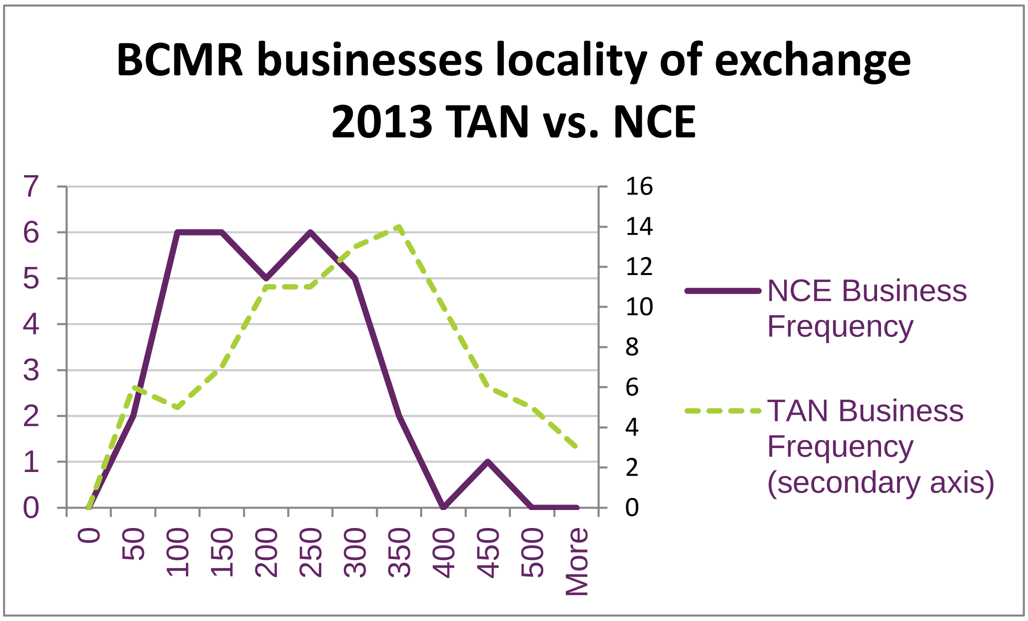
A15.95 Figure A15.4 below compares the distribution of business concentration around exchanges identified by applying the BT plus three PCOs criteria with the existing TANs. Although the existing TAN exchanges are on average located in areas of slightly higher business concentration, the difference is not large and the overall distribution shows a reasonable degree of similarity.

A15.96 By way of contrast, we have repeated this analysis for exchanges identified applying a BT plus two PCO criterion. This shows the average business concentration around BT plus two PCO exchanges is materially lower and the overall distribution very different.

Figure A15.4: Business concentration by exchange type



[54] Average figures based on median number of PCOs at each type of exchange.



Source: Ofcom 2016

A15.97 Overall, we consider the evidence suggests that identifying competitive exchanges based on the presence (direct or indirect) of two PCOs in addition to BT would be likely to result in extending the competitive CI core too widely. This is because there are reasons to believe there would not always be two rival backhaul services in these exchanges, and competitive indicators suggest the exchanges identified by this threshold still have a high degree of reliance on BT and appear markedly different from the existing CI core.

A15.98 In contrast, exchanges where there are at least three PCOs present show a lower degree of reliance on BT and appear more similar to the existing competitive core in relation to a number of key indicators. In light of this, we conclude it is not necessary to set the threshold higher still, and consider exchanges identified by applying a criterion of three PCOs (in addition to BT) are likely to be effectively competitive.

<u>We no longer apply further checks for CPs' presence based on proximity rules</u>

A15.99 We note that some stakeholders commented on the 200 metre criterion we used in the May 2015 BCMR Consultation. As noted above, this criterion was used in the absence of specific data on PCOs' presence as a means to infer whether interconnected CPs were likely to use their own core networks from a BT exchange.[55] However, we now consider it is not necessary to rely on 'deemed' presence based on a 200 metre proximity rule. This is because CPs' responses to our formal information request confirmed their presence at BT exchanges. Therefore, we consider we have addressed the concerns of stakeholders (BT, Vodafone and Six Degrees) that we should check for operators' actual presence

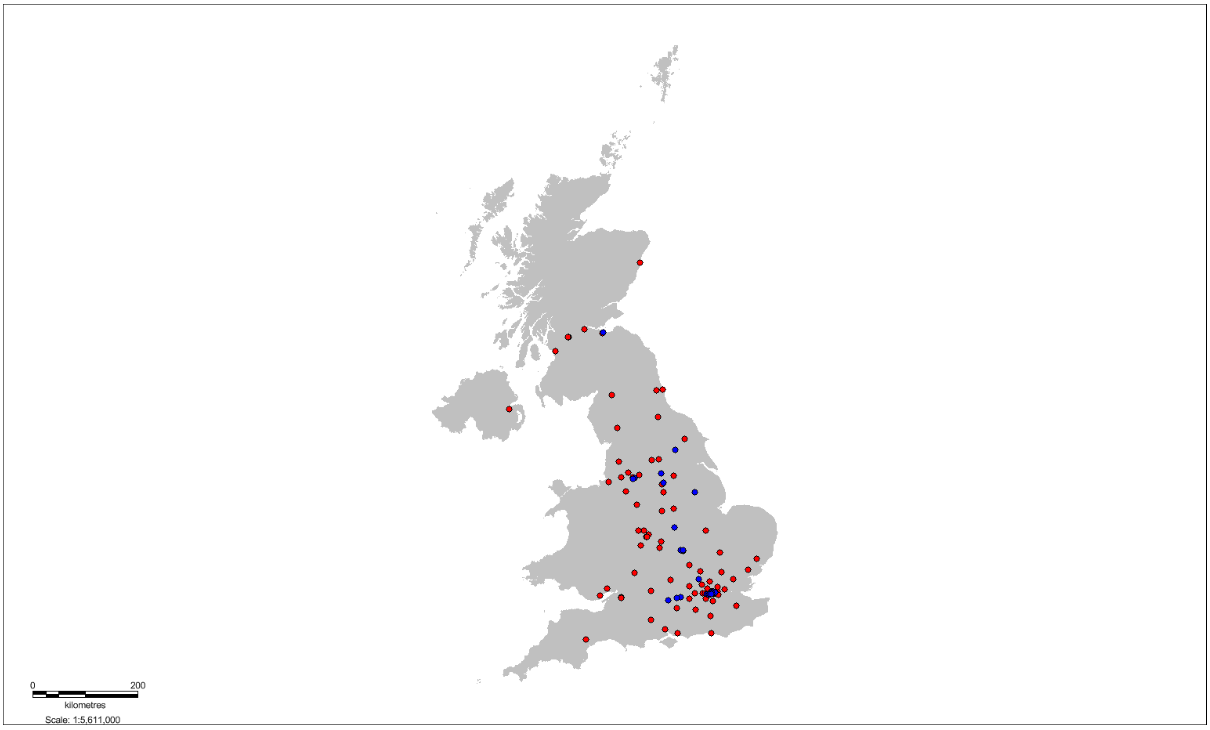
[55] We argued that if a CP had interconnected with BT at an exchange and had network nearby, then it would be reasonable to assume that the CP in question was able to self-supply core segments at that location.

rather than relying on the purchases of interconnect and the 200 metre rule alone. The concerns raised by Vodafone about the appropriateness of the 200 metre assumption also fall away.

Calculation and analysis of the New Competitive Exchanges (NCEs)

A15.100 We refer to the final set of exchanges that meet the ‘BT plus three PCO’ criteria as ‘New Competitive Exchanges’ (NCEs). The mapping of the 34 NCEs is illustrated by the blue dots in Figure A15.5. The red dots illustrate the 85 OHPs belonging to the 56 existing TANs identified in the BCMR 2013.

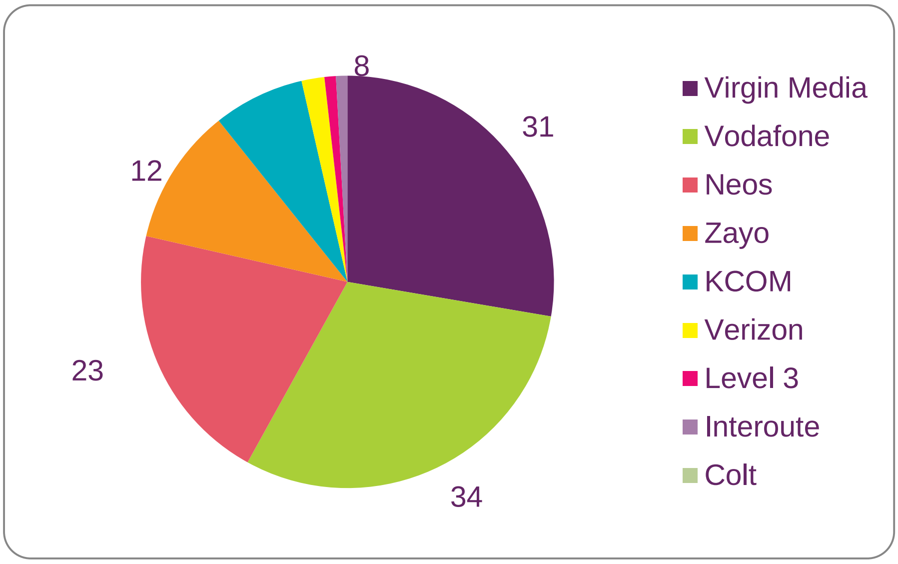
Figure A15.5: 34 NCE locations in blue, 85 exchanges belonging to existing TANs in red



Source: Ofcom 2106

A15.101 The breakdown of the 34 NCEs in terms of PCO presence is as follows:

Figure A15.6: Number of exchanges



Source: Ofcom 2016

A15.102 Virgin and Vodafone are present at almost all NCEs, whilst Neos, Zayo and KCOM[56] are also present at a significant number of these exchanges.

TAN Grouping

A15.103 In the BCMR 2013, we grouped some (but not all) of BT's main OHP exchanges into 56 TANs mainly centred on UK cities. Circuits sold between OHPs that belonged to different TANs were classified as part of the competitive core. Other circuits, including those between OHPs within the same TAN, were classified as terminating segments.

A15.104 The logic underlying the grouping of OHPs was that other CPs would be unlikely to aggregate their traffic back to points of interconnect at every one of BT's 106 OHPs (or their own equivalent network nodes). We concluded that, given the extent to which demand was concentrated at particular OHPs, BT's competitors could reasonably be expected to interconnect with BT in 56 TANs. The benefit of this regulation is that infrastructure players only have to interconnect at a limited number of exchanges in the major urban centres and from there can obtain regulated terminating segments from BT to provide services nationally.

A15.105 For our previous analysis of core, we identified 56 TANs, but we limited our assessment of competitive exchanges to BT's highest tier, i.e. OHP exchanges. Based on our assessment of demand concentration, we did not expect OCPs would interconnect to all OHPs, and so grouped them into TANs to ensure effective competition.

[56] CityFibre's recent acquisition of KCOM network outside of the Hull area may result in CityFibre replacing KCOM in this chart, although we do not have full details of the network arrangements to confirm this.

A15.106 In the current BCMR, however, our approach is necessarily different as there is not a clear type of exchange we consider appropriate to deregulate (i.e. we are not limiting our analysis to OHPs only). Instead, we are investigating where OCPs' presence outside of the existing core has increased sufficiently to warrant expanding the core to include new competitive exchanges. In order to investigate this, we have had to collect and analyse information on the number of OCPs present at different exchanges and reach a view on the number of OCPs that would need to be present at a particular exchange for it to be effectively competitive.

A15.107 As a result of responses received to the May 2015 BCMR Consultation, we have refined the basis on which we identify OCPs' presence and we have also conducted further analysis on the appropriate criteria for effective competition.

A15.108 In defining these criteria, we have used the existing CI core as a benchmark for effective competition, with the result that our criteria are now set at a level intended to ensure the exchanges identified are very similar in competitive conditions to TANs (rather than OHPs). The key rationale for grouping OHPs into TANs, i.e. that we would not expect OCPs to be present at all OHPs, does not apply to the exchanges meeting our criteria for effective competition (i.e. NCEs) as the latter all have a minimum of BT plus three OCPs. As a result we consider it more appropriate to treat NCEs each as separate TANs, rather than adopting the approach we took to OHPs, and do not propose to group them together.[57]

A15.109 We have considered whether not grouping NCEs into TANs means there are risks to users of existing circuits connecting NCEs to TANs or to each other. We think that any such risk is limited, because:

- the number of sales of Openreach circuits between NCEs, or between NCEs and existing TANs, is quite low.[58]

- Virgin and Vodafone are present at most NCEs, meaning there are other large OCPs that could provide a circuit from each such exchange.

- We further note that the SMP remedies imposed as a result of this Statement mean that outside of the CLA geographic area, operators can still request CISBO circuits from BT on regulated terms provided that those circuits are not between these NCEs or existing TANs.

A15.110 In relation to the last bullet point above, a concern we explained in the May 2015 BCMR Consultation was that smaller OCPs might be impacted by the expansion of the number of competitive exchanges identified as part of the CI core. In particular, the inefficiencies to a smaller OCP associated with handover of an access circuit from Openreach to another OCP, conveyance of the circuit on the rival core

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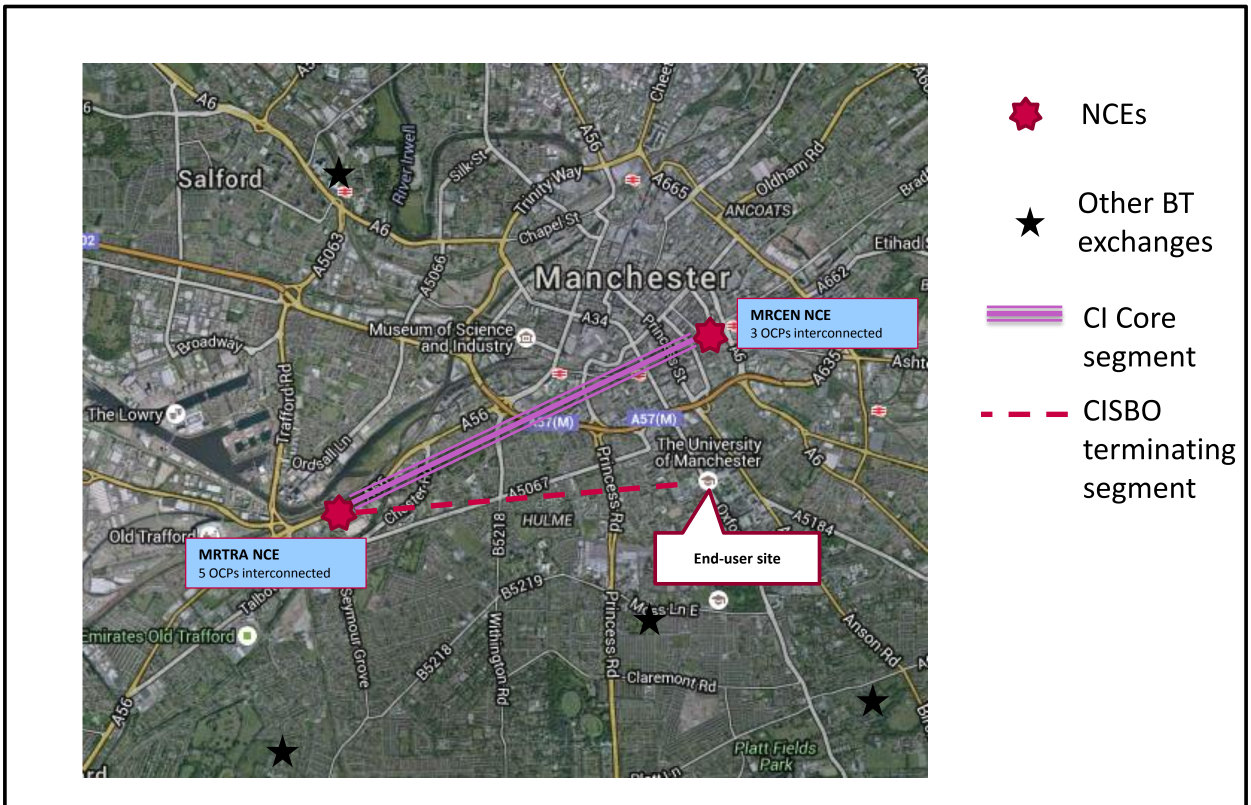
[57] Consistent with this logic, we consider it is appropriate to retain the existing 56 TANs as currently defined. The 56 TANs are made up of 85 OHPs, of which only 45% would by themselves pass the BT plus three OCP criteria test.

[58] This is based on our circuit analysis. We found 83 BT circuits going either between NCEs or NCEs and TANs. Therefore, grouping some NCEs (either as new TANs or to existing TANs) would only affect a marginal proportion of circuits. We further note that some of these circuits are located in the CLA so would be deregulated irrespective of whether the NCEs are grouped into TANs.

network, and handover of the circuit to the smaller OCP's own core network. However, we note in light of comments from BT that the risks of deregulating links between competitive exchanges should not significantly impact smaller operators that have not located at every exchange.

A15.111 Figure A15.7 illustrates an example of two nearby NCEs in the Manchester area (Manchester central – MRCEN and Trafford – MRTRA). In principle, these exchanges are close enough to each other to be grouped in to a TAN (we estimate they are less than 3.5km apart).

Figure A15.7: Example how existing regulation can protect smaller OCPs



Source: Ofcom 2016

A15.112 In this example, assume a smaller OCP serves a large customer in the central Manchester area (e.g. the University of Manchester) using a BT terminating segment that it connects back to its core node at the MRTRA exchange. The 'logical' route BT uses to deliver this circuit may be from the end-user's site to the nearest exchange (MRCEN) which is connected to the MRTRA.

A15.113 As we have identified MRCEN and MRTRA as competitive exchanges, then the route between these NCEs would now be deregulated (since the NCEs are not grouped into a TAN).

A15.114 One concern in this scenario is that BT could withdraw provision of the circuits between MRCEN and MRTRA (or raise prices) which may impact smaller OCPs not interconnected at both the MRTRA and MRCEN NCEs. In this scenario, we might be worried that smaller OCPs' ability to compete could be compromised unless they were interconnected at all of NCEs.

A15.115 However, this risk is limited for two reasons:

- First, we have identified at least three PCOs at each NCE capable of providing competitive core over the route. Indeed, in this example, we note that three OCPs are present at both locations [✂].
- Second, our regulation of CISBO services continues to apply to services that are not designated as core segments. In particular, our identification of MRCEN and MRTRA as NCEs and part of the CI core means that BT is no longer required to provide circuits between them on regulated terms. However, our regulation still requires BT (subject to technical limits) to provide terminating segments between those NCEs and any locations that are not designated core nodes. Hence, the smaller OCP could continue to receive a terminating segment between a customer end (e.g. University of Manchester) and its own core node (at MRTRA) on regulated terms.

A15.116 Therefore, we no longer consider the concerns we had about de-regulation of lower tier exchanges expressed in the May 2015 BCMR Consultation suggest applying TAN groupings to NCEs. This is due to the number of circuits impacted and coverage of competitors' networks. In addition, our approach to regulation means that smaller OCPs still have access to regulated services.

Conclusion

A15.117 In light of the above criteria, we identify 34 NCEs in addition to our existing 56 TANs. We note that the proposal not to group NCEs is more de-regulatory than that set out in the May 2015 BCMR Consultation. The net result is an additional 34 separate, fully deregulated, NCEs (each equivalent to a TAN) compared to the 18 TANs we proposed in the May 2015 BMCR Consultation.

Assessment of data centres

May 2015 BCMR Consultation proposals

Analysis used to identify DCs as competitive core nodes

A15.118 In the May 2015 BCMR Consultation, we inferred an operator's apparent presence at DCs by matching the 'on-net' leased lines circuit ends of a particular CP to the postcode of a particular DC. We used this information to identify a candidate list of competitive DCs, based on where two or more OCPs were present and other indicators of competition.

A15.119 In our May 2015 BCMR Consultation, we began the analysis with an initial list of 354 UK DC locations.[59] We then narrowed down the list based on indicators of competition differences and whether the DC is carrier-neutral.

A15.120 We only included DCs that advertise themselves as carrier-neutral because these locations would permit interconnection between multiple CPs. In contrast, a non-

[59] These came from a variety of sources, including stakeholder responses to the CFI and our requests for information on major network node locations. We also inspected the websites of the DCs in question and used other publicly available information.

carrier-neutral DC may permit interconnection only on to the network of the CP that owns the DC.

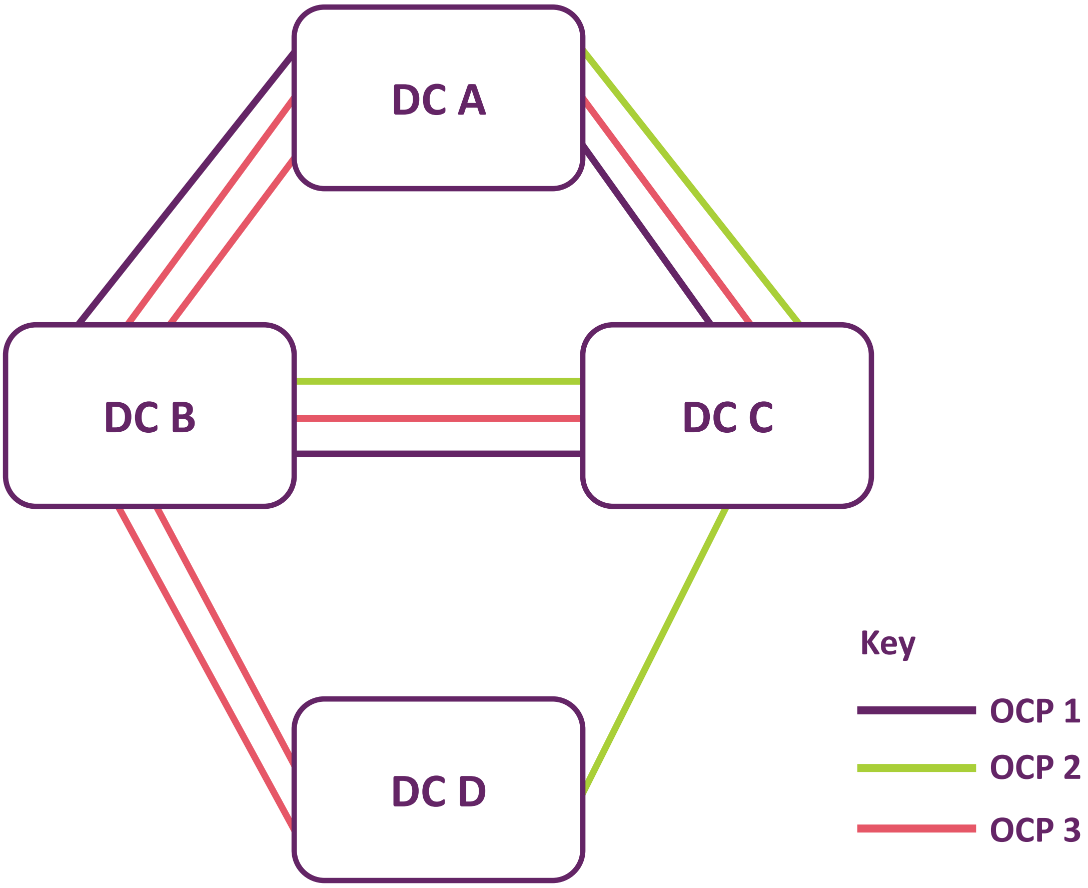
A15.121 We established the number of operators present at each DC and able to compete to provide core conveyance from it by first matching DC postcodes to on-net circuits provided by CPs, based on the circuit data we had collected.[60]

A15.122 We then analysed the interconnectivity between these carrier-neutral DCs to identify those DCs that could be functioning as (competitive) core nodes. We looked at interconnectivity between carrier-neutral DCs since, if a DC site is being used as a node in a CP's core network, we would expect it to have connectivity to other nodes of its type. We thought that the number of other DCs to which a DC has links, and the number of CPs competing to provide these links, are relevant criteria for identifying DCs that function as competitive core nodes.

A15.123 We proposed that a DC core node should be carrier-neutral and have at least two competitive routes to other carrier-neutral DCs. We also considered that each route would be competitive if our circuit data suggests that at least two OCPs provide circuits on that route. For the purpose of our analysis, we defined a single 'route' between a pair of DCs when there is at least one circuit that connects them. In the event that a route between two DCs existed, we counted the number of CPs that were able to provide circuits on that route.

[60] In particular, we inferred an operator's apparent presence at DCs by matching 'on-net' leased lines circuit ends of a particular CP to the DC's postcode.

Figure A15.8: Inter data centre connectivity example



Source: Ofcom, May 2015 BCMR Consultation

A15.124 To illustrate this, we showed (as depicted in Figure A15.8) circuits between four DCs (DCs A, B, C and D). Each line between two DCs represents a circuit, and the colour of the line gives the identity of the OCP (excluding BT) to whom the circuit belongs. We explained that DCs A and D would both be defined as having two routes to other DCs (i.e. both have circuits to DCs B and C). Meanwhile, DCs B and C each had 3 routes. We stated that we would only view DCs A, B and C as competitive, as they have more than one OCP on multiple routes out of each DC. In the case of DC D, neither route is competitive as there is only one OCP serving each of the routes to another DC from this location, therefore for the purpose of our analysis we would not identify it as a competitive network node.

<u>We proposed 60 data centres as part of the CI core</u>

A15.125 We identified 60 carrier-neutral DCs with at least two competitive routes (to other carrier-neutral DCs). Limitations with the available data again prevented us from computing CI core segment service shares at DCs, but we looked at a number of other competitive indicators.

A15.126 On average, we found that considerably more CPs were present at DCs with two or more competitive routes than at DCs with fewer than two competitive routes. On average there were nine CPs present at carrier-neutral DCs that satisfied our criteria, compared to only three at those that did not. DCs in the candidate competitive set were also found to be much more highly interconnected, with many far exceeding our minimum threshold for the number of competitive routes. Further, as anticipated, the proposed criteria tended to capture DCs where there is a high density of traffic[61] suggesting that such DCs act as a major network node.

A15.127 Finally, we noted that BT's estimated share of CISBO circuits is below 40% at almost all of the candidate competitive DCs. Whilst we did not place much weight on service shares, we noted that this evidence was consistent with the view that the DCs identified are competitively supplied with core network.

We planned to gather more data on CP presence at DCs

A15.128 We recognised that our assessment of competition at DCs was only approximate, given its reliance on inferences about OCPs' presence from 'on-net' circuit data. We noted, in particular, that:

- the CP in question may not use the DC as a core node;
- CPs may utilise other CPs' infrastructure to establish a presence in DCs; or
- a CP might be serving other end-user sites in the same postcode location as the DC.

A15.129 Therefore, to obtain a more robust view of OCPs' presence and use of DCs as core nodes, we indicated that we would ask CPs to provide further information. This was in order to confirm CPs' presence at the DC, to obtain details of the purpose of CPs' presence at the DC (i.e. what services are sold at that location) and to find out whether CPs had core network at that location.

Stakeholders' responses

A15.130 Stakeholders agreed with our general approach to identifying DCs as part of the core, but some had reservations about the scope of DCs we identified as competitive. Virgin and BT believed we should identify more DCs as competitive.

A15.131 BT considered that we had understated the number of competitive DCs. BT considered the exclusion of non-carrier-neutral DCs resulted in a perverse regulatory outcome whereby BT is required to provide links to DCs where it is effectively not currently present. BT claimed we should add these as competitive core nodes "enabling a more level playing field should opportunities for BT to enter these markets arise in future".[62] BT also considered we should also add a further 20 carrier-neutral DCs to the list of 60.[63]

A15.132 Virgin noted that for non-carrier-neutral DCs, the average number of CPs present is three, suggesting that some will have considerably higher numbers of CPs present

[61] As measured by total capacity: the sum of the bandwidth of all circuits at a DC.
[62] BT response to the May 2015 BCMR Consultation, Part A paragraph 6.6
[63] Sungard – Elland; ATOS – Longbridge; Ark - Corsham and Farnborough; Equinix LD5 – Slough; Level 3, Cambridge; Pulsant – Edinburgh; NTT – Slough; HP – Wynard and Doxford; Virtus – Hayes and Enfield; Virtus – Enfield; IBM – Portsmouth; CenturyLinkLO1 – Slough; NYSE – Basildon; IBM – Greenford Green Business Park, Warwick and Softlayer; Digital Realty – Chessington; Equinix LD6 – Slough.

and may well be competitive. Virgin also thought that Ofcom had incorrectly reduced the number of 'competitive' carrier-neutral DCs based on the additional requirement for them to have multiple competitive routes from other 'competitive' carrier-neutral DCs. Virgin thought this was a very restrictive approach, given that even DCs with one competitive route still have an average of three routes to other DCs and three CPs present (though not competing on all routes).[64] Virgin expected an increase in competition in relation to DCs over the review period, and was concerned that our analysis was not sufficiently forward looking.

A15.133 Six Degrees Group, by contrast, questioned our assessment that core connectivity at the DCs we identified is competitive. It said that, whilst DCs such as Telehouse or Telecity have a multitude of carriers present, some of the other DCs listed as carrier-neutral may have highly limited connectivity options. It noted that some CPs utilise other CPs' infrastructure to establish a presence in DCs resulting in a distorted picture of competition. Also, it noted that there are often limitations on the services provided at smaller DC sites. Six Degrees also stated that some DC sites such as Tutis Point were listed twice under different names.

Our response to stakeholders' comments and further analysis

A15.134 As discussed in paragraphs A15.131 to A15.132 above, in order to obtain a more robust view of OCPs' presence and use of DCs as core nodes, we sent a formal information request to CPs that asked them to confirm their presence at the DC. In addition, we asked each respondent to provide details of the purpose of its presence at DCs (i.e. what services it sold at that location) and whether it had core network at that location. We have used the data to confirm the OCPs present at each DC, and that each OCP present is using its own core network.

Results of our further analysis of data centres

A15.135 Our analysis of CPs' responses to the formal information request confirms that for the 60 DCs proposed as candidate competitive nodes in the May 2015 BCMR Consultation, there are at least three CPs (two OCPs) that have core network at those locations. Therefore, our further analysis confirms that these 60 DCs meet our criteria for competitive DCs, where at least two OCPs are present on at least two alternative routes (note these are all carrier-neutral DCs). Indeed, as set out in Table A15.1 below, in most cases there are more than three CPs present:

[64] Virgin noted for example that such some DCs will have multiple routes and multiple CP presence, but will still not be sufficiently interconnected to be considered competitive.

Table A15.1: Sensitivity table of the count of DCs that meet the 'on-net' network presence criteria

Min number of OCPs	Count of DCs
2	60
3	57
4	52
5	44
6	35
7	30

Source: Ofcom 2016

A15.136 Adjusting the criteria for minimum number of CPs present at a DC has little impact on the count of qualifying competitive DCs.

A15.137 We are satisfied that, in light of our checks of the data received from formal Section 135 information requests, we have correctly assessed presence at the 60 DCs identified in the May 2015 BCMR Consultation.

Views on additional data centres

A15.138 In our formal information request, we also asked stakeholders to provide information on additional DCs where they had presence and were using those DCs as core nodes. Separately to this, in response to the May 2015 BCMR Consultation and in correspondence, BT also suggested we should include additional DCs in our list. In total, BT suggested 20 additional DCs (see Tables A15.8 & A15.9).

A15.139 In total we have examined a further 29 DCs (i.e. 20 suggested by BT and nine as a result of s135 responses) in addition to the 60 identified in the May 2015 BCMR Consultation to see if they match the competition criteria in the consultation:

- At least two OCPs are present;
- there are at least two competitive routes (competitive routes being those with a minimum of two providers); and
- DCs are carrier-neutral.

A15.140 Tables A15.7, A15.8 and A15.9 show these 29 DCs identified through responses to the formal Section 135 information requests and BT's suggested DCs. A total of three met the criteria and, hence, we have decided to add them to our list.

A15.141 The DCs that did not meet the criteria were either non-carrier-neutral, not competitively interconnected or were already included as a core DC in the May 2015 BCMR Consultation, as noted in the last two columns of Tables A15.7, A15.8 and A15.9.

A15.142 We therefore added three DCs (outlined in Table A15.2 below) to the list of 60 competitive DCs, giving a total of 63 competitive DCs.

Table A15.2 – Additional data centres

Name	Address	Postcode
CenturyLink LO1	630 Ajax Avenue, Slough	SL1 4DG
NYSE	Cranes Farm Road, Basildon	SS14 3NY
Equinix LD6	Equinix LD6, Slough	SL1 4NB

Source: Ofcom 2016

Exclusion of 'non-carrier-neutral' data centres

A15.143 BT noted that we excluded from the list of DCs all those which are non-carrier-neutral. This criterion reduced the set of potentially competitive DCs from 354 to 167.

A15.144 BT thought that this resulted in a perverse outcome in terms of regulation, as it was required to provide connectivity to a non-carrier-neutral DC even though it might be prevented from providing other services at the DC site. BT therefore submitted that we should add these DC locations to the defined competitive core. Virgin also noted that for carrier-owned data centres, the average CP presence is three, suggesting that some will have considerably more CPs present and may well be competitive.

A15.145 We stated in the May 2015 BCMR Consultation that competition in carrier-neutral DCs is more likely to be effective. This is because a carrier-neutral DC does not favour any CP over another. By definition such DCs benefit from encouraging the presence of multiple CPs to increase customers' choice. At these locations, migration of end-users' services from one CP to another could be achieved with a low-cost interconnect with the new CP at a DC. This freedom of interconnection also applies between CPs. For instance, a CP can co-locate at a carrier-neutral DC and, via an interconnect, leverage the network footprint of any other CP co-located at that DC.

A15.146 We omit non-carrier-neutral DCs because a carrier-owned DC may not be designed to host or interconnect third party infrastructure, something which we would expect of a node in the competitive core. By contrast, carrier-neutral DCs benefit from encouraging the presence of multiple CPs to increase customers' choice. This is reflected in the lower apparent CP 'presence', on average, at non-carrier-neutral DCs shown in Table A15.3 (CP 'presence' in Table A15.3 is inferred based on their provision of (on-net) circuits to the same postcode as the DC).

Table A15.3: Carrier-neutral and Non-carrier-neutral DCs

DC type	Count of DCs	Average CP presence
Carrier-neutral	167	5.0
Non-carrier-neutral	187	3.0

Source: Ofcom 2016

A15.147 Although we find three CPs 'present' on average at non-carrier-neutral DCs, we note that this 'presence' is only inferred (based on circuits with at least one end matching a postcode of one of the non-carrier-neutral DCs). For the reasons set out above at paragraph A15.128, these inferences may overstate the number of CPs actually using the DC as a core node. We further note that even if the CP does have some degree of 'presence' at the DC, this does not necessarily mean that CPs can exercise competitive choice in procuring core conveyance to other locations. This is because the DC may not be designed to host or interconnect third party infrastructure, as explained in paragraph A15.146.

A15.148 In light of BT and Virgin's comments, we have analysed the data provided in response to our formal Section 135 information request to assess the extent of competitive presence at carrier-owned DCs. Using these data, we now identify 195 carrier-owned DCs for analysis. Of these, there were only five where at least two CPs stated they had core presence, and only one of these had at least two competitive routes from them. We note that these five carrier-owned DCs also had an average of only three competitive routes from them, whereas the additional carrier-neutral DCs had seven.

A15.149 We therefore consider that this evidence points to the existence of material differences in competitive conditions between carrier-owned and carrier-neutral DCs.

A15.150 Indeed, we note that BT, in its response to the BCMR 2013, observed differences between carrier-owned and carrier-neutral DCs:

> *'Ofcom have counted all types of Data Centre in the reach analysis without distinction. This will blur the difference between carrier-neutral data centres, who encourage multiple CP presence, and non-neutral (i.e. carrier-owned, end user operated and systems*

integrator) who either rely on own-infrastructure or chose a 1+1 CP diversity strategy, befitting their commercial model.'[65]

A15.151 Overall, we consider the evidence suggests that 'non-carrier-neutral' DCs are less likely to function as key competitive hubs for core networks where CPs are likely to interconnect than the carrier-neutral DCs meeting our criteria.

Establishing data centres as sufficiently interconnected

A15.152 In the May 2015 BCMR Consultation, we noted that we wanted to identify DCs not just where two OCPs are present, but that could be used as core nodes by those CPs. Our initial view was that DCs most likely to exhibit features of core networks nodes would have:

- a diversity of routes to other core node locations; and
- a large amount of traffic and a depth of competition on these routes.

A15.153 We have considered interconnectivity between carrier-neutral DCs since, if a DC site is used as a node in a CP's core network, we would expect it to have connectivity to other nodes of its type. Specifically, we think that the number of other DCs to which a DC has links, and the number of CPs competing to provide these links, are relevant criteria for identifying DCs that function as competitive core nodes.

A15.154 Virgin considered that we should not apply these criteria as they are unnecessarily strict and reduce the number of DCs we identify as competitive. Virgin did not specify the criteria it thought we should apply but noted that:

> "even data centres with one competitive route still have an average of three routes to them and three CPs present".

A15.155 We accept that changing these criteria would change the results in terms of the number of competitive DCs we identify. In Table A15.4 we show the effect of adjusting the criteria of each DC having at least two competitive routes served by two CPs.

[65] BT's response to Ofcom's consultation document, September 2012, section 4.7 https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Consultativeresponses/Ofcom/2012/BusinessConnectivityMarketReview/BT_part_1.pdf
BT suggested that 'Ofcom simply need to count sites which have 2 + CPs and are listed or advertised as carrier-neutral Colocation facilities'. BT proposed 'the identification of a set of carrier-neutral multi-tenant Data Centres which meet tests qualifying them as effectively core nodes'.

Table A15.4: Sensitivity analysis of number of qualifying competitive DCs for different competitive criteria

		Min number of competitive routes				
		1	2	3	4	5
Min number of OCPs for competitive route	1	122	114	106	93	86
	2	67	**60**	57	48	47
	3	46	46	44	41	40
	4	38	38	35	29	25
	5	29	27	26	23	18

Source: Ofcom 2016

A15.156 Table A15.4 shows that if we adjust the criterion for the minimum number of competitive routes from two to three (i.e. a stricter criterion) then the number of qualifying competitive DCs would fall from 60 to 57. Alternatively, if we were to adjust the criterion for the minimum number of competitive routes from two to one (i.e. a less strict criterion) then the number of qualifying competitive DCs would increase from 60 to 67. If we alter the minimum required number of CPs present at a given route for it to be competitive from two to three, we observe a deviation from 60 to 46. This pattern is consistent throughout the table, and indicates that the number of competitive DCs is not very sensitive to changes in the minimum number of competitive routes from the exchange, though it is somewhat more sensitive to changes in the required number of CPs on a given route. These results suggest that reducing the minimum number of competitive routes (as Virgin wanted) would not have a large effect. In any case, we would expect a DC that is used as a core node to have at least two competitive routes from it, and hence we consider that the criteria we have applied are appropriate.

A15.157 We consider that the available evidence supports our approach as the 63 DCs we have identified will be the most competitive locations. The number of DCs identified as competitive appears reasonably robust to changes in the criteria which gives us confidence that our conclusions are correct.

Conclusions

A15.158 In light of stakeholders' responses and our further analysis, we have identified – in addition to the existing 56 TANs - an additional 34 NCEs as part of the CI core market. We treat each of these NCEs as separate TANs. These exchange locations are listed in Table A15.5.

A15.159 Following suggestions by CPs on additional DCs and subsequent analysis, we find an additional three competitive DCs to the 60 we identified in the May 2015 BCMR Consultation, resulting in a total of 63 competitive DCs (listed in Table A15.6).

Table A15.5: New competitive exchanges

Attercliffe (SLAC)	Hemel Hempstead (SMHH)	Pimlico (WRPIM)
Barnsley (SLBY)	Holborn (CLHOL)	Poplar (LNPOP)
Bayswater (WEWBAY)	Kensington Gardens (WRKGDN)	Reading (THRG)
Bishopsgate (CLBIS)	Kings Cross (CLKXX)	Rose St (ESROS)
Central (MRCEN)	Kingsthorpe (EMKINGS)	Shoreditch (CLSHO)
Chiswick (LWCHI)	Leicester (EMCENTL)	Theale (THTH)
Clerkenwell (CLCLE)	Lincoln (SLLI)	Trafford (MRTRA)
Duston (EMDUSTO)	Marylebone (WEWMAR)	Westminster (WRWMIN)
Euston (CLEUS)	Mayfair (WEWMAY)	Whitehall (WRWHI)
Fulham (WRFULM)	Monument (CLMON)	York (MYYO)
Gerrard St (Soho) (WEWSOH)	Newbury (THNU)	
Hammersmith (LWHAM)	Paddington (WEWPAD)	

Table A15.6: Competitive data centres (Additional data centres in red)

City Lifeline - Lifeline House	Savvis LO6
Colt London 3, WGC	Sentrum - Sutton
Computacenter Romford	Sentrum - Watford
Computacenter Salford Quays	Sentrum - Woking
Coreix Limited datacentre	SSE - Fareham
CyrusOne - London	Sungard London Technology Centre
Digital Realty Redhill	Tata Communications Cressex

Equinix LD1 - London City	Tata Communications Stratford
Equinix LD2 - London West	Telecity - Kilburn House
Equinix LD3 - Park Royal	Telecity - Meridian Gate
Equinix LD4 - Slough	Telecity - Williams House
Global Crossing London datacentre	Telecity - 6&7 Harbour Exchange
Global Switch London #1	Telecity - 8&9 Harbour Exchange
Global Switch London #2	Telecity - Bonnington House
Interoute - Hoddesdon	Telecity - Joule House
Interxion LON1	Telecity - Oliver's Yard
Interxion LON2	Telecity - Powergate
Iomart London	Telecity - Sovereign House
Level 3 Braham Street datacentre	Telehouse East
Level 3 London datacentre	Telehouse Metro
MDS Technologies - Crawley	Telehouse North
Navisite - Woking	Telehouse West
Next Generation Data Newport	TeliaSonera HEX/A
Node 4 - Derby	Telstra - Docklands
Node 4 - Leeds	The Bunker - Ash
Pulsant - Reading East	Docklands DC Ltd - Tutis Point
Pulsant - Milton Keynes	Virtus LONDON1
Pulsant - Reading Central	Vital - Park Royal

Pulsant - Newbridge	Wildcard Networks IFL2
QiComm - Tutis Point	Wildcard Networks IFL3
CenturyLink LO1 - 630 Ajax Avenue, Slough	NYSE - Cranes Farm Road, Basildon
Equinix LD6, Slough	

Table A15.7 - Additional DCs following S135 requests

Parent Company	DC Name	Postcode	Carrier Neutral[66]	2 competitive routes
Equinix	Equinix LD5 Slough	SL1 4AX	Y	N
Infinity	Infinity Slough	SL1 4QZ	Y	N
Volta DC	Volta DC	EC1V 0AB	Y	N
Gyron - Hemel Hempstead	Hemel Hempstead	HP2 7SU	N	N
Gyron	Ajax 2 (Gyron Internet, NTT DC)	SL1 4BG	N	N
Savvis	Savvis UK LO1 DC (CenturyLink LO1)	SL1 4DG	Y	Y
IBM	Sampson House (IBM)	SE1 9JH	N	Y
Digital Realty DRT-Chessington	Fountain Court, Cox Lane, Chessington	KT9 1SJ	Y	N
Virtus 2	Virtus DC - London 2	UB2 5XJ	Y	N

[66] Based on information at: http://www.datacentermap.com/united-kingdom/

Table A15.8 - Additional DCs suggested by BT (email from BT to Ofcom of 2/11/2015)

Name	Address	Postcode	Carrier Neutral	2 competitive routes
CenturyLink LO1	630 Ajax Avenue, Slough,	SL1 4DG	Y	Y
NYSE	Cranes Farm Road, Basildon	SS14 3NY	Y	Y
IBM Greenford Green Business Park	Green Park Way, Greenford, Middlesex	UB6 0AD	N	N
Digital Realty	Fountain Court, Cox Lane, Chessington	KT9 1SJ	Y	N
IBM Warwick	Birmingham Road, Warwick, Warwickshire	CV34 5JL	N	N
IBM SoftLayer	Chessington	KT9 1SJ	N	N
Equinix LD6	Equinix LD6, Slough	SL1 4NB	Y	Y

Table A15.9 - Additional DCs suggested by BT (Consultation response)

Name	Address	Postcode	Carrier Neutral	2 competitive routes
Sungard	Sungard Elland	HX5 9DA	Y	N
ATOS	ATOS, DC 2, Crofton Centre, Longbridge	B31 4PT	N	N
Ark	Corsham	SN13 9GB	Y	N
Ark	Farnborough	GU14 0LX	Y	N
Equinix	Equinix LD5 - Slough	SL1 4AX	Y	N
Level 3	Level 3 DC, Unit 11, Robert Davies Court, Cambridge	CB4 1TP	N	N
Pulsant	South Gyle DC (AKA ScoLocate), The Clocktower Estate, South Gyle Crescent, Edinburgh	EH12 9LB	Y	Y*(already included)
NTT	631 Ajax Ave Slough	SL1 4BG	N	N
HP	Wynard	TS22 5TB	N	Y
HP	Doxford	SR3 3XN	N	Y
Virtus Hayes	9 Western International Markets, Hayes Road, Southall	UB2 5XJ	Y	N
Virtus Enfield	Unit 3, Tradecity, Crown Road, Enfield	EN1 1TX	Y	Y* (already included)
IBM	North Harbour Portsmouth	PO6 3AU	N	N

Annex 16

Local and national markets and our approach to geographic market definition

Introduction

A16.1 In this annex, we discuss some of the factors that determine whether competition is able to develop locally or only at the national level. This discussion is intended, firstly, to aid understanding of the reasons for the emergence of the geographic variations in competition identified in Section 4 and, secondly, to help us identify the conditions necessary for competition in distinct local markets to be sustainable in the absence of regulation in those markets. We then describe how we approach, for practical purposes, the definition of sub-national geographic markets in Section 4 of this review. The approach is largely as set out in Annex 21 of the May 2015 BCMR Consultation, but we have revised some sections for the sake of brevity and clarity, and to take account of stakeholder comments. This section includes a summary of the comments received on that annex, and our replies to those comments.

A16.2 We first describe the relevant regulatory framework, which emphasises the importance for geographic market definition of variations in competitive conditions between areas. We then identify factors which tend to lead to geographic variations in competition in leased line markets and other factors which tend to create homogeneity. Our main conclusions are:

- Competition is more likely to emerge in an area where a large number of leased line customers are located close together, because of economies of scale and scope;
- CPs expand local networks by incremental investment from existing infrastructure, resulting in local market areas that tend to be contiguous;
- Firms that use leased lines are unlikely to relocate a business premises in response to a change in leased line prices – a leased line to a site in one area is not a good substitute for a leased line in a different area – and this allows local variations in competition, and distinct local markets, to persist;
- National trends, such as the decline in demand for TI services, will tend to reduce the scope for local competition; and
- Any costs or difficulties associated with interconnecting networks, or a customer preference for single-sourcing multi-site networks, will also tend to reduce the scope for local competition.

To operationalise our approach to geographic market definition, we:

- use postcode sectors as the building block of geographic markets, as they strike a good balance between granularity and practicality;
- require geographic markets to be sufficiently material to support sustainable and effective competition (larger than a single postcode sector); and

- place weight on (near) contiguity when defining geographic markets.

The regulatory framework

A16.3 In addition to specifying the services to be included within a market, discussed in Section 4 and Annexes 6 to 8 of this Statement, the EC regulatory framework also requires the geographic scope of the market to be specified. As with product market definition, the aim is for market definition to accurately capture the strength of competitive constraints, thereby ensuring that any regulation is targeted to areas and services where there are competition problems.

A16.4 The SMP Guidelines state that:

> "According to established case-law, the relevant geographic market comprises an area in which the undertakings concerned are involved in the supply and demand of the relevant products or services, in which area the conditions of competition are similar or sufficiently homogeneous and which can be distinguished from neighbouring areas in which the prevailing conditions of competition are appreciably different. The definition of the geographic market does not require the conditions of competition between traders or providers of services to be perfectly homogeneous. It is sufficient that they are similar or sufficiently homogeneous, and accordingly, only those areas in which the conditions of competition are 'heterogeneous' may not be considered to constitute a uniform market."[67]

A16.5 In addition to the SMP Guidelines we have had regard to the BEREC Common Position.[68] The BEREC Common Position identifies criteria for the analysis of the homogeneity of competitive conditions in geographic markets.[69] It states that:

> "market definition should be based on the actual conditions of competition, reflected by the behaviour of the market players (e.g. pricing) and the effect of their behaviour on market structure (e.g. market shares). As is generally the case in ex ante regulation, the analysis of the criteria should also be forward-looking and should – as far as possible – take into account developments until the next review." [70]

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[67] See paragraph 56 of the SMP Guidelines.

[68] BEREC Common Position on Geographic Aspects of Market Analysis (definition and remedies), June 2014 http://berec.europa.eu/eng/document_register/subject_matter/berec/regulatory_best_practices/common_approaches_positions/4439-berec-common-position-on-geographic-aspects-of-market-analysis-definition-and-remedies

[69] In so doing, it is noted in Section 4 of the 2008 BEREC Common Position that the criteria it identifies "are those which are also of importance in an SMP analysis": the 2014 Common Position notes that the 2008 Common Position "is still valid" (*ibid* paragraph 105).

[70] *Ibid* paragraph 106.

A16.6 We identify factors that tend to lead to variations in competitive intensity in different geographies, and factors that tend to create homogeneity in competitive conditions across the country as a whole, or a significant part of it.

Local and national factors in geographic market definition

A16.7 As explained above and consistent with the BEREC Common Position, we consider it appropriate to undertake geographic market definition relying primarily on an assessment of competitive conditions. In Section 4, we explain why, in our view, the presence of rival infrastructure is the main determinant of competition, with geographic variations in intensity of competition likely following variations in the number of suppliers with rival infrastructure in an area able to compete with BT.

A16.8 To illustrate why we are likely to need regulation in some areas, and why an approach based on regulation in some areas (with variations between areas where appropriate) and deregulation in other areas can be effective in promoting national competition in downstream markets, we first consider how competition would be likely to develop if markets for leased lines were not regulated, and there were no merchant market. In such conditions, a CP would not be able to source terminating segments from another CP.[71] Leased lines are end-to-end services connecting sites in different locations, possibly many different ones where multiple sites need to be connected. Absent the possibility to source terminating segments from another CP, a CP would need to have its own network at all the locations the retail customer wants to connect, and these could be at sites across the UK.

A16.9 If the majority of retail customers required connectivity between sites in different locations in the UK, a potential entrant might need an extensive geographic coverage before it could win any customers. Barriers to entry would be very high and it is hard to see how local competition could emerge as only CPs with network in the proximity of most sites would be able to compete. Thus, in circumstances where all or most customers require connectivity to sites in widespread locations in different parts of the UK, terminating segment markets in the absence of regulation would be likely to be national in scope and dominated by incumbents.

A16.10 The ability to source one or more terminating segments from another CP, either at regulated terms in markets where there is SMP, or on commercial terms, seems to be a prerequisite for variations in local competition to exist.[72] The availability of wholesale terminating segments from other CPs increases the ability of a CP to compete for leased lines connecting to sites in areas where they do not have infrastructure nearby.

[71] For simplicity, we assume that the core conveyance market is competitive, with CPs either having their own core networks or able to meet their needs through purchases from third parties.
[72] The assumption here is that customers in the area require connections to sites outside that area. In practice, it seems likely that few if any candidate market areas could be identified in which competition could be effective and entirely self-contained. For example, Towerhouse Consulting, in its February 2015 report on market definition for Colt, Sky, TalkTalk and Vodafone, said “effective competition is unlikely to be sustainable in small and isolated geographic markets due to the considerable economies of scale and scope in fixed telecoms. Effective competitors to BT need to operate at scale, which precludes operating solely in such small geographic areas”, paragraph 3.113.

A16.11 The scope for providing leased lines using terminating segments sourced from another CP depends on:

- the availability of regulated terminating segments (in accordance with the *modified Greenfield* approach we assume that SMP regulation applies outside but not inside the candidate market[73]); and

- the extent to which terminating segments can be purchased in the merchant market.[74]

A16.12 As terminating segments are available to a certain degree – OCPs are willing to provide terminating segments to other CPs (subject to network presence), and we note that in most of the UK BT is most likely obliged to provide terminating segments at regulated terms (as we find BT to have SMP) – we consider it possible that there could be material variations in competition at a local level. We therefore consider it appropriate to analyse whether and to what extent such variations in competition exist when determining the extent of the geographic market.[75] In turn, we now discuss local and national factors affecting competition.

Factors promoting local variations in competition

A16.13 In this section, we outline some of the reasons why local variations in competitive conditions might emerge in leased line markets and consider the factors which cause competition to develop more rapidly in some areas than in others.

A16.14 We assume for the purposes of this discussion that it is possible to provide leased lines that partially rely on one or more terminating segments sourced from another CP – and there is therefore scope for local variations in competition. The question then arises as to where competition develops, and to what degree.

A16.15 As noted above, the key factor determining the intensity of competition is the number of suppliers which have network in an area and are active in the supply of leased lines. The key factors determining the number of suppliers are the size of the local market and the costs of supplying it, that is, the number and density of businesses demanding leased lines. We note in this regard that:

- The ability to exploit economies of scale and scope depends on the extent to which a CP can use the same local network to provide multiple services to multiple customers. By providing multiple services using the same duct network it can reduce its unit costs. It will clearly not be possible for services provided in different areas to share the duct network over which services are delivered. This points to costs and competitive conditions being determined to a significant extent by local scale.

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[73] So for example, where we consider competition in the CLA we assume that SMP regulation applies in the UK outside the CLA.
[74] The extent to which the required segments can be purchased in the merchant market will depend first and foremost on OCPs having network infrastructure near to sites that need to be connected.
[75] See for example the evidence of merchant market transactions in the WECLA set out in the BCMR 2013 Statement; see: http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/

- The overall scale of the local market will determine the number of suppliers which can operate economically, with competition more likely to be sustainable in markets which are large enough for more than one CP to operate at a reasonably efficient scale. A larger local market is also more likely to be able to support an active merchant market.

- Where demand for leased lines is concentrated in a small area, the network extensions needed to connect to individual customers can be kept relatively short, reducing unit costs.

- Local specialisation in particular industries may lead to local variations in demand for leased lines so, for example, areas where firms in the financial services sector are located may have higher demand for leased line products.

A16.16 We learned from responses to our Market Questionnaire, meetings with CPs and [✂] about CP approaches to investing in expansion of network infrastructure.[76]

- While some CPs may consider pro-active expansion to an area (without having specific customers to connect to), for example, in anticipation of sales opportunities and growing demand, most CPs only consider network extension where this is needed for connecting to a business purchasing leased lines.

- Virgin has recently announced its plans ("Operation Lightning") to undertake a significant extension of its fibre network. [✂][77]

- [✂][78] [✂].[79]

A16.17 CPs tend to develop the network infrastructure used for providing leased lines by incremental investments. One reason for this is that adding to an existing network is often the most cost-effective way to expand as it maximises usage of existing infrastructure. Incremental expansion thus allows better exploitation of economies of scope and scale in the existing network. A natural consequence of this is that competitive conditions at the wholesale level will tend to be similar in the geographic area across which the incremental extension of OCPs' networks has taken place. Local networks tend to be contiguous and this is also likely to be true of local market areas because of the way leased line networks are created by incremental investment. The ability to expand incrementally into an area which is adjacent to a competitive area at relatively low cost means that such areas tend themselves to be more competitive as a result.[80]

A16.18 The nature of investments in network infrastructure is one of the reasons why we consider competitive conditions to be more favourable in the LP than in CBDs. The

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[76] [✂]
[77] [✂]
[78] [✂]
[79] [✂]
[80] For example, Towerhouse Consulting, in its February 2015 report on market definition for Colt, Sky, TalkTalk and Vodafone, said: "A patchwork market area is unlikely to capture the essence of competitive conditions on a forward looking basis, in which we might expect suppliers to build network coverage in a reasonably contiguous manner", paragraph 3.112.

proximity to, and economic and physical links with, the CLA mean that OCPs in the LP likely have stronger incentives to invest in network infrastructure, because this can be done as an increment to their networks in the CLA. In addition, demand for leased lines is particularly strong in the CLA, and economic linkages to the LP (reflected in demand for connectivity between them) will increase the attractiveness of investment in the latter area. The benefit of proximity to the CLA will therefore already be reflected in the extent of the infrastructure investment which has occurred in the LP. In our assessment of competitive conditions in the LP in Section 4, we conclude that material further such investment is unlikely over the market review period. However, it remains a possibility, and we take this possibility into account in our impact assessment of remedies in the LP.

A16.19 By contrast, the small size of the CBDs outside London means that circuits there are more likely to connect to a site outside the area where fewer CPs have network. Only (the few) CPs with network at both ends would be able to provide such circuits entirely on-net.[81]

A16.20 In the above discussion we have focussed on supply-side factors but, when defining geographic markets, we also have to consider the potential for demand-side substitution. Because retail leased lines are provided at a fixed geographic location (the customer site), a retail consumer would only be able to switch its demand to an alternative area if it were willing to move to that alternative area. Given that the cost associated with moving location is likely to be very significant relative to the price of a retail leased line, it is reasonable to consider that geographic demand-side substitution is either a very weak or a non-existent constraint on leased-line prices in most cases. The price of a leased line is only likely to be a driving factor in choice of location where connectivity forms a significant part of the total costs of a business and where it has not yet committed to a particular site. In our view it is unlikely that a business would move from an existing site in response to a SSNIP on the price of leased lines. The absence of demand-side substitution possibilities then means that local variations in competitive conditions can persist and is a factor supporting the definition of local, rather than national, markets.

Factors tending to lead to homogeneous national competitive conditions

A16.21 In this section, we outline some of the factors which lead to geographic homogeneity of competitive conditions and which might prevent or hinder the development of local competition.

A16.22 We discuss the following factors:

- Trends in demand and technological change, such as the decline in markets for legacy TISBO services.
- Point-to-point provision for WDM-based services.

[81] For example, Towerhouse Consulting said: “The areas immediately surrounding the Inner London Zone…benefit from proximity to this area (e.g. from the ability to provide Ethernet circuits without trunk networking, and from economic links in general)”, (ibid. paragraph 2.18) and “it is important to acknowledge the unique characteristics of London, and its role in generating different competitive conditions in the surrounding areas” (paragraph 3.116).

- CPs incurring greater incremental costs when providing leased lines using (one or more) terminating segments purchased from another CP.

- Customer preferences for purchasing from a single national supplier and any costs associated with sourcing from multiple suppliers. A single contract, even a large multi-site one, may generate some incremental build but is unlikely to be sufficient to persuade a CP to invest widely where it does not already have network.

Trends in demand and technological change

A16.23 Trends in demand (increasing demand for bandwidth) and technological change likely have a similar bearing on supply, demand and competition throughout the UK. An example is the decline in use of legacy TISBO services throughout the UK. CPs are reluctant to enter and compete for customers in a declining market, even where they have infrastructure in place which could potentially be used (as for example is the case in the CLA, where BT retains SMP in the low bandwidth TISBO market).

WDM services are (commonly) provided end-to-end

A16.24 WDM services are typically provided as end-to-end circuits on a single network, without interconnection. WDM interconnection is technically possible, but is costly and at present is not widely used.

A16.25 End-to-end provision of WDM services requires CPs to have network infrastructure at both ends of the line and in between. Where a CP has network at only one end, the costs of interconnecting or network extension required will impair its ability to compete for provision of the line if another CP has network already present at both ends.

A16.26 As referred to above, BT has a much more extensive network and better geographic coverage than OCPs, in particular outside the major urban centres. As such, BT, and to a lesser extent Virgin, are better positioned to provide WDM services, particularly where one or both ends of the service are located outside major urban centres. This also implies that competition can remain limited, even for services having one end in a geographic area where several CPs have infrastructure. If the area where rival infrastructure is concentrated is small, so that most circuits with one end in that area connect to a site outside it, competition is likely to be ineffective. As long as the OCPs with presence in this area do not have infrastructure at the other end, they are likely to be unable to compete to provide WDM services.

Ability to provide services on-net

A16.27 OCPs have noted that, even in the presence of wholesale remedies, their ability to compete for provision of leased lines is impaired when they need to provide a line off-net, using a terminating segment sourced from another CP, as this tends to raise incremental costs. We note that transaction costs are a possible explanation for incremental costs being greater when providing a service off-net,[82] and that the cost difference between off-net and on-net will affect OCPs' decisions whether to purchase a terminating segment from another CP or instead undertake the network extension required for providing the service using their own infrastructure.[83]

Multi-site demand

A16.28 Some retail users seek to purchase connectivity services linking multiple sites located in different parts of the UK – i.e. multi-site demand. Users can meet multi-site (potentially multi-service) demand in differing ways:

- They can purchase the services in a bundle from a single vertically-integrated CP.
- They can purchase the services in a bundle from a single integrator, which provides the bundle by purchasing and reselling services from different CPs.
- They can purchase services from a number of different CPs, each of which may not have the coverage required for supplying the bundle on its own.

A16.29 The first option – purchasing from a single CP – is not consistent with intense competition at a local level as only CPs with a very extensive coverage (extending to the proximity of sites that need to be connected) can compete. CPs with less extensive coverage – in the proximity of some, but not all sites to be connected – will have an impaired ability to compete as the incremental costs they would incur in providing the bundle would be considerably greater than those incurred by CPs with network in proximity of most/all sites.

A16.30 The second and third options may facilitate competition at a local level as the integrators / retail users provide the bundle of services by sourcing services supplied to individual sites at the best possible terms. This will allow CPs with less extensive network, with network in the proximity of some, but not all, sites to compete.

A16.31 The BDRC end-user survey published alongside the May 2015 BCMR Consultation and responses to Ofcom's Market Questionnaire provide evidence and insights into the materiality and impact of multi-site demand:

- The BDRC end-user survey shows that 33% of end-users currently purchase, and 17% sometimes purchase, connectivity services as part of a wider

[82] Another is that CPs' wholesale charges will often include an allowance for recovery of common costs in addition to incremental costs. The charge controls to which BT is subject allow it to recover a reasonable share of common costs through its wholesale leased line charges.

[83] Earlier we noted that interconnection is necessary for local competition to occur and that this will require regulation where there is SMP. Ineffective regulation may therefore hold back competition at the local level. Regulation which is both effective and retains some incentive for a CP to invest in network of its own will allow local competition to take place, and also facilitate its expansion over time, even if it does not become fully national in scope.

package.[84] This points to multi-site, multi-service demand being a major feature of leased lines markets, in particular, as large businesses with more extensive requirements are more likely to purchase services as part of a package.

- The BDRC end-user survey also provides insights into how retail users view relying on one supplier or multiple suppliers. While most businesses use only one supplier, 25% of businesses rely on more than one supplier (this is more prevalent for large businesses).[85] Reasons for relying on one supplier included ease of managing, quality of services, and better discounts; reasons for relying on multiple suppliers included value for money, resilience, being able to make use of CPs' specialising in different services.[86]

- The Market Questionnaire informed us on the views and experiences of CPs as sellers and buyers of leased lines.[87]

  - Some respondents indicated that they use several different suppliers, that this has not created any problems, and that this allows them to use competition between suppliers to improve the terms on which services can be purchased.

  - CPs were asked to list factors which were important to them when selecting suppliers. Some listed many different aspects of service provision as important, but nearly all included coverage/location and price.

  - One respondent [✂][88]

  - When asked about which operators were well placed to meet their needs, BT was almost always amongst those mentioned and this was often explicitly linked to the coverage of its network.

  - A number of respondents said that using multiple third-party suppliers led to additional costs for various reasons including multiple connection fees, reduced reliability, inconsistent SLAs and the need to integrate different systems.

A16.32 Multi-site demand may affect competition compared to the case where demand is for provision of services to individual sites.

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[84] See Section 8 of the BDRC end-user survey. http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

[85] See Section 8 of the BDRC end-user survey. http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

[86] See Section 8 of the BDRC end-user survey. http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_2014_report-bdrc.pdf

[87] CP responses to questions 11 to 14 in the Market Questionnaire. The Market Questionnaire was sent to CPs in July 2014.

[88] [✂]

- A CP's ability to compete for multi-site demand will depend on the extent to which the CP has network in the proximity of most/all sites to be connected. This is likely to provide an advantage to CPs with greater network coverage.

- The greater value of retail contracts involving multi-site demand could (possibly) increase the incentives of CPs to extend their networks – if network extension is the key to securing large contracts, the revenues could be more likely to exceed the additional costs.

A16.33 If retail users insisted on the same vertically integrated supplier in all areas where they require leased lines, there would be a tendency for competition to be national in scope. As it is, local competition can and does take place, but larger networks are still likely to have an advantage.

A16.34 To see this, consider a retail user that wants its multi-site demand to be met, and preferably by a single supplier. CPs would then compete for the provision of a bundle of services. The ability of a CP to meet multi-site demand depends on the extent to which it has network in the proximity of sites that need to be connected.

- Where a CP has network in the proximity of a site, it can connect that site using its own network requiring limited network extension and thus at low incremental costs.

- Where a CP does not have network in the proximity of a site, it can provide the service using its own network (requiring material network extension) or sourcing a terminating segment from another CP. Either way, providing the service is likely associated with more considerable incremental costs.

- The greater the proportion of services that need to be provided to a site where a CP does not have network nearby is, the greater the CP's incremental costs of providing the bundle, and thus the more impaired the CP's ability to provide the bundle on competitive terms.

A16.35 A CP whose duct network extends to most sites in the UK would be able to meet multi-site demand providing services over its own infrastructure requiring neither significant network extension nor purchasing services from other CPs. Consequently, such a CP would be able to provide bundles of services at relatively low incremental costs. A prevalence of multi-site deals with very wide coverage would tend to lead to competition between national networks.

A16.36 Where multi-site demand is a major feature of leased lines markets, this may lead to broader geographic markets.

Comments in responses

A16.37 In its response to the May 2015 BCMR Consultation, BT said that geographic markets were neither local nor national but "spindly", including both access and core infrastructure, and appearing "not dissimilar to a map of main roads". BT argued that, for many CPs, the market was "a web of…clustered customers".

A16.38 BT also said that CPs do not generally all target all customers even if they have infrastructure nearby as other costs including marketing/sales also feature economies of scale and scope. Instead, CPs will have an incentive to target certain customer types to recover service and marketing costs which are common to those customers. This is a point about product market definition as much as one about geographic market definition. BT seems to be arguing that competitive conditions differ between services in an area rather than being a function only of the number of alternative networks, and that this should be reflected, not only in more narrowly-defined product markets (than the CISBO market) but also in geographic markets which might then differ between these product markets.

A16.39 BT also did not agree that in the absence of regulation or a merchant market, competition would be determined nationally. It drew attention to the proportion of business sites which were within reach of competing networks and also cited Colt as an example of a CP which tries to avoid off-net sales, as evidence that competition could take place within small entirely self-contained local areas.

Our views on these points

A16.40 We use the term "local" simply to mean a market which is not national. It does not have the specific meaning attributed to it by BT and does not exclude "spindly markets" by definition.

A16.41 One reason why we have not in fact defined geographic markets which are "spindly" is that it would be inappropriate to include access services and conveyance over core infrastructure in the same market. The core conveyance market is presumed to be competitive whilst markets for access or terminating segments generally are not. Competition in the provision of terminating segments is determined by conditions at the customer site but this is not true of core conveyance. There is therefore a quite fundamental difference in competitive conditions between them.[89]

A16.42 To the extent that BT's point is an observation about the actual coverage of OCPs' networks (where they overlap), we consider that this coverage is captured by our network reach analysis. For example, we have defined the LP as a separate geographic market to reflect the extent of competition in this area. However, a CP's geographic footprint is not the same as the geographic market in which it operates but may extend to several different geographic markets, as is the case for the CPs which operate in each of the CLA, the LP and parts of the RoUK. We discuss BT's concerns about the use of postcode sectors as the basis for geographic market definition below.

A16.43 A CP's "target market" may often not correspond to a definition of an economic market that is appropriate for regulatory purposes. It is true that there are some CPs which concentrate on market niches, for example VHB services. But we expect BT to take an increasing share of the VHB segment in future as the requirements of VHB users become more like those of lower bandwidth users. VHB customers will increasingly be users who have recently migrated from lower bandwidth services, and niche players will be less well placed than large CPs to meet their needs. We refer to this development as "standardisation", as we explain in Section 4.

A16.44 In addition, larger CPs are likely to sell a broad range of services perhaps employing different marketing approaches depending on the customer. For example, for customers buying low-value standard services, a web-based pricing

[89] In addition, CPs do not necessarily have flexibility points on core networks to connect to customers (see paragraph 5.117 of the 2013 BCMR Statement).

tool may be used whilst for large complex contracts a dedicated sales team may be employed. In general, retail costs of this nature are not sunk and would not be considered a significant barrier to entry to a segment that a CP did not address, and this is reflected in the fact that nearly all retail markets are competitive where regulated wholesale inputs are available. In any case, a CP could avoid most such costs by entering at the wholesale (passive access or CISBO) level if its business model were based on selling to other CPs.

A16.45 Given the economies of scale and scope in leased line provision, a larger network providing a full range of services would be expected to have lower unit costs (in any given area) than a smaller network or one providing only a limited range of services. In many areas, a single market segment will be too small to support investment in an access network and a CP will need to get customers from across the CISBO market to recover the costs of the shared infrastructure. This is one reason for expecting broad homogeneity of competitive conditions across services provided using a common infrastructure.

A16.46 We also consider that even if, in theory, a CP with a local network could compete for circuits wholly within the area it covered, in practice local competition would be unlikely to emerge in the absence of either regulation or a merchant market. The key point is that such a CP could not compete at all for a circuit of which any part was outside this area. If multiple sites in several locations had to be connected, such a CP would be at a great disadvantage and this, combined with the costs of creating a national network, could deter entry in any area. Any competition which did take place would be very limited in the absence of a merchant market or regulation.

A16.47 The local competition to which BT drew attention will therefore reflect the regulation which has long been in place and which enables CPs to have access to BT's network in most locations where they do not have their own. Whilst several CPs have told us that they prefer to sell, or are more competitive, on-net than off-net, this is entirely understandable as a CP's forward-looking marginal or incremental costs of using its own capacity, where it exists, are likely to be significantly below the cost of bought-in services from BT. In addition, CPs have greater control over services they provide on-net and can differentiate their products to a greater extent. Nonetheless, BT's external sales remain significant. It is also the case that Colt (the example cited by BT) does use off-net services, mainly to connect customer sites to its own network.

Our approach

A16.48 In light of the points discussed above, our approach is based on the view that competitive conditions are determined locally, and primarily by the extent and density of rival infrastructure in an area. We also acknowledge the potential importance of multi-site demand and other factors tending to lead to national markets and this is one reason why we only define separate markets where there are clear and sustainable differences in competitive conditions in a material area.

Practical solutions to operationalise our approach

A16.49 In Annex 21 of the May 2015 BCMR Consultation, we said that, in order to operationalise our approach, we had had to address a number of practical issues, including:

- The choice of geographic building block – whether to use postcode sectors as in the BCMR 2013;

- How to ensure that geographic market areas were sufficiently material to be capable of supporting sustainable and effective competition, taking account of CPs' approach to investments; and

- Whether to require geographic markets to be composed of (nearly) contiguous postcode sectors as we had in previous reviews.

A16.50 We explained that selection of the appropriate geographic unit involves a trade-off between granularity and practicality. We said that an assessment of competitive conditions at the level of individual sites would be impractical and disproportionate in terms of data collection and analysis, whereas wider geographic units would risk masking large variations in competitive conditions. We considered, having taken account of the criteria stated in the BEREC Common Position, that postcode sectors remain the most appropriate geographic unit, with our reasons including:

- Postcode sectors are mutually exclusive and granular – the UK is divided into over 10,000 postcode sectors;

- The network structure of all relevant operators and the services sold on the market can be mapped onto postcode sectors; and

- Postcode sectors are small enough that competitive conditions within the sector are likely to be broadly similar in most cases but at the same time large enough that the burden on CPs and us with regard to data delivery and analysis is reasonable.

A16.51 We considered that CPs would be unlikely to invest in an access infrastructure in an area just to serve a single postcode sector. They would instead aim to serve customers in a wider local area – including, where possible, multiple neighbouring postcode sectors – to benefit from the available economies of scale and scope. This suggested that competitive conditions would be determined over a wider area than a single postcode sector. In addition, this was consistent with the pattern of OCP investments in network infrastructure observed over the past decades, where OCPs have tended to target urban areas, benefiting from the greater density of (potential) demand, and possibly from better utilisation of their network. The implication was that, to be material enough to support sustainable and effective competition, a geographic market should comprise a number of postcode sectors, forming a larger local area than a single sector.

A16.52 We also said that we placed weight on (near) contiguity when defining the geographic scope of markets. We referred to Annex 15, paragraphs A15.172 – A15.174 where the relevance of contiguity to geographic market definition, and its application to the definition of the CLA as a geographic market, was explained.

Comments in responses

A16.53 BT said that postcode sectors are "often too large to accurately assess competitive conditions within the sector" and did not agree that competitive conditions would be broadly homogeneous within a postcode sector in most cases. It also disagreed with "imposing a contiguity constraint".[90] BT argued that economies of scale and scope are not local to neighbouring postcode sectors and that therefore a contiguity requirement is unjustified. It said that Slough, Croydon, Manchester, Birmingham and Bristol are all contiguous with central London.[91] It also said that CPs' target markets would be based on the locations of the sites of their customers and were neither local nor national.

A16.54 BT also included in its response what it described as "evidence of geographic markets from the 2013 BCMR". This consisted of reproductions of a number of Maps of the WECLA which had been published in Section 5 of the March 2013 BCMR Statement. BT re-interpreted the information in the Figures in support of its argument that geographic markets are "spindly" (see paragraph A16.37 above). BT claimed to be able to observe "spindly" clusters of leased line customers within the WECLA and said that these were reflected in the locations of CP networks, which followed customer demand. BT said this meant that geographic markets were similarly "spindly" and could not be well approximated by groups of postcode sectors.

Our views on these points

A16.55 The points BT makes in its response are the same as or closely related to arguments it advanced during the BCMR 2013. Indeed as noted above, BT relies for some of the points it makes on evidence published in the March 2013 BCMR Statement, albeit with a different interpretation. We have reviewed our conclusions on BT's arguments but find that they also are not materially changed since 2013 as we explain below. This is to be expected since there has been no fundamental change in the economics of leased line provision and the relevant guidelines on geographic market definition – the BEREC Common Position - remain applicable.[92]

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[90] BT also argued that the contiguity requirement was invalid because the "spindles" of geographic markets cut through postcode sector boundaries. For the reasons set out earlier in this annex we do not agree that geographic markets for terminating segments are spindly but, in any case, it appears to us that the logic of spindles suggests they would in fact be composed of contiguous access and core segments.

[91] Clearly BT did not mean that these areas are literally or physically contiguous. We understand it to be arguing that the linkages between these areas are such that competitive conditions are homogeneous despite the absence of physical contiguity. In other words, we believe BT to be arguing as it did in 2013 that there is "logical contiguity" between these areas.

[92] BEREC presented an updated common position on geographic aspects of market analysis (definition and remedies) on 6 June 2014. This maintains the position that "there is no need for competitive conditions to be perfectly homogeneous across all geographical areas included within one market…With a large number of small areas…there is likely to be a continuum of competitive conditions, so it will usually be difficult to draw a clear line between more and less competitive areas. One approach would be to evaluate competitive conditions in each geographical unit on its own and classify the area accordingly. However, this would cause a huge workload for NRAs and is also likely to be arbitrary to some extent. A more practical and appropriate approach is to define clear and

A16.56 BT's point that postal sectors are "often too large" is not a new one. In practice, a feature of postcode sectors is that they scale with address density and so, in central city areas, they are significantly smaller than in rural areas. This means using sectors provides greater precision where there are more businesses.[93] The small size of postcode sectors in the CLA, combined with the high density of networks and businesses, make it more likely that competitive conditions are homogeneous within postcode sectors in the CLA than in other areas. The boundary criteria themselves – in particular the requirement in Condition 2 that *at least 90%* of businesses in a postcode sector should be no further than 100m from a flexibility point of at least two CPs – will also tend to ensure homogeneity within the Postcode Sectors of the CLA.

A16.57 In Annex 10 of this Statement we present a series of sensitivity analyses on the CLA boundary. These allow us to conclude that the boundary is robust to changes in the criteria used to define it. In particular, competitive conditions in the CLA are clearly different to those in other areas whether measured on a postcode sector basis or at customer sites. This can be seen from Table A10.38 where we compare the network reach values for the CLA, the LP, the CBDs and the RoUK when calculated using data on leased line customer ends with network reach calculated using data on locations of business sites. As can be seen in the table, the corresponding values for business sites and customer ends are broadly similar, with the main difference being that network reach is higher in the LP than the CBDs for customer ends at 200m.[94]

A16.58 In Figure A10.46, we show the effect on the CLA boundary of using postcodes rather than postcode sectors to define it. The result has a more "patchy" appearance than the actual CLA boundary due mainly to the fact that many postcodes have no large businesses present. We consider that this patchwork effect would be a serious practical drawback of using postcodes as a basis for market definition. Nonetheless, the broad pattern of the intensity of competition within the CLA is still apparent.

A16.59 The decision to use postcode sectors in 2013 was taken only after detailed review of the appropriate geographic unit and in particular of the trade-off between the granularity of the unit and practicality. Having again reviewed the relevant arguments, we remain of the view that postcode sectors strike an appropriate balance between allowing sufficient granularity while also being amenable to a manageable analysis. In particular, postcode sectors satisfy the criteria set out by BEREC in its June 2014 common position on geographic aspects of market

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unambiguous criteria according to which the geographical units are grouped"; paragraphs 128 – 129 at http://berec.europa.eu/eng/document_register/subject_matter/berec/regulatory_best_practices/common_approaches_positions/4439-berec-common-position-on-geographic-aspects-of-market-analysis-definition-and-remedies

[93] See also paragraph 5.23 of the BCMR 2013 Statement and paragraphs A10.54 – A10.55 of this statement.

[94] See also the range of sensitivity results reported in the 2013 BCMR Statement in paras 5.124 – 5.134.

analysis.[95] BEREC states that "Generally, the choice of distinct geographical units should satisfy the following criteria:

a. They are mutually exclusive and less than national.
b. The network structure of all relevant operators and the services sold on the market can be mapped onto the geographical units.
c. They have clear and stable boundaries.
d. They are small enough for competitive conditions to be unlikely to vary significantly within the unit but at the same time large enough that the burden on operators and NRAs with regard to data delivery and analysis is reasonable."

A16.60 Whilst competitive conditions may vary within postcode sectors to some extent (though to a lesser extent in the CLA and other central areas), we consider that it would not be appropriate or practical to conduct an analysis using smaller and more numerous geographic units than postcode sectors, which themselves number over 10,000. Our conclusions are consistent with the BEREC Common Position where it states that, "[t]he number of geographic units will depend on the circumstances of the case, however, as experience shows, the number will usually be significant and may even go up to several thousands. Although it would theoretically be possible to make a separate SMP analysis for each of these units, it is likely to be more appropriate and more practical to aggregate units according to the homogeneity of competitive conditions, consistent with the SMP Guidelines".[96]

A16.61 We are not aware of any new factors which we should take into account and consequently we consider that postcode sectors continue to provide an appropriate trade-off between granularity and practicality.[97] This also ensures consistency of our approach with the BEREC Common Position, and over time.

A16.62 Similarly, the relevance of contiguity was discussed at some length in the March 2013 BCMR Statement.[98] We required contiguity in the 2008 BCMR and, with one limited exception, in the BCMR 2013, because investment decisions in leased line markets are often incremental to current network build and we therefore considered that competitive market areas would also tend to be contiguous. We continue to believe this to be the case.[99] As we note in Annex 10, the CLA is an area composed of one large and two smaller contiguous blocks each separated from the main block by a single postcode sector and likely to have strong economic links between them. We consider that defining the CLA as a single market is consistent with the approach we adopted to the WECLA in the BCMR 2013.

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[95] See BEREC common position on geographic aspects of market analysis (definition and remedies), June 2014, paragraph 86 at: http://berec.europa.eu/eng/document_register/subject_matter/berec/regulatory_best_practices/common_approaches_positions/4439-berec-common-position-on-geographic-aspects-of-market-analysis-definition-and-remedies.
[96] *Ibid.* paragraph 91
[97] For a full discussion of the issues around the use of postcode sectors, including the arguments put by Stakeholders and our replies, see also the 2013 BCMR Statement paragraphs 5.15 – 5.25 and 5.145 – 5.149.
[98] For a full discussion of contiguity, including the arguments put by Stakeholders and our replies, see the 2013 BCMR Statement paragraphs 5.63 – 5.66 and 5.153 – 5.178.
[99] See above paragraphs A16.17 – A16.18

A16.63 As noted above, BT's assertion regarding the contiguity of towns and cities in various locations outside central London appears to be a repeat of the argument for "logical contiguity" which BT advanced in submissions to the BCMR 2013 and which is discussed in paragraphs 5.153 – 5.178 of the March 2013 BCMR Statement. We have not included any of these areas in the CLA, the main reason being that competitive conditions in the CLA are not homogeneous with those in the LP, the CBDs or other parts of the RoUK including Croydon. [100] Our analysis shows that the number of competing networks in these areas is much smaller than in the CLA. But in any case we do not agree with BT's arguments for 'logical contiguity' since, for the reasons set out earlier in this annex, we consider that competitive conditions are determined locally and, to a large extent, by local scale.[101]

A16.64 We do not agree with the inferences BT draws from maps published in the March 2013 BCMR Statement. For example, BT's assertion that large business sites are more clustered than small business sites is not, in our view, supported by Figure 5.14. We consider that Figure 5.14 is in fact more consistent with our own view, reported in para 5.132 of the March 2013 BCMR Statement, that "larger and smaller businesses are generally located in similar areas". This view was also supported by statistical tests we carried out.[102]

A16.65 Similarly, whilst BT claims that Figure 5.11 of the March 2013 BCMR Statement (which shows network reach at customer sites) shows "enormous areas of HNR" outside the WECLA, our view remains that "the Figure does show that most postcodes with two or more OCPs within reach of customer ends are in the WECLA+ area, and that there are relatively few postcode sectors within the WECLA+ area that have fewer than two OCPs, which is broadly supportive of our network reach analysis based on large business sites".[103] We also consider that the example of Fulham, cited by BT as an area of low network reach which includes a significant number of business sites, tends to support our approach since it is apparently correctly defined as outside the WECLA. Moreover, the definition of "HNR" used in the March 2013 BCMR Statement was based on the presence of two OCPs within 200m of business sites on average, not the boundary tests used to define the CLA as a competitive market area. The "enormous areas of HNR" claimed by BT would therefore not be regarded as areas where competition is effective in any case.

A16.66 Figure 5.10 of the March 2013 BCMR Statement was a "sense check" of the WECLA boundary without using either business locations or postcode sectors which broadly supported the definition of the WECLA (paras 5.110 – 5.111 of the March 2013 BCMR Statement). Figure 5.14 shows the overlap between small and

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[100] Nor are competitive conditions homogeneous within the group of areas listed by BT: (part of) Slough is in the LP, Croydon is in the RoUK, whilst the central areas of the other three are CBDs
[101] For example, Towerhouse Consulting, in its February 2015 report on market definition for Colt, Sky, TalkTalk and Vodafone, said "It cannot be emphasised enough just how different the central London area is from the rest of the country", paragraph 3.91.
[102] See, in particular, footnote 450 which reports the results of statistical tests showing "a strong positive relationship between the number of large and smaller businesses in a postcode sector".
[103] See the discussion of Figure 5.11 in the 2013 Statement at paragraphs 5.126 – 5.127. The term WECLA+ was used in the 2013 BCMR Statement to refer to the West, East and Central London Area (WECLA) as defined in the June 2012 BCMR Consultation, plus the Slough sectors. The WECLA+ is now referred to simply as the WECLA.

large business locations. In our view, the superimposition of the two figures (as in BT's Figure 4) tends to confirm that the WECLA boundary was robust (given the boundary criteria used). Inspection of BT's Figure 4 suggests that the greatest overlap is in the WECLA and it is hard to discern any clear evidence of overlapping spindles outside the WECLA.

A16.67 We do however recognise that current competitive conditions are not fully homogenous throughout the LP. OCPs have invested in network to supply high value sites in the area but this rival infrastructure is patchy, reflecting the much sparser distribution of high value sites in the LP than in the CLA. This in turn is reflected in the much lower average network reach figures for the LP than in the CLA. A case has sometimes been argued for carving out those high value sites and finding them effectively competitive.[104] However, it would not be practical or proportionate to carve out individual sites from within the LP and our objective is not therefore to identify individual business sites which might have an effective choice of supplier.[105] Rather, we assess the area as a whole, finding that BT has SMP in the CISBO market in the LP. However, this judgement is more finely balanced than in the RoUK. This more finely balanced SMP finding in the LP is reflected in our assessment of remedies.

Our conclusions

A16.68 We consider, having taken account of the criteria stated in the BEREC Common Position, that postcode sectors remain the most appropriate geographic unit, with our reasons including:

- Postcode sectors are mutually exclusive and granular – the UK is divided into over 10,000 postcode sectors;
- The network structure of all relevant operators and the services sold on the market can be mapped onto postcode sectors; and
- Postcode sectors are small enough that competitive conditions within the sector are likely to be broadly similar in most cases but at the same time large enough that the burden on CPs and us, the relevant National Regulatory Authority, with regard to data delivery and analysis is reasonable.

A16.69 We also place weight on (near) contiguity when defining geographic scope of markets. We consider that local networks will tend to be contiguous and an area which is adjacent to a competitive area will itself tend to be more competitive as a result.

[104] More granular analysis of this kind was favoured by BT in its submissions to the BCMR 2013: see, for example, the "DotEcon critique" discussed in paragraphs 5.145 – 5.149 of the 2013 BCMR Statement. The "spindly markets" approach now advocated by BT represents a change from its 2013 position.

[105] As we noted above, our approach is consistent with the BEREC common position on geographic aspects of market analysis (definition and remedies).

Annex 17

Profitability analysis

Summary

A17.1 This Annex presents our analysis of the profitability of BT and KCOM's provision of wholesale leased lines. We rely on this analysis in our assessment of competition and market power in relation to the wholesale markets identified in Sections 4, 5 and 6 of this statement. Annex 9 explains the position and role of profitability analysis as part of a SMP assessment.

A17.2 In Annex 22 to the May 2015 BCMR Consultation we presented our preliminary analysis of profitability of relevant services provided by BT and KCOM. In this Annex we update our analysis, as both BT and KCOM have now published their relevant regulatory reports for the financial year 2014/2015. We also received a small number of comments on Annex 22 from stakeholders, in response to our Consultation. These comments are addressed below in the appropriate sections.

A17.3 The main findings based on profitability analysis are:

17.3.1 ROCEs relating to BT's provision of low bandwidth TISBO services have consistently and significantly exceeded BT's cost of capital and have been rising over time. This is consistent with a finding of SMP, although we do not put much weight on the precise figure as the relevant assets are heavily depreciated.

17.3.2 The high ROCE indicators relating to the provision of AISBO services outside of WECLA are consistent with BT having SMP in the supply of CISBO services in this area.[106]

17.3.3 ROCEs relating to the provision of AISBO services in the WECLA have been consistently and significantly above BT's cost of capital, at levels which, by themselves, would be consistent with BT having market power in the supply of CISBO services in this area.[107]

17.3.4 There is no variation in KCOM's ROCEs across product markets and over time. This strongly suggests that the ROCEs reported by KCOM do not reflect its true profitability. Hence we consider that the ROCEs reported by KCOM do not provide a reliable basis for inferring any market power KCOM may have.

[106] BT reports figures for the markets defined for regulatory purposes in the 2013 BCMR, which include the AISBO market.
[107] Profitability is only one of the criteria for SMP listed in the SMP guidelines. A full list of relevant criteria is given in Annex 9. In the CLA, other indicators, particularly the extent of competing infrastructure, point strongly to a no-SMP finding, as explained in Section 4.

Rationale for profitability analysis

A17.4 According to the SMP Guidelines, when assessing market power it is important to consider a CP's power to raise prices without incurring a significant loss of sales or revenue. A CP with significant market power has, by definition, the incentive to profitably raise prices above the competitive level, and will have the ability to do so if it is unregulated. By contrast, a CP without significant market power is constrained by competitors, customers and consumers, and will not be able to profitably raise and sustain prices above the competitive level. Where a CP's profits significantly exceed the competitive benchmark for an extended time period, we consider this to be an indicator that the CP in question may have significant market power.

A17.5 We recognise that caution is warranted when drawing inferences on market power based on profitability analysis:

- Measurement and interpretation of profitability are subject to a number of limitations and imperfections, described in more detail below.
- Temporary above-normal profits can be consistent with competitive markets, for example, if such profits reflect the rewards for successful innovation.[108]
- Profitability is affected by factors other than competitive conditions, for example, economic growth. At least in the short term, such factors can increase or decrease a CP's profitability while bearing no relation to underlying competitive conditions.

A17.6 For these reasons, and as explained in Annex 9, our market power determinations do not rely on profitability (or any other single indicator) alone. We interpret profitability as follows:

- We do not make inferences about competitive conditions in markets where we find low levels of profitability and that were also subject to price regulation in the period under review.[109]
- We place some weight on profitability as an indicator of market power where profitability significantly and consistently exceeds the competitive benchmark. However, we do not regard this to be a necessary condition for finding a CP to have SMP.

[108] Such a presence of temporary above-normal profits provides incentives for entry and expansion, which drive competition. However, in competitive markets we expect profits to erode over time. Persistently high profitability is more likely to be an indicator of SMP.

[109] Where we find that profits do not consistently exceed the competitive level, we do not automatically regard this as evidence of a CP not having market power. A CP with significant market power can make normal or below-normal profits if it operates inefficiently, or – if subject to *ex ante* regulation – a charge control prevents above-normal profits being made.

Measurements of profitability and the competitive benchmark

A17.7 As in the previous BCMR, we assess profitability by benchmarking a CP's return on capital employed (ROCE) against that CP's weighted average cost of capital (WACC).

- ROCE is the ratio of accounting profit to capital employed, with capital employed being the accounting value of the net assets used in producing an undertaking's output. Assets can be valued on either a Historical Cost Accounting (HCA) basis or a Current Cost Accounting (CCA) basis.[110] The latter is generally preferable as a measure of the value of the resources used to produce a service. Importantly, ROCE relates the return to the capital that was employed in producing the output on which the return was made.

- The WACC is determined by weighting an undertaking's costs of equity and debt by the proportions of equity and debt in that undertaking's financing.

A17.8 In the longer term, we expect that undertakings – at least in competitive markets – will achieve a return on capital employed that does not greatly exceed the minimum needed to reward providers of capital for the risk they bear. In other words, in competitive markets we expect ROCE to tend towards the WACC over time.

Financial data reported by BT and KCOM and some general factors that affect changes in reported results

A17.9 Under the existing SMP regulation, BT and KCOM are obliged to publish the financial results – including turnover, return, operating costs, mean capital employed – of their sales of wholesale leased lines in the markets in which they were found to have SMP in the BCMR 2013. BT publishes its financial results in its Regulatory Financial Statements (RFS), and KCOM - in its Regulatory Financial Review (RFR).[111]

A17.10 BT and KCOM report operating costs and mean capital employed on a Fully Allocated Cost (FAC) basis. FAC is an accounting measure of costs. Costs are attributed to services and markets using various attribution rules. Attributions of costs to different services and markets may change between years for many reasons. BT now publishes a report annually that explains the major methodological changes that they make when preparing its RFS and the effect of those changes.[112] When interpreting an operator's published ROCE results we therefore need to recognise that changes in allocations may explain some of the changes in profitability year on year.

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[110] Under the HCA convention, assets are valued at their original purchase cost. Under the CCA convention, they are valued at what it would cost to replace them with equivalent assets today.

[111] See http://www.kcomplc.com/regulatory/regulatory-accounts/ for KCOM's regulatory accounts for the regulatory year ending 31 March 2015, and http://www.btplc.com/thegroup/RegulatoryandPublicaffairs/Financialstatements/index.htm for BT's regulatory accounts covering the regulatory years 2010/11 to 2014/15.

[112] See for example BT's latest Reconciliation Report, 2 December 2015, https://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2015/ReconciliationReport201415.pdf

A17.11 There will also be changes to attribution because of volume movements. Many of BT's costs are shared or used to provide many different services. These include both operating costs and capital costs. We refer to these shared costs as common costs. Examples of common costs are general overhead costs and most duct costs. Many common costs are attributed across services using the underlying volumes. If volumes are growing faster in one market compared to another market then that will lead to the market with the higher growth rate attracting a higher proportion of common costs. We do not reflect this reattribution of common costs within our charge control models.

A17.12 We also note that profits calculated on an FAC basis may not be a good indicator of the benefit BT receives from selling a particular service. This benefit – the extra profit - is the difference between the revenues BT receives and the extra or incremental costs incurred in supplying the service, including the cost of the incremental capital employed.

A17.13 By contrast, an accounting measure of cost like FAC treats a share of BT's common costs as part of the costs of each individual service.[113] This is an appropriate way to account for common costs, and FAC is also useful as a benchmark for setting charge controls that allow BT to recover its common costs while ensuring that only a reasonable share of them is recovered from regulated services.[114] But because setting all prices equal to FAC may not be a very efficient way of recovering common costs, we do not require BT to set prices this way. As a result, rates of return on individual services, measured on an FAC basis can be above or below the cost of capital even where they are subject to a charge control. It may then be informative to look at profits across a group of services which share common costs, as well as at those of an individual service within that group. A high accounting rate of return on one service may not be excessive if overall costs are only just being recovered whilst, conversely, a low rate of return on one service may reflect the allocation of a large and perhaps disproportionate share of common costs, especially if overall profits are high. This can particularly be the case where a group of such services has been regulated as part of a single charge control basket. Part of the rationale for controls of this kind is that they allow BT to vary relative prices in order to recover costs more efficiently than if all charges were set at FAC.

Data on BT's profitability

A17.14 In this section we review data on BT's profitability. However, we first discuss how we map the data within BT's reported results onto our market definitions before then describing how we treat various CCA adjustments that are included within BT's statements.

[113] Common costs are costs which are shared with other services and are not incremental to any one service. Common costs could not be saved by ceasing to supply any one service.
[114] The most economically efficient way to recover common costs is through Ramsey prices which are inversely related to the price elasticity of demand. There is no reason to expect a Ramsey price to equal the FAC of a service, as FAC does not take account of demand-side factors.

Mapping the profitability data to the market definitions proposed in this consultation

A17.15 BT reports profitability data for the markets in which it was found to have SMP in the previous review. In this review we are proposing some changes to the markets defined, and therefore the available profitability data does not map precisely onto the market definitions proposed in this review. However, we consider that data available currently does provide a reasonable basis to inform our SMP analysis:[115] In summary, our considerations are:

- Product markets
  - Profitability of CISBO services can be inferred from the data for AISBO and MISBO services. Given the far greater number of AISBO sales than of MISBO, we consider that the profitability figure for AISBO services is the best guide to profitability for CISBO services. Outside the WECLA we can calculate profitability for CISBO services directly by combining the relevant data on AISBO and MISBO services;
  - We also have profitability data for the MISBO market alone, which we refer to in our discussion of competition in the provision of very high bandwidth CISBO services.
- Geographic markets
  - The “Rest of UK” geographic market defined in this review is identical to the “UK outside WECLA” used in 2013, so we can use these data to assess profitability in the “Rest of UK” geographic market.
  - In the London area, we do not have separate profitability data for our proposed CLA and LP markets, but only for the WECLA (which is the CLA and LP combined). However, we think that the data for the WECLA are likely to correspond reasonably closely to the CLA, as volumes in the CLA form the large majority of volumes in the WECLA. This also means that the WECLA data are likely to provide a less good indication of profitability in the LP. Although BT’s charges are generally the same in both the CLA and the LP, unit costs may differ between the two areas (as, for example, they appear to do between the WECLA and the UK outside the WECLA).

Asset valuation – treatment of holding gains and losses, and depreciated assets

A17.16 The ROCEs reported by BT are calculated on a CCA basis, with the return calculated by subtracting CCA operating costs from turnover.

[115] If market definition and SMP findings change following a market review, then these changes will be reflected in the financial data that BT reports. Thus, for the financial years 2010/2011 and 2011/2012, BT reported figures for a national market for AISBO services. Following the changes in market definition in the 2013 BCMR, BT reports figures for separate markets for AISBO and MISBO services in the UK outside the WECLA, and for AISBO services in the WECLA.

A17.17 BT reports CCA operating costs prepared under the FCM convention. Under this convention: (i) changes in asset values are considered 'holding gains' if the asset price increases, or 'holding losses' if the asset price falls, and (ii) holding gains/losses and other one-off adjustments are treated as 'costs' in the financial year in which they occur. An implication of this convention is that variation in reported ROCEs may not reflect changes in competitive conditions because holding gains/losses and other one-off adjustments can vary for reasons not related to underlying competitive conditions.[116]

A17.18 For this reason, and because of some particularly sizeable adjustments in the relevant period, we presented two sets of profitability data in the March 2013 BCMR Statement:

i) CCA figures from BT's regulatory financial statements, in order to reflect BT's reported ROCE; and

ii) adjusted figures based on the data from BT's regulatory accounts, but excluding all holding gains and losses and other one-off adjustments which resulted from changes in accounting methodology.

A17.19 In this review, we again assess BT's profitability based on reported ROCEs including holding gains/losses and other one-off adjustments as we consider those relevant to BT's profitability.[117] Moreover, holding gains/losses and other one-off adjustments, at least in the years 2012/13, 2013/14, and 2014/15[118], were relatively small in comparison to BT's operating costs, and did not vary materially over time, so we have not presented adjusted figures in this statement.[119]

A17.20 In markets in which the assets used to provide services are substantially or fully depreciated, asset depreciation can reduce the extent to which reliable inferences on market power can be made based on ROCEs. This is a particularly relevant consideration for the profitability analysis of low bandwidth TISBO services.

Analysis of BT's profitability

A17.21 Table A17.1 presents BT's ROCEs for the leased lines markets in which BT was found to have SMP in previous BCMRs for the financial years 2010/11 to 2014/15. It reflects changes in the product and geographic markets for which BT reports data in its RFS.

[116] For example, because of occasional revisions to asset values and/or changes in accounting practices

[117] In the previous market review, we calculated adjusted ROCEs with holding gains/losses and one-off adjustments subtracted from the CCA operating costs. An alternative would be to smooth adjustments over time reducing the impact of significant one-off changes.

[118] See Sections 5.1 and 5.2 of BT RFS for 2014/15. http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2015/RevisedCurrentCostFinancialStatements2015.pdf

[119] As other adjustments were significant in the regulatory years 2010/11 and 2011/12, we considered it in the 2013 BCMR appropriate to establish adjusted ROCEs that would mitigate for the effect of one-off adjustments on profitability.

Table A17.1 BT's reported ROCEs in wholesale leased lines markets in the financial years 2010/11 to 2014/2015

Market	2010/ 11	2011/ 12	2011/12 restated	2012/ 13	2012/13 restated	2013/ 14	2013/14 restated	2014/ 15
Low bandwidth TISBO (<=8Mbit/s) - *National*	14%	19%	24%	19%	21%	25%	28%	30%
AISBO – *National*	5%	14%	16%	31%	-	-	-	-
AISBO - *UK outside WECLA*	-	-	-	-	30%	21%	25%	22%
AISBO - *WECLA*	-	-	-	-	70%	48%	50%	48%
MISBO - *UK outside WECLA*	-	-	-	-	11%	32%	45%	15%

Source: RFS published by BT in 2012, 2013, 2014, and 2015 covering the financial years 2010/11 and 2011/12 (RFS 2012), restated accounts for 2011/12 and 2012/13 (RFS 2013), restated accounts for 2012/13 and 2013/14 (RFS 2014), restated accounts for 2013/14 and 2014/15 (revised RFS 2015).

A17.22 The above results have been affected to some degree by changes in attribution methodologies. For example BT made changes in 2012/13 and 2013/14 that resulted in lower costs in leased line markets, and these reductions were particularly large in 2012/13[120] These changes explain some of the increases in profitability in 2012/13 and 2013/14[121].

A17.23 In 2014/15 BT made further allocation changes that reduced operating costs and mean capital employed (MCE) in AISBO markets. The changes increased operating costs but reduced MCE in TISBO markets.[122] The net effect of these 2014/15 changes was negligible on BT's profitability in the low-bandwidth TISBO market and

[120] See page 18 or the 2012/13 reconciliation report requested by Ofcom (http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2013/ReportrequestedbyOfcomfortheyearended31March2013.pdf), and page 20 of the 2013/14 report (http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2014/ReportrequestedbyOfcomfortheyearended31March2014.pdf).

[121] For example, the effect of the change of methodology on ROCE for low-bandwidth TISBO in 2013/14 compared to 2012/13 was an increase of 1.4 percentage points, 1.8 percentage points for AISBO outside of WECLA, 2.3 percentage points of AISBO in WECLA, and 0.7 percentage points for MISBO outside of WECLA (Section 2.1 of the 2013/14 reconciliation report http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2014/ReportrequestedbyOfcomfortheyearended31March2014.pdf).

[122] See page 19 of the 2014/15 reconciliation report (http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2015/ReconciliationReport201415.pdf).

in the MISBO market outside WECLA, but it increased profitability in AISBO markets (by around 3% outside of WECLA, and by around 7% in WECLA).

A17.24 These results will also have been affected by volume movements. Volumes in AISBO markets are generally rising whilst those in TISBO markets are falling. A greater proportion of costs and assets common to both AISBO and TISBO markets will therefore have been allocated to AISBO markets over time. This re-allocation will have tended to increase BT's reported profitability in TISBO markets and decrease it in AISBO markets.

A17.25 However these published results do not reflect changes in attributions that we are proposing as part of the leased line charge control. For example we have decided to change the way general overheads are attributed that will reallocate some costs away from regulated areas into unregulated areas. We discuss the effect of these changes on leased line markets in Annex 28. If these changes had been reflected in the published numbers the published returns would have increased in 2014/15 from 22% to 25% in the AISBO market outside the WECLA and from 30% to 33% in the low-bandwidth TISBO market.

A17.26 Since 2005 Ofcom has disaggregated the BT Group WACC into an Openreach copper access WACC (Openreach WACC) and a 'rest of BT' (RoBT) WACC. The Openreach WACC has been used in charge controls on LLU and WLR services while all other charge controls on BT, including leased lines, have used the RoBT WACC. In the 2009 and 2013 LLCC Statements the RoBT WACCs of 11.0% and 9.9% respectively were applied to leased lines. In the 2016 LLCC Statement we have decided to disaggregate the BT Group WACC into three parts: Openreach (as previously), Other UK telecoms and RoBT, where the RoBT largely represents the ICT activities undertaken by Global Services and Other UK telecoms includes BT's remaining telecoms activities including leased lines, fixed voice, broadband and bundled services. In the 2016 LLCC the Other UK telecoms WACC applied to leased lines is 9.8%. Table A17.2 below shows the BT WACC determined by Ofcom in the 2009, 2013 and 2016 LLCC Statements. The WACC applied to leased lines has therefore been around 10-11% in the last three LLCCs. We note that the role of the WACC in profitability analysis differs to that in charge controls. Our conclusion on profitability is not dependent on a very precise estimate of the relevant WACC.

Table A17.2: Estimates of WACC applicable to leased lines

Source of estimate	BT Group	Openreach	Other UK telecoms	Rest of BT	Rate applicable to leased lines
2009 LLCC	10.6%	10.1%	n/a	**11.0%**	**11.0%**
2013 LLCC	9.4%	8.8%	n/a	**9.9%**	**9.9%**
2016 LLCC	9.9%	8.7%	**9.8%**	12.4%	**9.8%**

Source: Ofcom LLCC Statements 2009, 2013 and 2016.

A17.27 ROCEs relating to BT's provision of **low-bandwidth TISBO services** have consistently and significantly exceeded BT's cost of capital and have been rising over time. However, the assets used in providing these services are depreciated to a materially greater extent than assets used in providing CISBO services. This leads to relatively low MCE figures and hence to higher returns. Therefore, whilst the reported ROCEs are consistent with BT having SMP, we do not put great weight on these figures.

A17.28 ROCEs relating to the provision of **AISBO services** in the UK have increased since 2010/11.[123] Whilst ROCEs on AISBO services nationwide did not (substantially) exceed the cost of capital in 2010/11 and 2011/12, ROCEs on AISBO services in UK outside the WECLA were much higher than BT's cost of capital in 2012/13, 2013/14 and 2014/15. We note also that these returns have remained relatively high despite a charge control of RPI-11.5% since 2013/14 and the volume effect we noted above, which will tend to have allocated more common costs to AISBO services. We also note that including the impacts of the reallocations proposed by the leased line charge control would have increased 2014/15 returns by three percentage points.

A17.29 The ROCEs on **MISBO services outside the WECLA** were also significantly above the WACC in 2013/14. BT pointed out in its response[124] to the May 2015 BCMR Consultation that 2013/14 was an unrepresentative year as it saw particularly high growth for MISBO services, which resulted in a higher than average proportion of connections, on which margins were high, compared to rentals, where margins were lower. . As can be seen from Table A17.1 of BT's most recent RFS, the ROCE on MISBO services outside the WECLA fell to 15% in 2014/15. Our analysis of the RFS suggests that revenues have remained flat as prices have fallen significantly but the large increase in volumes in the previous year has resulted in higher operating costs and mean capital employed. Connection volumes were also much lower in 2014/15 compared to 2013/14. However, given the expected rapid growth in very high bandwidth CISBO volumes over the market review period and the current charge structure, future increases in connection volumes could again lead to increases in the ROCE whilst volume growth would also be expected to lead to reductions in unit costs in any event. It is unclear that 2014/15 should necessarily be considered more representative than 2013/14 therefore. In any case, because BT's MISBO volumes outside the WECLA are relatively low, we believe the profitability of AISBO services outside the WECLA remains the best guide to the profitability of CISBO services in this area.

A17.30 For the financial years 2012/13, 2013/14 and 2014/15 we can derive the ROCE on CISBO services outside the WECLA by aggregating the returns and the MCE for the corresponding AISBO and MISBO services from BT's RFSs (see Table A17.3).

Table A17.3 ROCE on CISBO services outside the WECLA

Market	2012/13 restated	2013/ 14	2013/14 restated	2014/ 15
CISBO - *UK outside WECLA*	29%	22%	27%	21%

Source: Ofcom analysis of RFS published by BT in 2014 and 2015.

[123] The separate 2013/14 and 2014/15 figures for AISBO in the WECLA and in the UK outside the WECLA are both above the national market figures for 2010/11 and 2011/12.

[124] Paragraph 5.62 of BT response

A17.31 The high ROCE indicators in the financial years 2012/13, 2013/14, and 2014/15 are consistent with BT having market power in the supply of CISBO services in the UK outside WECLA. The decline in 2013/14 will have to some extent reflected the effect of the current charge control. However, despite this control and the volume effect we have noted previously, the ROCE stabilised in 2014/15. Moreover, a comparison with Figure 7.11 of the March 2013 BCMR Statement shows that ROCEs have been persistently high since at least 2006/07.[125]

A17.32 ROCEs relating to provision of AISBO services in the WECLA are only available for 2013 - 2015. The WECLA encompasses both the CLA and the LP, with around 75% of WECLA AISBO services (lower bandwidth CISBO) supplied in the CLA. Whilst this implies that ROCEs reported are driven to a greater extent by profitability in the CLA, we consider that they can also inform our assessment of profitability in the LP, particularly given the uniform pricing of BT's AISBO services. In all three years, ROCEs significantly exceeded BT's cost of capital. Seen in isolation, the ROCEs reported in relation to AISBO in the WECLA appear higher than would be expected in competitive markets. They are, in any event, likely to be higher than in the rest of the UK because, while charges are uniform across BT's network throughout the UK, average costs in the WECLA are likely to be relatively low, due to the high density of businesses in that area. We discuss this as part of our SMP assessment for the CLA in Section 4.

Analysis of KCOM profitability

A17.33 In its annual RFR, KCOM reports financial figures – including returns, operating costs, mean capital employed and ROCEs – for the wholesale markets for low-bandwidth TISBO and AISBO services in the Hull area in which it was found to have SMP in the previous BCMR.[126,127] As market definition has not (materially) changed, comparison of reported figures over time is relatively straightforward. We consider that KCOM's profitability of providing low-bandwidth TISBO and AISBO services can inform our assessment of KCOM's position in the (wholesale) markets for low bandwidth TISBO and CISBO services identified in this review.

A17.34 We use BT's cost of capital, discussed above, as a proxy for KCOM's cost of capital, as we have not recently estimated the latter as part of our regulatory work. We consider that the cost of capital relevant to BT's leased line business (which, as noted above, has been around 10-11% in the last three LLCCs) provides an appropriate proxy for KCOM's cost of capital in the provision of similar types of fixed telecommunications services. We take account of the fact that our estimate of KCOM's cost of capital is a proxy when making inferences based on KCOM's profitability. Only where KCOM's ROCEs significantly and persistently exceed the cost of capital, will we consider that profitability clearly suggests that KCOM has SMP.

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[125] BCMR 2013 Statement, Figure 7.11 at http://stakeholders.ofcom.org.uk/binaries/consultations/business-connectivity/statement/Sections6-7.pdf

[126] ROCEs only relate to KCOM's activities in the Hull area.

[127] See http://www.kcomplc.com/media/1482/ofcom-statements-201415.pdf for the KCOM's accounts for 2014/2015, and http://www.kcomplc.com/regulatory/regulatory-accounts/ for the earlier periods.

A17.35 Table A17.4 (below) presents the ROCEs as reported by KCOM reported for both wholesale product markets for the financial years 2011/12 to 2014/15.

Table A17.4: KCOM's reported ROCEs in wholesale leased lines markets in the financial years 2011/12 to 2014/15

Market	2011/12	2012/13	2013/14	2014/15
Low-bandwidth TISBO	13%	13%	13%	13%
AISBO	13%	13%	13%	13%

Source: KCOM RFR's 2012, 2014 and 2015 covering the financial years 2011/12 to 2014/15.

A17.36 KCOM's ROCE was 13% in both wholesale markets and in each of the years considered, despite the fact that the absolute levels of return, defined by KCOM as turnover less total operating costs, have fluctuated from year to year, and sometimes significantly.[128]

A17.37 In the previous market review, we also observed a similar pattern – KCOM's ROCEs were around 13% and did not vary across product markets and over time. We understood this pattern as being driven by KCOM's approach to allocation of common costs and its accounting practices.[129]

A17.38 Markets are almost never completely static over time. Even where a firm has SMP, changes in demand and input costs will inevitably occur, affecting the firm's revenues, costs and profits. The absence of variation in KCOM's ROCEs across product markets and over time strongly suggests that the ROCEs reported by KCOM do not reflect its true profitability. Hence we consider that the ROCEs reported by KCOM do not provide a reliable basis for making inferences as to any market power KCOM may have.

[128] For example, return for AISBO services rose by 25% between 2013/2014 and 2014/2015 from £167,000 to £208,000. At the same time, return for low-bandwidth TISBO services fell by 7% in the same time period, from £243,000 to £225,000.

[129] KCOM is vertically integrated and the price of its wholesale services is an internal transfer price, rather than a market price. KCOM appears to have considerable discretion over the level at which this transfer price is set. According to KCOM's "Description of Cost Accounting System" (www.kcomplc.com/media/1481/docas-201415.docx), "Wholesale revenue is derived to ensure a regulated return on mean capital employed is achieved for each market" (page 6). Page 3 of the same document says "This cost of capital has been established at 13.0%". We understand that the wholesale revenue reported by KCOM every year is simply fixed at a level to derive a 13% ROCE.

Annex 18

Benefits of a dark fibre remedy

Introduction

A18.1 This annex contains our analysis of the benefits associated with a dark fibre remedy. This feeds into our overall assessment of the case for a dark fibre remedy, which is set out in Section 7 and supplemented by Section 9 and Annexes 19 to 24.

A18.2 This annex is structured around the following three broad categories of benefits that a dark fibre remedy could provide:

- dynamic efficiency in the form of greater scope for innovation and improvements in service quality;
- productive efficiency in the form of lower costs and prices over time as more of the cost stack is exposed to competitive pressure and as less equipment is used to deliver the service; and
- the potential to withdraw or relax some downstream regulation.

A18.3 We first set out a summary of our provisional analysis in the May 2015 BCMR Consultation. We then summarise relevant stakeholder responses. Finally we set out our position, taking into account these stakeholder comments.

A18.4 In summary we conclude that:

- In principle, dark fibre would allow a CP to determine whether, when and how to develop its own active services (rather than being reliant on BT). By allowing CPs control over whether, when and how to develop their own active products, they also have the ability to exploit the first-mover advantage benefits and product differentiation benefits that derive from innovating. Accordingly, the requirement for BT to offer dark fibre should encourage innovation and dynamic efficiency.
- In relation to productive efficiencies, a dark fibre remedy could provide CPs with opportunities to reduce duplication of equipment, reducing overall equipment costs and leading to lower prices.
- A dark fibre remedy could allow us to reduce the extent of regulation in future.

A18.5 We recognise that there are risks associated with a dark fibre remedy. We discuss these in Annexes 19 and 20. We explain in Section 7 why we are proceeding with a dark fibre remedy in this market review, but how duct access remedies may become relevant in the future for leased lines markets.

Dynamic efficiency in the form of greater scope for innovation and improvements in service quality

Summary of our consultation position

Product and service innovation and differentiation

A18.6 In the May 2015 BCMR Consultation, we considered that a dark fibre remedy (and passive remedies in general) would give competitors control over more elements of the network, providing CPs with more flexibility than they have now to make investment decisions and choices independently of BT.

A18.7 Under the current framework, Openreach operates the Statement of Requirements (SoR) process which enables CPs (and BT's downstream divisions) to formally request the introduction of a new product or a change to an existing one. Any new product that Openreach agrees to develop will be offered to all CPs at the same time, which means that the development is available on an EOI basis.

A18.8 In Annex 27 of the May 2015 BCMR Consultation, we assessed the effectiveness of the SoR process in bringing new products and service features to market in a timely fashion and assessed the extent to which these active products could have been delivered with passive remedies.[130] In summary we found that:

- Since 2006, less than one third of requests had been successfully developed, with the majority of the remainder either cancelled (usually at the initiator's request) or rejected by Openreach. Of those which had not been delivered, we considered that 27% (or 16% of the total number of SoR requests) could have been developed by CPs themselves with a dark fibre remedy.

- Of the SoR requests that were developed between 2006 and 2014, on average, it took Openreach around 17 months from submission to delivery. In some cases, the development time has taken up to five years. In addition, ten requests were still in development, five of which had been in development for more than four years.

A18.9 We also recognised that by making new products and developments available to all CPs simultaneously, this would reduce the incentives for CPs to innovate since a CP was unlikely to benefit from the first-mover advantages related to innovation. We considered that a dark fibre remedy could incentivise innovation by preserving the first-mover advantages to CPs.

A18.10 We also considered the evidence of applications currently provided by CPs with their own network infrastructure (e.g. technologies, service features and network features) and the extent to which similar applications may be provided using the Openreach network, if a dark fibre remedy was available.

A18.11 We considered that our analysis provided an indication of the scope of innovation and differentiation that could be possible with a dark fibre remedy by allowing CPs

[130] May 2015 BCMR Consultation, Annex 27.

to configure and deploy their own active equipment to better suit their customers' needs. In our view, the opportunity to provide differentiated active products in the market would put pressure on all operators (including Openreach) to innovate, driving greater dynamic efficiency.

A18.12 We considered that a dark fibre remedy (as opposed to a duct access remedy) addressed more directly CPs' key concerns around having more flexibility to make investment decisions and innovation choices independently from BT. In addition, dark fibre offered the potential for a more rapid roll out of services than duct access as it is simpler for CPs to use.

Improvement in service quality

A18.13 We considered that a dark fibre remedy could provide CPs greater control of some aspects of quality, for example controlling when and how to upgrade and/or reconfigure services. As such CPs could offer differentiation within service levels such as improved levels of customer service, improved resilience and/or faster repair times. However, we also recognised that a dark fibre remedy would not address all current concerns about Openreach's quality of service in relation to the provision of leased lines. This was because our analysis indicated that these issues relate mainly to the provision of the underlying fibre circuits that support its active leased lines rather than the provisioning of the active equipment.

Innovations in network design

A18.14 We considered that a dark fibre remedy could provide benefits:

- stemming from the control over the choice of network equipment, such as reduced duplication of network elements compared with active remedies; greater flexibility over the choice of access network equipment and in turn features offered to end customers; and greater flexibility about the location of end points from the ability to specify terminal equipment suited to the environmental conditions; and

- stemming from the control of the design of the fibre access network (although we considered that in this regard the scope would be constrained by the architecture of BT's fibre access network).

Stakeholder responses to the May 2015 BCMR Consultation

Product and service innovation and differentiation

A18.15 BT considered that the benefits of dark fibre had been overstated and were based on weak or speculative evidence.[131]

A18.16 BT considered that the scope for innovation resulting from dark fibre sits within a narrow slice of the production chain between innovation which must be carried out by Openreach as it directly involves the passive infrastructure and innovation which

[131] BT's response to May 2015 BCMR Consultation, Part A page 17.

can be carried out by CPs even with the current active remedies.[132] BT claimed that the majority of benefits cited by Ofcom cannot be achieved with the proposed dark fibre remedy.[133]

A18.17 BT considered that Ofcom's arguments around innovation centred on 'innovation in the active layer' however BT considered but that there was no explanation of what innovation sits in the active layer.[134]

A18.18 BT disagreed with Ofcom's suggestion that (under active remedies) the extent of innovation and service improvements is limited since active products do not offer CPs complete end-to-end control. BT considered that the Network Terminating Equipment (NTEs) of the EAD product do not interfere with end-to-end control and innovation since end-to-end control sits downstream of the current active remedies. BT argued that CPs exploiting price arbitrage opportunities as a result of geographic density differences and/or the bandwidth gradient cannot be classed as innovation.[135]

A18.19 Virgin argued that the likely innovation gains from dark fibre suggested by Ofcom have been overstated (and that there is little evidence of what actual innovation will be generated) and that current active remedies already offer scope for new and innovative products to be developed.

A18.20 Virgin also highlighted that Ofcom had previously considered the SoR process in the BCMR 2013 and in that review noted that BT was able to use its scale and scope to match the demand for innovation.[136]

A18.21 BT reviewed each of the SoR cases that Ofcom argued could have been furthered by dark fibre (in Annex 27 of the May 2015 BCMR Consultation). Based on that review, BT argued that Ofcom's analysis was misleading and claimed that BT's own analysis showed that:[137]

- for many of the SoRs, the availability of dark fibre would not have made any significant difference to the development or otherwise of the change requested under the SoR;

- some SoRs identified in the Ofcom list were in effect double-counted since they were superseded by subsequent and better specified SoRs and (a number of these were delivered);

- some SoRs requested changes which could not reasonably be described as major innovations, but were focused on Openreach operations or in some cases effectively seeking price reductions;

- some SoRs were for legacy technology or very low volume numbers; and

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132 BT response to May 2015 BCMR Consultation, Part B page 93.
133 BT response to May 2015 BCMR Consultation, Part B page 94.
134 BT response to May 2015 BCMR Consultation, Part B page 94.
135 BT response to May 2015 BCMR Consultation, Part B page 95.
136 Virgin response to May 2015 BCMR Consultation, page 32.
137 BT response to May 2015 BCMR Consultation, Part B page 102.

- the majority of rejections/cancellations listed by Ofcom were cases where the sponsoring/lead CP was a part of BT Group (either Openreach or a downstream division of BT). For example, 20 of the SoRs had a BT downstream division as the sponsoring CP and it is unlikely that had there been any really significant market-led innovation taking place that there would not have been a strong incentive on BT Group to address the market appropriately through either a downstream division or an Openreach service.

A18.22 In summary, BT considered that there was no evidence of an innovation that would have been developed with passive access that was not developed under the SoR process or appropriately assessed by the SoR process.

A18.23 Furthermore, in relation to the timeliness of the SoR process, BT disagreed with Ofcom's assessment of the time taken to deliver SoRs (between 2006 and 2014) and the implication that dark fibre would have resolved these. BT explained that the statistics used by Ofcom were heavily influenced by Openreach-generated SoRs that necessarily took a considerable time to deliver.[138]

A18.24 Virgin also reviewed Ofcom's SoR analysis and argued that once Openreach-generated SoRs and customers' own cancellations had been removed from the data, dark fibre may have only been able to provide solutions for eight SoRs over eight years (or one solution per year).[139]

A18.25 Virgin noted that the SoR process is already under a 12-month review following the Fixed Access Market Review (FAMR)[140]. It considered, insofar that there are barriers to innovation in relation to Ethernet SoRs, that review is the appropriate and proportionate way to investigate matters in the first instance.[141]

A18.26 BT noted that Ofcom 'recognises in principle' the role of passive inputs in giving CPs the flexibility to differentiate, innovate, and upgrade without being dependent on BT. However, it considered that Ofcom should take a view on the generic types of innovation that could occur with dark fibre. In summary, BT considered that Ofcom had asserted, based on weak evidence, a belief that innovation in the active layer would be unlocked by passive remedies and in effect is proposing a total transformation of regulation in the sector (with the inherent risks) without identifying a single meaningful innovation which would be unlocked.[142] Virgin also argued that Ofcom has been unable to point to a single major application that would emerge following the introduction of a passive remedy.[143]

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[138] BT response to May 2015 BCMR Consultation, Part B page 94.
[139] Virgin response to May 2015 BCMR Consultation, page 33.
[140] Ofcom, *Fixed access market reviews: Wholesale local access, wholesale fixed analogue exchange lines, ISDN2 and ISDN30, Statement on the markets, market power determinations and remedies*, 26 June 2014 http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/statement-june-2014/volume1.pdf
[141] Virgin response to May 2015 BCMR Consultation, page 33.
[142] BT response to May 2015 BCMR Consultation, Part B page 96.
[143] Virgin response to May 2015 BCMR Consultation, page 33.

A18.27 BT suggested that Ofcom should use its formal powers to ascertain which technical innovations CPs have firm plans to advance with dark fibre in the coming review period.[144]

A18.28 BT referred to Ofcom's analysis of innovations by CPs on their own networks. Of those that were not redacted, BT considered that:[145]

- those relating to Ethernet Network Interface Device (NID), Fault Management and Diagnosis provided limited evidence of significant service and network innovation given Openreach's existing high and consistent fault repair performance and CPs' reluctance to pay incremental charges (for such services);
- in relation to the example of FTTP-GPON technology, this has already been developed and deployed by Openreach for NGA services both as a pre-built FTTH service and as Fibre on Demand (FoD) service throughout the UK in its FTTC footprint. Additionally, a newly engineered service will form part of Openreach's NGA2 programme;
- circuit upgrades are a very limited example of innovation given the range of Openreach services;
- one example related to handover; this is an important issue for dark fibre since Openreach's automated monitoring and repair processes plus its service guarantees are significant benefits that will be undermined by the removal of BT's monitoring equipment;
- one example related to control of network equipment by the CP. This assumes that all relevant systems and processes have been developed and implemented. However, it is not clear that this will lead to greater efficiency; and
- one example related to Optimised Network Architecture and that it is unclear how the 'boxless EAD' dark fibre product proposed by Ofcom will allow innovation in this regard.

A18.29 TalkTalk argued that Ofcom does not need to identify specific innovations that will occur as a result of imposing passive remedies. Rather it needs to show the potential innovation that could be brought to the market earlier by introducing dark fibre. It considered that reliance on specific innovations would inevitably involve speculating on CPs' commercial strategies and market outcomes. TalkTalk argued that as a general matter allowing competitors to innovate (referred to as 'self-innovation') will result in more and earlier innovation due to the following reasons:[146]

- rivals are able to gain first mover advantage from their own innovation and so there is a stronger incentive to innovate (with no CP able to enjoy a first mover advantage when Openreach innovates, since its obliged to offer access to innovation at the same time to all CPs);

[144] BT response to May 2015 BCMR Consultation, Part B page 98.
[145] BT response to May 2015 BCMR Consultation, Part B page 109.
[146] TalkTalk response to May 2015 BCMR Consultation, page 9.

- self-innovation avoids coordination and transaction costs thereby making innovation more viable;
- Openreach may reject requested innovations that could have been pursued by competitors if they were able to self-innovate; and
- having competition in innovation will also increase pressure on Openreach to innovate.

A18.30 Colt considered that on-net connectivity allowed for an entirely different class of service to be offered to a customer and that dark fibre would allow a customer to be considered as on-net.[147] Colt explained that it is planning to use dark fibre [✂]. Colt considered that this would allow it to deploy its own technology and services, and optimise the way its network is implemented outside its current network footprint.[148]

A18.31 Colt referred to service offering benefits that derived from dark fibre. Colt explained that when a CP relies on an active input, it is necessarily constrained in what it can offer its customers by the underlying wholesale product. Colt argued that with dark fibre, CPs have substantially more ability to develop and offer different service levels and combinations of features as part of the overall product offerings. More specifically, they can adapt to any change in their customers' demand more quickly and easily because they have direct control of and access to the equipment. Colt highlighted that in this regard, CPs would have more control over:[149]

- SLAs;
- Layer 2 and Layer 3 technology;
- bandwidth/capacity provided (including factors such as symmetry, scalability and burstability);
- pricing structures; and
- quality of service.

A18.32 Colt indicated that it was planning to use dark fibre for the following applications that cannot be delivered using BT's active solution:[150]

Table A18.1: Colt's plans to use dark fibre

Application	Description
[✂]	[✂]

[147] Colt response to May 2015 BCMR Consultation, page 7.
[148] Colt response to May 2015 BCMR Consultation, page 10.
[149] Colt response to May 2015 BCMR Consultation, page 7.
[150] Colt response to May 2015 BCMR Consultation, page 10.

Provide ultra-low latency services that are currently not available from BT.	Colt is specialised in providing ultra-low latency to its customers but this is not a feature available from BT. Colt considered that as lower latencies become more widely available, the use of wide-area computing and storage applications able to take advantage of them, will flourish. BT's one-size fits all EAD solution is a significant barrier to innovation in this regard. Dark fibre, would allow Colt to use its own equipment and control all features such as latency in order to best adapt to customers' needs
Assist with data centre connectivity.	Colt explained that very high capacity is needed in order to provide the right level of data centre connectivity to our customers. In this scenario, dark fibre will be seen as the best solution to serve those customers in the event where it is not already connected to the data centre in question.

Source: Colt in response to May 2015 BCMR Consultation

A18.33 In addition, Colt thought that, with dark fibre, CPs would have a (greater) level of control at the equipment layer, thus offering much more flexibility for innovation than is possible with active remedies. It explained that CPs would be able to serve customers with scalable services such as software defined networking (SDN) and bandwidth on demand. It considered that the wider availability of more scalable infrastructure models would encourage innovation at the service layer through new types of Over-the-Top services, Software as a Service (SaaS) and systems for monitoring people's health.[151]

A18.34 Colt claimed that there would also be benefits in terms of commercial offerings from dark fibre. It explained that with dark fibre, CPs would be able to commit to longer term contracts than with active inputs as they can be confident that future demand can be served without needing to change the underlying wholesale product required from BT. It considered that under dark fibre the variety of services that can be delivered would be broader than under any active product. Colt indicated that with active products, CPs have to commit to a given set of parameters and are thereafter constrained by BT's upgrade and migration procedures, which it described as "woeful". Colt considered that dark fibre will allow CPs to control more easily the components of a commercial offering along the following lines:[152]

- tariffing structures – by allowing CPs greater flexibility to vary the price with the grade of service;
- contractual elements and terms of service, such as SLGs, payments for breach of service level commitments, minimum contract terms, rights of cancellation; and
- charging models – by allowing CPs greater flexibility in relation to pricing services (per transaction, by volume, time of day, flat rate, fixed charge) and terms of payment – in advance, in arrears, monthly, quarterly, annually.

[151] Colt response to May 2015 BCMR Consultation, page 8.
[152] Colt response to May 2015 BCMR Consultation, page 7.

A18.35 PAG considered that competitive pressure drives innovation, and that, with dark fibre, CPs would be able to introduce innovations themselves and derive competitive benefits from doing so. PAG explained that requiring BT to offer dark fibre would impose competitive pressure on Openreach to innovate, because if it fails to keep up with CPs, CPs will steal market share in the supply of active Ethernet services. PAG compared this to the current situation, where it considered that competitive pressure is lacking and innovation is therefore limited, in isolation, by BT's imagination and appetite about what to develop and introduce for the market (supply driven demand).[153]

A18.36 PAG considered that under dark fibre the circumstances in which innovations would be adopted by the market would be greater. It explained that currently, the adoption of innovation is based solely on whether it suits BT, for example whether it supports its business model, risk profile, willingness to invest and capabilities. With dark fibre available going forward, any CP would be able to decide for itself whether to adopt an innovation if its suits its own business model.[154]

A18.37 PAG considered that the pace of innovation would be likely to increase as a result of dark fibre. It explained that it was not appropriate that BT controls the rate of any innovation in the marketplace, especially when it does not face competitive pressure in that market and therefore has insufficient incentive to innovate itself. Accordingly, PAG considered that passive remedies were not just about enabling innovation where it otherwise would not exist, but also about providing the opportunity for CPs to compete with each other so that innovations are rolled out and ultimately enjoyed by customers as soon as possible.[155]

A18.38 PAG considered that dark fibre would allow CPs greater scope to differentiate their services by place, price and product:[156]

- place: PAG considered that an important use of dark fibre would be to extend the reach of existing fibre networks through physical interconnection. It highlighted that this was how dark fibre is often used today. CPs lease fibre from other CPs and splice it to existing fibre at the nearest point of interconnection. This enables innovation because:
  - It allows the CP to sell a product designed to work on its own network, rather than having to water down any features so that it will also work on BT's network. For example, it is technically difficult to achieve extremely low latency connections across an active interconnect. If the interconnect is physical (i.e. at the passive layer), then the active equipment is all controlled end-to-end by a single CP enabling new forms of low latency connections. To illustrate this, PAG referred to BT's leased lines having latencies measured in milliseconds whereas Colt is able to offer ultra-low latency measured in

[153] PAG supplementary response to LLCC Consultation and responses to the BCMR Consultation, page 3.
[154] PAG supplementary response to LLCC Consultation and responses to the BCMR Consultation, page 4.
[155] PAG supplementary response to LLCC Consultation and responses to the BCMR Consultation, page 4.
[156] PAG supplementary response to LLCC Consultation and responses to the BCMR Consultation, page 4.

microseconds – across its own network (but not for connections that rely on interconnecting with BT's active network). PAG explained that dark fibre would enable Colt to bring more services "on-net", allowing much wider availability of ultra-low latency services.

  - It is often more cost effective because a CP can avoid the need for the active equipment previously required to interconnect the two networks. [157]

- price: PAG argued that a CP that has greater control over more parts of the overall value chain will have more control over the overall pricing of its own services. PAG considered that this was particularly important in retail markets downstream of leased lines where its lesser reliance on BT's underlying cost structure means that a CP will have more control over its finances thereby enabling more flexible downstream pricing structures. PAG also considered that there would be flow through effects from CPs having greater economies of scale and scope resulting in greater innovation downstream. It considered that having more control over parts of the overall value chain implies that CPs' cost base would be more closely aligned with the actual costs of providing a service (rather than being aligned with BT's pricing structure) and therefore more closely aligned with that of competitors with their own passive infrastructure.

- product: PAG argued that innovation may not just be for downstream active services, but also in processes, pricing models, customer service and a range of other parts of the value chain that are not currently contestable. More generally, it considered that passive access would enable different business models for competitors, other than those enabled by BT, which will allow CPs to deploy their own types of products with their own technical and service characteristics.

A18.39 PAG considered that currently, BT sets (or has significant control over) the place, price and product dimensions that exist across almost the whole business connectivity market. This prevented any other CP from truly offering new and innovative products, except in areas where CPs can economically duplicate BT's passive infrastructure. In this respect PAG considered BT's concerns about CPs exploiting arbitrage opportunities to be misplaced since CPs will use dark fibre to innovate resulting in a better quality and range of services. It considered that such arbitrage opportunities could be dealt with by BT given its pricing flexibility. It added that CPs would not make substantial, long-term investments on the basis of temporary opportunities offered by BT's existing pricing structure.[158]

A18.40 Vodafone argued that dark fibre would allow for a more sophisticated level of investment where it would not be shackled to Openreach inputs and be able to develop products for customers across the country (not only where it has its own duct and fibre).[159] [160]

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[157] We discuss this type of benefit in the sub-section relating to productive efficiency benefits in the form of lower costs and prices.

[158] PAG supplementary response to LLCC Consultation and responses to the BCMR Consultation, page 5.

[159] Vodafone response to May 2015 BCMR Consultation, page 36.

A18.41 TalkTalk suggested that other types of innovation (beyond technology innovation) had been overlooked by Ofcom and highlighted innovations relating to new pricing structures and pricing innovations. Although Ofcom indicated that these innovations were not unique to passive remedies, TalkTalk suggested these could be encouraged since using dark fibre (rather than an active service) would mean that less of the cost structure was variable allowing CPs more flexibility in how they recover costs.[161] Colt also referred to dark fibre providing greater flexibility for CPs and thereby providing greater control over pricing structures.[162]

A18.42 Sky highlighted that the level of investment required by third parties to deploy fibre infrastructure is a significant barrier to entry. It considered that a viable business case for investment in alternative fibre infrastructure depends on using the most cost efficient and flexible deployment method and that access to BT's ducts, poles and dark fibre are essential inputs to the business case for investment in alternative fibre infrastructure.[163]

A18.43 A number of stakeholders commented that the treatment of non-domestic rates in relation to dark fibre could affect take-up. This is discussed in more detail in Annex 23.

Improvements in service quality

A18.44 BT considered that the imposition of a dark fibre remedy would make no practical difference to service provisioning lead times since the provisioning of the fibre is the time consuming process. BT added that the provision of NTE rarely causes any additional delays.[164]

A18.45 BT disagreed with Ofcom's statement that "most reported faults seem to occur in the active layer". BT argued that, over the last 12 months, fibre faults exceeded NTE faults by more than two to one.

A18.46 BT argued that under dark fibre, since Openreach would no longer provide the NTE, the following consequences are inevitable:[165]

- the number of misreported faults would increase as there is no demarcation point to monitor to distinguish customer faults from Openreach faults;
- the time taken for Openreach to confirm a fault would increase substantially since fault identification becomes more complex and time consuming; and

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[160] Vodafone also provided further evidence relating to innovations that could result from the introduction of dark fibre. While we acknowledge this evidence we do not consider that it materially adds to the evidence received from Vodafone and other stakeholders. See Vodafone response to May 2015 BCMR Consultation (Supplement 3) Dark Fibre Innovation.
[161] TalkTalk response to May 2015 BCMR Consultation, page 10,
[162] Colt response to May 2015 BCMR Consultation, page 7.
[163] Sky response to May 2015 BCMR Consultation, page 6.
[164] BT response to May 2015 BCMR Consultation, Part B page 96.
[165] BT response to May 2015 BCMR Consultation, Part B page 97.

- There would be considerable room for disagreements and disputes concerning intermittent faults since Openreach would not be able to monitor circuits to maintain a history of performance.

A18.47 BT said that nearly two-thirds of all faults reported to it are incorrectly reported when BT's service is in fact working properly, Ofcom's proposals would inevitably lead to a need for Openreach engineers to be on stand-by around the country to test fully working fibres at the request of the CP – and at operational and financial cost to Openreach.[166]

A18.48 TalkTalk argued that dark fibre could result in process and quality innovations such as lower fault rates/and or more rapid repair of faults in active equipment through, for instance, more reliable active equipment; better monitoring and proactive maintenance; hot standby; better fault handling; more engineers and added resilience. TalkTalk suggested that these innovations could be supported by stronger SLAs and SLGs.[167]

A18.49 Colt also considered that with dark fibre CPs would be able to develop different service levels and combinations of features as part of their overall product offering.[168]

<u>Innovation in network design</u>

A18.50 Colt considered that regulated dark fibre will enable CPs to invest more and serve customers in different geographic areas, compared to the current framework based on active inputs. [✂] It also indicated that regulated dark fibre will enable more competition in backhaul and therefore possibly unlock NGA investment.[169]

Our assessment of product and service innovation and differentiation benefits

<u>Benefits from dark fibre</u>

A18.51 CPs with their own infrastructure compete to meet their customers' requirements better and more quickly than their competitors by either introducing new technologies and/or offering differentiated services using existing technologies.

A18.52 Where CPs do not have their own network infrastructure, competition in applications which use leased lines is currently based on BT's regulated set of wholesale leased line services (i.e. active products). As such, CPs rely on regulated access to Openreach's active products to meet their customers' needs.

A18.53 While the current regulation based on BT's active products supports significant competition at the service level, it also has the effect of constraining innovation and product differentiation. The constraints arise from two main sources.

[166] BT response to May 2015 BCMR Consultation, Part B page 97.
[167] TalkTalk response to May 2015 BCMR Consultation, page 10.
[168] Colt response to May 2015 BCMR Consultation, page 7.
[169] Colt response to May 2015 BCMR Consultation, page 8.

- Firstly, BT necessarily determines whether, when and how its wholesale leased line products (i.e. active products) are developed. Ultimately, as the SMP provider, BT controls the nature of the network access services available to CPs.

- Secondly, we impose strict non-discrimination obligations on BT in the wholesale leased lines market to protect CPs against BT's incentives to favour its downstream businesses. Whilst these rules ensure a level playing field between CPs and BT, they necessarily restrict differentiation and first mover advantages derived from wholesale active leased lines (and thereby limit CPs' incentives to innovate and, therefore, limit and delay the benefits which innovation can bring to customers).

A18.54 These constraints are particularly evident in the context of the SoR process that Openreach operates for new developments where:

- Openreach determines whether to take forward and implement a CP's request for a product development. This decision depends on BT's own business plans and objectives, BT's assessment of the financial risks of delivering the product development, BT's costs and technical capabilities of delivering the product development, and BT's timescales for delivering the product. Where BT's objectives; assessment of risks; and technical capabilities do not align (or at the least, differ significantly) with a CP's, it is more likely that the SoR request will be rejected (or not delivered in the timescales required by the CP to meet its own business objectives); and

- Any new product development offered by Openreach is made available to all CPs at the same time (to comply with BT's EOI obligations), consequently a CP will have less incentive to initiate a product development since it will be unable to derive any first-mover advantage from innovation.

A18.55 Our regulations (in whatever form they may take and however we might attempt to improve them) must ensure that CPs are protected against BT's incentives to favour its own downstream business in relation to the provision of leased lines. In light of the above, we consider that as a long as active services are the most upstream form of access we regulate in relation to wholesale leased lines, CPs' incentive and ability to innovate and to differentiate services will be constrained.

A18.56 Our review of the SoR process may identify improvements that could be made to the SoR process, however, it would not be able to overcome the barriers to innovation discussed above given the inherent nature of the underlying constraints. We therefore do not agree with Virgin that our review of the SoR process would be a more proportionate alternative to a dark fibre remedy.

A18.57 We consider that if BT were required to offer dark fibre it would lead to two significant forms of benefit relative to a position where only active products are provided by BT:

- firstly, CPs would be in a much better position to be able to determine whether, when and how to develop their own active services (rather than being reliant on BT); and

- secondly, CPs would also have the ability to exploit the first-mover advantage benefits and product differentiation benefits that derive from innovating.

A18.58 We also consider that a dark fibre remedy (alongside active remedies) would provide additional scope for innovation, product differentiation and service improvements by exposing more parts of the value chain to CPs' control (and to competition) than under active remedies. Under a dark fibre remedy CPs would have complete (or near complete) control of the end-to-end circuit by virtue of having control of the active equipment. As such, CPs would have the ability to differentiate their services from other CPs, by choosing to invest in different active equipment than that used by Openreach or providing different services (using either the existing equipment or adapting the existing equipment). This could be done without reliance or oversight by Openreach, and outside the Openreach SOR process. CPs would also have greater control over quality of service as they would be responsible for all elements of their services other than the dark fibre elements rented from BT.

A18.59 In effect, this would mean that CPs wold be able to take forward product developments based on their own customer requirements and business objectives; their own assessment of the risks and financial viability; and their own technical capabilities, rather than BT's. CPs would also be able to set the pace of the product development to meet their customer requirements in a timely manner.

A18.60 As highlighted by PAG and Colt in their responses to the May 2015 BCMR Consultation, dark fibre would also allow CPs to offer services to their customers that more closely resemble 'on-net' services. More specifically, by only using the passive elements of BT's network, a CP will be able to choose active equipment that is designed to be fully compatible with its own network, rather than having to adapt any features to ensure that it is able to interconnect with BT's active leased lines network. An example of this would be Colt being able to offer ultra-low latency across its own network (but not for connections that rely on BT's wholesale leased lines).

A18.61 In addition, by using dark fibre a CP would be able to determine which features of the active equipment are enabled (rather than this being determined by Openreach). BT does not always automatically implement (or enable) features of its active equipment that are not necessary to meet the required specification of its EAD product.[170] With dark fibre a CP would be able to choose different active equipment or to use the same equipment but enable different features to better meet its business (and customer) needs.

Scope for innovation

A18.62 Above we explained why we would expect that the introduction of a dark fibre remedy would stimulate innovation and product differentiation.

A18.63 In this sub-section, we consider comments about the scope for innovation stemming from a dark fibre remedy.

A18.64 While the innovation resulting from a dark fibre remedy might relate to technological improvements and advances, we consider that innovation should be viewed more broadly in the context of the benefits that could derive from dark fibre (and should

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[170] [✂]

not be limited to technology alone). Accordingly, we also include the ability of CPs to effect change more readily (including to enable product differentiation) and CPs ability to make changes independently of BT based on their own assessment of risk and based on their own assessment of customer requirements.

A18.65 Virgin and BT have both argued that Ofcom has been unable to identify a specific innovation that would result from the introduction of a dark fibre remedy. BT suggested that we to take a view on the innovation that could result from a dark fibre remedy and should gather information from CPs about what planned innovation they expect to make in the event that a dark fibre remedy is introduced.

A18.66 TalkTalk argued that Ofcom does not need to identify specific innovations but instead referred to broader, more generic, benefits that could result from the introduction of a dark fibre remedy. In addition, PAG also highlighted that innovation is partly “speculative” since the very nature of innovation is that it arises from opportunities for experimentation with products and services that do not currently exist and therefore the precise spectrum of outcomes from such experimentation cannot be identified in advance.

A18.67 We do not consider that it is necessary to identify specific innovations. We have explained above why we consider that dark fibre will create an environment that is more conducive to innovation by CPs. Innovation is by its very nature forward-looking and uncertain, and some of the innovation benefits from dark fibre may only be realised in the medium or long term. We do not accept that it is necessary to conclusively identify specific innovations that would result from the introduction of the remedy in order to justify its imposition. Our analysis is directed towards identifying whether the dark fibre creates better conditions within which innovation could occur.

A18.68 We disagree with BT that there would be limited additional scope for innovation with a dark fibre remedy on the basis that most innovation rests either in the passive components (which would continue to be controlled by BT) or with downstream services. Nor do we agree with BT that its wholesale leased lines services do not limit CPs ability to deploy innovations and service improvements.

A18.69 Whilst we acknowledge that wholesale leased line services are often components of downstream services, it is not the case that innovation only occurs in downstream services or that such innovations are wholly independent of the upstream wholesale leased line inputs. Some features of downstream services are directly dependent on the features of upstream wholesale inputs. For example:

- Downstream services that offer synchronisation functionality (such as BT Wholesale’s MEAS mobile backhaul service) require wholesale Ethernet inputs that support the SyncE synchronisation protocol.

- As Colt has noted, it is not currently able to offer the ultra-low latency services that it offers on its own network when it uses BT’s wholesale leased line services.

- Service features such as repair and provisioning timescales depend on the corresponding features of upstream wholesale inputs.

A18.70 Whilst CPs can use the SoR process to request changes to BT’s wholesale leased line product, their ability to differentiate their products or progress product upgrades is constrained by the limitations of BT’s equipment or decisions by BT to develop their products to meet an SoR request.

A18.71 A dark fibre remedy would give CPs full control over the choice and operation of the terminal equipment connected to dark fibre circuits, giving them greater flexibility in relation to:

- choice of service protocols (e.g. flexibility to choose protocols other than Ethernet);
- choice of service features;
- selection of service quality features such as repair and provisioning timescales (see below for more detailed discussion); and
- harmonisation of services, features and service characteristics with those offered at locations where CPs operate their own networks.

A18.72 With a dark fibre remedy, CPs' choices in relation to terminal equipment and associated services features would be free of the constraints of the SoR process. CPs would be able to make commercial decisions about innovations, independently of BT (and of each other), based on their own assessment of their customers' needs and the potential risks and rewards.

A18.73 As explained earlier, we consider that dark fibre will expose more parts of the value chain to CPs' control (and to competition) than under active remedies, by allowing CPs to compete at the active level. Furthermore, we consider that exposing the active layer to competition could provide the incentive for innovation in other parts of the value chain which would not have been pursued in the absence of dark fibre. For example, CPs will have greater scope to be able to provide new services and features, or bundle existing features into different packages.

A18.74 Notwithstanding our view that it is not necessary for us to identify specific innovations, we have given consideration to the types of innovation that might be expected if a dark fibre remedy were introduced. In the following sub-sections we consider:

- The types of innovation that might arise in the future if a dark fibre remedy is introduced, drawing on examples collected from CPs' responses to the May 2015 BCMR Consultation, our own observations from the market and other evidence.
- Innovations that may have arisen in the past had a dark fibre remedy been available.
- Evidence that innovations could have been delivered more quickly had a dark fibre remedy been available.

A18.75 We consider that these are innovations that have the potential to result from the imposition of a dark fibre remedy and that therefore support our assessment that a dark fibre remedy will improve the prospects of innovation. The range of different examples (and other evidence) provided by stakeholders also gives us confidence that the innovation benefits which we could expect from dark fibre are likely to be valuable.

Examples of specific innovations that could derive from dark fibre

A18.76 In this sub-section, we review examples of innovations collected from CPs' responses to the May 2015 BCMR Consultation and from our own observations of the market, which we consider have the potential to result from the introduction of a dark fibre remedy.

A18.77 To be clear, we are not attempting to promote or evaluate particular innovations. Ultimately, the innovations that might arise from the introduction of dark fibre would come from CPs (and not from the regulator).

A18.78 We have received the following evidence relating to the innovations that could be exploited through a dark fibre remedy. Colt has told us that:

- [✂].

- Dark fibre would allow it to use its own equipment to control all features such as latency to best adapt to customers' needs and, more specifically, to offer ultra-low latency services more widely.

- Dark fibre would allow CPs to serve customers with scalable services such as software-defined networking (SDN) and bandwidth on demand. It also highlighted that the wider availability of more scalable infrastructure models would encourage innovation at the service layer through new types of Over-the-Top services, Software as a Service (SaaS) and health monitoring systems.

- There would be more general benefits relating to having more control over bandwidth/capacity provided to customers (including factors such as symmetry, scalability and burstability).

A18.79 CPs could potentially use the SoR process to request developments to BT's active products to facilitate these developments. However, we consider that with a dark fibre remedy, CPs would be able to develop such innovations more readily based on their own assessments of risks, timescales and business objectives. Therefore, we consider that these are plausible examples of the type of innovations that might be encouraged and pursued with a dark fibre remedy.

A18.80 We have also reviewed BT's own internal strategy documents relating to how it expects to use dark fibre. We consider that this provides further support to the innovation and product differentiation benefits that we anticipate could result from a dark fibre remedy. More specifically, [✂].

A18.81 [✂]

A18.82 [✂]

A18.83 We consider that since BT's downstream divisions compete with other CPs that are also customers of Openreach, we would expect that the types of opportunities for innovation, product differentiation and improvements identified by BT would be exploited more generally.

<u>Evidence related to closed SoR cases that could have been developed under a dark fibre remedy</u>

A18.84 In the May 2015 BCMR Consultation, we examined evidence relating to the effectiveness of the SoR process in bringing new products and service features to market in a timely fashion and assessed the extent to which these developments could have been developed by CPs had passive remedies been imposed.

A18.85 We analysed the SoRs for business connectivity products from 2006 to November 2014.[171] Our analysis showed that:

- there were 188 requests under the SoR process;
- approximately one-third of the requests had been delivered;
- of the requests that had been delivered, the average time from request to delivery was 17 months and development timescales ranged from one month to five years;
- of the 10 SoRs in development (as of November 2014), eight had been in development for more than two years, of which five had been in development between four and five years.

A18.86 In the May 2015 BCMR Consultation, we identified 30 SoRs which were cancelled by the customer or rejected by Openreach that we considered could have been delivered by using a passive remedy. We also identified three SoR cases that were still in development that we considered could have been pursued independently by CPs with a passive remedy.

A18.87 In light of the responses to the consultation, particularly the additional information about the SoRs provided by BT, we have revised our assessment. We provide a summary of our assessment of the SoRs in Table A18.9 at the end of this annex.

A18.88 In our revised assessment we have made the following changes:

- We have identified seven SoRs that were superseded by later SoRs and have treated such cases as single developments.[172] One of the replacement SoRs was delivered by Openreach and we therefore exclude the superseded SoR from our analysis.[173]
- We have reclassified five SoRs as unsuitable for development with a passive remedy.[174]
- We have identified three SoRs that were delivered by Openreach.[175]
- We have excluded six SoRs which relate to developments that fall outside of wholesale leased lines markets.[176]

A18.89 In light of these changes our revised assessment is that the developments requested in 13 cancelled/rejected SoR requests could have been taken forward by CPs independently of BT with a dark fibre remedy. To be clear, we are not

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[171] Our analysis is based on the SoR dataset submitted by Openreach on 11/11/2014. Subsequent changes have not been reflected in our analysis
[172] [✂]
[173] [✂]
[174] [✂]
[175] [✂]
[176] [✂]

suggesting that these services would necessarily have been developed under a passive remedy. However, our assessment highlights the potential scope of the innovation benefit associated with a dark fibre remedy.

A18.90 BT questioned the extent to which the 30 rejected/cancelled SoRs identified in the May 2015 BCMR Consultation might be regarded as including some form of innovation from a technology, network or CP perspective and suggested that perhaps only two met this benchmark. We do not accept that this is the case even were we to take a relatively narrow view of what innovation might comprise.[177] Furthermore, we consider that the innovation benefits should be viewed more broadly and include the ability of CPs to effect change more readily (including to enable product differentiation) at their own risk and based on their own customers' requirements, without Openreach's oversight.

A18.91 BT also noted that the vast majority of the 30 rejected/cancelled SoRs identified in the May 2015 BCMR Consultation were sponsored by Openreach or a downstream BT division. BT argued that it is unlikely that a passive remedy would have enabled any significant market innovations in relation to these cases as BT Group has a strong incentive to take forward these developments that have significant potential.

A18.92 Our revised analysis includes eight cancelled/rejected SoRs sponsored by BT's downstream divisions and none sponsored by Openreach.[178] Whilst we acknowledge that these SoRs may have been rejected because they were not regarded as commercially viable by BT Group, we do not accept that this undermines our assessment of the potential benefits from the introduction of a dark fibre remedy. We consider that these SoRs are representative of the types of developments that could have been initiated by other CPs. Other CPs would assess these developments based on their business requirements and assessment of the appropriate risks which are likely to be different from either those of BT Group or those of a particular downstream division of BT.

Evidence regarding SoRs in development that could have been developed with a dark fibre remedy

A18.93 We have also reviewed our analysis of SoRs in development as of November 2014 in light of the consultation responses. We remain of the view that two of the three SoRs identified in the May 2015 BCMR Consultation and listed in Table A18.2 below could have been pursued independently with a passive remedy.[179]

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[177] [✂]
[178] [✂]
[179] [✂]

Table A18.2: Potential impact of dark fibre remedy on SoR requests in development as of November 2014

Year	Customer	SoR	Title	Our view
✂	✂	✂	Re-design EAD shelf management connectivity when located in BT exchanges.	With a passive remedy, CPs would deploy their own equipment in BT exchanges and would not require Openreach assistance to make changes
✂	✂	✂	OSA Enhancements	Request for additional functionality that CP could deploy independently with a passive remedy

Source: Ofcom analysis based on Openreach data submitted in response to s135, Q.A8 on 11/11/14

Evidence regarding timeliness of the SoR process

A18.94 As noted above, our analysis of the SoRs presented in the May 2015 BCMR Consultation showed that the average time from request to delivery for SoRs in our sample was 17 months with development timescales ranging from one month to five years.

A18.95 BT argued that our findings were heavily influenced by SoRs initiated by Openreach, which necessarily took a considerable time to develop and that the implication that a passive remedy would have improved development timescales was not correct.

A18.96 Table A18.3 below shows development timescales by customer.

Table A18.3: Time taken for SoRs to be delivered by customer 2006-2014

	Number of SoRs Delivered	Time to deliver (months)		
		Average	Min	Max
BT downstream divisions	29	14	4	37
Other CPs	8	15	1	29
The OTA	1	17	17	17
Sub total	38	14	1	37
Openreach	22	22	1	65
Total	60	17	1	65

Source: Ofcom analysis based on Openreach data submitted in response to s135, Q.A8 on 11/11/14

A18.97 Table A18.3 shows that the average development timescales for Openreach requests is significantly longer than the overall average for all requests in our sample at 22 months compared with 17 months. The average development timescale for other customer groups is somewhat shorter than the overall average at 14 months. Similarly, the maximum development time for an Openreach SoR was significantly greater than for other requestors at 65 months compared with 29 months.

A18.98 We acknowledge that the variations between customer groups may be explained by differences in the types and complexities of the original requests. However, it is not clear to us that requests originated by Openreach should necessarily take significantly longer than requests submitted by other customer groups as BT suggests. Moreover, we see no reason why these requests should not be regarded as representative of innovations that other CPs might pursue independently with a dark fibre remedy. However, even if we confine our consideration to customer groups other than Openreach, average and maximum development timescales are in our view lengthy.

A18.99 We consider that the speed of development is an important factor in shaping the scope for innovation. Whilst we recognise the time taken to fulfil a SoR will be driven, at least to some extent, by the complexity of the specific SoR, we consider that a dark fibre remedy offers opportunities for CPs to set the pace of product development by removing the active elements from Openreach's sole control. As such, we consider that CPs would have a greater opportunity to develop products to meet their own customers' requirements in the timescales that CPs consider appropriate.

Innovation on other networks

A18.100 In the May 2015 BCMR Consultation we reviewed illustrative examples of innovations that might be facilitated by passive remedies, drawn from CPs' responses to our consultations. These included:

- Eight examples of applications currently provided by CPs with their own network infrastructure that they considered could be deployed more widely using dark fibre.[180]

- Seven examples of innovations/applications that CPs considered they could deploy if they had access to passive remedies.[181]

A18.101 For the reasons outlined in paragraph A18.28, BT considered that the non-redacted examples were not supportive of innovation on other networks.

A18.102 Having reviewed BT's comments, we remain of the view that with one exception, the examples provided in Table A18.4 and Table A18.5 are illustrative of the types of innovation/applications that CPs could be adopted with a dark fibre remedy. In relation to BTs comments, we note that:

- BT objected to three of the eight examples on the basis of the limited proof of innovation relating to fault diagnosis, proactive fault management or improved

[180] May 2015 BCMR Consultation, Table A27.11: Examples of innovation/applications used by CPs on-net

[181] May 2015 BCMR Consultation, Table A27.12: Examples of innovation/applications CPs claim they would be able to deploy using passive remedies.

fault identification.[182] BT objected to one example on the basis that dark fibre would remove the benefits of its automated monitoring and repair service.[183] BT objected another on the basis of the limited innovation arising from circuit upgrades.[184] BT objected to a third example on the basis that it was not clear that it would lead to greater efficiency (because of the costs).[185] However, in relation to these, we consider that the crucial point is that these examples provide an illustration of the type of innovation or product differentiation that CPs could take forward with a dark fibre remedy without requiring Openreach's oversight through the formal SoR process. As explained earlier, we consider that innovation does not necessarily involve new technology but is broader and includes the ability to effect change and differentiate products.

- BT objected to the GTC FTTH GPON example on the grounds that it related to an available technology from Openreach that could be developed further as part of BT's future plans (although BT has not committed to this further development).[186] This example related to the use of dark fibre for backhaul for GTC's own GPON FTTH networks rather the deployment of GPON network using a dark fibre remedy and is therefore in our view a relevant example.

- We accept that the Sky optimised network architecture example is less relevant to the dark fibre remedy that we proposed.

A18.103 The examples are reproduced in Table A18.4 and Table A18.5 respectively.

Table A18.4: Examples of innovation/applications used by CPs on-net

Type	Operator	Description
Technology or service feature	[✂]	[✂][187]
Network architecture	[✂]	[✂][188]

[182] The examples provided in the May 2015 BCMR Consultation document relating to Vodafone's Ethernet NID service monitoring and fault diagnosis functionality; Vodafone's proactive fault management; and Warwick Net's Use of dark fibre.
[183] The example provided in the May 2015 BCMR Consultation relating to Six Degrees Group view that dark fibre would improve handover by reducing points of failure in the network.
[184] The example provided in the May 2015 BCMR Consultation relating to Six Degrees Group view that dark fibre would provide the potential for more flexible bandwidth products.
[185] The example provided in the May 2015 BCMR Consultation relating to Sky's view that dark fibre would allow it to mandate its own NTE equipment on its active services.
[186] The example provided in the May 2015 BCMR Consultation document relating to GTC's FTTP-GPON technology.
[187] [✂ ✂].
[188] [✂ ✂].

Technology or service feature	**Vodafone**	**Ethernet NID service monitoring and fault diagnosis functionality** Vodafone has suggested that it could more widely roll out improved service monitoring and fault diagnosis capabilities by using network terminating equipment that supports Ethernet NID global industry standards. Vodafone claims that this would have benefits for service monitoring and repair – allowing the interrogation of devices via the traffic stream to report on errors, command test capabilities such as loopbacks and test patterns.[189]
Technology or service feature		**Proactive fault management** Vodafone noted that Openreach turned down its request for access to the service monitoring functionality of Openreach's Ethernet services. With a dark fibre remedy it would install its own equipment and would therefore have access to the service monitoring functionality, allowing it to carry out proactive fault management and repair.[190]
Technology or service feature	**Warwick Net**	**Use of dark fibre** WarwickNet already consume dark fibre and argue it enables them to implement a number of features not possible with active remedies.[191] These include scaling capacity, removing dependence on provider equipment and improved fault identification.
Network architecture	**[✂]**	**[✂]**[192]
Network architecture	**GTC**	**FTTP-GPON technology** GTC would be able to accelerate the adoption of PON technologies. This offers cost advantages over point-to-point fibre networks by passively combining traffic from a number of subscribers onto a single fibre. A GPON head end collocated in a BT exchange can serve many new housing developments via a passive optical splitter in the footway box next to each development. GTC mainly serve new residential developments but also smaller businesses.[193]
Network architecture	**[✂]**	**[✂]**[194]

[189] Frontier non-confidential report for Vodafone in response to the CFI, page17.
[190] Vodafone, non-confidential response to the CFI, page 21.
[191] WarwickNet, non-confidential response to the November Consultation, page 2.
[192] [✂]
[193] GTC, non-confidential response to the November Consultation, pages 8, 19.
[194] [✂].

Table A18.5: Examples of innovation/applications CPs claim they would be able to deploy using passive remedies

Type	Operator	Description
Technology or service feature	**[✂]**	**[✂]**[195]
Technology or service feature	**[✂]**	**[✂]** [✂][196]
Technology or service feature	**Six Degrees Group**	**Circuit upgrades** Six Degrees Group state that dark fibre would give CPs more flexibility over circuit bearer upgrades (i.e. to increase circuit bandwidth), rather than requiring co-ordination with Openreach. This would provide the potential for more flexible bandwidth products.[197]
Technology or service feature	**Six Degrees Group**	**Handover** Six Degrees Group argues that currently multiple devices are often used at both ends of an active service, which could be replaced by a single device. This could save power and space, lead to easier provisioning and monitoring and reduce points of failure in the network. [198]
Technology or service feature	**Sky**	**Network termination equipment** Sky argues that as Openreach mandates its own network termination equipment (NTE) on its active products, CPs cannot access the full capacity of the underlying fibres. They would invest in their own NTEs to manage capacity optimally, lower costs and improve quality of service.[199]
Technology or service feature	**[✂]**	**[✂]**[200]

Our assessment of the scope for improvements in service quality

A18.104 In this sub-section we consider in more detail the scope for innovation in service quality with a dark fibre remedy.

A18.105 A dark fibre remedy would give CPs greater control over some aspects of service quality. CPs would have greater flexibility in relation to aspects of service quality

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195 [✂]
196 [✂]
197 Six Degrees Group, non-confidential response to the November Consultation, page 4.
198 Six Degrees Group, non-confidential response to the November Consultation, page 4.
199 Sky, non-confidential response to the November Consultation, page 2.
200 [✂]

that stem from the choice and operation of the terminal equipment such as specification of service quality features and service upgrades requiring replacement or reconfiguration of terminal equipment. CPs could use this flexibility to offer better service quality than BT or to differentiate their services in other ways e.g. by offering different terms to BT or by offering bespoke service quality options.

A18.106 We note that a number of stakeholders have referred to the ability to offer their own types of products with their own service characteristics as a key benefit of dark fibre:

- PAG referred to passive access allowing CPs to deploy their own types of products with their own technical and service characteristics.
- TalkTalk referred to process and quality innovations such as lower fault rates/and or more rapid repair of faults in active equipment through, for instance, more reliable active equipment; better monitoring and proactive maintenance; hot standby; better fault handling; more engineers and added resilience.
- [✂]
- Colt argued that dark fibre will allow CPs to better control the components of a commercial offering including the terms of service, such as SLGs, payments for breach of service level commitments, minimum contract terms, rights of cancellation.

A18.107 CPs using dark fibre would still be dependent on BT for the provision and rearrangement of dark fibre circuits. Our analysis indicates that the current concerns about BT's provisioning quality of service relate mainly to the difficulties that BT encounters in the provision of the underlying fibre circuits that support its active wholesale services rather than provisioning and commissioning of the active equipment. Thus to the extent that these issues persist, they would also be likely to be present with a dark fibre remedy.

A18.108 However, with dark fibre there would be opportunities for CPs to improve fault repair service quality and also to differentiate their repair service offerings from those offered by BT. These opportunities would arise because:

- CPs would take primary responsibility for service monitoring and fault diagnosis and would select the terminal equipment and monitoring/diagnostic test equipment.
- There would be no need for CPs to coordinate with BT to diagnose terminal equipment faults.
- Dark fibre has the potential to reduce equipment duplication compared with active remedies, thereby lowering fault rates.
- CPs would be responsible for all terminal equipment and would therefore be responsible for a larger proportion of faults than with active remedies where BT is responsible for faults on its terminal equipment.

A18.109 With greater control of the fault repair process, CPs could for example:

- adopt more proactive circuit monitoring and fault management techniques; and

- offer different fault response and repair timescales, subject to the constraints imposed by BT's lead times for repairing fibre faults.

A18.110 BT disputed our analysis of its fault repair data, particularly our statement that most faults seem to occur in the active layer. In its view, there had been twice as many fibre faults as terminal equipment faults in the last 12 months.

A18.111 In Table A18.6, below we provide the fault repair data on which our analysis in the May 2015 BCMR Consultation was based. Table A18.6 shows the volume of Ethernet faults repaired by Openreach each month in the year ending February 2015 segmented by fault type.

Table A18.6: EAD faults reported to BT

	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15
Fibre Faults	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂
BT Terminal Equipment	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂
Customer Faults	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂
Total faults	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂	✂

Source: BT, Openreach Ethernet Service Pack presentation to Ofcom, March 2015

A18.112 As BT has pointed out, there were approximately twice as many Fibre Faults as BT Terminal Equipment faults. Importantly, Table A18.6 shows that about three quarters of faults currently reported to Openreach in this period related to elements that would be within CPs' domain with a dark fibre remedy (specifically the BT Terminal Equipment and Customer Fault categories).

A18.113 BT considered that the Customer Faults category, comprising nearly two thirds of fault reported to Openreach, were faults in CPs own networks that CPs had misdiagnosed. Given this, BT considered that a dark fibre remedy would inevitably require proportionately more engineering site visits and longer fault repair times, than active services, since BT would not be able to diagnose such faults remotely.

A18.114 We do not agree that all of the faults classified as Customer Faults should be regarded as misdiagnosed faults as BT suggests. Whilst this category may contain misdiagnosed faults, we consider it likely that most are tests requested by CPs in support of their own fault diagnosis activities.

A18.115 We acknowledge that dark fibre would require proportionately more engineering site visits than active services if CPs were to diagnose faults for dark fibre services less accurately than BT diagnoses faults for active services. We do not, however, agree that this will necessarily be the case and there are a number of reasons to believe that it is unlikely to be the case:

- We would expect CPs to deploy terminal equipment with comparable remote monitoring and diagnostic test facilities to those used by BT for active services.

- End-users typically require short repair timescales supported by SLAs and SLGs. CPs would therefore have a strong incentive to diagnose faults accurately in order to get faults repaired as quickly as possible. As BT points out, it would need to perform an on-site test to diagnose a dark fibre fault. CPs will therefore have a strong incentive to avoid reporting faults to BT unless their diagnostic tests indicate a fibre fault in order to avoid unnecessary delays.

- As with wholesale Ethernet services, it is likely that BT would raise Time Related Charges (TRCs) for abortive site visits relating to misdiagnosed faults.

A18.116 Furthermore, we would expect BT and CPs to agree handover arrangements for dark fibre faults including for example details of fault conditions and tests results to be provided to BT to enable it to respond efficiently to fault reports.

<u>Our assessment of the scope for innovations in network design</u>

A18.117 We consider that dark fibre could provide some scope to realise innovation benefits related to physical network design. In particular, we consider that Colt's response to the May 2015 BCMR Consultation relating to using dark fibre [✂] provides an illustration of the potential benefits that dark fibre could deliver.

A18.118 Notwithstanding this, we also recognise that the constraints imposed from the specification of our dark fibre remedy are likely to limit the scope for innovation in network design.

Conclusions on dynamic efficiency benefits

A18.119 Where CPs do not have the necessary network infrastructure to provide leased lines, competition in applications which use leased lines is currently based on BT's regulated set of end-to-end wholesale leased line services (i.e. active products). Accordingly, CPs rely on regulated access to Openreach's active products to meet their customer needs.

A18.120 While the current regulation based on BT's active products supports significant competition at the service level, it also has the effect of constraining innovation and product differentiation. We consider that the constraints to product innovation and differentiation relate to two main sources.

- Firstly, BT determines whether, when and how its wholesale leased line products (i.e. active products) are developed. Ultimately, as the SMP provider, BT controls the nature of the network access services available to CPs.

- Secondly, we impose strict non-discrimination obligations on BT in the wholesale leased lines market to protect CPs against BT's incentives to favour its downstream businesses.

A18.121 We consider that if BT were required to offer a dark fibre product it would allow CPs to break free of the two constraints outlined above. Firstly, each CP would be able to determine whether, when and how to develop its own active services (rather than relying on BT). Secondly, by allowing CPs control over whether, when and how to develop their own active products, dark fibre would also enable CPs to exploit the first-mover advantage and product differentiation that derive from innovating, and hence incentivise them to innovate. Accordingly, the requirement for BT to offer a dark fibre product should encourage innovation.

A18.122 In our view, a dark fibre remedy would increase innovation by allowing CPs to configure and deploy their own active equipment to better suit their customers' needs. The availability of differentiated active products in the market would also put pressure on all operators (including Openreach) to innovate, driving greater dynamic efficiency, and promoting competition.

A18.123 We consider that a dark fibre remedy would provide CPs with greater control over those aspects of service quality stemming from control over the choice and operation of the terminal equipment such as the specification of service quality features, service upgrades and reconfigurations. This would give them greater flexibility to offer better service quality and to differentiate their services in other ways e.g. by offering different terms to BT or by offering bespoke quality of service options.

A18.124 A dark fibre remedy would also provide CPs with greater control over fault repair processes, providing them with the opportunity to improve fault repair service quality and also to differentiate their repair service offerings from those offered by BT. Also a dark fibre remedy offers the potential to reduce the level of duplication of electronic equipment which should reduce the overall failure rate of the services.

A18.125 We consider that the scope for innovation provides support for a dark fibre remedy in its own right, without needing to identify in advance the innovations that will result from the remedy. Nevertheless, we have identified a number of specific innovations that we consider could result from the availability of regulated dark fibre, and a number of developments in past SoR requests that may have been more likely to be realised if CPs had access to regulated dark fibre.

Productive efficiency in the form of lower costs and prices

A18.126 We consider that there are two key issues relating to productive efficiency and price reductions resulting from a dark fibre remedy.

A18.127 The first relates to the prospect of genuine competition on the merits, and the benefits this may have in the form of lower costs (and therefore ultimately, prices) which we discuss in this annex.

A18.128 The second relates to potential arbitrage opportunities created by the interaction of passive access products with the current active pricing structure. These may result in price reductions for some downstream services relative to today but are not necessarily driven by cost-efficiencies. We discuss the implications of the arbitrage opportunities in Annex 19.

Summary of our consultation position

A18.129 In the May 2015 BCMR Consultation, we considered that competition based on a dark fibre remedy would make more elements of the network contestable for competitors to BT compared with active remedies, potentially reducing the total cost of delivery.

A18.130 We considered that a dark fibre remedy may allow CPs to aggregate capacity and avoid potential duplication of network monitoring elements and equipment, which could drive lower downstream prices than might occur with active remedies alone.

A18.131 In relation to the potential to avoid duplication of network monitoring elements we explained that with a dark fibre remedy, Openreach would not be required to provide any terminating equipment and the CP would normally be able to operate the circuit with the same equipment it currently deploys when it uses an active product (provided it is equipped with long-range optical interfaces rather than short-range optical interfaces). In effect, the use of dark fibre could allow CPs to deliver the same service at a lower cost than with active circuits, as less equipment, power and accommodation costs are required

A18.132 We estimated the potential savings for a CP using dark fibre by comparing the costs of provision of a leased line circuit using an active product with the costs of provision of a leased line circuit using dark fibre.

A18.133 We provisionally found that access to dark fibre would be likely to save equipment with a value of £[✂] per EAD 1Gbit/s circuit. We also estimated that the total savings based on the potential volume of circuits that may switch to passive remedies could lead to a significant cost saving of up to £3.5 - £7 million in the short-term and £60 - £120 million in the long-term.

A18.134 In addition, given the high cost of BT's system upgrades associated with new developments, we considered that CPs may have more scope to realise additional cost saving opportunities. This in turn may allow the industry to address niche demands more effectively in the future.

Stakeholders' responses to the May 2015 BCMR Consultation

A18.135 BT argued that the vast majority of Ofcom's identified cost savings are actually sunk and unrealisable. It argued that Ofcom failed to factor in the additional network investments BT has had to make in the monitoring of BT's end boxes which will not be recoverable as well as the incremental costs that CPs will also need to incur.[201]

A18.136 BT considered that Ofcom's estimate of cost savings of £120m was misleading and also inconsistent with the volume assumptions for dark fibre used elsewhere (e.g. in the LLCC consultation). BT noted that Ofcom's cost savings were based on the complete migration to dark fibre at all bandwidths, including the migration of active circuits that BT consumes (which would mean Ofcom is implying that BT can make savings on expenditures it has made for itself, which is illogical).[202]

A18.137 BT maintained that Ofcom has not considered the increased costs of test and repair which must arise from the loss of remote monitoring and fault diagnosis functionality built into BT's terminal equipment. BT considered that three options would be available with a dark fibre remedy:

- A manual test, potentially requiring a site visit by an Openreach engineer to each end of the dark fibre (which is considered only appropriate for a limited number of circuits)

- A manual customer site test (carried out by the downstream CP's engineers or even the customer's engineers) of sufficient quality and reliability that allows Openreach engineers sufficient trust to start intervention in the physical network (which is considered only appropriate for a limited number of circuits)

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[201] BT response to May 2015 BCMR Consultation, Part B page 98.
[202] BT response to May 2015 BCMR Consultation, Part B page 99.

- A fully automated OSS interface between the CP's real time monitoring OSS and Openreach's OSS to allow Openreach to test the fibre using the CP's facilities (which would require expensive development by all CPs including Openreach that would eliminate any cost savings from the reductions in NTE capital costs)[203]

A18.138 BT noted that Ofcom had referred to the cost of BT's Operational Support Systems (OSS) upgrades when implementing complex developments and the related scope for CPs to make additional efficiencies which may translate into lower systems costs. BT argued that these had been put in place to meet EOI regulatory obligations and would not change as a result of the introduction of passive remedies. BT argued that even if these lower costs made smaller projects more viable, these small projects would remain niche and would be inconsequential in the overall market.[204]

A18.139 TalkTalk considered that the introduction of dark fibre would result in less duplication of fixed costs overall and that although use of BT's dark fibre would result in some duplication of active layer costs this is likely to be minor since the vast majority of active layer costs are variable. It also considered that dark fibre would reduce duplication in the duct/fibre layer as CPs switch from using self-build infrastructure to dark fibre.[205]

A18.140 PAG considered that passive access would result in productive efficiencies (and reduced costs) through encouraging greater competition in more of the cost stack.[206]

Our assessment

Opportunities for competition further along the value chain

A18.141 As already discussed above in relation to our dynamic efficiency assessment, we consider that competition based on dark fibre would make more elements of the network contestable by BT's competitors compared with competition based on active remedies only.

A18.142 We consider that this would allow competitors to take advantage of opportunities to make additional efficiencies over BT. For example competitors would be able to make their own choices in relation to the network equipment used according to their own individual network requirements.

A18.143 In addition, CPs may be able to exploit efficiencies relating to how to aggregate capacity relative to active remedies.

A18.144 In this regard, we note that [✂]

Figure A18.1: [✂]

[✂]

[203] BT response to May 2015 BCMR Consultation, Part B page 99.
[204] BT response to May 2015 BCMR Consultation, Part B page 98.
[205] TalkTalk response to May 2015 BCMR Consultation, page 8.
[206] PAG response to May 2015 BCMR Consultation, page 29.

Figure A18.2: [✂]

[✂]

[✂][207]

A18.145 [✂]

A18.146 We consider that to the extent that increased competition along the value chain leads to increased productivity efficiency gains, a dark fibre remedy would drive lower downstream prices relative to active remedies only.

Opportunities to reduce equipment duplication

A18.147 We consider that a dark fibre remedy offers the potential to reduce the level of duplication of electronic equipment, which is a feature of the current active leased lines products and as such provides a clear opportunity to reduce costs relative to active remedies alone.

A18.148 For illustrative purposes we have considered the potential equipment cost savings from using dark fibre for new connections relative to EAD 1Gbit/s active circuits only.

A18.149 Figure A18.3, illustrates the equipment used to provide a typical Ethernet access circuit using an active product and a dark fibre product. In our illustration, this is an EAD 1Gbit/s circuit that connects a customer site to a network site located either in a BT exchange or a CP site. With active remedies, connections of this type are typically provided using Openreach's EAD and EAD LA products depending on the location of the network site.

[207] [✂]

Figure A18.3: Equipment saved by dark fibre remedy (EAD customer-to-network circuit)[208]

Source: Ofcom analysis
Notes: CP – communications provider, OR – Openreach, S – short reach optical interface, L – long reach optical interface

A18.150 Figure A18.3 shows that with an active remedy, Openreach and, typically, also the purchasing CP, install equipment at both ends of the circuit:

- Openreach installs Network Terminating Equipment (NTE) at the customer's premises and a Network Terminating Unit (NTU) at the BT exchange/CP PoP. These two pieces of equipment are labelled OR1 and OR2 in Figure A18.3. They are configured with long-range optical interfaces, marked (L) to enable data transmission over the distance between the customer's site and the BT exchange/CP PoP.

- The purchasing CP will often add its own equipment, both at the customer's premises and at the BT exchange/CP PoP. At the customer's site, the CP will typically add a router or other customer-premises equipment (CPE) to provide a downstream service (e.g. a VPN) to the end-user. The CP will also install equipment at the BT exchange or CP PoP for onward transmission. This equipment, labelled CP1 and CP2 in Figure A18.3, is equipped with short-range optical interfaces (marked as 'S' in Figure A18.3) as it is directly connected to the Openreach equipment.

A18.151 With a dark fibre remedy, Openreach would not provide any terminating equipment and the CP would normally be able to operate the same equipment it deploys in the active scenario, provided it is equipped with long-range optical interfaces rather than short-range optical interfaces.

[208] We recognise that some access circuits have EAD connections with a main link. This does not affect our analysis as the main link connection is only fibre and no additional equipment or services are used to form the main link.

A18.152 Based on the analysis above, Table A18.7 summarises the equipment that is likely to be saved per circuit with a dark fibre remedy (assuming that the long-range interfaces for the Openreach and CP equipment are equivalent) and our estimates of the associated cost savings.

Table A18.7: Equipment savings per circuit

	Equipment	Description	Number of units saved	Cost per unit	Saving per circuit
Customer site	OR1	NTE	1	£✂	£✂
	S	1Gbit/s short reach optical interface	2	£✂	£✂
Network site[209]	OR2	Head-end common equipment	1 per 15 circuits[210]	£✂	£✂
	NTU	Network Terminating Unit	1	£✂	£✂
	S	1Gbit/s short reach optical SFP	2	£✂	£✂
Total cost saving per circuit					£✂

Source: Ofcom analysis

A18.153 Our estimates of the potential savings in equipment per circuit are based on Openreach's forecast of equipment costs in 2018/19.[211, 212]

A18.154 We have assumed that one common head-end unit will be saved per 15 circuits. We consider this assumption is conservative since we are assuming that all the common head-end equipment is operating at full capacity. Accordingly, if utilisation is below 15 circuits on average, then the potential saving per circuit would be higher.

A18.155 We note that using less equipment would lead to additional savings in related costs. For example, using less equipment would also save on electrical power and accommodation costs. In addition, we consider that dark fibre could also lower the costs associated with systems developments since there is no intermediate EAD equipment (OR1 and OR2 in Figure A18.3) to incur costs.[213]

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[209] We recognise that alarm monitoring equipment may also be saved consisting of a broadband monitoring line and router which supports up to four head-end units. We believe the savings from these items will be relatively small and consequently we have excluded it from our estimates.

[210] BT uses head-end equipment comprising equipment chassis and power supply that supports the Network Terminating Units for up to 15 EAD circuits.

[211] BT response to 4th s135 notice, QA4, dated 11 November 2014.

[212] We have assumed that the cost of the optical interface is the same for Openreach and CPs. We recognise that CPs may pay higher prices for Optical Interfaces as Openreach may benefit from bulk discounts. However, we do not consider that this will have a material impact on our estimates.

[213] Changes to Openreach's active products lead to significant costs for Openreach associated with systems developments. In addition, for a CP to adopt that product change it will also incur costs for developing its systems. We recognise that Openreach would incur development costs to introduce a dark fibre product. However, we consider that in the long-run there is potential to save on the on-going costs of developing active products.

A18.156 Our analysis shows that dark fibre would be likely to save equipment with a value of £[✂ ✂] per EAD 1Gbit/s circuit.

A18.157 Our estimate of equipment savings is based on customer-to-network connections (i.e. 1Gbit/s EAD LA and some 1Gbit/s EAD circuits). We also note that EAD services are deployed in a range of configurations (including end-to-end services between customer sites and backhaul segments between BT exchanges and CP PoPs), bandwidths and circuit length options. Although the equipment used will vary according to the configuration, the equipment deployed by CPs will typically be capable of operating the circuit with suitable long range optical interfaces. Furthermore, our calculations suggest that varying the configuration results in relatively small differences in cost savings per circuit of plus or minus £[✂].[214]

A18.158 We have also considered more generally whether dark fibre would allow for savings in equipment in other leased line technologies in the CISBO market. We consider that a dark fibre remedy may not generate comparable equipment savings for WDM services because CPs using dark fibre would need to deploy additional equipment comparable to that used by Openreach for its OSA/OSEA services in order to provide WDM services. There may be potential for equipment savings for the other technologies in the CISBO market. However, we have not considered this in detail given they are relatively a small proportion of CISBO circuits.

A18.159 For illustrative purposes, we have estimated the potential total savings (equipment only) based on the volume of 1Gbit/s EAD new connections[215] that we forecast will switch to a dark fibre by the end of the forthcoming charge control period.[216] We only consider this for circuits outside the CLA (as we are not imposing a dark fibre remedy in the CLA).

A18.160 Based on these assumptions, we estimate equipment cost savings of up to £3.5 - £7 million for 2018/19 in relation to EAD 1Gbit/s alone. Furthermore, this estimate relates to equipment cost savings only and does not take into account related savings for power and accommodation.

Table A18.8: Estimate of potential cost savings for EAD 1Gbit/s circuits, 2018/19

	New connections volume (ccts)	Total potential cost savings (£)
EAD	✂	✂
EAD LA	✂	✂
Total	✂	✂

Source: Ofcom analysis

[214] Cost savings per circuit are around £[✂] for EAD customer-to-customer links and £[✂] for EAD network-to-network links.
[215] We recognise that some migration of existing EAD 1Gbit/s circuits to dark fibre could occur in the forthcoming charge control period. However, we do not include these volumes in our illustrative estimates below since the relevant equipment costs will already be incurred for those circuits.
[216] These volumes are consistent the forecasts of new connections of 1Gbit/s EAD circuits switching to dark fibre used in the LLCC.

A18.161 In response to our analysis in the May 2015 BCMR Consultation relating to potential cost savings from dark fibre (relative to active products), BT argued that the vast majority of the cost savings that we identified were sunk and therefore unrealisable.

A18.162 Our interpretation of BT's argument is that we have not reduced our estimates of cost savings to take account of equipment that has not been fully depreciated (and that therefore might be regarded as stranded). To be clear, we have estimated the forward looking potential cost savings for a CP resulting from using dark fibre as a result of avoiding duplication of equipment only. Furthermore, in our illustrative estimates we do not include the impact of existing EAD 1Gbit/s circuits switching to dark fibre. Therefore, to the extent that either a CP or BT has incurred costs that have not been fully recovered, these are not included in our estimates. However, to the extent that BT has stranded assets as a result of the introduction of dark fibre these are discussed in detail in Annex 19.[217]

A18.163 Notwithstanding the above, we consider that our estimate of £[✂] per EAD 1Gbit/s circuit provides an indication of the per-circuit saving that relates to new connections. As such, we consider that it also provides an illustration of the longer-term per EAD 1Gbit/s circuit cost saving from dark fibre. Furthermore,[✂]. [218]

Figure A18.4: [✂]

[✂]

Additional fault repair costs

A18.164 BT also argued that our estimates of the cost savings from the introduction of dark fibre do not include the incremental costs that CPs would need to incur in switching from a leased line circuit based on active remedies to one based on dark fibre. In particular, BT referred to the additional costs that could arise because BT would not have remote monitoring and diagnosis capabilities for dark fibre services.

A18.165 We acknowledge that BT could incur proportionately more engineering site visits if CPs were to diagnose dark fibre faults less accurately than BT diagnoses faults with active services. As explained earlier, we consider this is unlikely to be the case as CPs would have comparable remote monitoring and diagnosis capabilities to those deployed by BT for active services and would have a strong incentive to diagnose faults as accurately as possible.

Estimate of cost savings

A18.166 In the May 2015 BCMR Consultation, we provided an upper bound of the long-term estimate of the cost savings from dark fibre as a result of removing duplication of equipment. Our estimate was based on the assumption that all active circuits (i.e. the total volume of EAD, EAD LA and WES[219] circuits operating at 10Mbit/s,

[217] We discuss the risks related to stranding of assets in Annex 19 and issues of cost recovery relating to the introduction of a dark fibre remedy in Annex 33.
[218] [✂]
[219] We apply the cost savings for EAD connection to WES circuits because we assume that in the absence of passive remedies WES connections will migrate to EAD in the long-run.

100Mbits/s and 1Gbit/s and above) switched to dark fibre. Based on this volume we estimated potential equipment savings of up to £60 - £120 million in 2018/19.[220]

A18.167 We acknowledge that this estimate was based on an assumption that all active circuits would switch to dark fibre and therefore did not align with our assumptions elsewhere in the May 2015 BCMR Consultation (or June 2015 LLCC Consultation). Furthermore, it does not align with the assumptions relating to the migration of active circuits to dark fibre in this Statement. The estimate was intended to be illustrative only. Notwithstanding this, in this Statement we have not included an estimate of potential cost savings based on the assumption that all active circuits would switch to dark fibre. Instead we focus only on the potential cost savings from the migration of active circuits (specifically EAD 1Gbit/s circuits in our illustrative example) to dark fibre anticipated in this control period only.

Other productive efficiencies

A18.168 We consider that given the high cost of BT's system upgrades associated with new developments, the introduction of a dark fibre remedy may provide CPs with scope to realise additional cost saving opportunities. This may make smaller developments to address niche demand more viable.

A18.169 Whilst we acknowledge BT's comment that any niche developments will remain niche even with a dark fibre remedy, we also consider that CPs will have more scope to realise additional cost savings for projects of all sizes and therefore the cost saving benefits will extend beyond those relating to niche developments.

Conclusions on productive efficiency benefits

A18.170 We consider that competition based on a dark fibre remedy would make more elements of the network contestable for competitors to BT compared with active remedies, potentially reducing the total cost of delivery. A dark fibre remedy may allow competitors to aggregate capacity and would avoid the duplication of some elements of network equipment, which could drive lower downstream prices than might occur with active remedies alone.

A18.171 In particular, our analysis shows that the use of dark fibre could allow CPs to deliver the same service at a lower cost than with active circuits, as less equipment, power and accommodation costs would be required. As an illustration, we estimate access to dark fibre would be likely to save equipment with a value of £[✂] per EAD 1Gbit/s circuit. Based on the volume of 1Gbit/s EAD new connections alone that we forecast will switch to a dark fibre by the end of the forthcoming charge control period, we estimate total savings of up to £3.5 - £7 million in 2018/19.

A18.172 In addition, given the high cost of BT's system upgrades associated with new developments, CPs may have more scope to realise additional cost saving

[220] The calculation was based on a cost saving of £[✂] per circuits for 10 Mbit/s and 100 Mbit/s connections. Cost savings for these circuits are slightly lower than the cost saving per 1Gbit/s circuits [✂]. This is because i) we assumed the two units of short reach Optical interface for Openreach equipment are not saved and ii) the price of short reach interface for 10 Mbit/s and 100 Mbit/s circuits is different from 1Gbit/s circuits [✂].

opportunities. This in turn may allow the industry to address niche demands more effectively.

Potential to withdraw or relax downstream regulation

Summary of our initial view

A18.173 In the May 2015 BCMR Consultation, we recognised that a passive remedy would take some time to implement and that the industry would take some time to prepare to consume it. Therefore, we considered that it would be necessary to impose passive remedies alongside active remedies for the purpose of this charge control period. However, we also considered that in the longer term, if the availability of passive inputs allows CPs to replicate the functions of Openreach's active services, there may be less (or no) need to impose regulation of active remedies downstream.

Stakeholders' responses to the May 2015 BCMR Consultation

A18.174 BT considered that a parallel set of dark fibre obligations (alongside those for active services) will increase, not reduce, the overall burden on BT.[221] Furthermore, it considered that the potential future deregulation as result of imposing passive remedies can only be considered a benefit in the context of firm criteria on how and when such regulation would be withdrawn.[222]

A18.175 TalkTalk considered that although dark fibre will increase the overall regulatory burden in the short-term it has the potential to reduce the overall costs in the medium to long-term (if active products can be deregulated). TalkTalk argued that in contrast to active services, dark fibre has a limited number of variants and so is less costly to design and enforce and less prone to regulatory error. It was therefore considered to be more stable and predictable.[223]

Our assessment

A18.176 We consider that dark fibre would allow CPs to innovate and develop their own active leased lines and rely less on BT's active wholesale leased line services. Accordingly, we consider that dark fibre would be able to support effective competition and that, over time, there may be less need (or no need) to impose active remedies.

A18.177 For example, where CPs use dark fibre to develop active services, there would not be a need to use BT's SoR process. As such this could provide an opportunity to avoid some of the coordination and transaction costs and reduce the overall burden on BT. We also agree with TalkTalk that since dark fibre has a limited number of variants it is potentially less costly to design and enforce and less prone to regulatory error.

[221] BT response to May 2015 BCMR Consultation, Part B, page 99.
[222] BT response to May 2015 BCMR Consultation, Part A, page 15.
[223] TalkTalk response to May 2015 BCMR Consultation, page 19.

A18.178 As such, and depending on the success of the remedy, dark fibre offers the opportunity at some point in the future not to rely on regulation at the active level and therefore reduce the overall burden on BT.

A18.179 However, for the purposes of this review we consider it necessary for the dark fibre remedy to coexist with active remedies.

A18.180 In relation to whether as a result of proposing to introduce a dark fibre remedy we could remove active remedies in this review period, we have taken account of the following considerations:

- Active remedies are well established and CPs currently depend on BT's regulated wholesale services in all locations in which BT has SMP in the relevant markets, for all applications.

- Dark fibre will take time to develop and we are not requiring BT to launch it before 1 October 2017. Furthermore, leased lines are used as inputs in long and complex value-chains. Accordingly, BT, CPs and end-users of leased lines will need time to adjust to any changes brought about by the introduction of a dark fibre remedy, including developing business processes to take advantage of dark fibre.

- Although we have set out the key aspects of the dark fibre remedy design, we also recognise that many aspects of the product design will need to be developed through discussions between BT and other CPs. Furthermore, even after the launch of the product, there may be issues that will need to be addressed over time which may impact on the take-up of dark fibre.

A18.181 Imposing a dark fibre remedy alongside active remedies will add to the regulatory burden whilst active and passive remedies co-exist. However, we consider that dark fibre offers clear benefits in terms of innovation, product differentiation and lower costs and prices, along with the prospects of relaxing regulation in the future that outweigh the potential short-term increase in the regulatory burden for BT.

A18.182 We have not set out criteria as part of this review on how and when regulation (at the active level) would be withdrawn following the implementation of a dark fibre remedy. For the reasons given in A18.180, we consider that this would be premature.

A18.183 We acknowledge that drawing parallels between the evolution of regulation (and deregulation) between markets is difficult and uncertain. However, we consider that the introduction of LLU provides some evidence of how the imposition of a regulatory remedy, and the subsequent take-up of that remedy, can allow for deregulation in downstream markets. More specifically, the introduction of a LLU remedy has increased competition in wholesale broadband access services by allowing CPs to invest in establishing a presence in BT exchanges (i.e. by unbundling the local exchange).

A18.184 In our Wholesale Broadband Access market reviews, we have recognised that as CPs have increased their presence in exchange areas through the use of the LLU remedy, this exerts a competitive constraint on BT in the Wholesale Broadband Access market. Therefore, there has been a gradual relaxation of regulation on BT in the WBA market that (broadly) reflects the expansion of CPs in unbundling exchanges and their ability to offer wholesale broadband services relevant to a specific exchange area.

Conclusions on potential to withdraw or relax regulation

A18.185 We consider that where a dark fibre remedy leads to sufficiently vigorous competition, there would be less need to impose active remedies. Therefore, in principle, a dark fibre remedy could lead to the withdrawal of regulation of active services over time, reducing the overall regulatory burden.

Summary of conclusions

A18.186 Based on our analysis, we conclude that:

- at present most of the benefits of passive remedies for customers of leased lines will lie in exposing the active layer to competition, and that, for the purpose of this market review, dark fibre will deliver those benefits;
- A dark fibre remedy would allow CPs to determine whether, when and how to develop their active services (rather than relying on BT). By allowing CPs control over whether, when and how to develop their own active products, a dark fibre remedy would allow CPs to exploit the first-mover advantage and product differentiation that derive from innovating, and hence incentivise them to innovate. Accordingly, the requirement for BT to offer a dark fibre product should encourage innovation and dynamic efficiency;
- in relation to productive efficiencies, a dark fibre remedy could provide CPs with opportunities to reduce duplication of equipment, reducing overall equipment costs and leading to lower prices; and
- a dark fibre remedy could allow us to reduce regulation of active services at some point in the future.

Table A18.9: Our updated analysis of cancelled and rejected SoR cases (2006 – 2014)

Cancelled or rejected SoRs where dark fibre would not have provided scope for innovation since dark fibre not relevant to SoR					
SoR	**Year-submitted**	**SoR-Title**	**State**	**BT comments - SoR Review**	**Our view**
✂	✂	BNS (BSC STM-4 Site) Resilience options	Cancelled	[✂]	SoR represents initial request for resilience option and therefore CP would need a new variant of dark fibre even if dark fibre remedy was imposed.
✂	✂	Connectivity solution at BT Nodes	Cancelled	[✂]	Requirement for functionality within a BT exchange. Dark fibre is not relevant to specific SoR request.
✂	✂	Sync-E timing source in an exchange Access Locate space	Rejected	[✂]	Requirement for functionality within a BT exchange. Dark fibre is not relevant to specific SoR request
✂	✂	Fibre Connectivity to/from BTW 21C Fibre MSANs	Cancelled	[✂]	Requirement for functionality within a BT exchange. Dark fibre is not relevant to specific SoR request
✂	✂	Extension of Ethernet Access Products back to Aggregation Points or TANs	Rejected	[✂]	Not applicable to our analysis since request rejected given misunderstanding about requirements on BT.
Cancelled or rejected SoRs where dark fibre access could have provided scope for innovation					
SoR	**Year-submitted**	**SoR-Title**	**State**	**BT comments - SoR Review**	**Our view**
✂	✂	Launch of 10G WES LA	Cancelled	[✂]	Dark fibre could have provided the opportunity for the CP to develop

					product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	WES Diagnostic request	Cancelled	[✂]	[✂] Dark fibre would have provided the required functionality in CPs' own equipment to proceed with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	RO2 Product Enhancement	Cancelled	[✂]	Given the underlying resilient fibre arrangements are already in place for one product dark fibre would have provided the opportunity for CPs to proceed with further product developments without Openreach oversight.
✂	✂	Additional Interfaces for the OSEA Ciena product	Cancelled	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with

					development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	In-band Standards-based Ethernet NID Access	Cancelled	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	IEEE1588V2 on ADVA NTEs	Cancelled	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	Facility Looping Capability	Rejected	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with

					development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	Upgrade Ethernet Aggregation Phase 1	Rejected	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	Interim Aggregated Local Handoff of EAD Circuits	Rejected	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	Aggregation Phase 1 Backhaul	Rejected	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with

					development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	High Density Method of Handover for EAD circuits + Enhanced OAM Capabilities	Rejected	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	PPC & RBS Transfer to Connectivity Services Ethernet products	Cancelled	[✂]	Although Openreach is required to assist in the migration of active circuits, in the longer term a dark fibre remedy would have provided the opportunity for the CP to develop products without Openreach oversight. As such, a CP could proceed with development based on its view of appropriate risks, timings, requirements and expectations of its business.
SoRs delivered by Openreach					

SoR	Year-submitted	SoR-Title	State	BT comments - SoR Review	Our view
✂	✂	Loop-back on WES circuit as part of a co-op request on assurance.	Capability delivered on 28/2/2007	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	Synchronous WES/Backhaul	Delivered October 2014	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements and expectations of its business.
✂	✂	FSP3000 R7 NTE enhanced services	Delivered December 2012	[✂]	Dark fibre could have provided the opportunity for the CP to develop product without Openreach oversight. As such, CP could have proceeded with development based on its view of appropriate risks, timings, requirements

					and expectations of its business.
SoRs relating to products that fall outside wholesale leased lines markets					
SoR	**Year-submitted**	**SoR-Title**	**State**	**BT Comments - SoR Review**	**Our view**
✂	✂	Changes to the Broadcast Access Product	Rejected	[✂]	SoR relates to product that falls outside the wholesale leased lines markets.
✂	✂	Single Channel Digital CCTV Transmission Service	Cancelled	[✂]	SoR relates to product that falls outside the wholesale leased lines markets.
✂	✂	Street Access	Rejected	[✂]	SoR relates to product that falls outside the wholesale leased lines markets.
✂	✂	Street Furniture to Local Exchange backhaul product	Rejected	[✂]	SoR relates to product that falls outside the wholesale leased lines markets.
✂	✂	Street Furniture to Local Exchange backhaul product	Cancelled	[✂]	SoR relates to product that falls outside the wholesale leased lines markets.
✂	✂	Collection Hub	Cancelled	[✂]	SoR relates to product that falls outside the wholesale leased lines markets.

Source: Ofcom analysis based on Openreach data submitted in response to s135, Q.A8 on 11/11/14, Q8-10 on 10/9/15 and BT response to May 2015 BCMR Consultation

Annex 19

Risks of a dark fibre remedy for BT and users of its network

Introduction

A19.1 This annex sets out our consideration of the broad categories of potential impacts and risks associated with the introduction of a dark fibre remedy for BT and users of its network, based on the responses from stakeholders and our own analysis. We discuss the risks to third party infrastructure providers separately in Annex 20.

A19.2 We have identified five potential risks to BT and/or users of its network associated with the introduction of a dark fibre remedy[224]:

- risks to dynamic efficiency, including existing and future investment incentives for BT, as a result of the potential threat to BT's cost recovery;
- risks to allocative efficiency and distributional impacts arising from the implications of dark fibre for BT's common cost recovery (including the likely need for some rebalancing of active prices in response);
- risks to productive efficiency (including inefficient entry), if investment signals at different levels of the value chain are distorted by the pricing of dark fibre (both in absolute terms, and relative to downstream active remedy pricing if they co-exist);
- impact on the structure of competition among users of BT's infrastructure, as opportunities to exploit economies of scale with dark fibre could narrow downstream competition to a smaller number of larger players; and
- the direct implementation costs associated with introducing a new remedy (such as process and systems developments required to enable ordering, provisioning, repair and cessation of dark fibre), which could have an impact.

A19.3 At a high level, we received differing views on these risks to BT and users of its network in response to the May 2015 BCMR Consultation. [✂][225] and Sohonet[226] agreed with our assessment of the risks associated with imposing a dark fibre remedy, while GTC[227], PAG[228], Vodafone[229] and [✂][230] argued the risks are likely to

[224] We have also identified that a dark fibre remedy may have an impact on other infrastructure providers, including their existing and future incentives to invest in infrastructure, which we discuss in Annex 20.
[225] [✂]
[226] Response to question 7.3, Sohonet non-confidential response to May 2015 BCMR Consultation.
[227] P11 response to Q7.3, GTC non-confidential response to the May 2015 BCMR Consultation.
[228] Page 30 (response to Q7.3), PAG non-confidential response to the May 2015 BCMR Consultation.
[229] P37, Vodafone non-confidential response to the May 2015 BCMR Consultation.
[230] [✂]

be lower than we suggested and/or manageable in practice. BT argued that we underestimated the disruptive impact of the proposed dark fibre remedy, but also considered that the price of any DFA product is a key factor in determining the extent of these risks.[231]

A19.4 Our analysis indicates that while introducing a dark fibre remedy potentially poses some risks, the scale and scope of all of the identified risks is likely to be directly affected by its specific design (including price and non-price design features) as well as the interaction with active prices (as regulated by the LLCC). Further, we consider that it is feasible (and practical) to design a dark fibre remedy which can adequately limit these potential risks in this review period. We therefore discuss the risks of dark fibre for BT and users of its network in general terms in this annex (including potential interactions with pricing and design at a high level), and note where we consider the risks are mitigated by the specific dark fibre remedy design we are imposing. The specific design features are discussed in more detail in Annex 21 (in relation to pricing) and Annex 22 (non-price design features).

A19.5 We now address each of the identified risks in turn, first summarising our provisional view in the May 2015 BCMR Consultation and the responses received from stakeholders, and then setting out our analysis. Many stakeholders commented on passive remedies more generally (i.e. covering duct and dark fibre combined), and so we summarise these views which are relevant to dark fibre below.

Dynamic efficiency, including investment incentives

Our consultation position

A19.6 In the May 2015 BCMR Consultation, we considered that passive remedies could reduce BT's investment incentives relative to an active-only regime if they significantly undermined BT's ability to recover its efficiently incurred costs.

A19.7 We considered that as a result of BT's existing active pricing structure, there were three potential sources of arbitrage opportunities which could undermine BT's cost recovery:

a) Density of network usage: BT's active prices are generally geographically averaged, but there are marked differences in the intensity of network usage.[232] As a result, contribution to cost recovery will tend to vary by area. However, passive access could allow CPs to aggregate services, which may provide opportunities for competitor to target the provision of services in locations with above average utilisation (i.e. those geographic areas with a high concentration of value).

b) Circuit length: Some of BT's active services are priced on a constant per circuit basis, irrespective of the actual circuit length. However, longer circuits are likely

[231] Paragraph 3.27 and 3.36, Part A of BT's non-confidential response to the May 2015 BCMR Consultation.
[232] With some geographic areas supporting many circuits and very high bandwidths, while others are utilised comparatively lightly.

to have higher actual costs of provision. Therefore shorter circuits will tend to make a greater contribution to common cost recovery relative to their cost of provision than longer circuits, and therefore have a greater margin which could be targeted by CPs using passive access (all else equal).

c) The pricing of bandwidth (i.e. the bandwidth gradient): The current active pricing structure generally involves higher bandwidth services making a greater per circuit contribution to the recovery of common costs than lower bandwidth services (i.e. there is a 'bandwidth gradient'[233]). Therefore CPs will be incentivised to use passive access to target these higher margin active services.

A19.8 However, we considered that the scale and scope of this risk would be highly dependent on the design of any passive remedy.

Responses to the May 2015 BCMR Consultation

A19.9 Several respondents (including PAG, Sky, TalkTalk, and Vodafone) argued that we had overstated the risks to BT's common cost recovery, and therefore the risks to BT's investment incentives. Conversely, BT argued that we had understated these risks.

A19.10 Some respondents argued that providing prices were set appropriately, there should be limited risks of arbitrage and to BT's cost recovery.

A19.11 For example, PAG stated that an appropriate pricing model could ensure there is no material risk of BT being unable to recover its common costs (and should address any risk of BT over-recovering).[234] It considered this to be a question of how rather than if passive remedies are introduced.[235] Similarly, Sky stated that common cost recovery should not stand in the way of passive remedies as this is a short term risk that can be addressed through the setting of appropriate charges. It also noted that while the process by which Ofcom forecasts future usage of active and passive remedies may result in short term variance in cost recovery, this can be through both over and under recovery of common costs (and in any event, considered that the short term risk is significantly outweighed by the potential long term benefits of passive remedies).[236] Hyperoptic also suggested that as long as the price differential between active and passive circuits is based on the cost differential, there should be no reason for BT to prefer actives only.[237]

A19.12 Relatedly, TalkTalk argued that there will be no risk of arbitrage (and therefore to cost recovery) with dark fibre if it is priced on a per circuit basis and BT rebalances its active prices to remove any arbitrage opportunity (since rebalancing is in its

[233] I.e. the change in price charged when moving to a higher capacity circuit exceeds the gradient of the incremental cost in relation to bandwidth.
[234] For example, PAG argued that any arbitrage would be addressed by a Fully Allocated Cost approach to setting the dark fibre price. See paragraph 1.20, PAG non-confidential response to the May 2015 BCMR Consultation. We discuss specific dark fibre pricing options in Annex 21.
[235] Paragraph 2.9, PAG non-confidential response to the May 2015 BCMR Consultation.
[236] Paragraph 6.4, Sky non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.
[237] P11 (response to Q7.3), Hyperoptic non-confidential response to the May 2015 BCMR Consultation.

commercial interests). TalkTalk considered that even if BT chose to not fully rebalance active prices immediately once dark fibre becomes available and arbitrage opportunities occur for a short period, it is unlikely a CP will enter based on existing margins since it will recognise that prices will change to fully remove any arbitrage.[238] In a similar regard, [✂][239]

A19.13 In relation to BT's specific investment incentives, Vodafone agreed that the imposition of dark fibre is likely to require some changes in Openreach but did not agree that BT's incentives to invest will be lessened. It referred to the fixed access market in support of this view, stating that despite vigorous competition there BT has responded and adapted, and overall consumers have benefited greatly from the more upstream regulatory intervention.[240] TalkTalk also argued that there will not be any negative impact on BT's infrastructure investment incentives as a result of introducing dark fibre, since its duct/fibre investments will be utilised in the same way even if customers who purchase active services from BT today switch to purchasing dark fibre from BT.[241,242] Further, TalkTalk considered that BT's active layer investments will not be stranded since there is (a) very little sunk cost and (b) BT's investments will, to a large degree, be covered by contractual terms across their shorter asset life. TalkTalk also disputed that there would be a disincentive to invest in active services in the future (as BT suggested), instead arguing that the incentive to invest will be enhanced since there will be competition at that layer.[243]

A19.14 Conversely, [✂].[244] BT's arguments can broadly be categorised into three main risks to its ability to recover costs as a result of dark fibre being introduced:

a) scope for inefficient entry/arbitrage opportunities, and the stranding of assets which could occur as a result, particularly as CPs redesign their networks (short term and long term);

b) the need to rebalance the prices of active services, which would induce additional migration of the existing circuit base; and

c) the impact of the LLCC on these risks.[245]

A19.15 We now set out BT's comments within these broad themes.

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[238] Paragraph 3.5, TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.
[239] [✂]
[240] P37, Vodafone non-confidential response to the May 2015 BCMR Consultation.
[241] It also considered that in practice BT's network may be used more as rivals switch from building their own infrastructure or using others' infrastructure to using BT's dark fibre.
[242] Paragraph 3.14, TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.
[243] Paragraph 3.15, TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.
[244] [✂]
[245] Paragraph 17.1-17.12 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation.

Scope for inefficient entry/arbitrage opportunities

A19.16 In general terms, BT agreed that the impact on investment incentives and its ability to efficiently recover its costs will be mitigated through a higher dark fibre price.[246] However, it argued that there will still be substantial arbitrage-based opportunities for take up of dark fibre which is not based on any innovation or differentiation, but is purely price based.[247]

Density-based arbitrage

A19.17 BT argued that these arbitrage opportunities arise from the historic way in which BT has provided services on an individual fibre per circuit basis, with prices which reflect the average utilisation of all fibres across the network (rather than reflect the high upfront costs of providing the fibre strand[248]). In particular, BT stated that it had in the past made reasonable and economically rational network design decisions to provide each circuit on a separate fibre(s) (rather than to aggregate multiple services onto individual fibres) when electronics were comparatively more expensive than today. BT stated that this approach was the efficient way for it to invest (even though it would not always be the case that future demands for the same routes would require additional bandwidth and new circuits, and BT took on this risk).

A19.18 BT argued that dark fibre breaks this framework by allowing CPs to move to a ‘fibre lean electronics rich’ network design. As such, they would face a trade-off between marginal costs of electronics versus a regulated active price which is set on a completely different basis. BT argued that not only does this provide CPs with a retrospective arbitrage opportunity (which it could not have reasonably anticipated), but this trade-off is also offered once demand is certain/has materialised. As a result, it considered that there is no risk to the CP as it can be completely selective in where it shifts out from multiple active circuits to a single passive circuit (and effectively ignores the risk that BT assumed in its initial build decisions).[249]

A19.19 BT argued that significant aggregation opportunities will potentially lead to large volumes of dark fibre take up driven solely by the relative prices of actives and dark fibre.[250] In support of this view, BT presented an analysis based on the current base of Openreach Ethernet circuits, and the scope for density-based arbitrage (aggregation) in the overall base, by different CPs, on the busiest routes, and on access routes (we discuss this analysis further in Annex 33). BT stated that given the distribution of such circuits throughout the UK, it is apparent that the

[246] Paragraph 3.37 of Part A of BT’s non-confidential response to the May 2015 BCMR Consultation.
[247] Paragraph 3.27 of Part A of BT’s non-confidential response to the May 2015 BCMR Consultation
[248] BT stated that if an incremental cost approach for individual circuits or connections had been taken, customers would have paid the cost of access separately as a fixed charge but then paid a very small charge for any incremental fibres. They would then have faced a trade-off between more expensive electronic equipment to upgrade bandwidth and other necessary functionality as a cost choice against the marginal cost of lower bandwidth electronics fibres.
[249] Paragraph 17.3-4 and 17.58-60 of Part B of BT’s non-confidential response to the May 2015 BCMR Consultation.
[250] Paragraph 3.29 of Part A of BT’s non-confidential response to the May 2015 BCMR Consultation.

opportunities for aggregation are widespread (and not confined to highly dense urban areas).[251] [✂][252]

A19.20 BT also argued that beyond the near-term circuit migrations effects, these issues will have an impact on future demand [✂]. In particular, it indicated that its network expansion to connect higher cost off-net sites is often justified by the potential for subsequent circuit demand on that route. However, it argued that this could be undermined if dark fibre allows a CP to serve more of this subsequent demand by aggregating onto a single fibre. As such, BT argued that dark fibre may make selected routes less commercially viable because no further customer will take the route once built (suppressing future demand for subsequent circuits).[253]

Circuit-length arbitrage

A19.21 In relation to the circuit length-based arbitrage opportunities, BT agreed that pricing relative to active services reduces this risk. However it argued that this will not eliminate incentives to arbitrage based on circuit length, as it sets up an opportunity for CPs to re-structure their networks (in which the three aspects of density, circuit length and bandwidth gradient come into play).[254]

Bandwidth gradient-based arbitrage

A19.22 In relation to the arbitrage opportunities arising from the pricing of bandwidth, BT agreed that the higher the price, the less chance of arbitrage at that price. However, it argued that Ofcom misses the key dynamic and incentives on CPs to use dark fibre which will fundamentally undermine BT's ability to sustain an economic active portfolio and particularly one which can keep to the parameters of the charge control.[255]

A19.23 In light of the above, BT strongly disagreed that the three potential sources of arbitrage can be entirely eliminated through the remedy design or by active price rebalancing or de-averaging, stating that this will only affect where the arbitrage occurs. It therefore disagreed with the conclusion that the risks of introducing dark fibre (including the impact on investment incentives and BT's ability to recover its costs) are minimal as a result. Instead, BT argued that the three sources of arbitrage will act in conjunction, and not separately, and create significant disruptions and distortions as Ofcom will provide false economic incentives for downstream CPs to change their network structures to take advantage of the opportunities arising. As a result, BT argued that the only way in which the incentives can be properly analysed is to recognise the mismatch in underlying pricing principles and structure arising along with the charge control framework and

[251] Paragraphs 17.15-34 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation.
[252] [✂]
[253] Paragraph 4.25-4.27 of Part A and paragraphs 17.47-53 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation.
[254] BT gave aggregation of Main Link as an example of this, which we discuss further in Annex 33. Paragraph 17.41-46, Part B of BT's non-confidential response to the May 2015 BCMR Consultation.
[255] Paragraph 17.54, Part B of BT's confidential response to the May 2015 BCMR Consultation.

to see that in addition CPs have every opportunity to re-design their own networks to take advantage of the opportunities arising.[256]

A19.24 BT argued the arbitrage incentives created will lead to greater dark fibre volumes than assumed by Ofcom coming from both new connections and migrations (especially where there are opportunities for aggregating two or more circuits over one fibre).[257] As a result, BT argued dark fibre will lead to substantial disruption and risks to Openreach's ability to recover its efficiently incurred costs[258] as well as risks of significant stranded assets of both equipment and fibre.[259]

The need to rebalance the prices of active services

A19.25 BT argued that subject to the price level, dark fibre could create a significant downward pressure on the price of high bandwidth circuits, which would result in a sharp loss of revenue (for all players). As such, it considered that it would reduce investment incentives for higher bandwidth active circuits.[260] In addition, BT argued that the removal of the bandwidth gradient in a relatively short period would in practice mean that Openreach would reach a point where customers will only purchase two products (EAD 1Gbit/s and dark fibre), with other products having a lack of demand as CPs switch to dark fibre. Therefore BT argued that it will offer a narrower set of active options, as it will have reduced incentives and ability to develop new active variants.[261]

The impact of the LLCC

A19.26 BT argued that the proposed charge control would limit its ability to rebalance active prices in order to mitigate any impact of dark fibre on its cost recovery. BT also stated that pricing flexibility within a charge control basket can only partly compensate for the inability to recover costs when the requirement for overall price reductions is unchanged.[262]

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[256] Paragraphs 17.13 and 17.61-64, Part B of BT's confidential response to the May 2015 BCMR Consultation.

[257] BT argued that its own forecasts of volumes based on its understanding of the market and of all customers show that the introduction of dark fibre will have a far more disruptive impact on the volumes of active circuits and the overall amount of fibre which Openreach provides than Ofcom is suggesting. We discuss these further in the context of our specific remedy in Annex 33.

[258] BT argued this was particularly the case given the lack of flexibility Ofcom is proposing to give Openreach in relation to its active pricing. We discuss BT's arguments on the combined impact of our remedies in Section 7 where we consider the impact of all of our proposals.

[259] Paragraphs 3.28 and 4.28-4.29 of Part A and paragraphs 17.4, 17.65-70 and 17.91-94 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation. We discuss BT's estimate as well as the potential for stranded assets more generally given our specific dark fibre remedy design in Annex 33. We also discuss BT's views on the likely volume impact in light of our specific dark fibre remedy design in Annex 33.

[260] Paragraph 17.71-72 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation.

[261] Paragraph 4.14 of Part A of BT's non-confidential response to the May 2015 BCMR Consultation.

[262] Paragraph 3.38 of Part A and paragraphs 17.5-17.7 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation.

A19.27 In addition, BT argued that how it adheres to the LLCC will affect the short and long term incentives and have implications for the management of the wider active portfolio. For example, it stated that it may affect migration incentives, and cause difficulties in portfolio development and low uneconomic margins for some services [✂][263] [✂][264]

Our assessment

A19.28 Introducing a new remedy such as dark fibre could potentially have both positive and negative effects on dynamic efficiency. We discuss the potential positive impact in Annex 18, while in this annex we consider the potential negative impact on BT, with the potential impact on investment incentives of other infrastructure operators considered in Annex 20). Our overall assessment of these potential positive and negative impacts is set out in Section 7.

A19.29 Our general approach to regulation is to promote dynamic efficiency by seeking (where appropriate and relevant) to provide BT with a fair opportunity to recover its efficiently incurred costs (including a reasonable rate of return). This is known as a "fair bet". As a result, a key consideration in terms of the potential impact of a dark fibre remedy on BT's investment incentives is whether introducing new regulated wholesale access at a different point of the value chain unfairly undermines this fair bet. If it did, not only could this undermine BT's existing investments, but any perceived regulatory uncertainty/instability could also ultimately weaken BT's incentives to make further investments in the future.

A19.30 In considering this issue, we note that the charge controls on active products are designed to bring prices into line with forward looking efficiently incurred costs, in a way that is consistent with this fair bet. In principle, we consider that if we can introduce a dark fibre remedy in a way that does not undermine the fair bet, its imposition should not undermine BT's investment incentives.

A19.31 In light of this, we have considered whether there are any factors which may undermine the ability to price services in line with this principle as a direct result of the introduction of dark fibre, and so could pose a risk to BT's cost recovery.

A19.32 Competition based on regulated access to BT's network to date is based on access to downstream active services, and BT has set its service offerings and prices (including pattern of cost recovery) accordingly. However, dark fibre would provide regulated access at a different point in the value chain, and allow other CPs to provide their own active layer using BT's passive infrastructure, in order to compete in the provision of these downstream services. This potentially poses two main risks to BT's ability to recover its costs, which may affect its investment incentives:

a) arbitrage opportunities may occur, if regulated prices across the value chain are inconsistent and allow CPs to target high margin services (i.e. those which make the greatest contribution to BT's common cost recovery) with dark fibre, whilst leaving BT to provide the less profitable services; and

[263] [✂]
[264] Paragraphs 17.73-90 of Part B of BT's non-confidential response to the May 2015 BCMR Consultation.

b) there could be a risk of stranding of assets, to the extent that the introduction of dark fibre resulted in CPs switching away from BT's active services, since dark fibre could make less use of BT's existing infrastructure and assets (e.g. equipment).

A19.33 We now discuss whether these issues may undermine BT's fair opportunity to recover its common costs and how the design of a dark fibre remedy may be able to reduce the risk.[265] We then consider BT's arguments (see paragraph A19.25) that its incentives to invest in the active layer would be reduced as a result of the introduction of dark fibre, given the impact on its active volumes.

Potential arbitrage opportunities

A19.34 Where any passive access is introduced in markets with an established set of active wholesale products (such as wholesale leased lines), there is likely to be an effect on the pattern of common cost recovery (and therefore prices). This is because active products are service-specific, whereas dark fibre (or indeed any passive remedy) can be used to provide a range of possible services. Therefore depending on how the dark fibre is priced, it could potentially create opportunities for CPs to undercut BT's prices on some of the higher margin services based on the current structure (i.e. those which make the greatest contribution to BT's common cost recovery) as well as for genuine competition on the merits. As a result, BT may see a reduction in volumes of certain active products with a loss of the associated contribution to fixed and common costs.

A19.35 Depending on the active pricing structure (and in particular, the degree of variability in contribution to fixed and common costs between different circuit types) as well as the dark fibre price, this loss from the active circuit may or may not be fully offset by the contribution from dark fibre. Therefore although highly dependent on volumes and the pace of take up, if these potential arbitrage opportunities are not sufficiently taken into account in the pricing of remedies (both active and dark fibre), they potentially pose a risk to BT's cost recovery.[266]

A19.36 To take these risks into account effectively, we rely on appropriately identifying the arbitrage opportunities and forecasting their impact on BT's volumes and cost recovery, which is subject to uncertainty and forecasting error. Therefore to the extent that we can design the dark fibre remedy to reduce the scope for arbitrage and/or make the use of dark fibre more predictable, this should reduce the risk to BT's cost recovery (and ultimately its investment incentives).

A19.37 We consider that the introduction of a dark fibre remedy may give rise to three broad types of arbitrage opportunity based on BT's current active pricing structure:

a) Density of network usage;

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[265] We note that similar considerations around BT's investment incentives arise when considering how to implement any access remedy (including active remedies), so we do not see this potential concern as being unique to the question of whether or how we might impose a dark fibre access remedy.
[266] Although we focus here on the impact of arbitrage on BT's cost recovery, we note it also has other disadvantages, by encouraging inefficient entry. We discuss this further below in relation to the potential productive efficiency risks of dark fibre.

b) Circuit length; and

c) The pricing of bandwidth (i.e. the bandwidth gradient).

A19.38 We discuss each of these potential arbitrage opportunities in turn, and the risks these may pose to BT's cost recovery.

Density of network usage

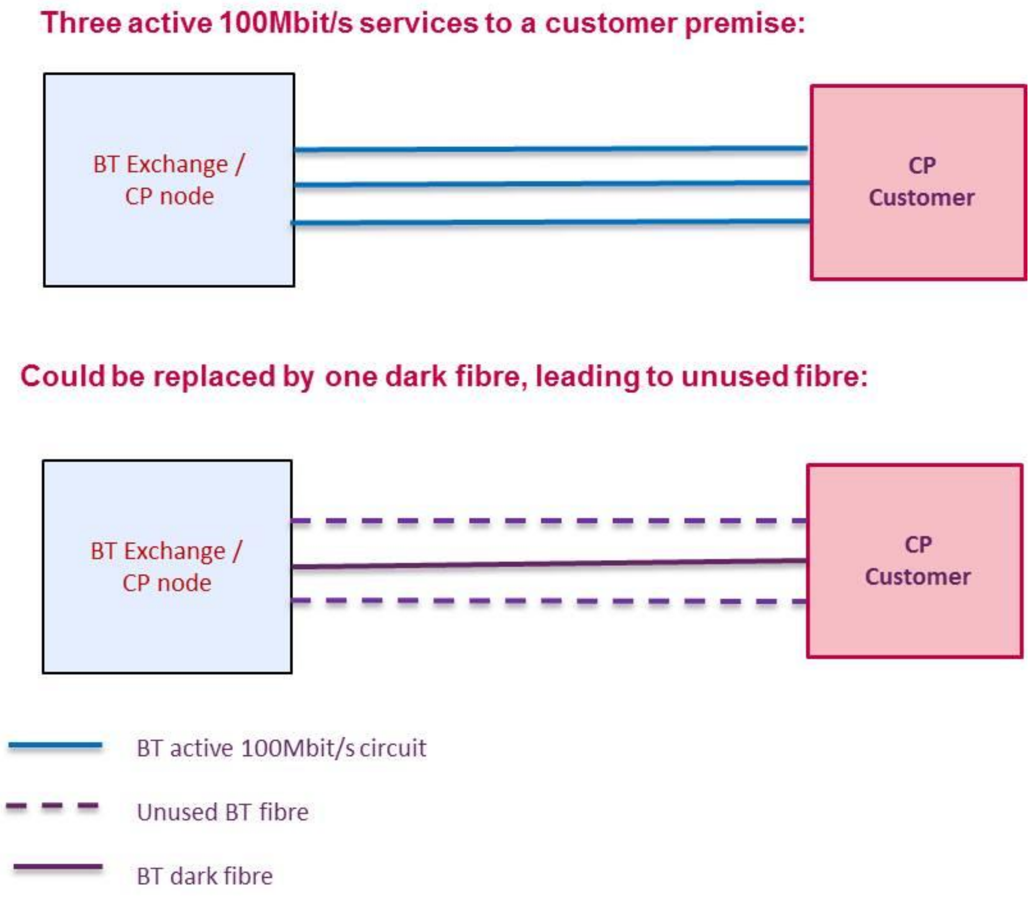
A19.39 BT's active prices are generally geographically averaged, meaning that equivalent circuits are sold for equivalent prices regardless of location (i.e. circuit prices are geographically uniform). However, there are marked differences in the intensity of usage of the network by geographical area, with some areas supporting many circuits and very high bandwidths, while others are utilised comparatively lightly. As a result, contribution to the recovery of BT's common costs will tend to vary by area, with areas with a high volume of circuits generating a higher contribution to common cost recovery.

A19.40 This geographic concentration of value could potentially lead to a situation where a competitor using a dark fibre product subject to a geographically-averaged uniform price will have the opportunity to target the provision of services in locations with above average utilisation. This is particularly true where multiple services can be aggregated and carried over a single dark fibre.

A19.41 As a starting point, we would initially expect the volume relationship between existing active circuits and dark fibre to likely be much closer to one-to-one rather than exhibiting large scale aggregation (subject to the specific access points permitted). This is because if a CP wants to provide a circuit between two points using dark fibre instead of buying the active circuit from BT, it will in many cases still likely require one fibre for each active circuit it replaces. Therefore it would seem plausible that dark fibre pricing could more closely replicate the active pricing structure, reducing the risks of density based arbitrage.

A19.42 However, there is an exception to this if there are particular routes where CPs currently purchase multiple active circuits which could be replaced by a single dark fibre (given the additional flexibility of dark fibre to provide multiple services). This could occur where, for example, an end customer had previously increased their demand for bandwidth over time, and rather than replace the existing low bandwidth circuit with a higher bandwidth active circuit, the CP purchased additional low bandwidth active circuit(s) alongside it (as illustrated in Figure A19.1 below). Similarly, a CP may have responded to growing backhaul bandwidth demands by adding additional active circuits, rather than upgrading the bandwidth of the pre-existing circuit. On such routes, there may be scope for consolidation of multiple active circuits onto a single dark fibre circuit.

Figure A19.1: Simplified illustration of the potential density-based arbitrage opportunities between active remedies and dark fibre as a result of aggregation



A19.43 This could be considered an arbitrage opportunity because it would allow CPs to target high density (and therefore high value) routes with dark fibre. This would mean BT could lose multiple active circuits on high density routes as CPs seek to aggregate those services onto a single dark fibre circuit, significantly reducing the contribution to common costs. The greater the density of use, the greater this risk as the number of active circuits BT could lose would be higher. Therefore we recognise that the scope for aggregation on high density routes with dark fibre could potentially pose a risk to BT's cost recovery if not adjusted for (as argued by BT, see paragraph A19.19 onwards).

A19.44 We consider that the scale of this risk to BT's cost recovery as a result of dark fibre will in part be affected by the dark fibre remedy design, and in particular the price, as this will affect the threshold at which dark fibre can be more cost effective than multiple active circuits. It will also affect the scale of the incremental price incentive as a result of dark fibre, over and above the aggregation incentives which already exist with active circuits.[267] In addition, we consider that to the extent we can

[267] For example, it is often cost effective to aggregate as few as 3 circuits onto a higher bandwidth active circuit rather than provide individual active circuits (e.g. use a 1Gbit/s circuit rather than three 100Mbit/s circuits).

reasonably forecast the impact of aggregation and adjust the relevant charge control(s) accordingly, dark fibre can be introduced in a manner consistent with the fair bet and the risks to BT's cost recovery can be reduced.

A19.45 Indeed, we consider the scope for aggregation as a result of our specific dark fibre remedy in Annex 33, including an analysis of existing circuits. This analysis suggests that:

a) importantly, such aggregation opportunities (and incentives to do so) already exist today under the active-only regime;

b) there are many aggregation opportunities for active services which have not been taken advantage of to date. This suggests that in practice there are likely to be barriers to CPs' ability and willingness to take advantage of aggregation opportunities (i.e. circuit rental charges may not be the only driver), particularly in the short to medium term, which we consider are also likely to be relevant with dark fibre; and

c) our dark fibre remedy (as designed) may create additional aggregation incentives (over and above those that exist with active circuits), but these appear to be relatively limited in this review period.

A19.46 Therefore we recognise that aggregation of circuits could in principle provide some arbitrage opportunities with dark fibre which could pose a risk to BT's cost recovery. However, we consider that the incremental aggregation from the dark fibre remedy is likely to be limited in this review period.

A19.47 In addition, we note the main risk of aggregation would appear to be from stranded assets, and as discussed further below and in Annex 33, we consider it is likely to be possible to adjust any approach to pricing of active and/or dark fibre so as not to run contrary to the "fair bet" in light of any stranding of assets, and therefore reduce the risks to BT's cost recovery.

A19.48 In relation to BT's arguments that the ability to aggregate with dark fibre will affect the commercial viability of sites/routes (see paragraph A19.20), we make the following observations. As set out above, it is not clear that dark fibre provides significant additional aggregation opportunities over and above active services, and so we consider that the scale of this effect is likely to be limited in this review period. In addition, to the extent it did occur (e.g. in the longer term), we consider this to be a pricing/cost recovery issue (for example, as discussed further below, if aggregation reduced the use of use of fibre, this may increase the price for such circuits). Indeed, we consider these arguments in relation to ECCs in Section 8 of Volume II. In addition, the scale of the issue will be affected by the offsetting contribution to fixed and common costs that the dark fibre product will make. As such, it is not clear this should undermine BT's investment incentives. Therefore while aggregation of circuits using dark fibre may affect BT's pricing, we do not consider this poses a risk to BT's investment incentives.

Circuit length

A19.49 Some of BT's active services are priced on a fixed per circuit basis, irrespective of the actual circuit length.[268] However, longer circuits are likely to have higher actual costs of provision. Therefore shorter circuits will tend to make a greater contribution to common cost recovery than longer circuits, and therefore have a greater margin which could be targeted by CPs using dark fibre (all else equal). In particular, if dark fibre was priced on a per-metre basis, CPs could target shorter active circuits with higher margins and replace them with dark fibre. This inconsistency between the active and dark fibre pricing approach would have the effect of reducing the contribution to common costs from these shorter circuits, while BT continues to provide the longer active circuits which make a smaller contribution. As a result, all else equal, BT may not be able to recover its common costs if its active prices were unadjusted, which could have adverse effects for its investment incentives.

A19.50 However, we consider this risk is reduced by ensuring consistency in pricing approaches between active and dark fibre circuits. In particular, this risk is reduced by pricing dark fibre on a per circuit basis (as we have done) rather than using a distance-dependent approach, so it replicates the existing distance-independent active pricing approach.[269] Accordingly, a CP would pay the same for dark fibre access irrespective of the circuit length and so there would be no opportunity to exploit length-based profitability variations in active services. By introducing dark fibre variants which mirror existing services (for example, an EAD LA and an EAD dark fibre variant), will also potentially reflect at least some existing distance-reflective pricing differentials between active product types. This therefore reduces the risk of arbitrage based on circuit length (and, as a result, the risk to BT's investment incentives) as there would be greater consistency between the active and dark fibre pricing approach.

A19.51 We recognise [✂].

The pricing of bandwidth (the bandwidth gradient)

A19.52 The current active pricing structure generally involves higher bandwidth services making a greater contribution to the recovery of common costs than lower bandwidth services when measured on a per circuit basis. In other words, the 'bandwidth gradient' (i.e. the change in price charged when moving to a higher capacity circuit) exceeds the gradient of the incremental cost of bandwidth.

A19.53 If dark fibre is made available to competitors at a price which reflects a share of the average costs, it could potentially create opportunities for CPs to undercut BT's prices on some of the higher margin services (i.e. those which make the greatest

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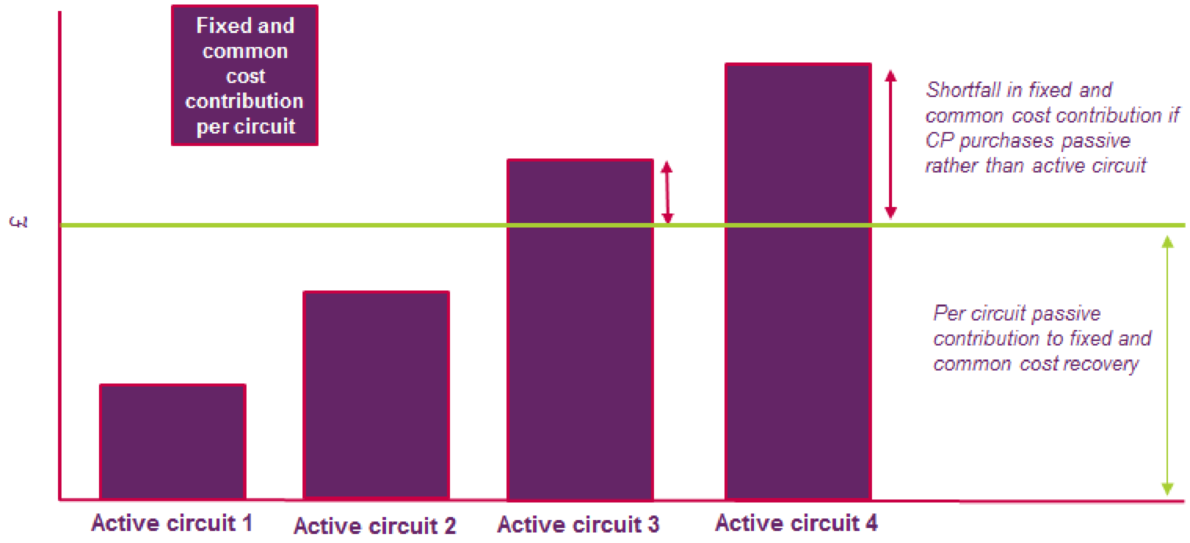
[268] The main exception to this is in relation to the Main Link product, which is distance-dependent. We also note that while this holds within product type (e.g. all 100Mbit/s EAD circuits are priced the same irrespective of length), there are variations in prices between services which are at least in part distance related (e.g. EADLA circuits tend to be shorter (and lower priced) than EAD circuits), and some circuit types have a distance-based limit (e.g. over a certain circuit length (which varies by bandwidth), an EAD Extended Reach circuit is required instead of an EAD).

[269] An alternative might be for BT to respond to the introduction of a distance-based dark fibre remedy by varying its active pricing structure such that the prices for all active circuits are also distance-dependent.

contribution to BT's common cost recovery). This is because it will be more profitable to recover a (relatively) fixed access charge from services where the available margin is greatest. This is the case irrespective of whether the dark fibre is priced on a per circuit or distance-dependent (e.g. per metre) basis as, either way, CPs will still be able to use the dark fibre to target the higher margin active services. As a result, BT could potentially lose a greater contribution to fixed and common costs from the active circuit than it makes up from the dark fibre that replaces it. This could have implications for BT's opportunity to recover its common costs.

A19.54 To illustrate this effect, consider the simplified diagram in Figure A19.2 below. In this illustrative example, BT only provides four active circuit types which increase in bandwidth (with "active circuit 1" being the lowest bandwidth, and "active circuit 4" being the highest bandwidth). It sets the pricing structure such that each makes a different contribution to fixed and common cost recovery (but overall costs are recovered in aggregate). This results in different margins across different product types, increasing with bandwidth. Introducing a passive remedy such as dark fibre which makes a constant per circuit contribution to cost recovery at a level illustrated by the green line would mean that CPs are likely to have an incentive to switch to dark fibre for those circuits which currently make a greater contribution (i.e. margin). As such, they will likely provide Active circuits 3 and 4, while they are unlikely to supply Active circuits 1 or 2. If BT continued to try to maintain this pattern of cost recovery, it is likely to lose Active circuits 3 and 4, which would result in an under-recovery of fixed and common costs since it would lose a greater contribution from the active circuit than it makes up for from the dark fibre product (illustrated by the red arrows).

Figure A19.2: Simplified illustration of the potential risk to cost recovery as a result of the existing bandwidth gradient, if active prices were unchanged



A19.55 However, we consider this arbitrage risk can be limited by design of the dark fibre remedy, and in particular the absolute level at which the dark fibre price is set. This is because all else equal, the higher the dark fibre price, the narrower the scope of active services making the greatest contribution to BT's common cost recovery which CPs could target (as noted by BT, see paragraph A19.22). For example, at one extreme, if the price was set such that dark fibre made the same contribution to common cost recovery as the highest priced active service, there would be no scope for CPs to exploit the current bandwidth gradient (although we note that depending on how the price was set, the density and/or circuit length concerns above could still be relevant). Therefore setting a higher dark fibre access price will (all else equal) reduce the scope for arbitrage based on the current bandwidth gradient, and therefore reduce the risk to BT's common cost recovery.[270] We discuss how we consider our pricing approach helps mitigate this risk in Annex 21.

A19.56 We also consider that the risk can be reduced further in terms of how the remedy is implemented, in particular by facilitating the rebalancing of the active pricing structure (and pattern of cost recovery) in response to the availability of dark fibre. This is because higher prices for certain services are likely to be required than if a dark fibre remedy was not introduced, to take account of its effect on demand for, and cost recovery from, active products. This would likely have the effect of reducing the margins on higher bandwidth services (and increasing the margins on other services) to reduce the scope for CPs to target those circuits currently making the greatest contribution to common costs (as discussed further below). We are including a cost uplift in the Ethernet basket[271] as well as some pricing flexibility in order to facilitate some rebalancing in the recovery of common costs (as discussed in Section 5 of Volume II), which should reduce the risk to BT's common cost recovery and therefore to its investment incentives.[272]

A19.57 We also note that both of these approaches to mitigating this risk are interrelated, since all else equal, the higher the dark fibre price, the lower the arbitrage risks with the current structure of active prices, which means less price rebalancing is necessary for cost recovery purposes (and vice versa).

A19.58 As a result, through active price rebalancing alongside careful design of the dark fibre remedy and appropriate adjustments to the active charge control, we consider that we can significantly reduce this risk to BT's common cost recovery.

A19.59 Related to this, BT has argued that the removal of the bandwidth gradient will affect its incentives to invest in active services (as summarised in paragraph A19.25). We consider there is likely to be a difference between Openreach and BT's downstream divisions in this regard.

A19.60 In particular, we recognise that there could be an effect on Openreach's incentives to invest in active services given the impact that price rebalancing may have on its revenues (and on its active volumes). However, we do not consider this should be significant providing the active control provides BT with a fair opportunity to recover the costs of such investment. This is because it will be better off providing the

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[270] However, this would also likely have the effect of limiting the use of the dark fibre remedy to only providing those active services with a greater contribution to common cost than the dark fibre price (as it would not be economic to provide those active services with a lower contribution using dark fibre). Therefore adopting this sort of approach would involve a trade-off, which we discuss further in Annex 26.

[271] This is to reflect the fact that dark fibre will reduce demand for active circuits, and hence the revenues (and fixed and common cost recovery) associated with those services, and is based on forecasting potential cannibalisation of active circuits by the dark fibre remedy as well as the pattern of cost recovery across different circuits. This is to ensure that BT is provided with a fair opportunity to recover an appropriate level of common costs from active circuit revenues. We discuss the interactions between the availability of a dark fibre remedy and the active charge control further in Annex 33.

[272] We discuss the potential impact of this type of price rebalancing further below.

service than not. In addition, we note that Openreach will remain subject to a general obligation to provide network access on reasonable request in this review period, and CPs can continue to request developments to active products within the SOR process.

A19.61 In relation to downstream BT, however, we consider that dark fibre will (as with all CPs) provide greater opportunities to invest in its own active offerings where it considers it appropriate. Indeed, increased competition in the active layer from CPs using dark fibre should stimulate efficient investment by downstream BT in order to remain competitive (a view reiterated by TalkTalk, see paragraph A19.13). This view is reflected in [✂] [273] [✂].[274] Therefore even if Openreach investment in active products reduced, the net effect on efficient investment by BT Group is uncertain (and investment overall may increase if all CPs are considered) due to the wider possibilities and opportunities that dark fibre offers. This is particularly so because downstream BT, like other CPs, will be able to introduce developments in active products that it wants and on its own timescale, without needing industry consultation etc. as part of the Openreach SOR process (these benefits are discussed further in Annex 18).

A19.62 In any event, it is not clear that significant long-term concerns would be raised if BT were to stop investing in active circuits once dark fibre is available and established, because other CPs would be able to invest in the active layer where appropriate (either directly for themselves, and/or on a wholesale basis for other CPs).

Risk of stranded assets

A19.63 We recognise that there could be a risk of stranded investments directly as a result of a new (dark fibre) remedy being introduced. We note that our focus is on those assets genuinely stranded within this review period as a direct result of the dark fibre remedy. We are not concerned about assets which are already fully depreciated (e.g. circuit-specific electronics for circuits which are out of contract period) or continue to be utilised within the new regime (such as existing ducts).If such stranded assets were not appropriately taken into account in setting the price for BT's remaining services, it could lead to perceived regulatory instability/uncertainty which could reduce BT's incentives to invest in infrastructure in the future.

A19.64 However, we consider this risk is likely to be limited (or at the very least, manageable).

A19.65 Firstly, we consider that the scale and scope of the risk of stranded assets will predominantly be limited to the active layer. This is because whilst BT's existing fixed passive infrastructure constitutes a large part of BT's costs with longer depreciation profiles, we consider that BT will be able to re-use these assets (and have a fair opportunity to recover the associated costs). Therefore even if take-up of dark fibre access to supply existing circuits was high, it would typically reuse the same passive infrastructure already supplying the existing active circuits (a view reiterated by TalkTalk, see paragraph A19.13), and so in this case it would seem

[273] [✂]
[274] [✂]

unlikely it could significantly undermine the investments by BT in building ducts and laying fibre to date.

A19.66 The main exception to this is where dark fibre provides additional aggregation opportunities (whereby multiple active circuits can be replaced by a single dark fibre circuit) over and above those currently available with active circuits (discussed above), which could lead to the stranding of some fibre to the extent it cannot be re-used. However, as discussed above (and in Annex 33), we consider this risk is likely to be affected by the remedy design, and as such, is relatively manageable, particularly in the short to medium term. Even if this occurs in the longer term, we consider this to be a matter of ensuring that prices (active and dark fibre) are set such that they reflect expected future volumes, including the impact of aggregation. Indeed, we note that BT's total fibre costs are currently recovered from the installed base of services which use them, and so to the extent that the volume of fibres in use fell in the future, we would expect the cost per fibre in use to increase, and so this could be reflected in any future charge control.

A19.67 In relation to the active-specific investment (e.g. in the electronic equipment) which could become stranded, we consider that this risk is likely to be relatively limited given the comparatively shorter lifetime of these assets (relative to duct and fibre), and the remedy design reducing this risk. For example, we would expect the risk of such assets becoming stranded to be higher if migration from active circuits to dark fibre was permitted within-contract, since we would expect BT to recover the majority of circuit-specific costs across its contract period (a view reiterated by TalkTalk, see paragraph A19.13). Relatedly, the assets can only be at risk of being stranded if CPs migrate existing circuits to dark fibre, and the extent to which this will occur will be directly affected by the remedy design. We have undertaken an analysis of the potential risk of stranded assets as a result of our proposed dark fibre remedy in Annex 33, and this analysis supports this view that stranding would be relatively limited.

A19.68 Therefore while we recognise that dark fibre could pose a risk of stranded investment, we consider the scale of any stranding is likely to be relatively limited in the short to medium term.

A19.69 Secondly, and in any event, we can seek to approach the pricing of both dark fibre and active remedies in this review period in a manner which provides BT with an opportunity to recover its efficiently incurred costs. This can include, where appropriate, an estimation of the efficiently incurred costs which may become stranded as a result of the new remedy, so as not to distort future investment signals. While we recognise it may be complex to identify the costs of all stranded assets, we still consider it likely to be manageable through the design of the dark fibre remedy, particularly since we expect a gradual (and therefore more predictable) transition to dark fibre. For example, any significant aggregation [✂] is likely to take time to materialise (given the likely detailed planning and implementation time required), which will provide a greater opportunity to manage the risk to (and impact on) BT's cost recovery in this review period through active and dark fibre pricing which reflects the volume impact. Indeed, we discuss our view of stranded assets in light of our dark fibre remedy in Annex 33, which includes an uplift to the Ethernet basket cost stack to reflect our forecast of stranded assets.

Overall conclusion on risks to BT's cost recovery and dynamic efficiency

A19.70 Overall, we recognise that dark fibre may introduce some arbitrage opportunities which could, if not taken into account in this review period, affect BT's ability to recover its costs (which could undermine its investment incentives). This could pose a risk to dynamic efficiency, although as noted above, BT is not the only driver of investments in active services (and therefore dynamic efficiency) if dark fibre is available. However, we also consider that certain measures can be undertaken to reduce the risks, so as to impose dark fibre in a way which is consistent with the fair bet.

A19.71 We consider that effectively forecasting the impact of dark fibre is important in managing this risk, and there are certain design features which may be able to reduce the scope for arbitrage and/or make the use of dark fibre more predictable (to reduce the risk of forecast error). In particular, broadly speaking, the greater the level of consistency between active and dark fibre products which can be achieved in this review period (e.g. in terms of topology, use of existing assets, pricing), the lower the risks to BT's common cost recovery and, ultimately, to its investment incentives when dark fibre is introduced (relative to active-only). This is because usage of dark fibre is likely to be more predictable, and so the impact can be managed and reflected in how the remedies are implemented. This consistency may be achieved through the non-price design as well as the way the dark fibre price is set and/or any active price rebalancing/adjustments made by BT in response to the availability of dark fibre.

A19.72 In light of this, we consider that while it is unlikely to be possible to introduce a dark fibre remedy with no arbitrage risk, the risk to BT's cost recovery is likely to be manageable in this review period. This is because, our dark fibre remedy is designed such that the risks to BT's cost recovery and investment incentives are manageable, and have been reasonably accounted for in the relevant charge controls for this review period. As such, we do not consider the risks to BT's investment incentives as a result of dark fibre to be significant. In particular:

a) we have identified design elements of the remedy which we consider can reduce the scale and scope of the arbitrage opportunities. We discuss the price and non-price design features in Annex 21 and Annex 22 respectively;

b) by reducing the arbitrage opportunities, we consider that the use of dark fibre by CPs is likely to be more predictable, which has allowed us to better adjust the charge control in this review period in order to provide BT with a fair opportunity to recover its efficiently incurred costs (contrary to BT's suggestion, see paragraph A19.23 to A19.24). We discuss how we have adjusted the LLCC by uplifting the costs in the Ethernet basket to reflect the availability of dark fibre (and the potential risks this could pose to BT's cost recovery, including stranded assets) in Annex 33; and

c) while BT's ability to adjust its active prices in response to dark fibre in this review period will be to some extent affected by the constraints of the LLCC (a point also raised by BT, as summarised in paragraph A19.26 to A19.27), we consider that we have allowed an appropriate level of flexibility for BT to adjust its prices (and pattern of cost recovery) in response to dark fibre and to provide BT with a fair opportunity to recover its costs, as discussed in Section 5 of Volume II.

Allocative efficiency and distributional impacts arising from the implications for common cost recovery and rebalancing of prices

Summary of our consultation position

A19.73 In the May 2015 BCMR Consultation, we considered that passive remedies are likely to trigger some rebalancing of active prices, which is likely to give rise to winners and losers among different customers depending on services typically purchased. This could generate distributional concerns. We considered it unlikely that a passive remedy could be introduced in a way that would have no distributional effects, but that the proposed design would reduce any negative impacts while minimising the risk to BT's common cost recovery.

Responses to the May 2015 BCMR Consultation

A19.74 BT argued that we understated the allocative efficiency and distributional impacts of dark fibre. In particular, it stated that Ofcom has consistently stated that there are benefits to allowing BT flexibility on how it recovers its common costs and that such flexibility is, in fact, efficient yet the current proposals will inevitably lead to the erosion of the bandwidth gradient. Therefore, by implication, BT argued it would result in a less efficient recovery of common costs.[275]

A19.75 The PAG recognised that passive remedies may lead to BT changing its pattern of cost recovery, noting that such disruption is common when new parts of the value chain are regulated and opened to competition. However, it argued that the current pattern of BT's pricing does not deserve to be protected because there is no evidence that BT's existing pricing either maximises efficiency or reflects Ramsey pricing. It also considered the impact of rebalancing is likely to be limited given demand is concentrated on lower bandwidth services.[276]

A19.76 TalkTalk argued that it is highly unlikely that current prices optimise output and efficiency, since setting efficient Ramsey pricing would require detailed data and complex calculations, BT has not suggested it has completed this analysis or presented any evidence to suggest that the current price structure is efficient, and BT has other clear reasons to set a steep price gradient.[277] Similarly, Sky stated that it does not consider the current active pricing gradient to be efficient or reflect efficient pricing decisions by BT to increase demand, given both the relatively inelastic demand for leased line services (since it is driven by end-users' data usage) and BT's incentives to maximise profit as opposed to output. Furthermore, Sky argued that even if the current tariff gradient were currently efficient, it is unlikely to remain efficient in the future due to changes in demand for bandwidth, as customers migrate to higher bandwidth services. Indeed it argued that given the charge controls on active products, a flattening of the gradient is likely to occur as

[275] Paragraph 3.31, Part A of BT's non-confidential response to the May 2015 BCMR Consultation. BT also argued that the removal of the bandwidth gradient will undermine access infrastructure investment incentives of other CPs. We discuss this argument further in Annex 20.

[276] Paragraph 2.9 and response to Q7.3, PAG non-confidential response to the May 2015 BCMR Consultation.

[277] Paragraph 3.36, TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.

an accelerated decline in the price of active services at higher bandwidths, rather than any increases in lower bandwidth prices.[278]

A19.77 Relatedly, Vodafone argued that the introduction of passive access is not the only factor that is driving price rebalancing, referring to the proposed LLCC (including the change in cost allocations) and BT's latest price changes in the current review period, which it argued contain rebalancing actions. As such, Vodafone argued BT would seek to rebalance of its own accord in response to general competition (as well as dark fibre) and as the bandwidth profile changes over time.[279]

A19.78 Hyperoptic stated that there will be some distributional impact of the proposed dark fibre remedy, but there is no reason to believe that there is any prejudice against particular CPs (subject to particular terms/conditions for equal access[280]).[281] Sky also argued that price rebalancing is unlikely to result in a negative impact on output for market participants.[282]

A19.79 TalkTalk stated that price rebalancing is not bad *per se*, but could have negative impacts if it resulted in the following:

a) allocative inefficiency – given the lack of evidence that the current pricing structure is efficient (and arguments to the contrary), TalkTalk argued that the most robust conclusion that can be reached is that the impact on allocative efficiency of a change in pricing structure is unclear, and could be an improvement[283] or detrimental (with no evidence either way);

b) price increases for particularly important or vulnerable customer groups – TalkTalk stated that there is no evidence that price rebalancing will be harmful or beneficial, and Ofcom does not appear to have identified particular vulnerable or important groups (or any specific economic or social benefits from certain customer groups having lower prices than others). TalkTalk considered that even if this were the case, it is not the role of *ex ante* regulation to adjust for these effects. Furthermore, it stated that is not correct to say that smaller enterprises will necessarily face higher costs, since smaller enterprises purchase mobile and broadband services (which rely on high bandwidth backhaul) and so will benefit from lower high bandwidth wholesale prices; and

c) significant and unforeseeable price increases for customers – TalkTalk argued that neither condition is likely to hold, given the LLCC context (i.e. starting charge

[278] Paragraph 6.10-11 and 8.7-10, Sky non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultations.
[279] P37, Vodafone non-confidential response to the May 2015 BCMR Consultation.
[280] For example, Hyperoptic referred to the need for portal based ordering and communications, no substantial one time fees, and consistency in fibre tax rates.
[281] P12 (response to Q7.3), Hyperoptic non-confidential response to the May 2015 BCMR Consultation.
[282] Paragraph 6.11 and 8.10, Sky non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultations.
[283] For example, TalkTalk suggested customers will make better and more efficient choices of bandwidth without the bandwidth gradient.

adjustments and a negative ‘x’) and the delay before dark fibre will be introduced when the price rebalancing can be expected to occur.[284]

A19.80 UKB Networks argued that BT’s current pricing structure should not dictate regulatory policy, and that Ofcom should not give material weight to the risk of active tariff rebalancing (particularly since it appears that returns on BT’s regulated services have been consistently above the rate required to compensate investors). Further, it argued there is no overall benefit in the business sector continuing to subsidise other user groups, if indeed that would be the outcome. Alternatively, the outcome might be that BT simply becomes more efficient and/or ceases to over-recover its costs.[285]

Our assessment

A19.81 As discussed above, the current active pricing structure (in particular, the bandwidth gradient and geographic averaging) means a dark fibre remedy could potentially create opportunities for CPs to undercut BT’s prices on some of the higher margin services as well as for genuine competition on the merits. While the design of the dark fibre remedy may limit the scale of common cost recovery at risk if BT’s active pricing structure remains unchanged, we do not think it is possible to design a remedy that has no impact at all. Therefore we have adjusted the active charge control to provide a fair opportunity for BT to recover its efficiently incurred costs (as discussed above and in Annex 33), by uplifting the costs in the Ethernet basket (to ensure that BT is provided with a fair opportunity to recover an appropriate level of common costs from active circuit revenues). This should provide BT with a fair opportunity to recover an appropriate level of common costs from active revenues.

A19.82 However, we also recognise that BT may need to adjust its prices to rebalance its pattern of cost recovery and reduce the arbitrage opportunities available (and therefore support competition on the merits), and have provided some flexibility to do this. Therefore for the purposes of considering the allocative efficiency implications of dark fibre, we now therefore discuss how this price rebalancing may occur.[286]

A19.83 To do this, we first consider BT’s current active pricing structure. We then consider the potential impact of dark fibre on this pricing structure, and the implications this could have for buyers of leased lines (as well as in other markets).

BT’s current active pricing structure

A19.84 In a large multi-service telecommunications network, there are many cost elements which are shared (i.e. common) across a variety of different wholesale and retail services. When setting a charge control for regulated services, we typically aim to

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[284] Paragraph 3.30-3.45, TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.

[285] P4 (response to Q7.3), UKB Networks non-confidential response to the May 2015 BCMR Consultation.

[286] We note that for services outside of any regulated pricing constraint, BT is free to adjust its prices as it considers appropriate. However, BT may also need a greater degree of pricing flexibility over charge controlled services to facilitate the required rebalancing (we discuss the level of flexibility required in the context of our specific dark fibre remedy in Section 5 of Volume II).

ensure that BT's charges for the regulated services reflect BT's incremental costs of provision of that service, plus a mark-up for common costs and its cost of capital. In order to estimate the costs for the regulated services, we start with the service costs reported in BT's Regulatory Financial Statements (RFS). These service costs are reported on a fully allocated cost (FAC) basis, which essentially include the incremental costs of a service as well as a contribution to common costs.

A19.85 Within the existing charge controls imposed on active leased line services, we provide some flexibility for BT in how it recovers its costs. That is, we do not require BT to set the price of each service at its FAC. Instead, we typically set a charge control for a broader basket of services such that we expect BT's revenues for the overall basket to come into line with FAC, including a return on capital, by the end of the charge control. BT then sets the charges for individual services within this broader constraint on the overall basket of services. This is because we recognise that there can be benefits in allowing some flexibility in cost recovery, for example:

a) it is more likely to result in charges which allow BT to recover its costs, particularly fixed and common costs, in an efficient way which maximises consumption. This is important in the case of wholesale leased lines because their provision is characterised by high fixed and common costs and low marginal costs. As such, simply setting all charges equal to FAC may result in a lower level of output than with a more flexible charging structure;[287]

b) higher mark-ups on some services than others can be used to provide efficient migration signals between an old service and/or technology and a new replacement; and

c) flexibility allows BT to respond to changing demand conditions and any changes in costs, so as to re-optimise its charges. This is particularly useful when demand is changing rapidly within the market review period.[288]

A19.86 However, we also recognised that BT may have incentives to exploit this flexibility to distort competition, and imposed sub-caps to limit its flexibility in areas where we identified that it has an incentive to change the pricing structure to favour its downstream operations.

A19.87 The consequence of this flexibility is that some services (particularly higher bandwidth Ethernet circuits) contribute more to common cost recovery on a per circuit basis than others, as a consequence of the 'bandwidth gradient'. Although absolute contributions to common costs increase with bandwidth, there is a reduction in the average price per unit of bandwidth as bandwidth increases (i.e. the average price per Mbit/s decreases). A positive gradient that declines in bandwidth allows the marginal price of bandwidth to get closer to its marginal cost (relative to a gradient that reflected average costs), and it increases demand for low bandwidth circuits (relative to the situation where the gradient reflected only the incremental

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[287] i.e. costs do not normally increase in direct proportion to bandwidth, and so setting all charges equal to FAC could mean spreading the fixed and common costs evenly across all products so that charges for lower bandwidth products are increased while they are reduced for higher bandwidths, the net effect of which could be a lower level of total output.

[288] BCMR 2013, paragraphs 18.10 to 18.13.

costs of bandwidth and fixed and common costs were recovered equally from circuits of all bandwidths).

A19.88 In the BCMR 2013, we did not identify any strategic incentives for Openreach to price the different bandwidth products in an unduly discriminatory and/or anti-competitive way. We also noted that an upward sloping bandwidth gradient accompanied by decreasing average costs could be an efficient way to recover common costs given the high fixed and common costs (and low marginal costs) which characterise Ethernet services. We therefore considered it appropriate to allow Openreach flexibility to determine the most appropriate structure of prices, subject to meeting the charge control conditions.[289]

A19.89 We remain of the view that in principle, BT has an incentive to maximise demand/output within the constraints of existing charge controls (and has better information on customer responses to prices to do this than Ofcom). Therefore, subject to charge control constraints, it should have incentives to recover costs in a reasonably efficient way. We also recognise that the existing structure may (broadly speaking) exhibit some of these characteristics/benefits, particularly relative to an average contribution/flat bandwidth gradient.

A19.90 However, we also note that there may be other considerations which mean this may not be the case (as argued by several stakeholders, see paragraph A19.75 onwards). In particular, maximising downstream demand may not be BT's only incentive in setting active prices, which could potentially undermine the efficiency of the current pricing structure. For example, the following factors may also affect BT's incentives:

a) downstream margins and market shares – given BT competes with wholesale customers in downstream markets, its profit maximising behaviour may take these factors into account;

b) substitutability (and therefore profitability) of services outside of the charge control baskets – optimal prices will be affected by this as well as willingness to pay, since prices for charge controlled services may affect the prices that can be charged for partially substitutable services that are outside of the charge control basket;[290]

c) extent of competition – for example, if the products sold externally differ significantly to internal consumption or there are particular products where competition from alternative products/infrastructure operators is weaker, BT's profit maximising incentives may be to price strategically; and

d) ability to optimise returns in the active charge control – given BT is constrained by the active charge control, it may have an incentive to set prices which maximise returns within the overall constraint rather than reflect demand (e.g. to take advantage of the prior year weightings used, given the trends in volumes).

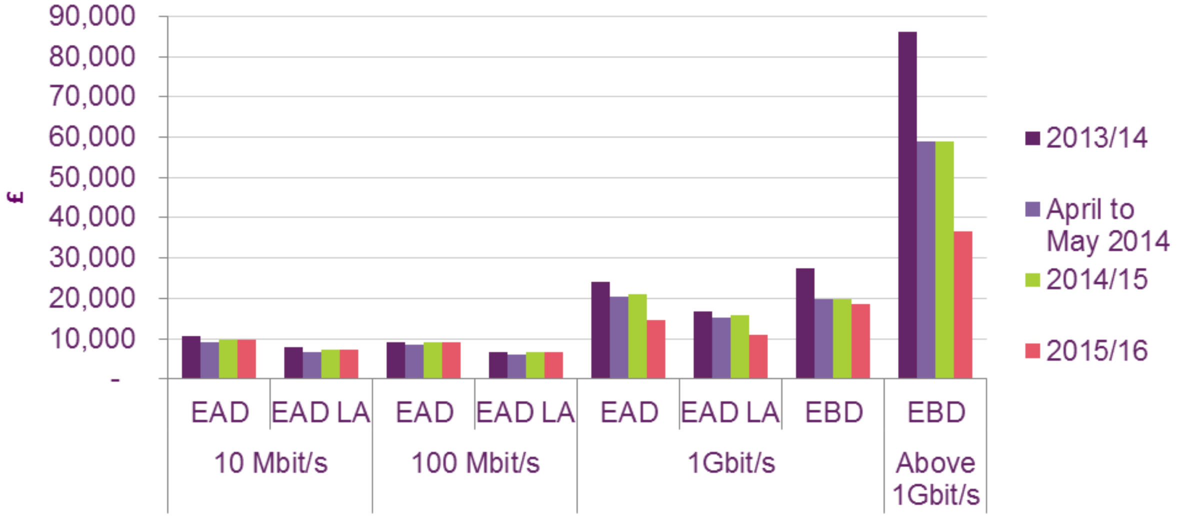
[289] BCMR 2013, Annex 12, paragraphs 165 to 181.
[290] Note, considering substitutability could be consistent with an efficient pricing structure in some circumstances.

A19.91 From a practical perspective, we also note that there are likely to be complexities involved in identifying profit maximising prices which meet Ramsey principles (although as noted above, BT is likely to have better information about its customers than other CPs or Ofcom).

A19.92 Therefore we recognise (as we have done previously) that pricing is complex, and maximising output may not be the only incentive that BT has. In particular, BT may have incentives to set prices in line with other motivations, some of which may still be considered desirable and beneficial (for example, to provide efficient migration signals between old and new technology), but others may be less so (for example any potential strategic or anti-competitive incentives). Disentangling the different factors and their effects on BT's pricing is complex, and there is no clear way to do this.

A19.93 We also recognise that there is not necessarily a single unique pricing structure which can demonstrate these general efficiency characteristics – indeed, we note that BT has been using its pricing flexibility in this review period to reduce the gradient of the active pricing structure. In particular, while the gradient is still positive and declines with bandwidth, it has become less steep. This is illustrated in Figure A19.3 which shows that lower bandwidth circuits have experienced more modest price reductions (or static prices) while high bandwidth circuits (i.e. 1Gbit/s and above) have generally experienced much greater price reductions. In effect we observe a rebalancing of prices over time which has reduced the bandwidth gradient. While part of this rebalancing may be driven by a need to comply with the charge control, there may be other factors (such as those described above) also at play.

Figure A19.3: Average three year (external) contract price for selected active products



Prices from published Openreach pricelist, based on three year rental plus connection charge. 2015/16 prices reflect prices as at September 2015. EBD is based on Band A prices, and for EBD above 1Gbit/s the price is based on UK excluding FlexZone. April to May 2014 prices included as EAD connection charges included a £548 ECC Fixed Fee to fund an ECC exemption of £2,800 from 1 June 2014.

A19.94 These price changes also illustrate the potential for factors other than Ramsey principles to be influencing BT's pricing. For example, we note that the 10Mbit/s EAD and EAD LA circuits are priced above 100Mbit/s, which would not appear consistent with a positive bandwidth gradient (and instead, potentially illustrates the role that migration incentives may have in BT's pricing). Additionally, we note that

BT has chosen to concentrate price reductions in the last two years on 1Gbit/s services in particular (and to some degree, the services of higher bandwidths). While this may reflect the market elasticity of demand for these services, it also potentially illustrates a desire by BT to migrate customers to higher bandwidths in order to increase revenues. In particular, we understand that there is a relatively low incremental cost differential between 100Mbit/s and 1Gbit/s circuits, and so this is likely to be outweighed by the incremental revenue gained by any circuit BT successfully upgrades, even with a price reduction on the latter.

A19.95 Overall, we do not seek to determine whether the current active pricing structure is definitively "efficient" or otherwise, as this would be highly complex (given the detailed information and data that would be required, as well as the complex range of factors that would need disentangling), and we consider there is no clear way to achieve a meaningful result. However, we recognise that in principle (and all else equal) a gradient with these characteristics is likely to be more allocatively efficient than a flat gradient (i.e. one with a flat contribution to common cost recovery) for the reasons set out above. Therefore there may be efficiency justifications for limiting the impact on the current pricing structure (and gradient) in this review period, or more specifically, continuing to provide BT with some flexibility to set an efficient bandwidth gradient. Given other potential pricing motivations as well as the potential scope for wider benefits from dark fibre, this does not mean that the current structure should be maintained indefinitely or that any price changes should be prevented (as BT appears to suggest, see paragraph A19.74). Rather, there may be a trade-off.

A19.96 We therefore focus on the potential impact of a dark fibre remedy on the current active pricing structure and the effect of any potential change, so we can then assess this impact (along with the other costs/risks) relative to the benefits of dark fibre, to inform our overall assessment. In particular, consistent with the idea of allocative efficiency, we consider below the potential for distributional effects as a result of any price rebalancing that could occur, and in particular any impact on total circuit volumes as a result of a change to the pricing structure relative to today. As TalkTalk has suggested (see paragraph A19.79), we have not identified particular groups which we consider warrant protection from price rebalancing – we are nevertheless seeking to understand the implications of any active price rebalancing.

A19.97 We now discuss the implications of a dark fibre remedy on prices (and the pattern of cost recovery) for active circuits, and the potential impact this may have on users of leased lines. We then consider the potential impact on other BT services.

Potential impact of dark fibre on BT's existing active pricing structure

A19.98 We consider that a price rebalancing of downstream active services could potentially manifest itself in three ways relative to a scenario without dark fibre:

- lower prices for active services where BT faces competition from CPs using dark fibre access (likely to be higher value/bandwidth services);
- higher prices for active products where BT does not face dark fibre-based competition (likely to be lower value/bandwidth services); and/or
- geographic de-averaging/rebalancing of active prices, to reflect the different customer/circuit densities in order to reduce any associated arbitrage opportunities discussed above (subject to the specific remedy design).

A19.99 The availability of dark fibre over time may therefore tend to produce a flatter structure than we observe today in charges for active services, (with differences between circuits more closely reflecting incremental cost differences), and on a potentially geographically de-averaged basis (subject to any regulatory constraints). The scale of this rebalancing will be directly affected by the scale of cost recovery at risk if active prices remain unchanged, and therefore we consider will be directly affected by level of the dark fibre price (in a similar way to that discussed above in paragraph A19.55-A19.57).

A19.100 However, such a rebalancing will result in redistribution of the pattern of common cost recovery, and while not necessarily a concern *per se*, the key risk in relation to allocative efficiency is what impact this may have on overall output (i.e. total circuit volumes).

Impact of price rebalancing on users of leased lines

A19.101 Price rebalancing will likely mean that some CPs (and end customers) will benefit and others may be worse off compared to the world without dark fibre, depending on the mix of services typically purchased and the scope for switching to dark fibre-based services. However, importantly, this impact will depend on the counterfactual. In particular, the appropriate comparison is between the world with and without a dark fibre remedy at the same point in time (i.e. relative to today's prices is not the correct comparison). In this regard, we note that BT has had flexibility in previous charge controls, and appears to have tended to reduce the bandwidth gradient over time (as discussed above). We also note that even without a dark fibre remedy, as demand for bandwidth increases per-circuit price rebalancing is likely to need to occur in order to avoid over-recovery of costs (as argued by Sky and Vodafone, see paragraph A19.76 to A19.77). Therefore if this pattern continues, by the time that a dark fibre remedy is available we may observe a flatter gradient in active prices than we observe today, and so the per-circuit impact of dark fibre may not be as stark relative to future prices as it may appear relative to today's pricing structure (although we note that BT may not continue this pattern).

A19.102 Nonetheless, some active circuits (expected to be low bandwidth) will likely have higher prices if dark fibre is introduced compared to a world without dark fibre. This could therefore have a negative impact on CPs who have invested on the basis of BT's current portfolio of regulated active services, and could raise allocative efficiency concerns.[291] In addition, we also note that if substantial, such rebalancing could potentially exacerbate the common cost recovery concerns if higher prices significantly reduce lower bandwidth volumes.[292]

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[291] For the reasons set out above, we focus here on the potential impact of such a change in prices, and do not simply consider that any change from today's pricing structure must result in allocative efficiency losses.

[292] For example, attempting to recover significantly more common costs from lower bandwidth services could alter the purchase decisions of businesses between different technologies, and if substantial, could lead to end user migration to alternative technologies (such as VULA and/or EFM) at the lower-bandwidth end of the market. However, in reality we expect this to be manageable, since we note that that BT has in 2015/16 maintained the existing nominal prices for low bandwidth circuits despite concerns about migration to VULA and/or EFM at the lower end of the bandwidth gradient (and so we might expect BT to continue to focus price reductions towards higher bandwidth circuits

A19.103 We acknowledge that volumes are concentrated in the lower bandwidths, and so since these are likely to be those that face the greater price increases (relative to if dark fibre was not introduced), it could suggest a greater volume of circuits (and therefore potentially customers) being adversely affected.

A19.104 However, the ultimate impact on these customers (and ultimately volumes) will depend on the scale of rebalancing that is required, and we consider there are several reasons why the scale and net impact of any price rebalancing is likely to be more limited and could potentially occur without an absolute real terms increase for any active product in this review period:

- Dark fibre pricing will largely determine the scale of any rebalancing. In particular, all else equal, a higher dark fibre price will likely reduce the extent of active price rebalancing that is required, and therefore the impact on lower bandwidth users. In addition, greater consistency in pricing between active services and dark fibre should reduce the risk that competition is driven by arbitrage rather than efficiency, which should also limit the rebalancing. We consider our pricing approach helps achieve this, as discussed further in Annex 21.

- The greater volumes at lower bandwidth are likely to mean that the impact of price rebalancing on a per circuit basis is limited, given the greater number of circuits affected.

- Even CPs which lose in the short term as a result of price rebalancing may benefit from the availability of dark fibre in the longer term given the general trends in bandwidth (meaning they can upgrade capacity for a lower incremental cost), and/or from the dynamic benefits that it will deliver (e.g. in terms of innovation, availability of alternatives to Openreach, greater competition).

- Despite our adjustment to the LLCC for cost recovery purposes as a result of dark fibre in this review period (as set out in Annex 33), the value of 'X' remains negative, and so it is not clear why any real price increases would be necessary as a result of dark fibre (as noted by TalkTalk, see paragraph A19.79). Indeed, as discussed in Section 5 of Volume II, we are not expecting nominal price increases to be required for charge controlled services.

A19.105 Therefore we consider that any price rebalancing triggered by our dark fibre remedy will not require a real increase in prices for any circuit type. This will limit any negative volume impact of the price rebalancing, and therefore reduce the risk to allocative efficiency.

A19.106 Further, although some CPs will likely face higher prices than in the world without a dark fibre remedy, we recognise that other CPs (and end users) will likely benefit as a result of this price rebalancing. In particular, CPs who purchase higher bandwidth circuits (or will do so in the future given the price rebalancing that is likely to occur) may face lower prices than they might have done in the absence of dark fibre and/or the potential for higher quality/bandwidth for the same cost relative to an

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even in the absence of a dark fibre remedy). As such, on the basis that the scale of rebalancing is manageable (for the reasons set out in paragraph A19.104), we consider the volume effect for lower bandwidth circuits may not be significant relative to an active-only regime.

active-only regime. These CPs may pass on the cost savings to end users and/or improve their services due to the competitive nature of downstream markets (e.g. backhaul cost savings may be passed on in lower retail broadband and/or mobile prices), which may benefit downstream customers. In the long term, this could also potentially lead to increased volumes at higher bandwidths relative to an actives-only regime, to offset any volume reductions at lower bandwidths (although this will depend upon the pricing level of the dark fibre remedy as well as the scale of price reductions which would have otherwise been imposed).

Potential implications of a dark fibre remedy for other markets

A19.107 We have in the first instance sought to give BT an opportunity to recover its efficiently incurred costs via a rebalancing of active prices from the current structure within the active charge control.[293] However, as we noted in the May 2015 BCMR Consultation, this adjustment to prices could potentially have an effect on other markets.

A19.108 In particular, the introduction of a dark fibre remedy could also have implications for the common costs recovered from other markets. If there is a significant impact in the long term such that usage of wholesale active leased lines sold by BT falls relative to other products, proportionately more common costs may need to be recovered from other (non-BCMR) services, including wholesale access services (such as Wholesale Line Rental (WLR), LLU and Integrated Services Digital Network (ISDN) lines).

A19.109 However this effect depends on a fall in usage of services within the BCMR relative to other services, and so for there to be a significant impact in other markets, dark fibre would need to have a significant effect on volumes. This could occur, for example, if there is scope for significant aggregation with a dark fibre remedy which is not possible under the active regime, which leads to a substantial reduction in absolute volumes in the business connectivity markets. However, the risk of this occurring will depend to some extent on the design of the dark fibre remedy. As discussed above and in Annex 33, we consider it unlikely that usage would materially reduce with dark fibre in the short to medium term (largely irrespective of how it is priced).

A19.110 While this could change in the longer term (if, for example, CPs sought greater aggregation opportunities), it is likely to be gradual and therefore more manageable within the BCMR, likely limiting the impact on other markets.

A19.111 Given this, and the general trend we observe for increased volumes in the active forecasts, we do not consider that the introduction of dark fibre would significantly reduce usage of BT circuits, such that more common costs needed to be recovered from other markets in this review period.

Our conclusion on the risk to allocative efficiency

A19.112 We recognise that introducing a dark fibre remedy is likely to have an impact on BT’s current pattern of cost recovery (and therefore ultimately, the active pricing

[293] We discuss the pricing flexibility provided to BT within the LLCC in Section 5 of Volume II.

structure), which could raise distributional concerns. However, the fact that some CPs may 'win' and some may 'lose' as a result of this is not necessarily cause for concern *per se*. Rather, our concern would be if dark fibre led to significant price rebalancing such that it caused overall volumes to significantly reduce in a way which reduced allocative efficiency.

A19.113 We consider that through the design of the dark fibre remedy (see discussion of pricing options in Annex 21), we have limited the scale of active price rebalancing necessary as a result of introducing a dark fibre remedy. This will reduce the distributional effect by limiting upward price changes for lower bandwidth circuits relative to the active-only world, and therefore the risk of negative total volume effects, while also mitigating the risk to BT's common cost recovery.[294] It will also retain some flexibility for BT to set an efficient bandwidth gradient.

Productive efficiency

Summary of our consultation position

A19.114 In the May 2015 BCMR Consultation, we considered that passive remedies (and any coexistence with active remedies) could distort the investment signals at different levels of the value chain, leading to inefficient entry. However, our initial view was that if passive prices can be set appropriately (both in absolute terms, and relative to active prices if remedies coexist), the risk of inefficient entry would not be significant.

Responses to the May 2015 BCMR Consultation

A19.115 PAG agreed that if prices are set appropriately, it is not clear that the risk of inefficient entry would be significant. Further, it argued that given the payback on dark fibre investment will occur over a number of years, inefficient entry is simply not a feasible business case since any short run differences in the recovery of fixed and common costs between active and passive services would be ironed out before the required investment could be paid off. It therefore considered that any fears about mass inefficient entry by CPs seeking to provide active services in competition with BT by purchasing dark fibre and 'a couple of boxes' are unfounded.[295]

A19.116 In addition, as part of its response to the May 2015 BCMR Consultation BT provided a technical paper[296] that considered the impact that a dark fibre remedy might have on its network architecture and design choices and those of other CPs. This could have implications for productive efficiency.

A19.117 In the paper BT discussed the various trade-offs that CPs have to make in designing networks to cope with uncertain demand and technical change. BT noted

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[294] This view is supported by our analysis of the potential rebalancing which may be required in light of our final dark fibre remedy design in the context of sub-caps in Section 5 of Volume II.
[295] Paragraph 1.20 and response to Q7.3, PAG non-confidential response to the May 2015 BCMR Consultation.
[296] Efficient Network Structure and the Provision of Dark Fibre under Regulation, BT's non-confidential response to the May 2015 BCMR Consultation.

that vertically integrated CPs can adopt various network topologies (particularly in relation to the nodes at which services are aggregated) and could choose whether to aggregate services at several different layers within their network (physical, transmission, packet or downstream service). CPs would have a strong incentive to adopt an efficient design and will therefore adopt a holistic approach, choosing the optimal combination of network topology and aggregation to suit their needs.

A19.118 BT argued that the introduction of a wholesale supply arrangement would disrupt these design choices by effectively segmenting the design process into upstream and downstream components. BT argued that it is unlikely that the price of the wholesale service, particularly if imposed by regulation, would reflect marginal costs and consequently the network designs adopted by the upstream and downstream CPs would be less efficient than that of a vertically integrated CP.[297]

A19.119 BT considered that the introduction of a dark fibre remedy would create a strong incentive for CPs to adopt a 'fibre lean' strategy making greater use of aggregation than vertically integrated CPs in order to reduce their consumption of dark fibre. As vertically integrated CPs generally adopt 'fibre rich' network architectures (i.e. use more fibre and less aggregation) BT considered that efficiency would be reduced.

Our assessment

A19.120 In relation to the risk that a dark fibre remedy may generate 'inefficient' entry and investment, we consider that it would depend on its specific design and the specific "efficiency" being considered. The key risk for inefficient entry appears to be related to the pricing of dark fibre relative to active prices.

A19.121 This is because, if it is not set appropriately, it could result in inefficient investment signals between different levels of the value chain, with the incentives to enter using active and/or dark fibre remedies potentially being distorted.[298] For example if the dark fibre price is 'too low' relative to the active price this could over incentivise take-up of dark fibre, potentially leading to productive inefficiencies by allowing inefficient competitors to profitably undercut BT's active services. Conversely, we note that if the dark fibre remedy price is 'too high' relative to the active price, this could disincentivise take-up of dark fibre (potentially forgoing dynamic benefits). As a result, competition would not be based on greater efficiency and/or superior product offerings, but responses to inefficient investment signals which can lead to productive and dynamic efficiency losses.

A19.122 However, we consider that if dark fibre prices are set appropriately and on a consistent basis with active prices (to the extent feasible), the risk of inefficient entry and distorted build/buy decisions should be more limited (and in any event not significantly higher than the case with regulated active prices). In particular, this should allow CPs to make efficient choices between different forms of access. This is a view supported by PAG, who also argued that inefficient entry is unlikely to be

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[297] BT also argued that as networks are designed holistically and not on a single circuit basis, the gap between true incremental costs and regulated prices can be large and so the '1G EAD minus' rule will not be the correct approach economically to facilitate proper investment decisions.
[298] We also note distortions could occur in the incentives for self-build depending on the level and structure of dark fibre (and active) pricing. We discuss this further in Annex 20.

feasible even with short run differences in the relative prices given the payback on dark fibre investment will occur over a number of years. We discuss this further in Annex 21 and Annex 23.

A19.123 With regards to BT's arguments about the increase in aggregation as a result of dark fibre, we discuss the scope for this above and in greater detail in Annex 33. In relation to its arguments that this will lead to inefficient network design, it is not clear to us that this is the case.

A19.124 Firstly, we agree that the choice of network architecture is complex. Therefore, we consider it unlikely that there will be a single structure which will be 'optimal' or efficient for all circuits or locations or traffic profiles, based on expectations of future demand and technology.

A19.125 Secondly, active wholesale remedies have been available for many years and therefore the appropriate comparator is not a vertically integrated operator

A19.126 Thirdly (and within this context), while dark fibre is likely to affect CPs' design choices at the margin, we consider that it does not constitute as large a change as BT suggests. We consider that the appropriate comparator is the current arrangements with active remedies rather than a vertically integrated CP. With the existing active remedies CPs already have a strong incentive to aggregate circuits and it is not clear that the incremental impact of dark fibre on these incentives is significant (as set out in Annex 33). This is both as a result of our pricing approach for dark fibre (which limits the additional price incentives to aggregate), but also the non-price barriers to migration of existing services. As a result, it is not clear there necessarily will be a significant change in network topology as a result of dark fibre.

A19.127 Finally, as BT notes, CPs face a trade-off when determining the level of aggregation, and dark fibre actually removes a barrier to transmission layer aggregation that is to some extent present with active remedies. We therefore consider that, providing prices are set appropriately, this could allow CPs to make more efficient choices about aggregation by facing the relevant costs.[299] It is also not clear that dark fibre will necessarily have a net result of less fibre being used (i.e. as discussed above, it's not clear that large amounts of fibre will be stranded since aggregation opportunities are not perfect, and there are other areas where demand for fibre may increase[300]). In any event, as discussed above, BT is able to recover its costs based on fibre in use (rather than all fibre), and so we would not expect this to pose a risk to BT's efficient cost recovery. Therefore even if there was a change in network topology as a result of dark fibre, it is not clear this would raise significant efficiency concerns.

A19.128 In light of the above, we consider that while there may be some aggregation as a result of dark fibre over time, this is likely to be gradual, and it is not clear this this raises significant efficiency concerns as a result.

[299] A similar issue around efficient trade-offs is relevant with regards to dual- and single-fibre WDM systems, which we discuss further in Annex 23 in relation to our dual-fibre dark fibre pricing approach.
[300] For example, where BT supplies multiple downstream CPs' services from a common platform (and effectively a single pair of fibres), e.g. EBD, it will experience an increase in fibre demand if each CP decides to move to dark fibre.

Conclusion on the risk to productive efficiency

A19.129 We consider that our pricing approach appropriately addresses the risk to productive efficiency (given the overall trade-offs involved in determining the pricing approach) for the reasons set out in Annexes 21 and 23, as well as the overall assessment in Sections 7 and 9.

Structure of competition

Summary of our consultation position

A19.130 In the May 2015 BCMR Consultation, we recognised that if economies of scale and long term commitments are more important for CPs using passive remedies than CPs using actives, introducing passive remedies could result in market consolidation, with smaller CPs exiting the market and reducing the extent of competition. However, we considered it unlikely that this impact would be large, and it may not necessarily be detrimental overall, given the greater opportunities that passives may open up.

Responses to the May 2015 BCMR Consultation

A19.131 As summarised above, BT argued that it will have reduced incentives and ability to develop new variants as a result of the removal of the bandwidth gradient, which it argued may lead to Openreach reviewing the length of time over which it is economic and feasible to support the broad set of product variants it has today. It considered that this is likely to impact, in particular, on smaller CPs who do not have the scale or resources to develop multiple product variants downstream using the input of EAD 1Gbit/s or dark fibre.[301]

A19.132 Hyperoptic stated that a dark fibre remedy would be purchasable by smaller CPs (subject to the business rates applicable, which are discussed further in Annex 23).[302]

A19.133 TalkTalk disagreed with the suggestion that smaller companies will be disadvantaged (as only larger firms will be able to consume dark fibre) since smaller companies will be able to purchase wholesale Ethernet products from a range of providers rather than having to rely on Openreach (ensuring they enjoy more innovation, higher quality and lower prices[303]) and it does not see any material consolidation or impact on the market structure. In any case, TalkTalk stated that the objective of regulation is not to maintain a particular market structure through a

[301] Paragraph 4.14, Part A of BT's confidential response to the May 2015 BCMR Consultation.
[302] P12 (response to Q7.3), Hyperoptic non-confidential response to the May 2015 BCMR Consultation.
[303] TalkTalk stated that this same model has developed in broadband where, for example, it purchases MPF from Openreach and sells wholesale broadband products to a range of wholesale partners and resellers.

'one-size fits all' set of remedies (or lowest common denominator) but to meet consumers' interests.[304]

A19.134 Vodafone argued that it is unlikely that dark fibre will bring about any new issues around economies of scale that do not already exist today, and considered it may only be detrimental to smaller players if a passive remedy is only possible with significant investment.[305]

A19.135 PAG stated that the business case for fibre investment and the economies of scale and scope required to provide active services if dark fibre was available is challenging – but noted that the scale requirement to serve the market exists today and will continue to exist in the same way with dark fibre available.[306] PAG also considered that any impact from changes to the structure of the market (e.g. consolidation) due to passives is unlikely to be large or detrimental in light of the benefits that passive remedies offer.[307]

Our assessment

A19.136 We focus here on whether there could be an impact on the competitive landscape among users of BT's infrastructure as a result of a dark fibre remedy. The potential impact of dark fibre on third party infrastructure operators (and the impact on the wider competitive environment which could result) is discussed further in Annex 20.

A19.137 To the extent that economies of scale are important in the use of dark fibre, we recognise that there is potentially a risk that the downstream market could become more consolidated relative to today. We consider this risk is likely to be relatively low for dark fibre, since the additional investment required by CPs for dark fibre is relatively low compared to the current active products, and is mainly confined to different circuit interfaces/equipment (we note that such equipment is manufactured globally and is already readily available). Therefore it is not clear that dark fibre should necessarily require significantly greater economies of scale than active services, such that smaller CPs could be excluded (as argued by Hyperoptic, the PAG, TalkTalk and Vodafone).

A19.138 However, even if this were not always the case (and dark fibre still required significant economies of scale and/or investment by some CPs), that is not to suggest that we will necessarily see smaller CPs exit the market. In particular, even in the absence of economies of scale, smaller CPs may still want to purchase regulated dark fibre, particularly if they are currently providing more specialist services as it would increase the flexibility they have over the services they provide. In addition, we consider that dark fibre could potentially lead to increased wholesale competition upstream, meaning smaller CPs may buy an active service from alternative (dark fibre-based) suppliers to continue providing services in the event they did not want to purchase dark fibre directly from BT themselves (a view

[304] Paragraph 3.58, TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.
[305] P38, Vodafone non-confidential response to the May 2015 BCMR Consultation. We discuss Vodafone's arguments on the appropriate design in Annex 22.
[306] Paragraph 1.20, PAG non-confidential response to the May 2015 BCMR Consultation.
[307] Page 30 (response to Q7.3), PAG non-confidential response to the May 2015 BCMR Consultation.

expressed by TalkTalk). Therefore smaller CPs may still have a choice of active services even if BT reduced its offering as suggested (see paragraph A19.131). This could work much like the market today where non-BT infrastructure operators offer active services to downstream CPs (as well as dark fibre). Therefore it is not clear that smaller CPs will necessarily be priced out of the downstream market, even in the event that they themselves lack the economies of scale required to utilise dark fibre access directly.

A19.139 If dark fibre did require greater investment by CPs, we might expect them to seek longer downstream contract periods in order to recoup this investment. It could be argued that this may not be desirable for competition and could reduce switching, but we note that longer term contracts (including discounts) already exist under the active regime (as set out in Section 5 of Volume II, typical retail contracts for leased lines are around three years). We also understand that variability in contract lengths (including where new build is required) is also apparent in the offerings of non-BT infrastructure operators. Therefore (subject to the specific design of the dark fibre remedy) we consider there is likely to remain some commercial scope to vary such terms in response to the market even in the event of new infrastructure build, and we do not think that this should be a particular concern in relation to a dark fibre remedy.

Our conclusion on the risk to the structure of competition

A19.140 We recognise that there may be some changes to the market structure and competitive environment (for example, we could see the emergence of dark fibre-based wholesale competitors and alternative, more differentiated offerings). However, we do not think that there is a high likelihood of a large impact or that the impact would be to reduce competition.

Implementation costs

Summary of our consultation position

A19.141 In the May 2015 BCMR Consultation, we recognised that BT will likely incur some costs as part of developing and implementing a new remedy. However, it seemed unlikely that these would be significant, particularly since there are likely to be ways to limit them, and we would in any event make an allowance for BT to recover these costs in the LLCC (so they would not pose a risk to BT's cost recovery or investment incentives).

Responses to the May BCMR 2015 Consultation

A19.142 PAG agreed that implementation costs are likely to be minimal (given dark fibre is merely a cut-down version of an Ethernet leased line).[308]

A19.143 Vodafone agreed there will be costs to implement dark fibre, but argued these were no more so than the costs that customers are incurring with poor service from the

[308] Page 30 (response to Q7.3), PAG non-confidential response to the May 2015 BCMR Consultation.

current EAD processes, and noted that the flexibility of dark fibre means its implementation only needs to be done once.[309]

A19.144 BT argued that the practical implications and costs of the implementation of a dark fibre remedy have been materially underestimated in these proposals, particularly in terms of the loss of monitoring of the service (to identify any faults) which will lead to significant additional industry-wide processes and cost to ensure that quality of service is maintained.[310] It also argued that the disruption that would occur as a result of dark fibre has been underestimated. BT's additional comments appear to more directly relate to the specific remedy design, and so we consider them further in Annex 22.[311]

Our assessment

A19.145 We recognise that introducing a new remedy would likely result in BT (and indeed other CPs) incurring associated development and implementation costs. As a result, we consider it reasonable to seek to provide BT with a fair opportunity to recover efficiently incurred implementation costs, just as we do with other efficiently incurred costs (including investment, as discussed above). We discuss where and how these costs will be recovered in Annex 33.

A19.146 We note that the scale of implementation costs and any disruption (including as a result of the loss of service monitoring) is highly dependent upon the design of any dark fibre remedy and how exactly it is implemented (for example, the specification of repair requirements). For example, if a dark fibre remedy is largely based on the existing active circuits was introduced, we would expect the implementation costs to be relatively modest because it is likely that many of the existing processes could be re-used.

Our conclusion on implementation costs

A19.147 Overall we recognise that there are likely to be implementation costs incurred by BT (and other CPs) as a result of introducing dark fibre, and that these need to be considered as part of the overall assessment. However, we consider that our design of the dark fibre remedy limits the scale of these costs, such that they are unlikely to be significant. We set out the magnitude of these costs incurred by BT, and how we will provide BT with a fair opportunity to recover them, in Annex 33.

Summary of final conclusions on impacts and risks of a dark fibre remedy

A19.148 In Table A24.1 below, we present a summary of the impacts and risks of introducing a dark fibre remedy discussed above.

[309] P38, Vodafone non-confidential response to the May 2015 BCMR Consultation.
[310] For example, BT argued that it is currently able to establish that a high proportion of reported faults are not in the fibre but in equipment, and in future the only way to do this will be to test fibres by physically removing CP equipment from the fibre itself.
[311] Paragraph 3.33-4, Part A of BT's confidential response to the May 2015 BCMR Consultation.

Table A24.1: Summary of the impacts and risks of introducing a dark fibre remedy

	Description	Scale and scope of risk
Dynamic efficiency	The introduction of a dark fibre remedy could reduce the investment incentives of BT relative to an active-only regime, by posing a threat to its cost recovery.	Largely mitigated through the price and non-price design of our dark fibre remedy (see Annex 21 and 22). In addition, risks to cost recovery have been considered through approach in LLCC (see Annex 33 and Section 5 of Volume II).
Allocative efficiency and distributional impacts	A dark fibre remedy is likely to result in some rebalancing of active prices, from which some customers may benefit while others may be worse off depending on services typically purchased. This could create allocative efficiency concerns relative to today.	While it is unlikely that a dark fibre remedy could be introduced in a way which would have no impact on the pricing structure, we consider that design of the dark fibre remedy significantly mitigates this risk (see Annexes 21 and 22).
Productive efficiency	The existence of a dark fibre remedy (and any coexistence with active remedies) could distort the investment signals at different levels of the value chain, leading to inefficient entry.	We consider that our approach to pricing dark fibre (both in absolute terms and relative to active prices), means that the risk of inefficient entry would be not be significant (see Annex 21).
Structure of competition in the market	To the extent that economies of scale and long term commitments are more important to a CPs ability to utilise a dark fibre remedy than actives, introducing the former could result in market consolidation, with smaller CPs exiting the market and reducing the extent of competition.	While the remedy may have an impact on the downstream market, it is not clear that the impact will be large or that this will necessarily harm competition, given the greater opportunities that dark fibre may open up.
Implementation costs	BT (and other users of dark fibre) will likely incur some costs as part of developing and implementing a new remedy.	We consider that our design of the dark fibre remedy limits the scale of implementation costs (see Annex 22). Furthermore, the design of LLCC provides BT with the opportunity to recover implementation costs (see Annex 33).

Annex 20

Impact of dark fibre on rival investment

Introduction

A20.1 This annex presents our assessment of the impact of a dark fibre remedy on investment in rival passive infrastructure (rival investment). In assessing this impact, we take the design of the dark fibre remedy, in particular its pricing, explained in Section 9 as given.

A20.2 In this annex, we focus on the incremental impact of our dark fibre remedy, that is, on its impact on rival investment over and above any impact that the Leased Lines Charge Control (LLCC) may have. This is because we are considering the merits of a package of remedies including both active remedies and a dark fibre remedy compared with a package of remedies containing only active remedies.[312] Annex 19 presents our assessment of the impact of a dark fibre remedy on BT's incentives to invest in its passive infrastructure. Volume II Section 5 sets out our considerations in relation to the impact of the LLCC on rival investment.

A20.3 In the May 2015 BCMR Consultation, we explained that while a dark fibre remedy may have an adverse impact on rival investment, we considered that our proposed approach to design and price the dark fibre remedy would largely mitigate this risk.

A20.4 This annex is structured as follows:

- We summarise the assessment of the impact of a dark fibre remedy on rival investment from the May 2015 BCMR Consultation.[313]
- We summarise stakeholders' responses relating to the impact of the proposed dark fibre remedy on rival investment.
- We set out our overall assessment of the impact of the dark fibre remedy, with design and pricing as outlined in Section 9, on rival investment. As part of reaching our final view we:
  - describe the efficiency trade-offs associated with access regulation.
  - discuss the potential impacts of a dark fibre remedy on rival investment.
  - discuss further evidence regarding the impact that a dark fibre remedy may have on rival investment. We look at the volumes of circuits that could be affected by the dark fibre remedy, and we discuss stakeholders' submissions as regards our dark fibre proposals.

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[312] We also account for the impact of a dark fibre remedy in our design and application of the LLCC as and where the dark fibre remedy would affect our ability to provide BT an opportunity to recover the costs it would incur in providing its active products efficiently.
[313] Ofcom, May 2015 BCMR Consultation, Annex 24, pages 538-542.

Summary of our conclusions

A20.5 As set out in Section 4, the high costs of building passive infrastructure mean that in the UK outside the CLA and Hull, competition based on end-to-end infrastructure is not effective. As a result, many OCPs rely on wholesale access to BT's network in order to provide services to customers. We consider that a requirement for BT to provide dark fibre as well as active circuits would result in a number of benefits to competition (and ultimately end-users). These are set out in Annex 18.

A20.6 The dark fibre remedy would have some benefits for infrastructure-based competition. It would enable OCPs to provide a service combining BT's dark fibre with their own infrastructure in a way akin to full network competition. This will allow these OCPs to compete more effectively (e.g. for multi-site contracts) than with the existing active remedies, increasing the profitability of their existing infrastructure. Moreover, the ability to use dark fibre may facilitate some roll out of end-to-end infrastructure, using a combination of self-build and dark fibre.

A20.7 However, members of the IIG (which comprise of Virgin, CityFibre, Zayo and EU Networks) have argued that the proposed dark fibre remedy would undermine their incentives to invest in infrastructure, as it would reduce prices for higher bandwidth and dark fibre circuits.

A20.8 In order to review the potential adverse impact on rival investment, we have analysed the incentives that our pricing approach would provide for efficient investment, based on a range of evidence (including the volumes and prices of the products that a dark fibre remedy would likely affect).

A20.9 Our approach is designed not to deter efficient investment. It requires BT to set the price of dark fibre by reference to its charge-controlled products operating at 1Gbit/s, and is therefore consistent with the design of the controls which we are imposing on BT's charges for regulated active services, which provides incentives for efficient investment for BT and for rival infrastructure operators.

A20.10 This pricing approach should limit the impact of the dark fibre remedy on rival revenues mainly to CISBO circuits with bandwidths above 1Gbit/s and commercial dark fibre circuits.[314] Jointly, these circuits represent (and they will continue to do so over the review period)[315] a relatively small proportion of the total supply of business connectivity. Moreover, these products can continue to be priced at a level at least as high as BT's costs. We consider that this pricing approach will mitigate the risks to efficient infrastructure investment by rival infrastructure operators.

A20.11 Our review of the evidence is consistent with this view. We find that the proportion of circuits whose prices are directly impacted by the introduction of the dark fibre remedy is relatively low: only 2% of the total supply of CISBO customer ends (in the London Periphery (LP) and the Rest of the UK (RoUK)). While this proportion is

[314] As noted in Annex 21, we expect the benefits of dark fibre to be wider, as we anticipate take-up at 1Gbit/s circuits.
[315] We are mindful of the share of above 1Gbit/s active products in the overall supply of CISBO circuits increasing over the review period. Even when accounting for the growth forecast, these products will represent a small proportion of total supply.

forecast to grow, we expect it to remain relatively small. For BT, we forecast that the share of its above 1Gbit/s circuits in its total supply of CISBO circuits will increase from 5.2% in 2015/16 to 9.6% in 2018/19. When we review the circuits sold by Virgin and CityFibre, the two operators that have announced significant infrastructure investment plans, we find [✂].

A20.12 We have also compared the price of our dark fibre remedy with the price of commercial dark fibre. Such a price comparison is not straightforward: the dark fibre remedy is not yet available and, by the time it is available, prices of dark fibre are likely to be significantly reduced due to the LLCC. We have therefore compared prices based on what the dark fibre remedy price would have been under our pricing rule in 2015, had the remedy been available. We find that [✂]. We consider that this is not unexpected, as much existing dark fibre supply is to niche market segments with bespoke customer requirements. A regulated access product, intended to be used at scale, may be expected to have a [✂] price than a niche product which is supplied in small volumes to a group of (mainly) specialist users.

A20.13 Although we consider that our dark fibre remedy may have some impact on this supply to niche market segments (though less than a price comparison would imply as many existing users of dark fibre are likely to still seek bespoke solutions), we do not consider this impact to be very significant given the limited volumes affected, the specialist nature of this supply, and the price still being at least as high as BT’s costs. Moreover, we consider that these operators are not well placed to provide a competitive constraint to BT as service bandwidths above 1Gbit/s become more widely used.

A20.14 Overall, we consider that our pricing approach to dark fibre significantly mitigates the impact of the remedy on rival infrastructure investment.

Our assessment of risk to rival investment in the May 2015 BCMR Consultation

A passive remedy can both encourage and discourage rival investment

A20.15 We presented our assessment of the risks of a passive remedy in Annex 24 of the May 2015 BCMR Consultation.

A20.16 We explained that a passive remedy could encourage rival investment when and to the extent that passive access complements self-build. By reducing barriers to entry, a passive remedy could make it more attractive for OCPs to invest in their own infrastructure. For example, OCPs could be willing to build infrastructure in areas where they have no existing infrastructure as using a mix of self-build and passive access could allow them to compete more effectively for the supply of business connectivity.

A20.17 We recognised that a passive remedy could also discourage rival investment since:

- The passive remedy would offer a low cost alternative to replicate part of the self-build benefits and hence, OCPs could have incentives to use a passive remedy instead of self-build. While other benefits from self-build would remain, a passive remedy may reduce the incentives of OCPs to invest in their own infrastructure when the incremental benefits of self-build over using a passive remedy are small.

- It would intensify downstream competition by exposing more of the value chain to competition. With passive access available, access-seeking OCPs would have an enhanced ability to compete for the supply of connectivity, using a mix of passive access and own infrastructure. The resulting greater competition in downstream markets would exert pressure on downstream prices and margins, thus potentially reducing returns on existing and future investment in rival infrastructure.

A20.18 We explained that the scale of any impact on rival investment would depend on the form of the remedy (i.e. dark fibre or duct) as this determines the extent to which a passive remedy allows for the replication of self-build benefits, and on the pricing of a passive remedy.

A20.19 Our provisional view was that a passive remedy may undermine some rival investment relative to an ‘actives-only’ regime. However, we considered that our proposals – a dark fibre remedy priced with reference to EAD 1Gbit/s – would help to mitigate the risk to rival investment. This was because our proposals supported a higher price for dark fibre (relative to other pricing approaches we considered) and higher prices for high bandwidth active circuits would retain incentives for OCPs to invest in their own passive infrastructure.[316]

Stakeholders’ responses on the impact of the proposed dark fibre remedy on rival investment

A20.20 We discuss stakeholder responses in two groups:

- Those that supported the introduction of the proposed dark fibre remedy and argued that it would not have an adverse impact on efficient rival investment.[317] This included the Passives Action Group (PAG) which is comprised of Colt, Vodafone, H3G, TalkTalk and Sky.

- Those that objected to the proposed dark fibre remedy and argued that it would adversely affect incentives for rival infrastructure operators to invest in their own infrastructure. This included BT and the Infrastructure Investors Group (IIG), which is comprised of CityFibre, Virgin, Zayo and EU Networks.

Stakeholders arguing that dark fibre would not harm efficient rival investment

A20.21 Frontier Economics, in a submission on behalf of PAG, argued that Ofcom should use a ‘cost-based’ approach to set the dark fibre price. It claimed that using this approach would provide greater certainty, send more appropriate ‘build-buy’ signals (thus encouraging efficient investment), and would not deter efficient investment.[318]

[316] Also, setting the ‘minus’ on a LRIC basis would provide OCPs with appropriate build-or-buy incentives at the 1Gbit/s level. This element of the pricing of dark fibre and any bearing it has with (efficient) investment is discussed in Annex 23.
[317] In addition, a number of additional OCPs, including [✄], support the introduction of a dark fibre remedy.
[318] Frontier Economics report, page 46.

A20.22 TalkTalk considered that Ofcom should assess the extent to which a dark fibre remedy would have an impact on efficient investment. It argued that Ofcom has mistakenly set itself the policy objective of reducing any adverse impact on rival infrastructure operators independent of whether the investment concerned is efficient or not.[319] TalkTalk also noted that Ofcom, in the June 2015 LLCC Consultation, had recognised that a passive price that was too high could support inefficient investment in passive infrastructure.

A20.23 Sky considered that passive remedies would encourage investment in rival infrastructure.[320] It explained that rival investment is at present challenging due to the presence of significant barriers to entry and that access to BT's passive infrastructure would be essential to make rival investment viable. It considered that a passive remedy would offer OCPs the flexibility to develop business models using a mix of self-build and passive access. Sky further noted the importance of scale and scope in generating the revenue required for OCPs to be able to justify further investment in rival infrastructure.[321]

A20.24 Vodafone argued that a dark fibre remedy, through its complementarity with OCPs' own access capabilities, would enable OCPs to compete more effectively and innovatively in a range of markets. Accordingly, it argued that by enhancing the ability of OCPs to compete, the dark fibre remedy would encourage efficient rival investment.[322] Vodafone also argued that regulation should only provide incentives for efficient investment, and noted that past investment had been encouraged on a false premise, "facilitated" by BT's pricing (bandwidth gradient) and excess profitability on Ethernet services.[323]

A20.25 Colt argued that dark fibre would allow access seekers to provide services as if they are on-net and that this would dramatically increase the flexibility of access seekers in relation to their service and commercial offerings. It considered that access seekers would have more flexibility to develop offerings that meet customer requirements and would be able to respond to changes in customer demand more quickly and easily.[324]

A20.26 Colt argued that dark fibre would enable CPs to invest more and serve customers in different areas compared to the current 'actives-only' framework.[325] Colt explained that its key use for dark fibre would be [✂] Colt considered that this model [✂] would enable it to expand its network to new cities and/or to other parts (e.g. business parks) of cities in which it already has some existing infrastructure.[326]

Stakeholders arguing that dark fibre would harm efficient rival investment

A20.27 BT argued that a dark fibre remedy would reduce the incentives of rival operators to invest in their own passive infrastructure. It considered that while Ofcom

[319] TalkTalk's response to the May 2015 BCMR Consultation, page 25.
[320] Sky's response to the May 2015 BCMR Consultation, page 13.
[321] Sky's response to the May 2015 BCMR Consultation, page 6-7.
[322] Vodafone's response to the May 2015 BCMR Consultation, page 37.
[323] Vodafone's response to the May 2015 BCMR Consultation, page 38.
[324] Colt's response to the May 2015 BCMR Consultation, page 7.
[325] Colt's response to the May 2015 BCMR Consultation, page 8.
[326] Colt's response to the May 2015 BCMR Consultation, page 8.

understated the risk of a dark fibre remedy to such rival investment, it overstated the extent to which the proposed pricing of the dark fibre remedy would mitigate this risk.[327]

A20.28 The members of IIG, in a joint submission, argued that the proposed dark fibre remedy, in combination with Ofcom's LLCC proposals, would severely harm existing infrastructure-based competition and future prospects for investment in rival infrastructure. IIG claimed that our proposals would result in the dark fibre remedy being priced at a level significantly below the current prices of dark fibre supplied on a commercial basis.[328]

A20.29 IIG analysed and assessed the impact of Ofcom's dark fibre proposals on providers of rival infrastructure.[329] Based on its analysis, it argued that:

- [✂]
- [✂]

A20.30 IIG argued that [✂]

A20.31 CityFibre argued that Ofcom's proposals:

- [✂];
- [✂];
- [✂] [330]; and
- are contrary to the objectives of the Digital Communications Review (DCR), in terms of the need for and value of supporting investment in end-to-end infrastructure.

A20.32 CityFibre argued that Ofcom:

- had failed to quantify the harm of a dark fibre remedy and unjustifiably considered that any harm would be sufficiently mitigated by the proposed pricing approach;
- had underestimated the impact on alternative infrastructure in parts of the UK where BT would have to offer dark fibre, and thereby the impact of dark fibre on both existing and future investment;
- failed to sufficiently consider alternative pricing approaches, including:
    - benchmarking to commercial dark fibre prices; and

[327] BT's response to the May 2015 BCMR Consultation, Part A, page 23.
[328] Stakeholders also commented on the adverse impact of the LLCC proposals on rival investment. We discuss these comments separately in Volume II Section 5.
[329] We obtained the model used to support the IIG analysis as part of a section 135 notice, dated 27 August 2015.
[330] [✂]

- using EAD 10Gbit/s as the reference product, which, it considered would preserve higher prices and leave more value in the market and thereby more appropriately mitigate the harm to investment in alternative infrastructure.

A20.33 [✂].

- [✂].
- [✂].
- [✂][331]

A20.34 Virgin argued that the proposed dark fibre remedy would inadequately mitigate the negative impact on rival investment.[332] It claimed that by devaluing the market for higher bandwidth active services and by pricing the dark fibre remedy at a level below the current commercial dark fibre price, the dark fibre remedy would undermine existing and future investment.

A20.35 Virgin considered that Ofcom had failed to undertake substantive analysis of the magnitude of the risks of undermining incentives on CPs to invest in infrastructure, and had relied on arguing for risks to be mitigated by the proposed pricing of the dark fibre remedy.[333] It called on Ofcom to assess the risks "remaining" under the proposed dark fibre remedy and it stressed the importance of regulatory stability in protecting infrastructure investment.

A20.36 Virgin explained the benefits of end-to-end infrastructure competition and noted that these benefits are well-established in the economic literature.[334] It argued that the dark fibre remedy if implemented as proposed would undermine end-to-end competition and that this would represent a failure on the part of Ofcom to appreciate the longer-term benefits of end-to-end competition.

A20.37 Virgin argued that alternative pricing approaches would leave greater value in the markets providing better investment incentives.[335] It asked Ofcom to consider the need for and appropriateness of a dark fibre remedy in the broader context of the DCR, noting that this would allow for a more appropriate assessment of how to achieve investment objectives.[336]

A20.38 [✂] [337] [✂]

A20.39 [✂][338]

A20.40 [✂][339]

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331 [✂]
332 Virgin's response to the May 2015 BCMR Consultation, page 8.
333 Virgin's response to the May 2015 BCMR Consultation, page 9.
334 Virgin's response to the May 2015 BCMR Consultation, page 34-35.
335 Virgin's response to the May 2015 BCMR Consultation, page 9-14.
336 Virgin's response to the May 2015 BCMR Consultation, page 15.
337 [✂]
338 [✂]

Our assessment of the impact of dark fibre on rival investment

A20.41 This sub-section of the annex is structured as follows:

- We explain why the dark fibre remedy we impose can affect rival infrastructure investment in differing ways;
- We explain why we consider that our dark fibre remedy is consistent with efficient investment decisions, and that we expect the pricing of our dark fibre remedy, as set out in Section 9, to mitigate a potential adverse impact on (efficient) rival investment;
- In light of additional evidence received following the May 2015 BCMR Consultation, we have conducted some further analysis. Overall, our analysis does not lead us to change our view that the impact of our dark fibre remedy on efficient rival investment would be limited.

Potential impacts of a dark fibre remedy

A20.42 In fulfilling their customers' requirements, CPs can choose between investing in building their own network infrastructure and/or buying BT's regulated access products.

- When building its own infrastructure, an OCP has full control over the assets used in providing connectivity. Accordingly, an OCP has complete discretion over the services it provides over the network, the network design, the choice of equipment and the quality of service it offers to its customers.
- Conversely, when 'buying' a regulated access product from BT, an OCP does not have control over all of the assets and equipment used in providing connectivity. As a result, it has less control of the network design, the choice of equipment and the quality of service provided to their customers. However, this drawback of less control is likely to be countered by the typically lower costs associated by 'buying' regulated access products relative to building one's own infrastructure.

A20.43 The introduction of our dark fibre remedy is likely to alter the costs and benefits of an OCP investing in its own network relative to buying BT's regulated access products. This could have the effect of either encouraging or discouraging rival infrastructure competitors to invest.

A20.44 On the one hand, compared to BT's regulated active products, dark fibre could enable OCPs to achieve additional benefits (from having greater control over connectivity provided) at similar (or lower) costs than BT's regulated active products. Since dark fibre will make the access remedy more effective, it is possible that at the margin it could make OCPs less likely to build their own network and more likely to purchase access to BT's network.[340]

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[339] [✂]

[340] To the extent that previously some OCPs may have constructed their own infrastructure, even though their costs were higher than those of BT, but because the existing active remedies did not

A20.45 However, introducing dark fibre can also improve the opportunities for OCPs to invest. Where an OCP has invested in its own infrastructure in addition to using BT's regulated active products (which will be the case for the majority of OCPs), the introduction of dark fibre can potentially allow an OCP to exploit more of the benefits of self-build by enabling it to provide a uniform set of services across its own network and dark fibre in a similar way to services that are delivered on-net. Therefore, dark fibre can improve the relative benefits to an OCP of investing in its own infrastructure and therefore, at the margin, may increase rival investment.

A20.46 PAG (and its individual members) argued that the dark fibre remedy would enhance the ability of OCPs to compete for the supply of business connectivity, and that in turn, this would make it more attractive for OCPs to invest in their own passive infrastructure.[341]

A20.47 One area where a positive impact on investment might be expected is where OCPs are seeking to compete for a multi-site contract and where they are able to connect only some of those sites using their own infrastructure.[342] In these circumstances, and in the absence of a dark fibre remedy, an OCP would need to rely on BT's regulated active products. This would reduce its ability to differentiate its offering from those of its competitors, and/or exploit the full benefits of its own infrastructure in being able to offer a uniform service offering across all sites.

A20.48 We consider that dark fibre would enhance the ability of OCPs to compete for multi-site connectivity, as they would be able to provide a similar service to the customer in areas where they rely on BT's network as in areas where they use their own network. Accordingly, by increasing the prospects of competing for more multi-site contracts, the use of dark fibre could act as a complement to own infrastructure, thus encouraging rival infrastructure investment. In this regard we note that in its response to the May 2015 BCMR Consultation, Colt explained [✂]

A20.49 [✂]

Our dark fibre remedy is unlikely to adversely affect incentives for efficient investment

A20.50 As explained above, we consider that a dark fibre remedy can affect rival investment in differing ways. Dark fibre can potentially encourage rival (infrastructure) investment (as suggested by PAG in response to the May 2015 BCMR Consultation). At the same time, we also recognise that dark fibre has the potential to discourage rival infrastructure investment (as indicated by IIG in response to the May 2015 BCMR Consultation). In this sub-section, we explain why we consider that the pricing of our dark fibre remedy is consistent with efficient investment signals.

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provide sufficient control, then the introduction of dark fibre will lead to build/buy decisions that are more consistent with productive efficiency.

[341] Colt response to the May 2015 BCMR Consultation, page 8. Vodafone response to the May 2015 BCMR Consultation, page 33.

[342] The BDRC end-user survey finds that most demand for 1Gbit/s and above connectivity comes from users with multiple sites, and that such users commonly require several of their sites to be connected.

A20.51 In designing our remedies, our regulatory objective is to ensure that the interest of end-users are protected, and to promote effective competition, efficient investment, innovation and choice. As set out in Section 4, we have found BT to have SMP in the CISBO markets in the London Periphery (LP) and the Rest of the UK (RoUK). This SMP stems from BT's ubiquitous network and its economies of scale and scope. This means that we regard competition in these markets based on end-to-end infrastructure as not effective nor likely to become effective over the course of the review period.

A20.52 In the light of BT's SMP in the CISBO markets in the LP and the RoUK, we need to impose access remedies that protect consumers from the potential adverse impacts of BT's SMP, but at the same time provide incentives for efficient investment (by both BT and rival infrastructure operators).

A20.53 In designing and pricing access remedies for these markets we aim to replicate, as far as possible, the outcomes of a competitive market. We recognise that there is a trade-off between static and dynamic efficiency. Access prices that are closer to incremental costs may be consistent with productive and allocative efficiency in the short-term; however, by deterring investment may reduce dynamic efficiency which may bring benefits to consumers in the long-term. In our charge controls we balance these risks. In particular, we follow an approach based on incentive regulation, where we aim for prices over time to reach a level which is consistent with efficient investment signals. In Volume II Section 5, we set out our view that setting our charge control of BT's supply of active products based on BT's CCA FAC is consistent with productive efficiency, and with setting efficient investment signals. This mimics the outcome of a competitive market where entry would occur when entrants are at least as efficient as the existing operators.[343] In choosing the cost standard for this charge control we wish to encourage entry where it is efficient and is likely to benefit consumers, rather than entry *per se*.

A20.54 In its response to the May 2015 BCMR and June 2015 LLCC Consultations, CityFibre argued that setting charges based on BT's costs places new entrants at a disadvantage.[344] As we set out in Volume II Section 5, the costs of a new entrant may differ from those of BT in a number of ways. A new entrant is likely to adopt a different network architecture to that of BT, which may be better suited to serving existing demand. Moreover, a new entrant can choose to enter only in low cost, higher density areas. BT, instead, has a national network and typically prices on a geographically averaged basis. Jointly, these factors point to the charge control of BT's active products, as designed, preserving opportunities for new entrants to compete with BT, in particular when the new entrant can target the supply of higher margin products in higher density areas. In all, we consider that the charge control, of BT's active products retains opportunities for efficient entry, even if the new entrant will take time to realise economies of scale and scope.

[343] Virgin, BT's largest infrastructure competitor, agreed with the use of BT's cost base from a productive efficiency perspective. See Virgin's Non-Confidential Response to the June 2015 LLCC Consultation, page 5.
[344] CityFibre's response to the May 2015 BCMR Consultation, page 7.

A20.55 As we explain in Annex 21, in our approach to pricing dark fibre, we have taken account of the potential impact on rival investment.[345] In doing so, we have allowed BT to maintain a bandwidth gradient, and have given BT some flexibility to set the price of dark fibre above FAC. In particular:

- We have set the price of BT's dark fibre with reference to the price of EAD 1Gbit/s products. This would allow BT flexibility to recover more of its common costs from dark fibre. Our estimates suggest that this would provide BT the flexibility to price its dark fibre (and its EAD 1Gbit/s products), towards the end of the review period (2018/19) materially above its FAC (which includes a return on capital) of providing dark fibre. Indeed, BT would have the flexibility to price dark fibre at over 50% above an indicated 'cost-based' dark fibre remedy price in 2018/19.[346]

- BT's dark fibre delivered in dual-fibre will be priced at up to double the price of its dark fibre delivered in single-fibre, less any incremental cost savings to BT associated with delivering dual instead of single-fibre.[347] At current prices, an OCP seeking to provide a service similar to BT's OSA product (which is delivered with dual-fibre) would face similar costs when using dark fibre from BT and installing its own active equipment than when buying BT's OSA product.

A20.56 This pricing approach is consistent with our objective to introduce a dark fibre remedy that supports the use of dark fibre where it offers additional benefits relative to regulated active products, but not solely to encourage price arbitrage opportunities. Also, the approach will enable rival infrastructure operators to profitably compete for the supply of higher bandwidth circuits, even when a dark fibre remedy is introduced, as long as their costs do not materially exceed BT's FAC. This recognises the dynamic efficiency benefits of such competition.

A20.57 Accordingly, we consider that our approach strikes an appropriate balance between supporting the dynamic efficiency benefits that infrastructure-based competition can deliver, while seeking to achieve productive and allocative efficiency by bringing prices closer to costs over the review period.

A20.58 In addition to our pricing approach, we consider that the potential adverse impact of the dark fibre remedy will be further limited by the proportion of CISBO circuits

[345] We also placed weight on the allocative efficiency benefits of a bandwidth gradient in pricing, which (as we explain in Annex 19) can be an efficient way for BT to recover its fixed costs.
[346] This is based on an indicative comparison of the pricing approaches, using blended EAD and EAD LA cost and price data (i.e. blended across individual variants, such as ER, RO2 etc). The 1Gbit/s active minus prices are inferred by assuming the active benchmark prices are reduced in line with the SCA and then the 1Gbit/s EAD and EAD LA sub-basket controlling percentage of -6.75% (the 'minus' is as calculated in Annex 33). We have estimated illustrative cost-based dark fibre prices based on a volume weighted average of FAC minus the active specific incremental costs for 10Mbit/s, 100Mbits, 1Gbit/s EAD and EAD LA circuits, plus an adjustment for the dark fibre related costs discussed in Annex 33. A true cost-based price may differ as no allowance is made for lost common cost recovery on higher bandwidth circuits as a result of a lower dark fibre price.

[347] Also, only a single Main Link will be charged to customers that purchase dual-fibre dark fibre from BT.

whose price it may affect. Only CISBO circuits with a bandwidth above 1Gbit/s will face an incremental price reduction as a result of dark fibre, and these circuits represent a small proportion of the total supply of CISBO circuits and will continue to do so over the review period. Commercial dark fibre may also be impacted, though as we note later, volumes of this to end users are very low.

A20.59 The combination of dark fibre priced materially above BT's FAC and, the limited volumes of (CISBO and commercial dark fibre) circuits that would be affected by the dark fibre remedy means that the remedy's incremental impact will be limited compared to a package which just includes active remedies.

Our analysis of further evidence gathered

A20.60 Some OCPs have claimed that we have not sufficiently reviewed the evidence and more particularly, that we have failed to quantify the harm to, and have underestimated the impact that a dark fibre remedy may have on rival investment. We have therefore undertaken a further examination of the evidence including analysis of evidence gathered since the publication of the May 2015 BCMR Consultation.

A20.61 We recognise that a regulated dark fibre remedy is likely to have some impact on OCPs who provide competing services. In particular, dark fibre prices on a "1Gbit/s active minus" basis will constrain the prices of VHB services. In principle, these CPs' reduced VHB revenues would be offset by the benefit which lower VHB prices, based on use of regulated dark fibre, would bring to VHB users. However, a concern could arise to the extent that the reduced prices led to a reduction in efficient investment.

A20.62 In considering this evidence, we focus particularly on Virgin and CityFibre. This is because, these two operators (as noted in Section 3 (CityFibre) and Annex 16 (Virgin)) have announced significant infrastructure investment plans.[348] We note that these operators are continuing their investment plans following the announcement of our proposals in the May 2015 BCMR and June 2015 LLCC Consultations. In particular, we note that in December 2015, CityFibre acquired KCOM's national fibre and duct network assets for £90 million, and at the same time secured £180 million to facilitate this acquisition and to continue to commercialise its national network.[349]

A20.63 We now consider three sets of evidence on the impact of the dark fibre remedy on rival infrastructure operators:

i) The volumes likely to be impacted by the dark fibre remedy;

[348] We focus on new investment, as the costs of OCPs building duct and fibre networks are largely sunk and so existing infrastructure-based competition is unlikely to be harmed in any event. Moreover, we note that extensions of OCPs' infrastructure for business services tends to be in response to committed contracts which underwrite all or most of this investment.

[349] http://www.cityfibre.com/news/2015/12/14/cityfibre-acquires-kcoms-national-network-assets-for-90m-facilitated-by-180m-fundraising

ii) A comparison of our dark fibre remedy price with the prices of commercial dark fibre;

iii) Submissions from operators on the impact of the dark fibre remedy on their returns and revenue.

The volumes likely impacted by the dark fibre remedy

A20.64 The first set of evidence concerns the volumes of circuits that a dark fibre remedy would likely impact. The greater the volume of affected circuits, the greater the likely impact of dark fibre.

Circuits with bandwidths above 1Gbit/s as a proportion of all CISBO circuits

A20.65 Given our pricing approach, we consider that the dark fibre remedy would not affect the prices of CISBO circuits with bandwidths at or below 1Gbit/s. As explained in Annex 33, it would not be cost effective to use dark fibre to provide circuits with bandwidths below 1Gbit/s.[350] Stakeholders agreed that under our proposed approach for pricing dark fibre, it would not be economic to use dark fibre to supply circuits with bandwidths below 1Gbit/s. [351]

A20.66 Although we would anticipate that dark fibre would be used to supply new connections involving 1Gbit/s connectivity, we consider that dark fibre would not materially affect the prices of 1Gbit/s CISBO circuits. This is because using dark fibre to provide a 1Gbit/s product would result in the same (or broadly similar) price as BT's EAD 1Gbit/s product. Therefore, while the price of competitors' 1Gbit/s products will be constrained by the price of BT's EAD 1Gbit/s price we do not expect a material incremental price impact from the dark fibre remedy. We therefore do not consider this further below.

A20.67 Conversely, for above 1Gbit/s circuits prices supplied by rival infrastructure operators, we anticipate that the dark fibre remedy will replace BT's above 1Gbit/s active products as the main competitive constraint. In order for their products to remain competitive, rival operators might have to reduce their prices of above 1Gbit/s active circuits, possibly to the level of the dark fibre remedy price plus the costs of the active components used in providing these circuits.

A20.68 Table A20.1 shows the total volumes of above 1Gbit/s CISBO circuits (measured in customer ends), and the share of these circuits in the total supply of CISBO circuits. This shows that above 1Gbit/s CISBO circuits are provided in limited volumes (less than 5,000 customer ends in total), and only account for a small proportion of the total supply of CISBO circuits (3% in the LP, 2% in the RoUK).

[350] A possible exception is if it is profitable to aggregate multiple below 1Gbit/s circuits together. However, our analysis in Annex 33, suggests the potential for this is not material.
[351] In the absence of aggregation, which we discuss in Annex 33.

Table A20.1 The supply of above 1Gbit/s CISBO: (2014)

	London Periphery	Rest of UK
Above 1Gbit/s CISBO	410	4,468
Total CISBO	12,452	264,651
Above 1Gbit/s CISBO as a share of total CISBO	3%	2%

Note: volumes of CISBO are expressed in customer ends. [✂]
Source: Ofcom analysis using the active circuit dataset compiled by Ofcom on the basis of operators' responses dated March-May 2014 to question A1 of the 1st s135 notice.

A20.69 Although the share of above 1Gbit/s in the overall supply of CISBO is forecast to increase significantly, above 1Gbit/s circuits will remain a small minority of new CISBO circuits (and thus of the total supply of CISBO circuits). We also note that, as we explain in Section 4, that as above 1Gbit/s circuits are used more widely, we expect the distribution of shares in the supply of above 1Gbit/s CISBO circuits to converge towards that in the supply of CISBO circuits of lower bandwidths. This would mean that BT's share in the supply of above 1Gbit/s CISBO circuits is likely to increase relative to its current level.

A20.70 We used our forecasts of BT's rental volumes in the LLCC to forecast the growth of the above 1Gbit/s circuits as a share of BT's supply of CISBO circuits. Our forecasts indicate that BT's rental volumes of above 1Gbit/s circuits would more than double over the review period, and as a proportion of BT's overall supply of CISBO circuits will increase from 5.2% in 2015/16 to 9.6% in 2018/19.[352] This growth, though rapid is measured from a small base level, and above 1Gbit/s circuits will still account for less than 10% of supply in 2018/19.

<u>Share of above 1Gbit/s CISBO circuits in the supply of rival infrastructure operators</u>

A20.71 The limited volumes of above 1Gbit/s CISBO circuits, and the low proportions of these circuits in overall supply of CISBO circuits suggests that the dark fibre remedy would only materially reduce the profitability of a rival infrastructure operator's investment when an operator's investment relies heavily on the supply of above 1Gbit/s circuits (which can be provided using CISBO or dark fibre circuits). We therefore also consider the breakdown of the supply of CISBO circuits, by bandwidths, amongst rival infrastructure operators.

A20.72 Table A20.2 presents, by operator, volumes of above 1Gbit/s CISBO circuits (measured in customer ends), and the share of these circuits in an operator's total supply of CISBO circuits.

[352] [✂]

Table A20.2 The supply of above 1Gbit/s CISBO circuits: by rival infrastructure operator (2014)

	London Periphery		Rest of UK	
	Above 1Gbit/s CISBO circuits	Share of above 1Gbit/s in an operator's total supply of CISBO circuits	Above 1Gbit/s CISBO circuits	Share of above 1Gbit/s in an operator's total supply of CISBO circuits
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂
✂	✂	✂	✂	✂

Note: volumes reported are in customer ends. [✂].
Source: Ofcom analysis using the active circuit dataset compiled on the basis of CPs' responses dated March-May 2014 to question A1 of the 1st s135 notice.

A20.73 Table A20.2 shows that rival infrastructure operators supplied, in 2014, less than 3,000 above 1Gbit/s CISBO customer ends in the LP and RoUK combined.

A20.74 [✂] of this supply was accounted for by Virgin, yet, this represented only, [✂], of Virgin's total supply of CISBO customer ends. This suggests that for Virgin, the proportion of its supply of CISBO circuits whose price is likely to be directly impacted by the dark fibre remedy is low. Moreover, we note that the dark fibre remedy will be priced at a level that most likely will exceed BT's FAC[353]. Given these facts, even taking into account the growth in above 1Gbit/s, and a potentially greater impact on revenues, we consider it unlikely that the dark fibre remedy would by itself, lead to a substantial change in Virgin's investment incentives.

[353] Moreover, we note that Virgin's overall business is considerably greater than its supply of business connectivity alone, with provision of connectivity and services to residential customers being particularly important for Virgin. For example, increasing its coverage to residential customers forms a significant part of Project Lightning.

A20.75 The second and third largest operators, in terms of the supply of above 1Gbit/s, [✂] and [✂], support the dark fibre remedy, even though a material proportion of the active products they supply may potentially face an incremental price reduction due to a dark fibre remedy being introduced.

A20.76 Conversely, we acknowledge that the supply of CISBO customer ends by, [✂], and [✂] are particularly concentrated at above 1Gbit/s. However, we note that the volumes of customer ends supplied by these operators are limited [✂]. These operators are of relatively small sized and have targeted to date a small group of users with specialised needs. In Annex 5, we have explained that we consider that the existing niche operators will not be well placed to serve customers moving up the bandwidth scale – such as multi-site customers e.g. a retail bank – as they do not have the geographic network coverage required and thus would unlikely be geared to meeting the needs of these customers.

A20.77 We acknowledge that the proportionate impact may be greater on some smaller rival infrastructure operators who historically have targeted sales of VHB products. However, we note that the sales of these operators are small in terms of the number of circuits that the dark fibre remedy will have an impact on. Furthermore, the dark fibre product they would compete with is likely to be priced at a level above BT’s FAC. We consider that it would not be proportionate to not impose a dark fibre remedy only in order to protect a niche business opportunity. In doing so, we note that these operators supply limited circuit volumes and, in our view, are not well-placed to provide a competitive constraint to BT once VHB becomes more widely used.

Volumes of commercial dark fibre

A20.78 As regulated dark fibre may also impact existing suppliers of commercial dark fibre, we have also considered the impact that a dark fibre remedy may have on the supply of commercial dark fibre. We do this, even though, as we explain in Section 4, dark fibre does not form part of the CISBO market.

Table A20.3 The supply of dark fibre: by operator (2014)

	London Periphery	Rest of UK
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂
✂	✂	✂

Note: volumes of dark fibre are in customer ends.
Source: Ofcom analysis using the dark fibre circuit dataset that Ofcom compiled on the basis of CPs' responses dated March-May 2014 to question A4 of the 1st s135 notice dated 12 March 2014.

A20.79 This data shows that overall, the supply of dark fibre involves limited volumes (less than 4,000 customer ends in the LP and RoUK combined) and is small relative to the total supply of CISBO circuits (more than 270,000 customer ends in the LP and RoUK combined). The limited use of dark fibre and, in most cases, the very small volumes of customer ends involved, is consistent with our view in Section 4 that retail dark fibre is mainly purchased by niche customers with specialist needs.

A20.80 Regulated dark fibre, once introduced, will increase the choice available to users of commercial dark fibre, especially for services with bandwidths greater than 1Gbit/s, and this will increase competitive pressure on commercial providers of dark fibre. However, this increased commercial pressure may be mitigated by existing operators mainly supplying to specialised users with bespoke needs. A specialised, nimble supplier may be better placed to meet the requirements of such users relative to a CP that uses a high-volume regulated product (i.e. the dark fibre remedy).

A20.81 We acknowledge that not all dark fibre circuits are used for such specialised customers. [✂][354]

A20.82 [✂]

[354] [✂]

A20.83 [✂][355] [✂][356] [✂]

A20.84 In summary, we consider that the impact of a dark fibre remedy on existing dark fibre operators is likely to vary. It seems reasonable to anticipate that a dark fibre remedy would, to some extent, compete with the existing dark fibre products offered by existing operators and so may impact these operators, in particular where dark fibre is used to provide above 1Gbit/s bandwidth.[357] [✂] We return to this aspect when we compare the dark fibre remedy price with the commercial dark fibre prices in the next subsection.

Conclusions on the volumes likely impacted by a dark fibre remedy

A20.85 In summary, we consider that the dark fibre remedy would impact only on limited volumes:

- Our pricing approach means that only CISBO circuits with bandwidths above 1Gbit/s are likely to face a material incremental price reduction as a result of a dark fibre remedy being introduced, and these circuits are limited, both in volumes and as a proportion of the total supply of CISBO circuits.

- Similarly, the volumes of commercial dark fibre that could be affected are low. We would expect the dark fibre remedy to impact on the prices of dark fibre supplied by operators providing dark fibre to a niche of users with bandwidth requirements of 1Gbit/s and above. [✂]

Comparison of the dark fibre remedy price relative to commercial dark fibre prices

A20.86 The second set of evidence that we consider involves a comparison of the dark fibre remedy price relative to commercial dark fibre prices. IIG members have claimed that the dark fibre remedy, at the time of its launch in 2017/18, would be priced at a level substantially below the prices of commercial dark fibre.

A20.87 We explain in Section 4 that use of dark fibre is currently very limited, with dark fibre commonly taken up by a niche of (specialist) users ([✂]). This partly reflects that many end-users may not be able to use dark fibre, but also that BT does not supply dark fibre to end-users.

A20.88 Although we have not analysed the competitiveness of the supply of dark fibre to end-users, it may be expected that a regulated access product, intended to be used at scale, has a lower price than a niche product which is supplied in small volumes to a group of (mainly) specialist users.

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[355] [✂]

[356] We undertook this analysis based on the responses of CPs dated March-May 2014 to the 1st s135 information request. Information provided concerned CPs' supply of active products in early 2014.

[357] In Section 4, Figure 4.5, we present the connectivity rates of dark fibre circuits based on a sample of dark fibre users. It indicates that dark fibre is mainly used to provide 1Gbit/s and above connectivity, not for below 1Gbit/s connectivity. [✂]

A20.89 While we consider that our pricing approach is consistent with supporting efficient rival investment and while the niche nature of much of the existing dark fibre demand may limit its relevance, we have compared the dark fibre remedy price with the prices of commercial dark fibre. We have done so by comparing prices in 2015 terms, thus assuming that the dark fibre remedy would have been available in 2015, and priced in accordance with our pricing rule.

A20.90 We first set out our general methodology for comparison, before presenting the comparison for CityFibre, and then for other rival infrastructure operators that provide dark fibre (including Zayo, Interroute, Surf, Colt and EU Networks).

Methodology for comparison

A20.91 The aim of our price comparison is to consider the likely incremental impact of our dark fibre remedy on commercial dark fibre prices. We consider that this impact should exclude the impact of the LLCC. This is for two reasons. Firstly, in introducing the dark fibre remedy, we consider the merits of a package of remedies including both active remedies and a dark fibre remedy compared with a package of remedies containing only active remedies. Secondly, we consider it reasonable for the LLCC to have some impact on commercial dark fibre prices.

A20.92 Our decision requires BT to make the dark fibre remedy available from 1 October 2017, during the second year of the charge control. Our charge control, including start charge adjustments, requires Openreach to reduce its prices for Ethernet services of bandwidths up to and including 1Gbit/s services by approximately 30% on average by that point. These reductions are large, and may have some impact on commercial dark fibre prices.

A20.93 [✂][358], [✂][359]and [✂][360] [✂][361] [✂]

A20.94 [✂]

A20.95 [✂]

A20.96 [✂]

A20.97 [✂]

A20.98 We present our comparison of dark fibre prices separately for CityFibre, and for other rival infrastructure operators that currently supply dark fibre on commercial terms.

CityFibre

A20.99 CityFibre claimed that [✂[362]]

358 [✂]
359 [✂]
360 [✂]
361 [✂]
362 [✂]

A20.100 [✂]:

- [✂];
- [✂];
- [✂]

A20.101 [✂[363][364]].

A20.102 [✂]

Table A20.4 Comparison of CityFibre and dark fibre remedy prices (2015)

	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]

Source: [✂]

A20.103 [✂]

A20.104 [✂[365][366]]

Other rival infrastructure operators

A20.105 [✂[367][368]]

A20.106 [✂]

A20.107 [✂[369]]

A20.108 [✂]

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363 [✂]
364 Main Link charges are included to determine the price of the dark fibre remedy in non-LA, but not in LA variant.
365 [✂]
366 [✂]
367 [✂]
368 [✂]
369 We determined the weighted average dark fibre remedy price as a weighted average of the prices of the dark fibre remedy in non-LA and LA variants, using BT's EAD-EAD LA split at the 1Gbit/s level as weights.

Table A20.5 Comparison of the prices of dark fibre remedy and other operators' dark fibre

[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]
[✂]	[✂]	[✂]	[✂]	[✂]

Note: [✂]
Source: [✂]

A20.109 [✂]

Conclusions on the comparison of a dark fibre remedy price with commercial dark fibre prices

A20.110 Our comparison of the implied 2015 price for the dark fibre remedy with the 2015 prices of dark fibre supplied by rival infrastructure operators reveals that the remedy would be priced at a level [✂] However, although we find that the dark fibre remedy price would have been below the price of dark fibre supplied by rival infrastructure operators, the differentials we find (which can be significant) are often lower than claimed by IIG members.

A20.111 We note that a lower price for a regulated dark fibre remedy would not be unexpected, given the currently limited supply and usage of retail dark fibre, and with the exception of [✂]

A20.112 Our comparisons of dark fibre prices do not lead us to change our view that the impact of the dark fibre remedy on rival infrastructure operators will not be significant. The limited volumes that would be affected (above 1Gbit/s CISBO and dark fibre circuits only), and the small share of these circuits relative to the total supply of CISBO and dark fibre circuits, points to a dark fibre remedy unlikely having a material adverse impact on overall efficient rival investment, [✂] We also note that the dark fibre remedy price would continue to materially exceed BT's FAC and that the nature of the supply of much existing dark fibre may allow for operators to retain opportunities for specialist supply.

Submissions on the impact of the dark fibre remedy

A20.113 The third set of evidence we consider relates to submissions we received on the impact of the dark fibre remedy on individual rival infrastructure operators.

A20.114 [✂]

A20.115 [✂]

A20.116 [✂][370]

Virgin

A20.117 [✂]

A20.118 [✂[371]]

- [✂]
- [✂]

A20.119 [✂[372]]

CityFibre

A20.120 [✂][373]

A20.121 [✂]

A20.122 [✂][374]

A20.123 [✂]

A20.124 [✂]

A20.125 [✂][375]

A20.126 [✂]

- [✂]
- [✂]
- [✂[376]]
- [✂]

A20.127 In summary, for the reasons set out earlier, we consider that our pricing approach does not deter efficient investment, and our review of the evidence has not led us to change that view.

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370 [✂]
371 [✂]
372 [✂]
373 [✂]
374 [✂]
375 [✂]
376 [✂]

Annex 21

Approach to pricing dark fibre

Introduction

A21.1 The pricing of BT's dark fibre relative to its regulated active products is likely to be a key driver of how and where dark fibre is used, and of its impact on competition, on rival operators, and on access-seeking Other Communications Providers (OCPs). For this reason, our assessment of the relative performance of differing pricing approaches informs our assessment as to whether and how to introduce this dark fibre remedy.

A21.2 This annex presents our assessment of different approaches that can be used to set the dark fibre price, building on our assessment of the benefits and impacts of a dark fibre remedy (as outlined in Annexes 18 to 20).

A21.3 We have decided that dark fibre should be priced on an active-minus basis using a 'single active reference product' approach, with Ethernet Access Direct (EAD) 1Gbit/s as the reference product. We consider that this pricing approach provides the best balance between maximising the benefits of dark fibre and mitigating any risks associated with it. Determining the dark fibre price would involve subtracting the active incremental cost from the price of the relevant benchmark product. Annex 23 provides our guidance as to how the active incremental cost (i.e. the 'minus') should be estimated.

A21.4 This annex is structured as follows:

- We provide a summary of our analysis and proposed approach to pricing dark fibre from the May 2015 BCMR Consultation.[377]

- We summarise relevant responses from stakeholders on this issue.

- We present our final assessment of the different approaches that can be used to set the dark fibre price. In doing so, we take account of stakeholders' responses, further evidence collected and analysis undertaken following the May 2015 BCMR Consultation.

    - We discuss pricing approaches that do not use a charge control to set the dark fibre price (including: no specific pricing obligation; pricing on fair, reasonable and non-discriminatory terms; and benchmarking with regard to prices of commercial dark fibre supplied in the Central London Area (CLA)). We explain that we do not regard these approaches as appropriate as they would not sufficiently restrict BT in its pricing of dark fibre.

[377] Ofcom, *Business Connectivity Market Review - Annexes: Review of competition in the provision of leased lines, Consultation, Annex 26*, 15 May 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/bcmr-2015/annexes/BCMR_Annexes_Non_Confidential.pdf

  - We discuss approaches for setting a dark fibre price based on a charge control. First, we explain why we consider that a charge control should be based on BT's costs. Then we discuss the various pricing approaches available when using a charge control, identifying three pricing approaches that we consider in further detail:
    - a 'cost-based' approach;
    - a 'single active reference product' approach, with EAD 1Gbit/s as the reference product (variant of active-minus approach); and
    - a 'single active reference product' approach, with EAD 10Gbit/s as the reference product (another variant of active-minus approach).
  - We assess each of the selected pricing approaches with regard to four criteria: economic efficiency (including allocative, productive and dynamic efficiency), compatibility, risk of gaming and ease of implementation.
- We explain our final decision to set the dark fibre price using a 'single active reference product' approach, with EAD 1Gbit/s as the reference product. In reaching this decision we place particular weight on mitigating the adverse impact on rival investment and on the allocative efficiency benefits of having a bandwidth gradient in BT's pricing of active products.

Summary of our proposed approach to pricing dark fibre in the May 2015 BCMR Consultation

<u>'Single active reference product' identified as preferred pricing approach</u>

A21.5 In the May 2015 BCMR Consultation we considered several different approaches to pricing a passive access remedy. We proposed that a charge control would be a more appropriate approach for pricing passive access relative to approaches that would give BT greater discretion in setting its prices, such as no specific pricing obligation, or a requirement to set pricing on fair, reasonable and non-discriminatory terms.

A21.6 We identified 'cost-based' and 'active-minus' approaches as the two main approaches for pricing dark fibre using a charge control. Broadly speaking, a 'cost-based' approach sets the price based on the underlying costs that BT incurs in providing the dark fibre. An 'active-minus' approach sets the dark fibre price with reference to the price of BT's active products minus the incremental costs associated with providing the active components.

A21.7 We identified three ways of implementing an 'active-minus' approach:

- **Each product individually**: Under this approach the dark fibre price would depend on, and vary according to, the specific downstream service provided by the OCP that consumes the dark fibre. We did not regard this approach as practical as it would require BT monitoring the downstream sales of the OCP to ensure that the correct price was charged. Furthermore, access-seeking OCPs would have to offer products that can be readily identified as being similar to BT's active products.

- **Active basket**: Under this approach the dark fibre price would be set with reference to the average price of a basket of BT's active products. This approach would result in a single dark fibre price which would apply irrespective of the downstream service it was used to provide.

- **Single active reference product**: Under this approach the dark fibre price would be set with reference to a single active product. Again, the price would apply irrespective of the downstream service it was used to provide.

A21.8 Using a qualitative assessment, we assessed three pricing approaches in further detail:

i) the 'cost-based' approach;

ii) the 'active-basket' approach (variant of 'active-minus');

iii) 'single active reference product' approach (another 'active-minus' variant).

A21.9 We explained that when using a 'single active reference product' approach, we would select a reference product that makes an above average contribution to BT's common costs. This was because this would support a higher dark fibre price that could help to mitigate the potential adverse impacts from introducing a dark fibre remedy.

A21.10 We explained that of the three pricing approaches, a 'cost-based' approach would likely give rise to the lowest dark fibre price, while a 'single active reference product' with a reference product that makes an above average contribution to BT's recovery of its common costs would give rise to the highest dark fibre price.

A21.11 We also explained that:

- Since a 'cost-based' approach would result in a lower dark fibre price, we would expect more widespread take-up and therefore greater benefits arising from the introduction of dark fibre.

- Since a 'single active reference product' approach would result in a higher dark fibre price, this would limit take-up of dark fibre but at the same time help to mitigate the potential adverse impacts of dark fibre.

A21.12 We assessed the three selected approaches against four criteria:

i) economic efficiency (including productive, allocative and dynamic efficiency);

ii) compatibility;

iii) risk of gaming; and

iv) ease of implementation.

A21.13 Table A21.1 provides a summary of our assessment of the selected pricing approaches in the May 2015 BCMR Consultation.

Table A21.1 Assessment of pricing approaches in the May 2015 BCMR Consultation[378]

Pricing approach	Economic efficiency				Active compatibility	Risk of gaming	Ease of implementation
	Allocative efficiency	Productive efficiency	Dynamic efficiency				
			Active layer	Passive layer			
Cost-based	○	●	●	○	○	●	◑
Active-minus approaches							
Active basket	◔	●	●	○	○	●	●
Single active reference product	◑	◑	◑	◑	◑	◑	●

Source: Ofcom analysis as presented in the May 2015 BCMR Consultation published, page 637.

A21.14 We considered that the 'cost-based' and 'active basket' approaches perform in a similar way – well in terms of productive efficiency and dynamic efficiency in the active layer, but poorly in terms of dynamic efficiency in the passive layer and allocative efficiency. We considered that the 'single active reference product' approach had fewer benefits in terms of productive efficiency and dynamic efficiency in the active layer, but reduced the risks of adverse impact on allocative efficiency and dynamic efficiency in passive infrastructure.

A21.15 We considered that a 'single active reference product' approach with a reference product making an above average contribution to common costs was likely to provide the best balance between the benefits and risks of a dark fibre remedy. In particular, we considered that this approach would mitigate the adverse impact on allocative efficiency and on dynamic efficiency in the passive layer by better preserving the existing bandwidth gradient. At the same time, we recognised that this approach would reduce the benefits that dark fibre could deliver relative to an approach that would result in a lower dark fibre price.

<u>EAD 1Gbit/s proposed as the reference product</u>

A21.16 We proposed to use EAD 1Gbit/s as the reference product. This was because BT's EAD product is an existing active product and represents a high (and increasing)

[378] We used a qualitative ranking system where approaches that perform relatively poorly compared to other approaches are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

proportion of BT's active products. Furthermore, the 1Gbit/s bandwidth was proposed since EAD 1Gbit/s makes a higher than average contribution to BT's common costs relative to other EAD products. This would support the preservation of the bandwidth gradient to a greater extent than choosing a lower bandwidth product as reference product. Accordingly, we considered that this would mitigate the potential adverse impacts on allocative efficiency and dynamic efficiency in the passive layer.[379]

BT to offer dark fibre products that correspond to variants of its EAD 1Gbit/s products

A21.17 We proposed that as long as BT retains its current EAD structure (i.e. with EAD and EAD Local Access (EAD LA) variants) it would be required to offer its dark fibre in variants equivalent to the EAD and EAD LA variants, with each variant priced on an active-minus basis. We explained that dark fibre priced with reference to the EAD variant would not, generally speaking, be economic for 'LA' applications, while dark fibre priced with reference to the EAD LA variant would give rise to an arbitrage opportunity if it could be used to replace EAD products. Annex 22 discusses our considerations and decisions relating to the design of the dark fibre remedy.[380]

A21.18 In summary:

- we proposed that BT should price dark fibre on an active-minus basis using a 'single active reference product' approach;
- we proposed using BT's EAD 1Gbit/s product as the reference product; and
- we specified that BT would to have to offer its dark fibre in variants matching its EAD product offering.

Stakeholder responses to our proposals for pricing dark fibre

A21.19 We summarise stakeholders' responses by grouping them into four categories.

- PAG (Passives Action Group) members[381] argued that dark fibre should be priced using a 'cost-based' approach as this would allow dark fibre to deliver greater benefits.
- BT argued that Ofcom ought to consider the risks of its approach to setting the price of dark fibre on BT, users of BT's network, and rival operators more closely.
- IIG (Infrastructure Investors Group) members[382] were concerned that the proposed dark fibre price would harm their investment in passive infrastructure through its impact on prices, revenue and returns.

[379] We explained that we did not regard EAD 10Gbit/s – which BT was planning to launch at the time of our Consultation– as a suitable reference product as it would not be likely to support material take-up of dark fibre, therefore offering little net benefit.
[380] Annex 22 discusses our considerations and decisions as regard the design of the dark fibre remedy.
[381] Its members comprise of Vodafone, Colt, Three, Sky, H3G and TalkTalk.

- Other stakeholders (including Hyperoptic, GTC and [✂]), while generally supportive of our dark fibre proposals, asked Ofcom to consider the impact of (asymmetric) cumulo rates, or argued that the dark fibre remedy as proposed would not be appropriate to support the supply of fibre to residential estates.

PAG members

A21.20 PAG submitted a report prepared by Frontier Economics on its behalf (the Frontier report) about our proposed approach to pricing dark fibre. The Frontier report argued that:[383]

- use of the proposed dark fibre remedy would be economically viable only for a small part of the supply of business connectivity services (i.e. above 1Gbit/s). It would not be viable below 1Gbit/s and it was uncertain whether it would be viable at 1Gbit/s. This would limit the benefits that a dark fibre remedy would deliver;

- the dark fibre price would not be predictable (and the calculation of the 'minus' in particular) and this would reduce take-up and deter investment; and

- Ofcom had unjustifiably argued that there are benefits in allowing BT to maintain its current active pricing structure (i.e. the bandwidth gradient).

A21.21 The Frontier report compared 'active-minus' and 'cost-based' pricing approaches using the same framework that Ofcom had relied on. It concluded that a well-designed 'cost-based' approach would be superior overall to the proposed 'active-minus' approach, particularly in terms of economic efficiency and the ease of implementation. It observed that Ofcom appeared to favour an 'active-minus' approach over a 'cost-based' approach on the grounds of an 'active-minus' approach allowing BT to partially maintain the existing bandwidth gradient.

A21.22 The Frontier report disagreed that an 'active-minus' approach would perform materially better than a 'cost-based' approach in terms of allocative efficiency. It considered that the potential benefits of an 'active-minus' approach would likely be minimal as:

- BT would have no incentive to set efficient prices under Ofcom's proposals and would have little ability to set such prices even if it were to have such an incentive;

- the likely allocative efficiency gains would be small even if wholesale Ethernet prices were set according to Ramsey pricing principles (which they are not); and

- Ofcom does not present evidence that BT's current active pricing is allocatively efficient.

A21.23 The Frontier report broadly agreed with Ofcom's assessment and scoring of productive efficiency and dynamic efficiency in the active layer.[384] It considered that

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[382] Its members comprise of Virgin, CityFibre, Zayo and EU Networks.
[383] Frontier report, page 3.
[384] Frontier report, page 34-36.

Ofcom potentially overestimated the performance of the 'active-minus' approach in assuming that dark fibre would be used for providing 1Gbit/s connectivity, and potentially underestimated the benefits that increased certainty would have in stimulating take-up and innovation under a 'cost-based' approach.

A21.24 The Frontier report considered that a 'cost-based' approach deserved a higher score on dynamic efficiency in the passive layer as:[385]

- Ofcom's lower score appeared to be based on the consideration that a 'cost-based' approach would lead to stranded assets for OCPs;

- future investment in rival infrastructure would not be lower under a 'cost-based' approach. Frontier argued that investment would be driven by density of demand rather than by the current pricing structure, and rebalancing of active prices should not significantly affect future returns as it would be revenue-neutral; and

- a 'cost-based' approach would be more predictable and thereby incentivise efficient investment in rival infrastructure.

A21.25 In relation to the ease of implementation and the risk of gaming, the Frontier report:

- agreed that the risk of gaming would be greater with an 'active-minus' approach as BT would have a greater opportunity to distort prices in an anti-competitive way;

- considered that Ofcom attached too low a score to the ease of implementation under a 'cost-based' approach. Implementation would be straightforward when using a top-down approach as Ofcom could rely on the same model and data as used for the charge control of BT's active products; and

- argued that setting the prices of both regulated active and dark fibre using charge controls based on BT's costs would in the medium term result in prices of regulated products being more consistent.

A21.26 Based on its assessment of both the 'active-minus' and 'cost-based' approach to pricing dark fibre, the Frontier report concluded that an 'active-minus' approach would only perform better if a very high weight were given to allocative efficiency where this approach performs marginally better than a cost-based approach. It considered that such weighting would be inconsistent with weights that Ofcom placed on types of efficiency in the June 2015 LLCC Consultation.[386,387]

[385] Frontier report, page 38.
[386] Ofcom, Business Connectivity Market Review: Leased lines charge controls and dark fibre pricing, Consultation, 12 June 2015, http://stakeholders.ofcom.org.uk/binaries/consultations/llcc-dark-fibre/summary/llcc-dark-fibre.pdf
[387] Frontier report, page 43.

A21.27 PAG, in a joint submission, argued that Ofcom's assessment of the pricing approaches against the criteria of its framework was flawed, and that as proposed the dark fibre remedy would fail to achieve its objectives.[388]

A21.28 PAG argued that there is a risk that an 'active-minus' pricing approach would create a margin squeeze, either in a market for sub-1Gbit/s services or in a sub-1Gbit/s segment of a wider market. PAG considered it unlikely that a viable competitor would be able to compete purely on the basis of supplying high-bandwidth services, as customers will typically require services across a range of bandwidths. Supplying such a portfolio would require investment in both dark fibre and active products, and an active-minus approach would deny CPs the same economies of scale as BT.[389]

A21.29 PAG also raised concerns with the extent to which the proposed pricing rule is consistent with Ofcom's statutory duties and objectives applying under the Common Regulatory Framework (CRF). In particular, it argued that while the margin squeeze concerns suggest that Ofcom's proposed rule will not enable competition, an SMP condition must meet a higher objective because unlike competition law (which in the margin squeeze context is narrowly concerned to avoid an abuse of dominance – that is, to enable competition), Ofcom has a broader duty to actually promote competition. Therefore, PAG argued to enable and actively promote competition, Ofcom should move away from a proposed rule that only allows CPs to efficiently deploy dark fibre in a small proportion of the market, and to instead adopt pricing that enables CPs to enjoy the same economies of scale enjoyed by BT.[390]

A21.30 PAG members commented on the pricing proposals in their individual submissions:

- TalkTalk argued that Ofcom had incorrectly concluded that pricing dark fibre on an 'active-minus' basis would be preferable over cost-based pricing.[391] It argued that cost-based pricing would actually deliver more benefits (through greater take-up) and would prevent inefficient investment in rival infrastructure. It considered that Ofcom had unjustifiably placed considerable weight on preservation of the bandwidth gradient contributing to allocative efficiency.

- Sky explained that pricing dark fibre on an 'active-minus' basis, while not performing better in terms of efficiency, would significantly restrict the benefits that would be delivered under a 'cost-based' approach. There would be lower take-up of dark fibre and there would be less scope for OCPs using dark fibre to benefit from economies of scale and scope.[392] Sky claimed that there was no evidence that maintaining the bandwidth gradient is efficient and argued that incentives to invest in active products and passive infrastructure, contrary to what Ofcom concluded, are not worse under 'cost-based' pricing.[393]

- Vodafone identified cost orientation as the most appropriate pricing structure, noting that limiting the number of circuits for which dark fibre could be viably

[388] PAG response to the May 2015 BCMR Consultation, page 6.
[389] PAG response to the May 2015 BCMR Consultation, page 16.
[390] PAG response to the May 2015 BCMR Consultation, page 16.
[391] TalkTalk response to the May 2015 BCMR Consultation, page 1-2.
[392] Sky response to the May 2015 BCMR Consultation, page 2.
[393] Sky response to the May 2015 BCMR Consultation, page 12.

consumed would reduce benefits to consumers and would decrease the extent to which OCPs could benefit from economies of scale when consuming dark fibre.[394] Vodafone referred to the risk of margin squeeze where OCPs seek to use dark fibre to provide connectivity below 1Gbit/s.[395]

- Colt argued that Ofcom was overly cautious in its pricing proposals.[396] It considered that the proposed dark fibre price was too high and would remove the benefits that dark fibre could deliver by restricting its use to higher bandwidths. It also indicated that BT might have the ability and incentives to implement Ofcom's proposals in a way (through pricing and cost allocation) that would distort competition.

<u>BT</u>

A21.31 BT opposed the proposed approach to setting the dark fibre price. It argued that Ofcom overestimated the extent to which the proposed pricing would mitigate the risks of dark fibre, and had not given sufficient consideration to pricing approaches that would support a higher dark fibre price, such as using EAD 10Gbit/s as the reference product.[397] BT had significant concerns over the sustainability and certainty that the proposed approach to setting the dark fibre price would provide.[398]

A21.32 BT argued that if Ofcom is to mandate BT to offer dark fibre, then the regulated price should be higher in order to reduce the risks associated with its introduction, including the adverse impact on investment, the removal of the bandwidth gradient, and the risk of under-recovery of costs and stranded assets on the part of Openreach. [399]

A21.33 BT explained that the proposed price of dark fibre would cap the price that can be achieved by rival infrastructure operators, thereby inhibiting new investment.[400] It claimed that the proposed dark fibre price would be considerably lower than the prices of dark fibre sold on commercial terms.

A21.34 BT argued that the proposed dark fibre price would result in the removal of the bandwidth gradient at 1Gbit/s and above, forcing BT to rebalance prices of lower bandwidth products in order to maintain cost recovery. It explained that price rebalancing could result in a removal of the bandwidth gradient over time, with customers purchasing either EAD 1Gbit/s or dark fibre. In turn, this would force BT to review its support for offering a broad set of product variants (across bandwidths), potentially resulting in reduced availability of options for customers, and Openreach having reduced incentives to develop new variants.[401] BT also

[394] Vodafone response to the May 2015 BCMR Consultation, page 35.
[395] Vodafone response to the May 2015 BCMR Consultation, page 36.
[396] Colt response to the May 2015 BCMR Consultation, page 2.
[397] BT response to the May 2015 BCMR Consultation, Part A, page 23.
[398] BT response to the May 2015 BCMR Consultation, Part A, page 26-27.
[399] BT response to the May 2015 BCMR Consultation, Part A, page 27-28.
[400] BT response to the May 2015 BCMR Consultation, Part A, page 23.
[401] BT response to the May 2015 BCMR Consultation, Part A, page 24.

argued that the proposed dark fibre price would reduce Openreach's incentives to invest as more individual routes would become less commercially viable.[402]

A21.35 BT considered that take-up of dark fibre would be significant under the proposed pricing, and that Ofcom had underestimated the impact of volumes migrating from its active products to dark fibre.[403] We discuss BT's arguments and analysis on cannibalisation and migration in Annex 33.

A21.36 BT argued that the proposed dark fibre price would create a significant risk of stranded assets for BT, estimated at £58m over the review period, relating to network equipment used in providing above 1Gbit/s active products.[404] We discuss BT's arguments and analysis of stranded assets in Annex 33.

A21.37 BT also raised concerns in relation to Ofcom's proposal to set the dark fibre price with reference to BT's EAD 1Gbit/s product. It considered that:

- the proposed reference product would generate price arbitrage opportunities, undermining cost recovery and increasing the need for price rebalancing;
- there would be complexity of having multiple dark fibre prices for the same connectivity service; and
- the proposed 'each and every' charge obligation would be disproportionate.[405]

Infrastructure Investors Group (IIG)

A21.38 IIG, in a joint submission, objected to the proposed approach to pricing dark fibre.[406] It considered that the proposed dark fibre price would foreclose the market since BT would be required to offer dark fibre at a price that is likely to be below the cost of dark fibre provided by a reasonably efficient operator. IIG argued that pricing dark fibre in this manner could breach competition law.

A21.39 IIG argued that Ofcom, if it were to go ahead with introducing a dark fibre remedy, ought to consider three alternative pricing approaches:[407]

i) **Single active reference product approach with EAD 10Gbit/s as the reference product –** IIG argued that Ofcom had not given sufficient consideration to 'active-minus' pricing with EAD 10Gbit/s as the reference product. It considered that this would be a more defensible approach, allowing for more orderly transition, reducing risks (including impact on rival investment), and providing more flexibility for future pricing adjustments.

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[402] BT response to the May 2015 BCMR Consultation, Part A, page 26.
[403] BT response to the May 2015 BCMR Consultation, Part A, page 25.
[404] BT response to the May 2015 BCMR Consultation, Part A, page 26.
[405] We consider the 'each and every' charge obligation further in Annex 23. This obligation requires that 'each and every charge' of a dark fibre access product is reasonably derived from the charge for the corresponding active products for ancillary services.
[406] IIG response to the May 2015 BCMR Consultation, page 15-17.
[407] IIG response to the May 2015 BCMR Consultation, page 29-33.

ii) **Based on the costs of a reasonably efficient operator (REO) –** IIG considered that using BT's costs as the relevant base for cost-based pricing would not be consistent with Ofcom's objective of promoting competition. It argued that Ofcom should consider a cost-based pricing approach based on the costs of a REO, modelled bottom-up as a new entrant or a Modified Equally Efficient Operator (MEEO). It considered that setting prices based on the costs of other operators, while initially resulting in prices above BT costs, would provide BT's rivals with better incentives to invest in infrastructure.

iii) **Benchmarking with regard to the prices of commercial dark fibre supplied in the CLA –** IIG said that under section 88(4)(a) of the Communications Act 2003, Ofcom is invited to take account of the price at which services are available in comparable competitive markets and that Ofcom had not done that.[408] As advantages of this pricing approach, IIG identified tracking market dynamics, not being sensitive to future changes in the methodology used in pricing under an 'active-minus' approach, and the decoupling of the prices of dark fibre and regulated active products in a way that would support more efficient take-up of dark fibre.

A21.40 The submissions of individual IIG members largely echoed the views and arguments presented in the joint IIG submission.

A21.41 Virgin considered the proposed pricing approach for dark fibre was inadequate in mitigating the risks posed by dark fibre, noting that:

- the selected reference product (i.e. EAD 1Gbit/s) did not reflect expected and current use to which dark fibre will be put;
- the market for high bandwidth active services would be devalued, undermining existing and future investment in rival infrastructure; and
- the price of regulated dark fibre would be set below the current commercial price.[409]

A21.42 Virgin considered that Ofcom had not or only partially examined alternative pricing approaches.[410] It considered that:

- benchmarking to commercial dark fibre prices would be possible, with commercial dark fibre prices providing a proxy for efficient cost (including a return on investment);
- Ofcom had dismissed the 'fair and reasonable' pricing option too easily, failing to recognise the benefits of a 'light touch' approach; and
- choosing a reference product with a higher bandwidth (e.g. EAD 10Gbit/s) would substantially reduce risks to rival investment.

[408] IIG response to the May 2015 BCMR Consultation, page 16.
[409] Virgin response to the May 2015 BCMR Consultation, page 3.
[410] Virgin response to the May 2015 BCMR Consultation, page 9-10.

A21.43 Virgin argued that Ofcom should reconsider the option of pricing dark fibre based on fair, reasonable and non-discriminatory pricing obligations.[411] It emphasised the merits of a lighter-touch approach in light of emerging competition for the supply of higher bandwidth CISBO products.[412]

A21.44 CityFibre discussed the merits of the three pricing options identified in the joint IIG submission and said the following:

- It explained the benefits of setting the dark fibre price based on the costs of an entrant or a MEEO.
- It argued there would be considerable benefits from investment in rival infrastructure if EAD 10Gbit/s were chosen as the reference product; and
- It reiterated the possibility and advantages of benchmarking the dark fibre price with reference to prices of dark fibre supplied commercially in the CLA.

A21.45 EU Networks claimed that [✂[413]]

A21.46 Zayo considered that [✂]:

- [✂]
- [✂]

Other stakeholders

A21.47 A number of other stakeholders commented on the proposed pricing approach:

- [✂[414][415]]
- Hyperoptic[416] and Six Degrees Group[417] considered ‘active-minus’ to be a sensible approach for setting the dark fibre price. Both OCPs shared the concern that the current application of non-domestic rates to fibre would make the use of dark fibre impractical and/or would favour BT.
- GTC[418] did not regard ‘active-minus’ as an appropriate pricing approach as this approach failed to reflect the way in which BT charges its own downstream

[411] Virgin’s response to the May 2015 BCMR Consultation, page 11-12.
[412] Virgin’s response to the May 2015 BCMR Consultation, page 39-40.
[413] [✂]
[414] [✂]
[415] We considered treatment of cumulo rates in Annex 6 of the June 2015 LLCC Consultation. We explained that we regarded cumulo rates as an active incremental cost, that cumulo costs can be calculated as a proportion of non-pay operating costs in 2013/14, and that the 2018/19 cumulo costs can then be established, for each reference product separately, by multiplying this proportion with the 2018/19 non-pay operating costs.
[416] Hyperoptic response to the May 2015 BCMR Consultation, page 12.
[417] Six Degrees Group response to the May 2015 BCMR Consultation, page 8.
[418] GTC response to the May 2015 BCMR Consultation, page 2-3.

business. GTC suggested that setting a "specialist tariff" for use by fibre-to-the-new-home (FTTNH) operators would provide great benefits.[419]

- UKB Networks[420] noted its preference of 'cost-based' over 'active-minus' pricing, as 'cost-based' pricing would better reflect the remedy's infrastructure nature.

Assessment of pricing approaches

A21.48 In light of stakeholder responses to the May 2015 BCMR Consultation, we have reviewed the following approaches for setting the dark fibre price:

- Pricing approaches that do not use a charge control:
  - imposing no specific pricing obligation;
  - requiring that pricing be set on fair, reasonable and non-discriminatory terms; and
  - benchmarking with reference to prices of commercial dark fibre supplied in the Central London Area (CLA).
- Pricing approaches that use a charge control:
  - 'cost-based' approach; and
  - 'active-minus' approach (with variants including: 'active basket' and 'single active reference product').

A21.49 Our assessment is based on evidence reviewed and analysis undertaken prior to and following the May 2015 BCMR Consultation, and takes account of stakeholder responses. The approach we follow takes the framework for consideration of remedies, set out in Section 7 of this statement, into account. Where appropriate, we have also set out our responses to specific points raised by stakeholders in their responses to the May 2015 BCMR Consultation.

A21.50 In assessing pricing approaches, we are mindful of the objectives that we have in introducing a dark fibre remedy. When setting the dark fibre price, we aim to achieve a balance between maximising the benefits that dark fibre can deliver – recognising that more widespread take-up of dark fibre is likely to allow greater benefits to be delivered – and limiting the adverse impacts that dark fibre might have. We discuss the benefits of dark fibre at Annex 18, and the adverse impacts that dark fibre might have on BT and users of BT's network, and on rival (infrastructure) investment at Annexes 19 and 20 respectively.

[419] We understand this "specialist tariff" to mean a specific price for the use of dark fibre by fibre-to-the-new-home operators.
[420] UKB Networks response to the May 2015 BCMR Consultation, page 4-5.

Pricing approaches that do not use a charge control

A21.51 We have considered three approaches that do not use a charge control to set the dark fibre price:

i) imposing no specific pricing obligation;

ii) requiring that pricing be set on fair, reasonable and non-discriminatory terms; and

iii) benchmarking with reference to prices of commercial dark fibre supplied in the CLA.

A21.52 We do not regard these approaches as appropriate for setting the dark fibre price as they are unlikely to support widespread take-up of dark fibre and would not provide incentives for efficient investment. We explain our thinking on each approach below.

(i) <u>Imposing no specific pricing obligation</u>

A21.53 Under this approach, BT would be required to provide dark fibre, but there would be no ex ante obligation imposed on BT in relation to how it should be priced.

A21.54 We consider that BT is likely to have an incentive to price dark fibre in a way that would discourage its take-up and the absence of a specific pricing obligation would allow BT to price freely and in a manner that could discourage take-up. Specifically, BT could set the dark fibre price at such a high level that dark fibre is not used, even where it could bring significant benefits. Accordingly, this approach would not align with our objective of introducing a dark fibre remedy that supports widespread take-up of dark fibre.

(ii) <u>Requiring that pricing be set on fair, reasonable and non-discriminatory terms</u>

A21.55 Allowing BT to set the dark fibre price on a fair, reasonable and non-discriminatory basis would provide BT with significant flexibility. It could allow BT to set the dark fibre price in a way that reduces (inefficient) arbitrage opportunities, and takes account of preferences and users' willingness to pay. As such, this approach could support efficient pricing, possibly helping to limit distributional impacts.

A21.56 However, our aim is to introduce a remedy that supports widespread take-up of dark fibre and in a way that BT and OCPs are given incentives to invest and operate efficiently. To encourage widespread take-up we consider that the price needs to be set at an appropriate level and that OCPs are provided with a sufficient degree of certainty to make investment decisions using dark fibre.

A21.57 We consider that allowing BT to price dark fibre on fair, reasonable and non-discriminatory terms would provide BT with too much flexibility to set the dark fibre price at a level that discourages take-up. Moreover, it would not provide sufficient certainty about the dark fibre price for OCPs to make informed investment decisions.

A21.58 Furthermore, even if we were to provide guidance on how we would interpret these terms, we consider that in the context of a fair and reasonable requirement this would still provide BT too much flexibility to set a dark fibre price at a level that discourages take-up. In addition, the lack of certainty would make it more likely that we would be required to determine the appropriate pricing approach through dispute resolutions as OCPs would likely challenge the terms of access that BT had offered to them.

A21.59 With regard to Virgin's argument that a lighter touch approach could be appropriate when competition is emerging, we consider (as we explain in Section 4) that competition for the supply of active products in the London Periphery (LP) and Rest of the UK ('RoUK', defined at the UK excluding the CLA, the LP and the Hull area) is not emerging to the extent that such an approach would be appropriate.[421]

A21.60 In light of these considerations and the disadvantages identified, we do not consider that a requirement for the dark fibre price to be set on fair, reasonable and non-discriminatory terms is appropriate.

(iii) *Benchmarking with reference to the prices of dark fibre supplied in the CLA*

A21.61 IIG argued that Ofcom should consider the option of pricing dark fibre by benchmarking with reference to the prices of commercial dark fibre supplied in the CLA. We interpret the rationale of the IIG to be that since Ofcom proposed the supply of active products in the CLA to be effectively competitive, the prices of dark fibre supplied in the CLA would provide an indication of the costs incurred in providing dark fibre in a competitive market.

A21.62 We consider that benchmarking may be useful under a cost-based approach, if the benchmark provides a reliable indicator for the costs of the remedy. Where the dark fibre price is set to reflect a number of different regulatory objectives, benchmarking is likely to be less appropriate as it is unlikely that any one benchmark would fully capture all the trade-offs which we need to take into account.

A21.63 That said, even if we were to consider a benchmarking approach potentially suitable, we consider that the prices in the CLA would not be a suitable benchmark as they would be a poor proxy for the costs of supply in the RoUK. Our reasons for this assessment are summarised in Table A21.2.

[421] We present our assessment and conclusions as regards the extent of competition in the supply of active (CISBO) products in the LP and the RoUK in Section 4 of this Statement.

Table A21.2 Summary of our assessment of benchmarking as an approach to set the dark fibre price

Principle	Description	Our assessment
Supply of dark fibre in the CLA needs to involve significant volumes, should not be too concentrated, and should be relatively homogeneous	Establishing a robust benchmark based on the prices of dark fibre supplied in the CLA is more likely if: i) dark fibre volumes in the CLA are significant ii) the supply of dark fibre in the CLA is relatively unconcentrated, such that the price is competitive iii) dark fibre supplied in the CLA is relatively homogeneous, for example in terms of prices, customers and product features so that a clear competitive price can be observed	*Volumes and degree of concentration* The total volume of dark fibre supplied in the CLA is limited: only [✂] This compares to total active volumes of [✂] and 1Gbit/s and above active volumes [✂]. The supply of dark fibre in the CLA is highly concentrated. [✂] has a high share of [✂]%, and [✂] jointly supply more than [✂] of the dark fibre in the CLA. The low volume of commercial dark fibre (both in total and relative to total circuit volumes) provided in the CLA in addition to the high degree of concentration would make the benchmark price more at risk of being skewed by the price offered by an individual CP or by the price of individual circuits. This would raise concerns over the robustness of setting the dark fibre price in the LP and the RoUK by benchmarking using this information. *Homogeneity* Our analysis points to the supply of dark fibre (in the CLA, and across the UK) exhibiting a high degree of heterogeneity. • **Pricing of dark fibre –** significant variation in the pricing and level of prices of dark fibre supplied. • **Customers –** significant variation between CPs in the customer types that make up their customer base (and the customers types that are typically targeted by different CPs); with some CPs supplying largely to private sector customers, while others supplying to public sector customers. Also notable differences in the value and likely use of dark fibre supplied between different CPs. • **Product features –** variation in delivery (single or dual fibre), and in (associated) services and quality offered. The high degree of heterogeneity implies that the benchmark would be based on products varying in features, pricing and customers. This would render the benchmark less robust, as it would not be based on the prices of homogeneous products.
Exogeneity	The benchmark prices need to be exogeneous from the dark fibre price that they are being used to set, i.e., the set of	In order for the benchmark to be exogeneous, the prices that individual CPs set for the commercial dark fibre provided in the CLA should not depend on BT's dark fibre price in the LP and the RoUK.

	benchmark prices should not be affected or influenced by the resulting dark fibre price.	In our view the benchmark is unlikely to be exogeneous since CPs providing commercial dark fibre in the CLA are likely to have incentives and the ability to influence the dark price set on the LP and the RoUK. • The major suppliers of dark fibre in the CLA (✂) also supply dark fibre and above 1Gbit/s active products in the LP and RoUK. Consequently, they could have an incentive to set commercial dark fibre prices in the CLA (used for benchmarking) in a way that affects the dark fibre price set in the LP and the RoUK to their advantage. • The low volume of commercial dark fibre (both in total and relative to total circuit volumes) provided in the CLA in addition to the high degree of concentration would make the benchmark price more at risk of being skewed by the price offered by an individual CP or by the price of individual circuits.
Similarity of competitive conditions in the CLA and those in the LP and the RoUK	The supply and use of dark fibre in the CLA need to align with the objectives we have in introducing the dark fibre remedy. Benchmarking is more likely to provide a suitable basis for setting the dark fibre price if supply and demand conditions in the CLA are broadly similar to those in the LP and RoUK.	Our objective is for dark fibre to be taken-up and used on a significant scale. However, our assessment of the supply and use of dark fibre in the CLA indicates that it is being used only for niche customer groups. Supply and demand conditions in the CLA are materially distinct from those in the LP and RoUK: • With regard to supply, we note that both the density of existing infrastructure and the cost of network extension are much greater in the CLA. • With regard to demand, we note that the number and density of users seeking 1Gbit/s and above connectivity is materially greater in the CLA. Moreover, the proportion of customers requiring high bandwidth, with an ability and interest in using dark fibre, and with willingness to pay for greater control over connectivity is greater in the CLA. The differences in supply and demand conditions of the CLA compared to LP and RoUK limits the extent to which benchmarking could be an appropriate approach to setting the dark fibre price.

Regulatory predictability and transparency	The methodology used and information on which to establish the benchmark should be sufficiently clear, providing the regulatory predictability and transparency that supports efficient investment and take-up decisions.	A greater degree of regulatory certainty around the dark fibre price would provide better incentives for OCPs to invest in active and passive assets, and to take up dark fibre efficiently. This would align with our aim of a dark fibre remedy supporting effective competition downstream, while retaining incentives for efficient investment in active and passive assets, by both BT and OCPs. We consider that this benchmarking approach is unlikely to provide the levels of regulatory certainty and transparency that we regard as necessary and appropriate for introducing a dark fibre remedy that could achieve our objectives. For example, OCPs wanting to invest in infrastructure or wanting to use access products would find it difficult to forecast the dark fibre price for the following reasons: • We would be unlikely to be able to publish the pricing (and other) information on which the benchmark is set. This would prevent OCPs validating how the benchmark is set, and understanding how the benchmark may change over time. • The low volume of commercial dark fibre (both in total and relative to total circuit volumes) provided in the CLA in addition to the high degree of concentration would make the benchmark price more at risk of being skewed by the price offered by an individual CP or by the price of individual circuits.

Source: Ofcom analysis using the active and dark fibre circuits datasets compiled by Ofcom from information supplied by CPs in March-May 2014 to questions A1 and A4 of the 1st s135 notice dated 12 March 2014.

Our conclusion on benchmarking approach

A21.64 Based on the assessment above, we do not consider that benchmarking would offer an appropriate way to set the dark fibre price.

Assessment of approaches using a charge control

A21.65 We now present our assessment of approaches that use a charge control to set the dark fibre price. These approaches involve setting the dark fibre price by applying an explicit regulatory control on the maximum charges that BT can set.

A21.66 By restricting BT's flexibility, these approaches will typically provide greater certainty around the dark fibre price and support a lower price relative to approaches that do not use a charge control (discussed above). Accordingly, these approaches should encourage higher take-up of dark fibre and increase the potential benefits from dark fibre identified and discussed in Annex 18. For this reason, we regard approaches that use a charge control as more appropriate for setting the dark fibre price.

A21.67 In the following sub-section of this annex, we:

- explain why we consider that a charge control should be based on BT's costs;

- describe the options available in setting the dark fibre price based on BT's costs, distinguishing between 'cost-based' and 'active-minus' approaches; and
- explain why we selected three pricing approaches – 'cost-based', 'single active reference product – EAD 1Gbit/s', 'single active reference product – EAD 10Gbit/s' – for our in-detail assessment.

Charge control should be based on BT's costs

A21.68 A charge control commonly involves setting charges based on the costs incurred in providing a regulated product. The costs can relate to those that are actually incurred by the SMP operator providing the regulated product. Alternatively, costs may be based on those incurred by another (possibly hypothetical) CP providing a product similar to the regulated product.

A21.69 CityFibre and the IIG urged Ofcom to consider a variant of the latter option, with the costs based on those of a hypothetical new entrant operating at a smaller scale and scope than BT.

A21.70 As we explain in Section 15, we have decided that the charge control applied to BT's active products should be based on the forward-looking costs that BT is forecast to incur when efficiently providing these products. This provides BT, and rival infrastructure operators, with efficient incentives to invest in and use infrastructure to provide active products.

A21.71 As regard the incentives of rival infrastructure operators, we consider that the charge control of BT's active products involves a trade-off between static and dynamic benefits. A higher dark fibre price might improve dynamic efficiency by encouraging rival investment, but could result in a loss of static efficiency with lower take-up of dark fibre and with users having to pay more for business connectivity products over the review period.

A21.72 We consider that these considerations set out in Section 15 are also relevant to the discussion on the cost base to use for setting the dark fibre price. To the extent that there are additional reasons why a higher or lower dark fibre price relative to active products may be appropriate, we take these into account in our discussion of pricing approaches below. In particular, we are mindful of how the introduction of a dark fibre remedy can affect rival investment.

Approaches that use a charge control based on BT's costs

A21.73 We consider that there are two main approaches to setting the dark fibre price using a charge control based on BT's costs:

i) **'Cost-based' approach –** the dark fibre price would reflect the underlying (and efficient) cost that BT incurs in providing dark fibre; and

ii) **'Active-minus' approach –** the dark fibre price would be set with reference to BT's active products (or a particular active product) minus the incremental costs that BT avoids by not providing the active components.

Cost-based approach

A21.74 Under a 'cost-based approach', the dark fibre price would reflect the underlying costs of BT's passive infrastructure.

A21.75 The dark fibre price, under this approach, could be set so that they are at the level of BT's forecasted efficient cost towards the end of the charge control period and trend towards this point using a glide path. This approach would be consistent with our proposed approach for implementing the Leased Lines Charge Control (LLCC) in relation to BT's active products that fall within the Ethernet basket. However, we consider that this approach for setting dark fibre prices would result in broadly similar dark fibre prices to those when using an active-minus approach with reference to a basket of BT's Ethernet products (which is included in our more detailed assessment below) and thus would perform similarly against the criteria used in our assessment. Therefore, we do not consider a cost-based approach using a glide path further in our assessment.[422]

A21.76 Alternatively, a 'cost-based' approach could be implemented with the dark fibre price based on the underlying costs that BT incurs in providing dark fibre in each year of the charge control (i.e. without a glide path). This is the variant of a 'cost-based' approach that we consider in our detailed assessment of selected pricing approaches below.

A21.77 In comparing the 'cost-based' approach relative to other (active-minus) approaches, we focus on the level of the dark fibre price that it would give rise to. We acknowledge and are mindful of cost-based pricing likely differing from BT's current active pricing on a number of aspects e.g. a 'cost-based' price may be based on a price per metre or may differ geographically. Where the comparison depends on the likely pricing structure of a 'cost-based' price, we set this out in the discussion below.

'Active-minus' approach

A21.78 Under an 'active-minus' approach the dark fibre price would be based on the price of a BT active product (or basket of BT active products) less the relevant incremental costs attributable to the active product (or basket of active products).

A21.79 We have considered variants of an 'active-minus' approach that would support a dark fibre price that would be above the 'cost-based' dark fibre price. This is because an 'active-minus' approach that resulted in a price below a 'cost-based' dark fibre price would not provide BT with a fair opportunity to recover its costs (in addition to having adverse impacts on allocative efficiency and rival investment); and an approach that resulted in the same price as a 'cost-based' approach would perform the same on our assessment.[423]

A21.80 We consider that an 'active-minus' approach could be implemented in a number of different ways:

[422] More specifically, both approaches ('cost-based' with glide path and 'active-minus' using a basket of BT's active products) would place similar constraints on dark fibre prices in the last year of the review period.
[423] Moreover, we would not want BT's active products to help recover the common costs associated with BT's supply of dark fibre. Hence, we would not want a price below that determined under a 'cost-based' approach.

1. **Each product individually –** the dark fibre price would depend on (and vary according to) the particular downstream service supplied by the CP that consumes dark fibre.

2. **Active basket –** dark fibre would be priced with reference to the price of a basket of BT's regulated active products, with the dark fibre price determined as a weighted average of the prices of products in the basket less the costs of active components used to provide these products.

3. **Single active reference product –** the dark fibre price would be set with reference to the price of a single active reference product. The reference product would be used to set the dark fibre price and would be independent of the downstream service that the CP (or other customer) was using the dark fibre for. In assessing this option, we assumed that it would be implemented by choosing a reference product which an above average contribution to BT's common costs and considered a number of different active services as the reference product.

Each product individually

A21.81 We do not consider that pricing dark fibre 'for each product individually' is practical. It would require monitoring the downstream services that CPs provide when using dark fibre. This would be unduly burdensome for BT, and in reality, impractical for ensuring compliance. Moreover, we note that this pricing approach would likely introduce issues in relation to non-discrimination. BT would be able to observe the services that its customers (including the competitors of its downstream divisions) provide when consuming dark fibre. This could increase the ability of BT to set the prices of its active products to the advantage of its downstream divisions.

Active basket

A21.82 In the May 2015 BCMR Consultation, the 'active basket' approach was one of the three approaches that we assessed in detail using our framework and set of criteria.

A21.83 The 'active basket' approach would result in a very similar dark fibre price (and thus in similar take-up) as the 'cost-based' approach, in particular towards the end of the review period. This implies that these approaches would perform similarly in terms of benefits and impacts. Given the limited difference between these two approaches in terms of outcome, we have opted to not consider the 'active basket' approach separately this time around, and instead to reflect in our assessment where a cost-based approach may differ if an 'active-basket' approach were adopted.

Single active reference product

A21.84 Under the 'single active reference product' approach, the dark fibre price would be set with reference to a reference product, which would apply irrespective of the downstream services provided by CPs consuming dark fibre. The aim of this approach would be to provide a link between the prices of dark fibre and regulated active products. This has the advantage of reducing opportunities for inefficient arbitrage.

A21.85 The choice of the reference product would have a direct effects on both the and potential impacts of dark fibre. Under BT's current active pricing structure, higher bandwidth products make a greater contribution to recovery of BT's common costs than lower bandwidth products. Accordingly, choosing an active product with a higher bandwidth as the reference product would reduce the need for and scale of price rebalancing on the part of BT. At the same time, it would restrict take-up of dark fibre to connectivity at and above the bandwidth of the reference product.[424]

A21.86 We do not consider that either WES and BES are appropriate to use as the reference product since these are legacy products that are no longer available for new supply. Also, we do not consider that products that aggregate and share bandwidth on a fibre such as Ethernet Backhaul Direct, are suitable to use as the reference product as they do not provide a price for a dedicated fibre circuit.

A21.87 We consider BT's EAD product to be the logical reference product, particularly on a forward-looking basis. It represents a significant proportion of BT's supply of active (CISBO) products [✂]% in 2014/15, and this proportion is forecast to grow to [✂]% in 2017/18.[425]

A21.88 EAD is currently offered at four bandwidths – 10Mbit/s, 100Mbit/s, 1Gbit/s and 10Gbit/s. Our assessment of a 'single active reference product' approach relative to a 'cost-based' approach is predicated on choosing a reference product that makes an above average contribution to common costs. We consider that this would help to mitigate the potential adverse impacts that dark fibre may have. At the same time, we recognise that choosing a reference product that would support a higher dark fibre price would limit take-up of dark fibre, thus limiting the benefits that dark fibre can deliver. In considering the relative performance of approaches to set the dark fibre price, we have recognised these opposing effects.

A21.89 In light of our objectives in introducing a dark fibre remedy, we do not consider that EAD 10Mbit/s or EAD 100Mbit/s are appropriate reference products. These products make a below average contribution to BT's common costs and would therefore place greater pressure on rival investment and BT's existing active pricing structure.[426] Therefore, given our objectives, we consider that EAD 1Gbit/s is the more appropriate reference product.

A21.90 In the May 2015 BCMR Consultation, we did not regard EAD 10Gbit/s as a suitable reference product since it would significantly limit the take-up of dark fibre and thus the benefits that dark fibre can deliver. In light of stakeholder responses, specifically the responses from IIG and BT that asked Ofcom to consider this option in greater detail, we have included in our detailed assessment below the 'single active reference product ' approach with EAD 10Gbit/s as the reference product.

A21.91 We note comments from stakeholders arguing that use of a 'single active reference product' approach would create an anti-competitive margin squeeze between dark fibre and active products with a bandwidth below that of the reference product. We do not consider this to be the case. When using a 'single active reference product' approach, take-up of dark fibre would be limited to using it for providing connectivity

[424] As explained in Annex 33 and in relation to our proposed pricing approach (so, with reference to EAD 1Gbit/s), we consider that given the benefits of using dark fibre over active products, access-seeking OCPs would use dark fibre to provide new 1Gbit/s and above circuits.

[425] We determined these proportions based on BT's actual volumes in 2014/15 as per the LLCC, and Ofcom's forecast of BT's LLCC volumes in 2017/18. Volumes include both access and backhaul products.

[426] In addition, we note that a pricing approach that would use EAD 100Mbit/s as the reference product would result in a dark fibre price below the costs incurred by BT in providing dark fibre.

at or above the bandwidth of the reference product. As such, we would not expect (and are not requiring) BT's downstream divisions to use dark fibre to supply lower bandwidth active products. We therefore consider it unlikely to be appropriate to assess a margin squeeze on this basis.

A21.92 Moreover, even if an *ex post* margin squeeze assessment were conducted in relation to the lower bandwidth active products, it is not clear to us that there would be anti-competitive effects, given that CPs would be able to match BT's product offering by purchasing a mixture of dark fibre and regulated active products on an EOI basis.

Further assessment of selected pricing approaches

A21.93 In light of the above, we have assessed the following three pricing approaches in further detail:

i) **'Cost-based' approach:** of the three approaches, this approach would result in the lowest dark fibre price, thus enabling more widespread use of dark fibre.

ii) **'Single active reference product' approach – EAD 1Gbit/s:** this was the approach we proposed to adopt in the May 2015 BCMR Consultation.

iii) **'Single active reference product' approach – EAD 10Gbit/s:** of the three approaches, this approach would support the highest dark fibre price, thus restricting take-up of dark fibre to a greater extent than the other two approaches.

A21.94 We have assessed these approaches by using the same framework (and set of criteria) that we used in the May 2015 BCMR Consultation. While stakeholders generally supported the framework in itself, they provided their views on our assessment of individual criteria, and the trade-offs and considerations underlying our overall assessment.

A21.95 We have assessed the performance of each of the pricing approaches against four criteria:

i) **economic efficiency**, including allocative, productive and dynamic efficiency;

ii) **compatibility** with our approach to regulating the prices of BT's active products, and the extent that dark fibre pricing gives stability to our overall regulatory approach;

iii) **risk of gaming**; and

iv) **ease of implementation**.

A21.96 In assessing the performance of the selected pricing approaches against these criteria, we use a qualitative ranking system. Our assessment is necessarily qualitative as the merits of the different approaches cannot be quantified. We depict approaches that perform relatively poorly against a particular criteria by an empty ball, and approaches that perform relatively well by a fully shaded ball.

A21.97 The level of dark fibre prices that would likely apply under the differing approaches, and the take-up of dark fibre that these prices would support, are significant factors in our assessment of the selected approaches. We estimated[427] the dark fibre prices that these approaches would give rise to, and considered the likely take-up under these prices. Of the three approaches, the cost-based approach supports the lowest dark fibre price and the EAD 10Gbit/s variant the highest.

A21.98 With regard to the 'cost-based' approach, the level of take-up will depend on the extent to which BT rebalances its active prices:

- If BT does not rebalance its active prices then dark fibre priced at cost is likely to be more costly to use than active circuits to provide 100 Mbit/s connectivity. This could mean that dark fibre would be used to provide new 1Gbit/s and above circuits, but not to provide new below 1Gbit/s circuits.

- If BT were to fully rebalance its active prices, then this would be likely to result in a flatter bandwidth gradient (or indeed no bandwidth gradient), with higher prices for lower bandwidth products, relative to the situation without dark fibre. This could mean that all active circuits would be priced at dark fibre plus incremental costs of the active element, leading to widespread dark fibre use across all bandwidths.

A21.99 We consider that while rebalancing with a cost-based price would be likely to occur over the longer-term, there is uncertainty over how much will occur in the short term, and particularly over the period of this charge control.

A21.100 We consider that the 'single active reference product' variants would support the use of dark fibre in providing (new) circuits at and above the reference product's bandwidth. The potential for take-up under both variants can be illustrated by the proportion of BT's supply of (regulated) active products that involves 1Gbit/s and above, and 10Gbit/s and above active circuits, which stand at [✄]% and [✄]%, respectively.[428] In light of these proportions, we consider that (potential for) take-up is very limited for the EAD 10Gbit/s variant, yet more material for the EAD 1Gbit/s variant.

Economic efficiency

Allocative efficiency

A21.101 In assessing the performance of pricing approaches with regard to allocative efficiency, we consider that:

- Allocative efficiency is maximised when all consumers who value a product more than its incremental cost are able to purchase it.

[427] We estimated the 'cost-based' price based on the fully allocated costs incurred by BT in providing dark fibre, and the prices of the 'active-minus' approaches by subtracting our estimate of the incremental costs in providing a reference product from our forecast of the reference product's price.
[428] We determined these proportions based on BT's actual volumes in 2014/15 as per the LLCC. Volumes include both access and backhaul.

- However, when common costs are significant (as is the case in the supply of business connectivity), setting prices at incremental cost would not allow for recovery of common costs and thus would not be sustainable. In such circumstances, pricing structures where contributions to the common costs vary across products depending on customers' willingness to pay tend to increase allocative efficiency. Such structures would limit the impact on total output relative to when common costs would be recovered more evenly across all products.

Table A21.3: Assessment of selected pricing approaches – allocative efficiency and distributional impacts

Pricing approach	Score on allocative efficiency[429]	Notes
Cost-based	○	Likely to create a much flatter pricing structure, with little or no link between the prices of BT's active products and the willingness to pay of users of BT's network. Active products of varying bandwidth would make more similar contributions to common costs. Price rebalancing would likely increase the relative (and possibly absolute) prices of lower bandwidth active products. This could result in a loss of total output, and in distributional impacts.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	◐	Supports maintaining a bandwidth gradient up to and including 1Gbit/s. This concerns the great majority of BT's supply of active products. Since the dark fibre price would be below the current price of BT's above 1Gbit/s active products, we anticipate that BT will rebalance its active prices by reducing the relative price of its above 1Gbit/s products. Accordingly, the relative price of up to and including 1Gbit/s active products is likely to increase with those products making a higher contribution to the recovery of BT's common costs. However, given the relatively limited volumes of BT's above 1Gbit/s products, the risk of BT's common costs going unrecovered will also be limited. Therefore, the increase in relative prices of up to an including 1Gbit/s circuits, that could occur due to BT price rebalancing, is likely to be limited.
Single active reference product – EAD 10Gbit/s	●	Supports maintaining a bandwidth gradient up to and including 10Gbit/s. This virtually covers BT's entire supply of active products. The risk of BT's common costs being unrecovered would be very limited, and there would be little or no need for price rebalancing on the part of BT. Hence, there would be little or no risk of a loss in total output or of adverse distributional impacts.

Source: Ofcom analysis.

A21.102 We find that a 'cost-based' approach performs relatively poorly with regard to allocative efficiency. BT, under this approach, would need to rebalance its active prices to a more significant extent in order to maintain recovery of its common

[429] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other selected approaches) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

costs. This would increase the risk of an increase in the relative (possibly absolute) prices of its lower bandwidth active products, and this could dissuade some potential users from taking up these products.

A21.103 Both variants of the 'single active reference product' approach would perform better with regard to allocative efficiency. They would allow the existing active pricing structure to be preserved to a greater extent. This would reduce the need for and scale of price rebalancing, and thus would limit the risk of a loss in total output (and relatedly distributional impacts).[430]

A21.104 The scale of price rebalancing, and thus the risk of a loss in total output, would depend on the proportion of BT's volumes that are above the bandwidth of the reference product (so above 1Gbit/s for the EAD 1Gbit/s variant, and above 10Gbit/s for the EAD 10Gbit/s variant). This proportion is limited for the EAD 1Gbit/s variant, only 5%,[431] and very limited for the EAD 10Gbit/s variant. Hence, the risk of a loss in total output is limited for the EAD 1Gbit/s variant, and non-existent for the EAD 10Gbit/s variant. On this basis, we rank the EAD 10Gbit/s variant as performing better in allocative efficiency than the EAD 1Gbit/s variant.

A21.105 Frontier, in a report submitted on behalf of the PAG, argued that there is no evidence that BT's existing active pricing structure maximises efficiency and deserves protection. Frontier considered that while, under certain circumstances, a flatter pricing structure may have lower allocative efficiency, this effect would in practice not likely be material.[432],[433] It provided a number of reasons for this, including the complex relationship between wholesale prices and final demand, the current tariff gradient unlikely being efficient, and a flatter tariff structure unlikely reducing wholesale demand.[434]

A21.106 On the other hand, BT considered that Ofcom understated the adverse impact on allocative efficiency. It argued that flattening the bandwidth gradient would result in less efficient recovery of common costs, and it noted that Ofcom had previously accepted there to be benefits in giving BT a certain discretion in recovering its common costs.

A21.107 In Annex 19, we consider the impact of the bandwidth gradient on allocative efficiency and recognise that the relationship between wholesale prices and end-user demand is complex. All else being equal, we consider that giving BT the opportunity to set an efficient bandwidth gradient is likely to result in a pricing structure that performs better in terms of allocative efficiency (as BT would have the information and incentives to take account of the impact of prices on total output) than a pricing structure that is based solely on the costs that BT incurs in providing its business connectivity products.

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[430] More specifically, they would allow retaining a bandwidth gradient up to and including the bandwidth at which the reference product is offered.
[431] This proportion is determined based on BT's LLCC actual volumes in 2014/15 and includes both access and backhaul.
[432] Frontier report, page 33.
[433] Overall, it considered that the ability to increase the efficiency of end users prices through the structure of wholesale pricing would be limited whichever option is chosen.[433]
[434] Frontier report, page 32.

A21.108 In addition, we consider that distributional impacts are relevant, especially in the context of a transition to new arrangements, and consider that the market should be given time to adapt to the introduction of dark fibre. Accordingly, we continue to place some value on the impact on the bandwidth gradient being lower under the EAD 1Gbit/s variant of the "single active reference product" approach.

A21.109 Nonetheless, we also take into account that considerations other than efficient common cost recovery may influence BT's pricing decisions, that BT has not provided evidence that its current charging structure is allocatively efficient and the potential scope for wider benefits from dark fibre.

A21.110 Taking all the considerations together, while we place some weight on the allocative efficiency and distributional impacts of a bandwidth gradient, we consider that allocative efficiency does not mean that BT's current pricing structure should be maintained indefinitely nor that any price changes should be prevented: rather there may be a trade-off which we need to reflect in our regulatory decisions. In doing so, we are mindful of there being an advantage in providing BT with pricing flexibility, as this is more likely to result in a more efficient pricing structure.

Productive efficiency

A21.111 Productive efficiency relates to the unit costs of providing connectivity. We consider that a pricing approach performs better in terms of productive efficiency if it allows for the supply of business connectivity products at lower unit costs.

A21.112 Introducing a dark fibre remedy has both benefits and risks in terms of productive efficiency.

- Benefits – We explain in Annex 18 that dark fibre would reduce unit costs as less equipment would be used in providing connectivity than with active products. Moreover, dark fibre would expose more of the cost stack to competition, and this could reduce the costs incurred in the supply of business connectivity products.

- Risks – We explain in Annex 19 that the potential for transient entry into the active layer, a potential loss of scale and scope economies in BT's active business, and stranded passive assets on the part of OCPs are the main productive efficiency risks relating to the introduction of a dark fibre remedy.

A21.113 In reaching a view on the impact of dark fibre on productive efficiency, we take account of both the benefits and risks identified. In relation to the risks identified, we consider:

- while we consider transitory inefficiencies, we regard them as less of a concern than more permanent inefficiencies.

- that arbitrage opportunities would be reduced, thus limiting potential for inefficient entry, if and to the extent that BT rebalances the prices of its active products in response to the introduction of a dark fibre remedy.[435]
- that scale and scope economies are not particularly important in relation to BT's active business since economies of scale and scope reside mainly in the passive layer;[436] and
- in addition, we account for stranded passive assets on the part of OCPs in our assessment of dynamic efficiency in the passive layer. For this reason, we do not consider this risk here.

A21.114 Take-up of dark fibre, as reflected by the benefits and risks identified, is likely to have conflicting impacts on productive efficiency. On the one hand, higher take-up would increase the benefits (e.g. avoiding duplication of active equipment, and more of cost stack exposed to competition) that dark fibre can deliver. On the other hand, higher take-up would increase the potential for inefficient entry as arbitrage opportunities would be greater. Of these two effects we place greater weight on higher take-up increasing the potential for dark fibre to deliver greater benefits. That being the case, we consider that a pricing approach performs better on productive efficiency when it supports more widespread take-up of dark fibre.

[435] This assumption is consistent with our assessment of the impact of a dark fibre remedy on allocative efficiency.

[436] Most active equipment is customer-specific and can be shared only between a limited number of customers.

Table A21.4: Assessment of selected pricing approaches with regard to productive efficiency

Pricing approach	Score on productive efficiency[437]	Notes
Cost-based	●	The lower dark fibre price would support more widespread take-up of dark fibre, thus offering greater potential for dark fibre to deliver productive efficiency benefits. At the same time, there would be more material scope for transient inefficient entry as the dark fibre price would be (at least initially) less compatible with the current active pricing structure. This risk, however, could be partially mitigated by BT rebalancing the prices of its active products.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	◐	Take-up would be material but less widespread than under a 'cost-based' approach, and therefore the potential productive efficiency benefits that could be delivered would be lower too. Scope for inefficient transient entry would be limited. Only above 1Gbit/s active products would be susceptible to inefficient arbitrage, and by rebalancing the prices of its active products BT could further mitigate this risk.
Single active reference product – EAD 10Gbit/s	○	Take-up would be very limited as dark fibre would be used only to provide 10Gbit/s and above circuits, which represent a very small proportion of BT's total supply of active products. In turn, the very limited take-up of dark fibre would limit the potential for dark fibre to deliver productive efficiency benefits to a very significant extent. At the same time, opportunities for inefficient arbitrage would be very limited.

Source: Ofcom analysis.

A21.115 We rank the 'cost-based' approach as performing best in terms of productive efficiency as it would support the most widespread take-up of dark fibre, particularly in the longer term. The more widespread take-up would translate into a greater potential for both the benefits and impacts (e.g. risk of inefficient arbitrage) associated with productive efficiency to materialise. As mentioned above, we place greater weight on more widespread take-up of dark fibre increasing the potential for dark fibre to deliver benefits.

A21.116 We rate both variants of the 'single active reference product' approach less favourably in terms of productive efficiency. These approaches would support less widespread take-up of dark fibre relative to a 'cost-based' approach, thus restricting potential to deliver productive efficiency benefits. The potential scope for benefits to

[437] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other approaches) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

be delivered under these two variants depends on the take-up that they would support. In this regard, we consider that:

- Under the EAD 1Gbit/s variant, we consider that dark fibre would be used to provide new 1Gbit/s and above circuits, with relatively low rates of migration from existing 1Gbit/s and above active circuits anticipated. [438,439] This approach would support material take-up, as illustrated by 1Gbit/s and above active products representing 28% of BT's total supply of active products.[440]

- Under the EAD 10Gbit/s variant, dark fibre would only be used to provide new 10Gbit/s and above circuits, and thus potential for take-up would be very limited.

A21.117 As we have already explained, less widespread take-up would reduce the potential of these approaches to deliver the productive efficiency benefits associated with dark fibre relative to the 'cost-based' approach. This is particularly the case for the EAD 10Gbit/s variant, given the very limited take-up of dark fibre it would support. Hence, we rank the EAD 10Gbit/s variant as performing less well on productive efficiency than the EAD 1Gbit/s variant.

A21.118 We find a 'cost-based' approach to perform better on productive efficiency than the EAD 1Gbit/s variant of the 'single active reference product' approach as it would support more widespread take-up. The extent of the difference in performance would depend on the difference in take-up supported by these approaches. We consider that this difference will be greater in the longer term than in the short term.

Dynamic efficiency

A21.119 We assess the selected approaches with regard to dynamic efficiency by reviewing the extent to which they would support investment by BT and rival infrastructure operators in both the active and the passive layer. We consider the impacts on investment for the active and the passive layers separately because the features of a pricing approach that increases investment in one layer might reduce investment in the other layer.

Active layer

A21.120 As explained in Annex 18, we consider that dark fibre can result in dynamic efficiency benefits since it will encourage innovation by offering CPs greater choice and control over the active equipment used to provide connectivity.

A21.121 We consider that the potential for dynamic efficiency benefits in the active layer will be higher with higher take-up of dark fibre. Accordingly, we regard a pricing

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[438] See Annex 33 for our discussion and assessment of this.

[439] Frontier doubted that dark fibre would be used to provide 1Gbit/s connectivity. Our analysis, presented in Annex 33, shows that access-seeking OCPs would want to use dark fibre to provide new 1Gbit/s circuits, and to (slow) migration of existing 1Gbit/s active circuits to dark fibre reflecting the benefits of using dark fibre instead of active products.

[440] Proportion determined based on BT's LLCC actual volumes in 2014/15, and includes both access and backhaul.

approach that supports more widespread take-up of dark fibre as performing better against this criterion than an approach that supports less widespread take-up.

Table A21.5: Assessment of selected pricing approaches – dynamic efficiency in the active layer

Pricing approach	Score on dynamic efficiency in the active layer[441]	Notes
Cost-based	●	This approach would support more widespread take-up of dark fibre, thus offering greater potential for dynamic efficiency benefits in the active layer to be delivered.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	◐	This approach would support material take-up of dark fibre, yet take-up supported would be less widespread than under a cost-based approach. Hence, while this approach offers material potential for dynamic efficiency benefits in the active layer to be delivered, this potential would be less than under a ‘cost-based’ approach.
Single active reference product – EAD 10Gbit/s	○	Very limited take-up of dark fibre, and hence very limited potential for dynamic efficiency benefits in the active layer to be delivered.

Source: Ofcom analysis.

A21.122 We conclude that a ‘cost-based’ approach, by supporting more widespread take-up of dark fibre, performs better in dynamic efficiency in the active layer than both other approaches. More widespread take-up implies that greater benefits can be achieved. The extent to which the ‘cost-based’ approach would support take-up would likely increase over time: in the short-term, take-up may be similar to the EAD 1Gbit/s variant, but as BT rebalances its active prices, take-up is likely to be higher.

A21.123 Both variants of the ‘single active reference product’ approaches would perform less well on dynamic efficiency in the active layer as they would be likely to lead to lower take-up of dark fibre relative to a ‘cost-based’ approach, particularly in the longer-term.[442]

Passive layer

A21.124 In assessing the impacts of dark fibre on investment in the passive layer we have considered BT and rival infrastructure operators separately. In summary, our view is that:

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[441] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other available options) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

[442] Again, we note that Frontier argued that Ofcom was overestimating take-up of dark fibre for providing 1Gbit/s connectivity. Based on our analysis in Annex 33, we remain of the view that dark fibre would be used to provide a material proportion of 1Gbit/s circuits: new circuits, and with migration of existing active circuits.

- as explained in Annex 19, in relation to setting a charge control (and requiring BT to provide dark fibre), we consider that BT should have an opportunity to recover its efficiently incurred costs. This principle is commonly referred to as BT being provided with a 'fair bet'. We consider that our design of the LLCC and the dark fibre remedy (see Annexes 15 and 22, respectively) accord with the 'fair bet' principle; and

- rival infrastructure operators find themselves in a different position. Dark fibre, through its impact on their prices, volumes and returns, could discourage them to invest in their own passive infrastructure.

Impact on BT

A21.125 We explain in Annex 19 that the impact of dark fibre on BT's incentives to invest in infrastructure would largely be mitigated as a result of:

- BT being given the opportunity to recover the additional costs it incurs as a result of introducing the dark fibre remedy (i.e. development costs) as these costs are added to the Ethernet basket; and

- BT having the flexibility to rebalance the prices of its active products, subject to the control of the Ethernet basket and other price controls, thus allowing BT the opportunity to recover its costs efficiently.

A21.126 We assume that under each pricing approach BT would be provided with a 'fair bet', i.e. with the opportunity to recover its efficiently incurred costs. By doing so, we would provide BT with incentives to invest efficiently in its passive infrastructure.

A21.127 We are mindful that offering BT a 'fair bet' depends on our ability to correctly forecast BT's costs and volumes. This ability would likely vary between pricing approaches. There would be a greater risk of forecasting error, and thus of BT not being offered a 'fair bet', when a pricing approach would support more widespread take-up of dark fibre (as this would result in greater changes in the volumes of active products), and would involve a greater change in our regulatory approach.

A21.128 Accordingly, we consider that the risk of forecasting error would be higher under a 'cost-based' approach as BT, under this approach, would likely want to rebalance the prices of its active products to a more significant extent in order to limit inefficient arbitrage opportunities. Under such circumstances, forecasting BT's costs and volumes would be subject to greater uncertainty and unpredictability, thus increasing the risk of BT not being offered a 'fair bet'.

A21.129 We consider that the risk of forecasting error would be lower under both 'single active reference product' variants.

- Under these approaches, the dark fibre price would be consistent with one of BT's active products. This would enable us to forecast volumes with a greater degree of confidence, and to make adjustments to the LLCC to mitigate the risk of BT not being given an opportunity to recover its efficiently incurred costs.[443]

- Take-up would be higher under the EAD 1Gbit/s variant, and hence this variant would have a greater risk of forecasting error relative to the EAD 10Gbit/s variant. Having said this, and as set out in Annex 33, we consider that the forecast risk for the EAD 1Gbit/s variant is manageable and our LLCC is consistent with the principle of providing BT with an opportunity to recover its efficiently incurred costs.

A21.130 While we find that the ‘cost-based’ approach may perform less well in terms of encouraging efficient infrastructure investment on the part of BT, we do not place great weight on this finding in concluding on the performance of pricing approaches with regard to dynamic efficiency in the passive layer. We place greater weight on the impact on investment in passive infrastructure by rival infrastructure operators, which we discuss next.

Impact on rival infrastructure investment

A21.131 A number of rival infrastructure operators, including Virgin, CityFibre and Zayo, claimed that the introduction of a dark fibre remedy would harm their ongoing investment, and would discourage them from future investment in passive infrastructure. Annex 20 presents our review of these claims, and our overall assessment of the (incremental) impact that a dark fibre remedy may have on rival (infrastructure) investment.

A21.132 In summary, we consider that by pricing dark fibre by reference to BT’s EAD 1Gbit/s products, we have:

i) chosen an approach linked to efficient investment signals as it is linked to a charge controlled product

ii) makes some allowance for rivals not immediately being able to achieve BT’s economies of scale and scope as it is by reference to a product which makes an above average contribution to costs

iii) has a limited impact on rival infrastructure investment as only a small proportion of circuits will see a price reduction, and even those see a reduction to a price which is in excess of BT’s FAC.

A21.133 Pricing that allows for prices to potentially exceed BT’s FAC is consistent with placing weight on the dynamic benefits of end-to-end competition developing.

A21.134 The ‘cost-based’ dark fibre price would be set equal to BT’s FAC. In principle, this pricing would retain incentives for rival investment as long as rival infrastructure operators are more or similarly efficient to BT. It would also involve a very large incremental reduction of prices for higher bandwidth services, additional to the impact of the LLCC. This would limit the ability of rival infrastructure operators to

[443] We discuss potential for aggregation and the impact that aggregation may have on BT’s volumes of active products in Annex 33.

compensate for a lack of initial economies of scale and scope, by targeting higher bandwidth circuits. As rival infrastructure operators account for a higher share of higher bandwidth products, the result is likely to be a greater reduction in their investment incentives, relative to a reference product approach.

A21.135 We assess the performance of the selected approaches depending on the extent to which they mitigate a potential adverse impact on rival investment. In doing so, we consider that a higher dark fibre price would mitigate this impact to a greater extent, and thus those approaches that support a higher dark fibre price would perform better in terms of dynamic efficiency in the passive layer.

Table A21.6: Assessment of selected pricing approaches – dynamic efficiency in passive layer

Pricing approach	**Score on dynamic efficiency in passive layer**[444]	**Notes**
Cost-based	○	Would result in a dark fibre price equal to BT's FAC, thus in principle retaining incentives for efficient infrastructure investment by rival operators. Rival infrastructure operators would likely need to implement significant price reductions on their higher bandwidth active products and dark fibre as they currently sell these at much higher prices. This would have a material adverse impact on investment in rival infrastructure since the expected returns for higher bandwidth active products and dark fibre would likely be materially lower.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	◑	Would result in a dark fibre price above the 'cost-based' price, thus reducing the potential adverse impact on rival (infrastructure) investment relative to the 'cost-based' approach. It would preserve greater value in the market, and would help to sustain higher prices on higher bandwidth active products and dark fibre. Importantly, the opportunities for rival infrastructure operators to sell these products at higher prices and margins has likely supported rival investment to date.
Single active reference product – EAD 10Gbit/s	●	Would support a dark fibre price that would be significantly higher than under both other approaches. This would help to very materially mitigate any adverse impact that dark fibre could have on rival investment. It would do so by allowing rival operators to sustain higher prices and margins on higher bandwidth active products and dark fibre. The need for and scale of price reductions on the part of rival operators would likely be very limited. In absence of a material impact on the prices and margins of the products most likely to support rival investment, the risk of a dark fibre remedy having the effect of a reduction in rival investment would be almost entirely mitigated.

Source: Ofcom analysis.

A21.136 We consider that a 'cost-based' approach performs less well on dynamic efficiency in the passive layer. By supporting a materially lower dark fibre price, set equal to BT's FAC, it would not mitigate the adverse impact on rival investment to the same extent as both 'single active reference product' variants. By being equal to BT's

[444] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other available options) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

FAC, the 'cost-based' dark fibre price would retain incentives for rival investment only to the extent that rival infrastructure operators are as (or more) efficient as BT. We consider that this approach would not support rival investment to a great extent, in particular when and to the extent that rival infrastructure operators are at a temporal disadvantage in terms of scope and scale. Moreover, it would not place great weight on the uncertainty surrounding infrastructure investment, and the impact hereof on investment.

A21.137 The 'single active reference product' variants would mitigate the adverse impact on rival investment by supporting a dark fibre price materially above BT's FAC. By allowing for higher prices on higher bandwidth products and thus by preserving greater value in the market, these variants would retain greater opportunities for rival investment. As the EAD 10Gbit/s variant would support a higher dark fibre price, we consider that this variant would mitigate adverse impacts on rival investment to a greater extent than the EAD 1Gbit/s variant.

Assessment of pricing approaches with regard to compatibility

A21.138 Dark fibre would have to co-exist with regulated active products over the next review period as dark fibre would on its own not be sufficient to support effective downstream competition over this review period.[445] We have therefore considered the compatibility of dark fibre and regulated active products, and in doing so we acknowledged implications this may have for BT, users of BT's network, BT's competitors, and Ofcom.

A21.139 In our assessment of pricing approaches, we consider two aspects of compatibility:

i) **Compatibility with our approach to regulating the prices of BT's active products –** We prefer a pricing approach that is compatible with our approach to regulating the prices of BT's up to and including 1Gbit/s active products where we apply a charge control that will bring prices down to BT's FAC with a 'glidepath' towards the end of the review period. As explained in Section 15, this approach has significant efficiency advantages. Bringing prices down to BT's costs towards the end of the review period provides BT with efficient incentives to invest in and run its network. Determining the charge control based on BT's FAC would allow for and support efficient investment on the part of BT and rival infrastructure operators.

ii) **Stability of the existing regulatory regime –** We prefer a pricing approach that supports the stability of the regulatory regime. This would provide greater certainty to suppliers (both BT and rival infrastructure operators) and users of business connectivity. As such, it would support investment and take-up of dark fibre. Moreover, we value the extent to which a pricing approach supports a managed introduction of the dark fibre remedy, realising benefits while mitigating the risks of arbitrage between active and passive remedies. This would give all

[445] For reasons explained in Section 8, we require BT to offer both active products and dark fibre, and we consider that the prices of the active products that BT offers should be regulated through a charge control. While dark fibre on its own would not be able to support effective downstream competition for this review period, we consider that this may change in future review periods.

involved time and opportunity to respond to a regime that mandates BT to offer both active products and dark fibre.

A21.140 As explained above, we favour pricing approaches that do not require BT to significantly rebalance the prices of its active products. As we have already considered this issue in relation to allocative efficiency, we do not consider this aspect as part of our assessment of compatibility below.

Table A21.7: Assessment of selected pricing approaches – Compatibility

Pricing approach	Score on compatibility[446]	Notes
Cost-based	○	Low level of compatibility with our approach to regulating the prices of BT's active products. The more widespread take-up of dark fibre would likely result in more significant changes in the volumes and prices of BT's active products, with significant rebalancing needed, potentially both by bandwidth, but also disaggregation into distanced-based charging and possible geographic differentiation. The impact is likely to be particularly difficult to forecast, making it hard to ensure that our approach is consistent with providing BT the opportunity to recover its efficiently incurred costs. This approach would involve a major regulatory change as there would be a significant change in our regulatory regime. This would have implications for BT, users of BT's network, competitors to BT, and Ofcom.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	◑	Reasonably good level of compatibility with our approach to regulating prices of BT's active products. The choice of price point limits the disruption to the market and makes it more straightforward to account for the impact of a dark fibre remedy on BT's supply of active products. Moreover, this approach has the advantage of maintaining the glidepath (as EAD 1Gbit/s is part of the Ethernet basket), thus providing BT with efficient incentives. Supportive of the stability of the current regulatory regime as it would limit the changes that BT, and users of BT's network, would need to make in order to adapt to the new regulatory regime. Moreover, supportive of more gradual introduction of a dark fibre remedy.
Single active reference product – EAD 10Gbit/s	●	High level of compatibility with current approach to regulating prices of BT's active products. Very limited changes in BT's active volumes and prices to be expected. As reference product is not part of the Ethernet basket, a glidepath cannot be employed. Would support the stability of the current regulatory regime to a very significant extent, thus limiting the

446 We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other available options) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

		changes that BT, users of BT's network and competitors to BT may need to make following introduction of a dark fibre remedy. Accords with a (very) gradual introduction of a dark fibre remedy.

Source: Ofcom analysis.

A21.141 We rate a 'cost-based' approach as performing less well in terms of compatibility relative to both 'single active reference product' variants.

- It would be less compatible with our approach to regulating BT's active products. The more widespread take-up of dark fibre would likely result in materially greater changes in the volumes and prices of BT's active products. Given the existing active structure, this could open many arbitrage opportunities, giving inefficient investment signals. While such inefficient investment signals would be reduced if BT significantly rebalanced its active prices not only in bandwidth but also in other dimensions (e.g. distance, geography), this would cause significant disruption to customers. In turn, any changes made by BT would have an impact on and/or require actions by users of BT's network and of BT's competitors. It would also make it more difficult to design and apply a charge control which retains the opportunity for BT to recover its efficiently incurred costs. This latter point is of particular relevance in this review period where competition will primarily be based on active remedies.

A21.142 We consider that the 'single active reference product' variants perform better in terms of compatibility.

- They would be largely compatible with our approach to regulate the prices of BT's active products. The more controlled take-up of dark fibre would limit changes in the volumes and prices of BT's active products, particularly in the introductory period. Furthermore, when the reference product is part of the Ethernet basket (which EAD 1Gbit/s is), there is the advantage of a 'glidepath' bringing prices down to cost towards the end of the review period.

- They would support the stability of the current regulatory regime as the products that would be affected by both charge control and the dark fibre remedy would be limited for the EAD 1Gbit/s variant, and very limited for the EAD 10Gbit/s variant.

A21.143 We consider that the EAD 10Gbit/s variant performs somewhat better than the EAD 1Gbit/s variant in terms of compatibility. The EAD 10Gbit/s variant would limit the changes in volumes and prices of BT's active products to a greater extent, and furthermore limits the number and volumes of active products that would be subject to both charge control and dark fibre remedy.

Assessment of pricing approaches with regard to risk of gaming

A21.144 The dark fibre remedy could be less effective if BT were able to manipulate the chosen pricing approach in a way that would discourage take-up of dark fibre. We consider this risk (the risk of gaming) as part of our assessment of selected pricing approaches, as we recognise that the ability of BT to take actions that would discourage take-up of dark fibre could undermine the benefits that dark fibre can deliver.[447]

A21.145 We consider that the key way through which BT could discourage take-up of dark fibre would be for it to take actions that would result in a higher dark fibre price.[448] When the dark fibre price is higher, in particular relative to the prices of active alternatives, this can be expected to discourage take-up of dark fibre as users of BT's network would opt for the more cost-effective active alternatives instead.

A21.146 The ability of BT to take actions that would result in a higher dark fibre price varies across the pricing approaches.

- Under the 'cost-based' approach, BT would have limited pricing discretion. The dark fibre price would be based on the costs that BT incurs in providing dark fibre.

- Under the 'single active reference product' variants, BT would have some pricing discretion. By setting the price of the reference product as high as possible within the constraints of the price regulation that it is subject to, BT could achieve a higher dark fibre price.

  - BT would be restricted by the EAD 1Gbit/s sub-basket (and the control that applies to the Ethernet basket) in the EAD 1Gbit/s variant.

  - BT would only be restricted by the 0% safeguard cap in the EAD 10Gbit/s variant.

[447] Annex 18 identifies and explains the benefits that we expect a dark fibre remedy to deliver.
[448] In addition, we recognise that there is a possibility of BT being able to discourage take-up of dark fibre by introducing a new active product that would be similar to the reference product in terms of bandwidth and functionality, and to then price this new product attractively relative to the reference product (and thus to the dark fibre). While BT could discourage dark fibre take-up by doing this, we note that if it would do so, this would result in an improved outcome for users of BT's network, and moreover it would not be clear how BT would benefit from this.

Table A21.8: Assessment of pricing approaches – Risk of gaming

Pricing approach	Score on risk of gaming[449]	Notes
Cost-based	●	A 'cost-based approach', once in place, would leave BT with very limited discretion to discourage take-up of dark fibre. The dark fibre price would be based on BT's costs of providing dark fibre.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	◐	Some risk of BT being able to discourage take-up of dark fibre by setting the price for the reference product as high as it can within the constraints of the charge control. In setting the price of EAD 1Gbit/s, BT would have limited discretion as it would need to comply with both the EAD 1Gbit/s sub-basket and the Ethernet control.
Single active reference product – EAD 10Gbit/s	○	Greater risk of BT being able to set a dark fibre price that could discourage take-up of dark fibre since there would be limited regulatory safeguards. In setting the price of EAD 10Gbit/s, BT would only be subject to a 0% safeguard cap.

Source: Ofcom analysis.

A21.147 We find the 'cost-based' approach to perform better in terms of risk of gaming than both 'single active reference product' variants. Under the 'cost-based' approach, BT would have very limited pricing discretion, and hence, it would not be able to take actions that result in a higher dark fibre price.

A21.148 Instead, under the 'single active reference product' variants, BT would be able to discourage take-up of dark fibre by setting the price of the reference product as high as it can within the constraints of the price regulation. As the constraint applying would be less stringent in the EAD 10Gbit/s variant, we consider that this variant performs worse on risk of gaming than the EAD 1Gbit/s variant.[450] In relation to the EAD 1Gbit/s variant, we consider that our LLCC basket design decisions (the sub-basket applying to EAD 1Gbit/s, in particular) significantly mitigates this risk (see Section 15).

Assessment of pricing approaches with regard to ease of implementation

A21.149 Any major change in our approach to regulating BT's supply of active products, and the introduction of a dark fibre remedy is such a change, would involve significant efforts on the part of BT, users of BT's network and Ofcom. As some approaches for setting a dark fibre price would be easier to implement than others, we have considered ease of implementation as part of our assessment of the selected

[449] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other available approaches) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

[450] This assessment is based on our current charge control proposals. It is possible that we would seek a tighter constraint on EAD 10Gbit/s pricing, in the event that it were used as the reference product.

pricing approaches. We value approaches that are easier to implement, that require less effort and with fewer risks for all involved.

A21.150 We recognise that BT would incur costs in developing and offering dark fibre, and in altering its processes in support of the introduction of a dark fibre remedy. In Section 15, we discuss our decision to allow BT to recover these costs (through the Ethernet basket) in more detail.

Table A21.9: Assessment of pricing approaches – Ease of implementation

Pricing approach	Score on ease of implementation[451]	Notes
Cost-based	◑	Although some of the information needed to determine the dark fibre price will be available, forecasting BT's costs is likely to be more challenging as a 'cost-based' price is likely to lead to higher take-up of dark fibre. In particular, a 'cost-based' price may result in BT having to de-average its prices – possibly both by geography and by circuit length Given that the market will primarily rely on active remedies in this review period, there are likely to be greater challenges in ensuring that the prices we set are consistent with BT's opportunity to recover its common costs.
Active-minus approaches		
Single active reference product – EAD 1Gbit/s	●	Not difficult. Involves subtracting the cost of the active components used in providing an EAD 1Gbit/s product from the price of that EAD 1Gbit/s product. The information needed to determine the cost of the active components used in providing EAD 1Gbit/s products is not difficult to collect and analyse. See Annex 23 for our Guidance on how we determine the 'minus' under this approach.
Single active reference product – EAD 10Gbit/s	●	Not difficult. Involves subtracting the cost of the active components used in providing EAD 10Gbit/s products from the price of the relevant EAD 10Gbit/s products. The information needed to determine the cost of the active components used in providing a EAD 10Gbit/s product should not be overly difficult to collect and analyse.

Source: Ofcom analysis.

A21.151 We find a 'cost-based' approach to perform less well on compatibility than both 'single active reference product' variants. If we were to use a 'cost-based' approach, we would be likely to implement it using a top-down approach as that would ensure

[451] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other available options) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

greater consistency with the charge control applied to BT's active products.[452] While some of the information required for implementing this approach would be available to us (as similar information is used in designing the charge control of BT's active products), we expect that there would be material difficulties in forecasting the volumes and prices of both dark fibre and BT's active products, particularly in the introductory period where dark fibre is first launched.[453] In particular, a cost-based approach may open up significant arbitrage opportunities given the current active pricing structure which could lead to inefficient take-up signals or to significant price rebalancing (by bandwidth, other dimensions). The more widespread take-up of dark fibre would likely result in more significant changes in the volumes and prices of BT's active products. These changes and the uncertainty surrounding these changes would make it harder to ensure that BT is provided with a 'fair bet'.

A21.152 The 'single active reference product' variants would perform better than the 'cost-based' approach. We consider both variants would perform equally well. Once the reference product has been chosen, setting the price would be largely a mechanical exercise. These approaches would require us to identify and determine the active costs relating to the reference product, and to subtract these costs from the price of the reference product. As both the price of the reference product and the costs of the active components relating to a reference product can be determined without difficulties, we consider that these variants are easy to implement. Moreover, we would have a better ability to forecast take-up of dark fibre under these approaches: because take-up would be less widespread, and because the link between dark fibre and the active reference product allows us to better forecast when dark fibre or actives, respectively, are likely to be used.

Conclusion – Overall assessment

A21.153 Table A21.10 below summarises the results of our qualitative assessment of the selected pricing approaches with regard to the four identified criteria.

[452] A top-down approach would involve setting the dark fibre price by subtracting the costs associated with the active components from the total costs incurred in providing active products.
[453] When dark fibre has been around for some years, e.g. in future review periods, we would expect to be better placed to use a charge control to set the dark fibre price as we would have a better understanding of when dark fibre is used, and how this depends on both the price of dark fibre as on the prices of active products.

Table A21.10: Assessment of selected pricing approaches – Overall assessment[454]

Pricing approach	Economic efficiency				Compatibility	Risk of gaming	Ease of implementation
	Allocative efficiency	Productive efficiency	Dynamic efficiency				
			Active layer	Passive layer			
Cost-based	○	●	●	○	○	●	◑
Active-minus approaches							
Single active reference product – EAD 1Gbit/s	◑	◑	◑	◑	◑	◑	●
Single active reference product – EAD 10Gbit/s	●	○	○	●	●	○	●

Source: Ofcom analysis.

A21.154 The regulatory framework, as explained in Section 9, requires us to take account of a range of considerations in assessing what remedies to impose, including the impact on economic efficiency (including allocative, productive and dynamic efficiency). In addition to economic efficiency, we also considered the performance of pricing approaches with regard to three other criteria: compatibility[455], risk of gaming and ease of implementation.

A21.155 Our assessment of the selected pricing approaches is set against our aim of weighing up the benefits from introducing dark fibre against the potential adverse impacts that might arise. In relation to our aim we highlight the following:

- We seek to introduce a dark fibre remedy that supports widespread take-up of dark fibre, as this is required for dark fibre to deliver significant benefits. We recognise that widespread take-up requires a dark fibre price that is not too high and not subject to great uncertainty.

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[454] We use a qualitative ranking system where approaches that perform relatively poorly (compared to the other available options) are depicted by an empty ball, whereas approaches that perform relatively well are depicted with a fully shaded ball.

[455] As explained above, in assessing performance with regard compatibility we consider both the support for the stability of our regulatory approach and the compatibility with our approach to regulating the prices of BT's active products.

- At the same time, we are mindful of the potential risks of dark fibre, including: the impact on rival investment, loss in total output, distributional impacts and disruption. With regard to these potential adverse impacts, we prefer a pricing approach:
  - **that retains the bandwidth gradient in BT's active prices to some extent.** This helps to mitigate the risk of a loss in total output and distributional impacts that could occur if lower bandwidth products would need to contribute more to recovery of BT's common costs. Furthermore, this would have the advantage of retaining higher margins for higher bandwidth products which have supported rival operators in investing in and competing for the supply of business connectivity.
  - **that limits disruption to the supply of business connectivity.**
- We also place (some) weight on practical implications relating to the introduction of a dark fibre remedy. We wish to introduce a dark fibre remedy that limits the risk of gaming, that does not impose a too great burden (in terms of efforts and risk on BT, users of BT's network and Ofcom, that accords with our approach to regulating BT's active products, and that supports the stability of our regulatory approach.

A21.156 Before presenting our overall assessment, we reiterate the key features of the selected approaches.

- A 'cost-based' approach performs well on some criteria, including productive efficiency and dynamic efficiency in the active layer, yet performs less well on other criteria: dynamic efficiency in the passive layer (i.e. rival investment) and allocative efficiency, and compatibility with our existing regulatory approach.
- The EAD 1Gbit/s variant of the 'single active reference product' approach performs consistently across all criteria.
  - It performs well on criteria on which the 'cost-based' approach performs less well, including dynamic efficiency in the passive layer, and allocative efficiency. By supporting a higher dark fibre price, this approach would mitigate the potential adverse impact on rival investment to a greater extent. Moreover, by reducing the extent to which lower bandwidth active products would need to contribute more to recovery of BT's common costs, it would limit the risk of a loss in total output and distributional impacts. Disruption would be a less material risk as changes would be less great relative to under 'cost-based' approach as the dark fibre price would be linked to the price of a key active product.
  - The reverse is also true. It performs less well than a 'cost-based' approach in terms of productive efficiency and dynamic benefits in the active layer. This is due to this approach not supporting take-up of dark fibre to the same extent as the cost-based approach. By doing this, it would limit the potential for dark fibre to deliver benefits, though we consider that this limit will be more apparent in the longer term than in the short term.
- The EAD 10Gbit/s variant of the 'single active reference product' approach would produce more extreme effects than the EAD 1Gbit/s variant. It would very materially restrict both the benefits and risks associated with introducing a dark fibre remedy.

A21.157 In relation to our detailed assessment of both variants of the 'single active reference product' approach, we find that:

- the EAD 10Gbit/s variant would significantly restrict the take-up of dark fibre and will not deliver significant benefits (in accordance with our aim);
- The EAD 1Gbit/s variant, instead, would support more widespread take-up of dark fibre thus allowing more benefits to be delivered. While we recognise that there are potential adverse impacts associated with this variant, we consider that these can be sufficiently mitigated by our design and pricing of the dark fibre remedy;
- Hence, we consider that, of these two variants, the EAD 1Gbit/s variant is the more appropriate approach for setting the dark fibre price, particularly taking into account that this is the first time BT will be required to provide a dark fibre product, and the resultant disruption that could cause to the market.

A21.158 In relation to a comparison of the 'cost-based' approach and the 'active-minus' approach with EAD 1Gbit/s as the reference product, we find:

- A 'cost-based' approach would support more widespread take-up of dark fibre, thus offering greater potential for benefits to be delivered. However, this potential for benefits needs to be assessed against the potential adverse impacts (rival investment, potential loss in total output, distributional impacts, disruption) that this approach would not materially mitigate. Our regulatory judgment is that the benefits of additional take-up of dark fibre under the 'cost-based' approach would not be sufficient to outweigh the risk of the potential adverse impacts, particularly when taking into account that the market will largely rely on active products in this review period.
- By contrast, the EAD 1Gbit/s variant of the 'single active reference product' approach would mitigate the potential adverse impacts to a more material extent. We consider that this approach would mitigate adverse impacts to the extent of likely outweighing the reduced potential for dark fibre to deliver benefits. In doing so, we place weight on mitigating potential adverse impacts on rival investment, potential for a loss in total output (and associated inefficiency in recovering common costs), distributional impacts, and the more limited disruption that can be expected when introducing a dark fibre remedy in a more managed way.

A21.159 In light of the above, we conclude that the EAD 1Gbit/s variant of the 'single reference product' approach is our preferred pricing approach to set the price of dark fibre for this review period. It offers the best balance of the benefits and impacts associated with the introduction of a dark fibre remedy.

A21.160 We explain in Section 9 that we mandate BT to offer dark fibre in variants resembling the EAD variants that it offers (EAD and EAD LA), and that BT would need to price its dark fibre with reference to the relevant EAD variant. BT would thus have to offer dark fibre that is equivalent to BT's EAD and EAD LA product, and would need to set separate charges for both variants. We consider the determination of the active incremental costs (the minus) in Annex 24.

Annex 22

Design of the dark fibre remedy

Introduction

A22.1 In Section 9 we set out our analysis and decisions in relation to the scope and design of a dark fibre remedy. More specifically, in that section we set out our decision to require BT to provide dark fibre on reasonable request and to impose non-discrimination and EOI obligations relating to dark fibre. We also set out our approach to the pricing of dark fibre (which is discussed in more detail in Annex 21), the minimum requirements of the Reference Offer for dark fibre, the implementation timetable for dark fibre, and issues around the quality of service for dark fibre.

A22.2 In this annex we explain some of the more detailed technical and operational aspects of the dark fibre remedy arising from our analysis and our review of stakeholders' responses to the May 2015 BCMR Consultation.

A22.3 In summary we have decided the following:

Table A22.1: Summary of the design of the dark fibre remedy

Markets	Dark fibre remedy	
CISBO in the Rest of UK excluding Hull CISBO in the London Periphery	**Distance limits**	Distance limit of 45km for dark fibre based on the end-to-end radial distance of the circuit.
	Use of dark fibre for CPs' access network extensions	BT to provide dark fibre terminating segments of the following types: • disaggregated access and backhaul segments; and • short range end-to-end segments.
	Handover locations	No specific obligation for BT to terminate dark fibre segments in joint boxes, manholes and other external structures.
	Arrangements concerning provision of new infrastructure	The same arrangements should apply in both the active and dark fibre remedies and the existing charging arrangements for network extensions in relation to active services would provide the most suitable solution for dark fibre.
	Provisioning and repair processes	The provisioning and repair processes (along with appropriate Service Level Agreements (SLAs) and Service Level Guarantees (SLGs)) should be developed by BT and agreed with industry as part of the implementation process for dark fibre.
	Service migration processes	The requirements for migration processes are best agreed by negotiation between CPs and BT during the implementation process.
	Infrastructure discovery	No specific requirement for BT to provide infrastructure information.

Distance limits

Proposals in the May 2015 BCMR Consultation

A22.4 In the May 2015 BCMR Consultation we identified a risk that if a dark fibre remedy were imposed without any distance restrictions then it might undermine existing infrastructure investments in the competitive market for core conveyance.

A22.5 We noted that regulated dark fibre is inherently more flexible in terms of circuit lengths and circuit end-points than active remedies and, absent other restrictions, could more readily be used to provide core conveyance. For example, if there were no distance restrictions, a CP could use dark fibre to provide a long distance link between London and Birmingham, a route which we consider to be competitive.

A22.6 We noted that with the current active remedies, we do not impose distance limitations, but the risk of use for core conveyance is minimised by BT's specifications for its wholesale services. BT specifies distance limits for most of its

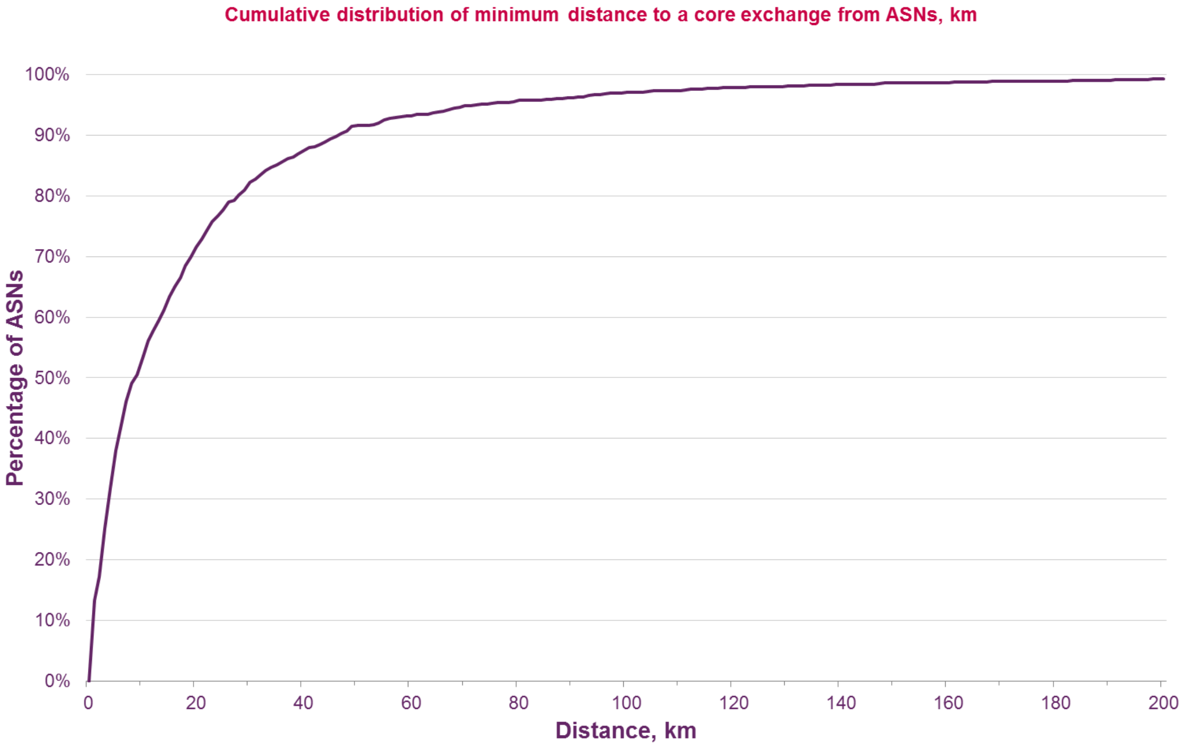
Ethernet services, and its main backhaul product Ethernet Backhaul Direct (EBD) is only available between specified locations.

A22.7 To mitigate the risks which regulated dark fibre might pose to infrastructure investment in core conveyance, we considered that an appropriate distance limit would be one sufficiently long as to allow a CP to provide access circuits and backhaul connections to the nearest competitive core nodes. Beyond this limit, CPs could either provide their own core connectivity or purchase such connectivity in the competitive core market.

A22.8 We assessed the radial distance limit likely to be sufficient for most backhaul circuits by analysing the distribution of distances between each of BT's Access Serving Nodes (ASNs) and its nearest core node. We considered that the ASNs' locations would be useful proxies for CPs' choice of aggregation nodes because they tend to correspond to areas of concentration of population.

A22.9 Our analysis, summarised in Figure A22.1, found that the majority of ASNs are within 20km of a core node and that 90% are within 50km. This suggested that a dark fibre remedy with a distance limit of around 50km would be sufficient to serve the large majority of backhaul needs. We therefore proposed to set a distance limit of 50km.

Figure A22.1: Distance of ASNs from competitive core nodes



Source: Ofcom analysis

Stakeholders' responses to the May 2015 BCMR Consultation

A22.10 BT was concerned that the proposed dark fibre remedy would undermine existing infrastructure investments in the competitive core network market and also the prospect of future investment in fibre networks connecting towns and cities in the UK.

A22.11 BT considered that the regulated dark fibre prices would be likely to be considerably below the cost of building new core fibre routes because:

- Ofcom had proposed that the dark fibre price should be set by reference to 1Gbit/s Ethernet Access Direct (EAD) circuits, a bandwidth that is likely to be below the typical bandwidth of core connections; and

- 1Gbit/s EAD prices reflect BT's historic average cost of Ethernet connections and the 'bandwidth gradient' in leased line prices (reflecting BT's approach to common cost recovery).

A22.12 BT indicated that if operators have a choice of using regulated dark fibre instead of self-building core network, the relatively low proposed price of dark fibre would mean that it was very unlikely that any further competitive build would take place. In effect, it considered that Openreach would become the default supplier of fibre capacity for core connectivity.[456]

A22.13 Although BT welcomed the fact that Ofcom recognised this concern by proposing a distance limit on the use of dark fibre and by excluding trunk segments (circuits between nodes in different Trunk Aggregation Nodes (TANs)) from the scope of the remedy, it was concerned that these limits alone would have very little impact on limiting a CP's ability to use regulated dark fibre to build a long distance or core route at all.[457]

A22.14 BT explained that it would be straightforward for CPs to construct circuits spanning distances in excess of 50km by joining multiple dark fibre circuits (or if required using mid-point amplification equipment to boost the optical signals in order to drive longer distances) without Ofcom's and/or Openreach's knowledge.[458]

A22.15 BT considered that additional constraints should be imposed to prevent CPs using dark fibre on regulated terms to bypass or undermine competitive core infrastructure. BT suggested the following additional constraints should be applied to the dark fibre remedy:[459]

- Defined TAN areas - Ofcom should identify areas nominally covered by each listed TAN (i.e. map all points in the UK to a parent TAN) and that there should be no requirement to provide dark fibre between any two such areas.

- Usage restrictions – a restriction preventing CPs from using dark fibre for the purpose of building, replicating or extending core networks, with strict definitions of what constitutes this usage to be developed, for example, by negotiation with an appropriate industry group.

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[456] BT response to May 2015 BCMR Consultation, Part A, page 34.
[457] BT response to May 2015 BCMR Consultation, Part A, page 35.
[458] BT response to May 2015 BCMR Consultation, Part A, page 35.
[459] BT response to May 2015 BCMR Consultation, Part A, page 35.

A22.16 Vodafone disagreed with the proposed 50km distance limit and suggested that the distance limit should loosely reflect current equipment capabilities. It considered that BT's wholesale services provide the appropriate reference, in particular, BT's Optical Spectrum Access (OSA) service which has a distance limit of 104km.[460]

A22.17 In its response to the May 2015 BCMR Consultation, and notwithstanding its opposition to our proposals to impose dark fibre, BT proposed that the distance limit should be specified in terms of the circuit 'main link'[461] radial distance, in line with its current practice for circuit length measurements. It also proposed that the distance limit should be set at 45km, the radial distance limitation used for BT's EAD Extended Reach (ER) product, which reflects the optimum reach of optical circuits before additional amplification is required. BT considered this would achieve the same policy objective and avoid unnecessary systems development costs and running costs associated with operating two processes in tandem.[462]

A22.18 BT subsequently wrote to Ofcom in December 2015 to explain that further work had revealed that the relevant pre-existing system component that could most easily be re-used for the dark fibre development was that used to apply maximum distance limits to its EAD products which are, in fact, defined in terms of end-to-end radial distance. BT therefore proposed that distance limits for dark fibre using existing EAD Extended Reach distance limitations of 45km end-to-end radial distance (subject to an overall maximum route limitation of 86km) would enable consistency between products and avoid unnecessary development costs and additional operational complexity.

Our assessment of stakeholders' responses

<u>Choice of distance limit and measurement methodology</u>

A22.19 We accept BT's argument that having a distance limit for dark fibre that is consistent with that for its EAD product (45km end-to-end radial distance) would enable consistency between products and avoid unnecessary development costs and additional operational complexity. In addition, setting distance limits for dark fibre that are the same as BT's EAD 1Gbit/s is consistent with our approach to pricing dark fibre and mitigates the risks to BT's common cost recovery, which might arise if the dark fibre distance limits were not the same as those for EAD 1Gbit/s.

A22.20 We have updated our analysis of the distances between BT's ASNs and the nearest core node to reflect the amendments we have made to the list of competitive core nodes (as discussed in Section 4). This analysis is intended to give an approximation of the distances relevant to providing backhaul circuits. Our updated analysis is provided in Figure A22.2.

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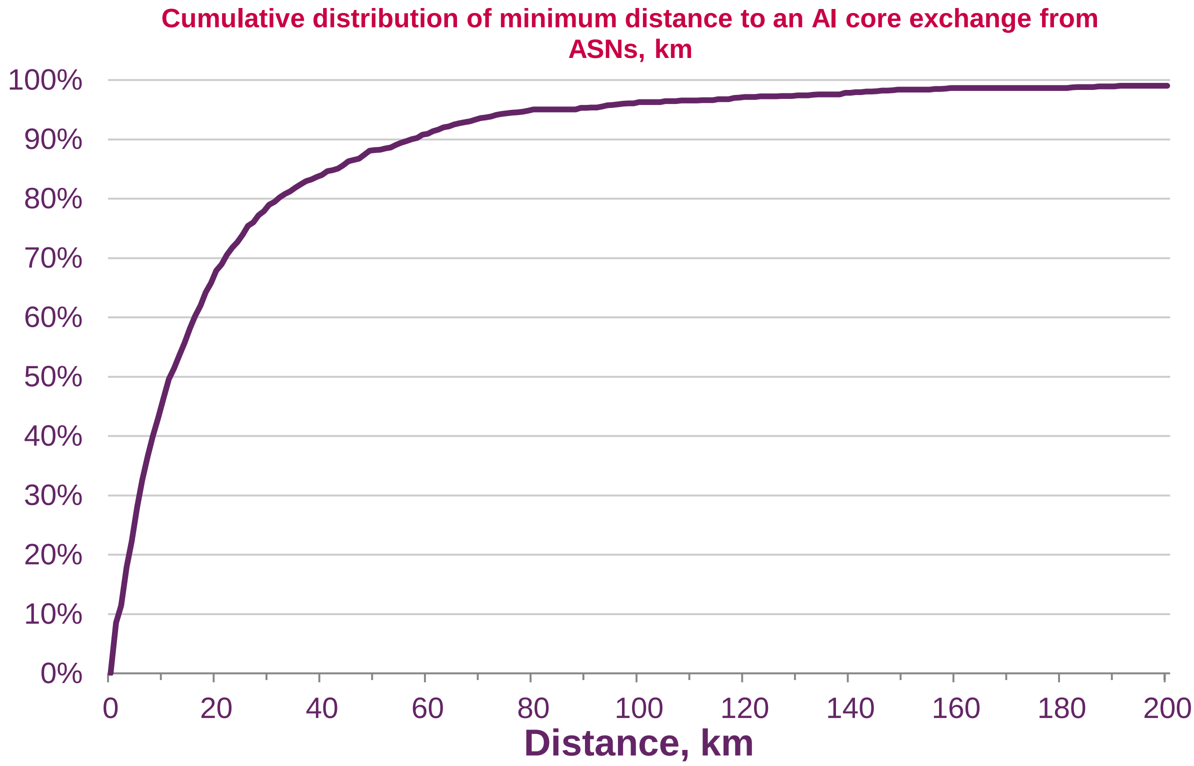
[460] Vodafone response to May 2015 BCMR Consultation, pages 7, 41 and 44.
[461] The circuit segment between the serving exchanges at each end of the circuit.
[462] BT response to May 2015 BCMR Consultation, Part A, page 34.

Figure A22.2: Distance of ASNs from competitive core nodes



A22.21 Our updated analysis shows that the majority of ASNs are within 20km of a core node and that around 86% are within 45km. Therefore, we consider that a distance limit of 45km for dark fibre would be sufficient to serve the large majority of backhaul needs.

A22.22 We do not agree with Vodafone that the distance limits should be longer and based on the distance limits of equipment (such as OSA which has longer limits than EAD). For the reasons explained above, we consider that longer limits would increase the risk that dark fibre would be used to provide core conveyance and thereby undermine infrastructure investments in the competitive core market.

Additional constraints proposed by BT

A22.23 We consider that BT's TAN area proposal would raise significant practical issues and could also hinder legitimate use of the dark fibre remedy. To implement such a constraint we would need to decide a basis for mapping geographic areas (and boundaries) between TANs. We do not consider that there is a clear and rational way of doing this and therefore the area boundaries imposed would be arbitrary. Consequently, such a constraint would prohibit legitimate use of dark fibre between locations in different 'TAN areas' and therefore restrict the benefits of dark fibre by restricting the opportunities for its use. While it may help to mitigate the risks of dark fibre being used to provide core connectivity, we consider that it would be impractical.

A22.24 We note that the SMP conditions expressly limit the scope of the remedy to the wholesale markets we have specified.[463] In particular:

- we are imposing the dark fibre remedy in the identified wholesale CISBO markets, which exclude core segments; and

- the dark fibre remedy we are imposing also reflects the scope of the wholesale markets and requires BT to provide wholesale terminating segments and short-range wholesale end-to-end segments.

A22.25 We therefore consider that it may be reasonable for BT to limit access to reflect the scope of the SMP conditions e.g. to limit usage to terminating segments and short-range wholesale end-to-end segments. We consider there may be a role for industry discussion to develop workable and robust rules.

Risk of usage for core connectivity

A22.26 We have also considered the residual risk that, notwithstanding the distance limit, dark fibre might be used in contravention of any usage restrictions to provide core connectivity. BT identified two specific risks:

- firstly, that CPs would be able to overcome the distance limit by joining together multiple dark fibre segments; and

- secondly, that the price of dark fibre would undermine CPs' incentives to invest in core fibre connectivity.

A22.27 We agree with BT that even with a distance limit it would be technically possible to build longer distance circuits using multiple dark fibre segments (or if required using mid-point amplification). However, it is worth noting that in the event that a CP joined multiple segments of dark fibre together, the CP would correspondingly incur multiple charges for the dark fibre product.

A22.28 Furthermore, we do not consider that the risks to core network investment as a result of dark fibre are significant. In this regard, and by way of illustration, we have examined the current price of BT's 10Gbit/s EBD circuits which are available in circuit lengths that are comparable to those that might be offered in core conveyance, and compared these prices with the proposed price of dark fibre. We acknowledge that BT's 10Gbit/s EBD product is regulated and since BT does not have SMP in core conveyance Openreach would not make EBD available for core conveyance.

A22.29 Nevertheless, the illustration is informative because prices for transmission in (competitive) core conveyance can be expected to be similar or lower than prices for EBD (since EBD prices are above BT's FAC). However, comparison showed that, for circuits longer than 19.2km, a customer would not have a price incentive to

[463] Schedule 1, Part 1, Paragraph 1

use dark fibre.[464] Therefore, given BT currently offers EBD circuits in distance lengths that are representative of distances used for core conveyance (and that EBD circuits are currently priced below the proposed dark fibre price for distance lengths that are representative of core conveyance) we would not anticipate that the introduction of dark fibre would have a significant risk of undermining core network prices and investments.

Our decision

A22.30 We have decided to impose a radial distance limit of 45km for dark fibre. This accords with the distance limits used by Openreach in relation to its active EAD circuits.

A22.31 Our SMP conditions expressly limit the scope of the dark fibre remedy to the wholesale markets we have specified. In particular:

- we are imposing the dark fibre remedy in the identified wholesale CISBO markets, which exclude core segments; and
- the dark fibre remedy we are imposing also reflects the scope of the wholesale markets and requires BT to provide wholesale terminating segments and short range wholesale end-to-end segments.

A22.32 In light of the above, we consider that it may be reasonable for BT to limit access to reflect the scope of the SMP conditions, e.g. to limit usage to terminating segments and short-range wholesale end-to-end segments.

Use for access network extensions

Proposals in the May 2015 BCMR Consultation

A22.33 In the May 2015 BCMR Consultation we noted that responses to the April 2014 CFI and the November 2014 BCMR Consultation reflected differing views about how regulated dark fibre might be used. These could be categorised into two broad scenarios of use:

- ‘dark leased line’ - dark fibre might be used by CPs in a very similar manner to BT’s existing active wholesale products. CPs would order access segments, backhaul segments and short-range end-to-end connections, to provide connectivity between nodes in their networks and connectivity to end-user premises, much as they do now with active leased line services; and
- ‘access network extension’ – CPs might use dark fibre to extend their existing access networks, in configurations ranging from small extensions (e.g. to provide connectivity from an existing access network flexibility point to an end-user premises) to potentially larger schemes to extend an access network to a group of premises.

[464] This estimate is based on a comparison of the total cost of ownership (i.e. price of rental and connection) of dark fibre and Band A EBD 10Gbit/s prices (over a 3-year period). [✂ ✂]

A22.34 We noted that with the dark leased line scenario, BT could provide circuits in the same way as it does for active circuits using its existing access network infrastructure, augmenting and extending it as necessary. In contrast, we considered that the access network extension scenario was in effect a full-service infrastructure model in which BT would allow CPs to use its duct infrastructure, but would deploy the fibre to order on CPs' behalf.

A22.35 We took the view that the access network extension scenario would be more relevant to promoting investment in fibre infrastructure generally than to addressing specific competition problems in leased lines markets. We considered that to impose regulatory requirements on BT which would require it to change the architecture of its physical infrastructure was unlikely to be a proportionate way to address the competition problems that we have identified, and therefore proposed that BT should not be required to support the access network extension scenario.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.36 Sky argued that for the dark fibre remedy to be fit for purpose, CPs should be able to backhaul traffic between the intermediate points of aggregation before the BT local exchange in the specific distance combinations that they require. The dark fibre design should therefore be sufficiently flexible to allow connection of any two intermediate aggregation points (whether to each other or to the BT local exchange) without requiring that each intermediate point is linked to the BT local exchange in a mirror image of Openreach's EAD design.[465]

A22.37 Vodafone argued that dark fibre should not be linked with a requirement to connect/pass back to a BT exchange.[466]

A22.38 The Passive Access Group (PAG) reiterated the views provided by stakeholders to the 2014 November BCMR Consultation, which indicated that the benefits of dark fibre (and passive remedies more generally) would be greatest it they are not constrained by usage restrictions.[467]

Our assessment of stakeholders' responses

A22.39 The responses to the May 2015 BCMR Consultation reflect the differences in views discussed above about how regulated dark fibre might be used.

A22.40 We consider that the additional flexibility sought by Sky, Vodafone and PAG relates to the deployment of access networks and the extension of existing access networks, and therefore fits with the 'access network extension' scenario discussed above. We remain of the view that this type of usage would be more relevant to promoting investment in fibre infrastructure more generally than to addressing specific competition problems in leased lines markets. Therefore, we do not consider it proportionate to impose regulatory obligations on BT in this review to support the access network extension scenario.

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[465] Sky response to May 2015 BCMR Consultation, page 10.
[466] Vodafone response to May 2015 BCMR Consultation, Annex 3, page 1.
[467] PAG response to May 2015 BCMR Consultation, page 25 to page 28.

A22.41 Given the competition problems that we have identified in the relevant markets in this review our aim is for the dark fibre remedy to enable CPs to provide leased line services in competition with BT, which supports innovation, competition and investment in the supply of downstream markets. We therefore consider that it is more appropriate and proportionate in this review to require BT to support the 'dark leased line' scenario and to impose a requirement for BT to provide dark fibre terminating segments including:

- disaggregated access and backhaul segments; and
- short-range end-to-end segments.

A22.42 These obligations will allow CPs to obtain dark fibre terminating segments in comparable configurations to the current range of active services. They will allow CPs to use dark fibre terminating segments to design and build active access products and enable CPs to compete in downstream markets more effectively than they can with active access products.

Our decision

A22.43 We have decided to impose an obligation on BT to provide dark fibre terminating segments of the following types:

- disaggregated access and backhaul segments; and
- short range end-to-end segments.

Handover locations

Proposals in the May 2015 BCMR Consultation

A22.44 In the May 2015 BCMR Consultation we noted that dark fibre could offer more flexibility than BT's wholesale leased lines services in terms of the locations at which services could be terminated.

A22.45 Whereas BT's wholesale leased line services are typically terminated at end-user premises, in part because of the power and environmental requirements of the Network Terminating Equipment (NTE), dark fibre could be terminated at different locations for several reasons:

- CPs rather than BT would select the NTE and could therefore select equipment suitable for alternative locations (e.g. equipment suitable for installation in street furniture);
- dark fibre could be terminated on passive components, such as passive optical splitters, which would be suitable for outdoor locations; and
- the termination could be a fibre splice with a CP's fibre network.

A22.46 In view of these considerations we proposed that BT should be required to terminate dark fibre segments in joint boxes, manholes and other external structures, as well as in end-user premises.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.47 BT considered that we did not provide any technical justification for our proposal that it should be required to terminate dark fibre segments in external structures (other than that power and environmental requirements may not be the same). It also considered that we had overlooked the cost and complexity to BT to re-engineer its workforce to support these arrangements and for which industry demand is so far unknown.[468]

A22.48 BT argued that were it required to offer handover in CPs' footway boxes, with direct splicing to CPs' fibre, this would raise the following issues:[469]

- Dark fibre repair and provision technicians would be required to be Underground (UG) trained to work in footway boxes and manholes and Overhead (OH) trained for wall mounted furniture;
- Provision and repair timescales would be longer, potentially with separate SLAs/SLGs;
- Complex contractual arrangements would need to be arranged to address issues including health and safety and liability; authority to enter manholes; and authority to break fibre for testing and repair purposes; and
- A premium price may be necessary to cover additional costs which would be incurred.

A22.49 Furthermore, BT considered that the additional cost, complexity, and logistical issues that BT and industry would need to address would not provide CPs with any benefit beyond the capability already offered by the existing Cablelink products. Therefore, it considered that it would be disproportionate for any such arrangements to form part of any dark fibre remedy.[470]

A22.50 BT considered that the dark fibre SMP remedy should be limited to a 'basic' dark fibre product that emulates the existing functionality available for the current active product today.[471]

A22.51 BT proposed to use a fibre patch panel as the handover demarcation point for dark fibre. BT considered that the patch panel would provide the optimal engineering solution and a physical demarcation of the dark fibre end points. BT considered that a patch panel offers the following advantages:[472]

- it provides a robust termination point which would help reduce the incidence of faults caused by engineering work on nearby circuits;

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[468] BT response to May 2015 BCMR Consultation, Part A, page 33.
[469] BT response to May 2015 BCMR Consultation, Part A, page 33.
[470] BT response to May 2015 BCMR Consultation, Part A, page 34.
[471] BT response to May 2015 BCMR Consultation, Part A, page 33.
[472] BT response to May 2015 BCMR Consultation, Part A, page 31.

- from a repair perspective it would offer an acceptable test point which can be readily identified, so the repair engineer does not have to search within multiple fibre tails, potentially causing further faults on CP equipment; and

- patch panel demarcation would give the CPs full control of their equipment layouts and would avoid the need for Openreach involvement elsewhere.

Our assessment of stakeholders' responses

A22.52 As discussed above, we consider that in principle, dark fibre could provide more flexibility for external handover of services than the current range of active services. These arrangements differ from Openreach's Cablelink product in that they relate to the handover of circuits (typically at the customer end) whereas Cablelink is provided in support of accommodation services at BT exchanges.[473]

A22.53 We acknowledge BT's concerns that practical issues associated with handover in external structures, such as joint boxes and manholes, could add complexity and costs to dark fibre. For example, BT would need to train and equip its dark fibre technicians to work in external structures and would need to address contractual matters relating to health and safety and issues relating to its authority to break and test dark fibre.

A22.54 Although we do not consider that these issues are insurmountable, given the demand for such variants is uncertain we now consider that it would be disproportionate to impose hand-over requirements beyond those required of active services.

A22.55 We consider that BT could assess demand for external handover arrangements as part of the implementation process. However, as we discuss in more detail in Section 9, in order to keep the implementation timescale as short as possible, we do not consider that BT should be required to deliver external handover arrangements for the initial service launch.

A22.56 As we discuss in more detail in Section 9, we have decided that BT should be subject to an obligation to provide network access on reasonable request and also subject to a 'new network access' obligation requiring it to have a process for dealing with requests for new service developments (commonly known as the Statement of Requirements (SoR) process). Thus if demand for external handover emerges at a later date, CPs could use the SoR process to request it.

A22.57 In our view, BT's proposal to use fibre patch-panels for circuit handover seems be a reasonable approach which could be progressed with industry as part of the implementation process.

Our final decision

A22.58 We have decided not to impose a specific obligation for BT to terminate dark fibre segments in joint boxes, manholes and other external structures. We consider that

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[473] Cablelink is a tie-cable product. The external variant connects a CPs cable located within 100 metres of a BT exchange to the CP's equipment rack within the BT exchange.

demand for such arrangements is best assessed as part of the implementation process.

New infrastructure arrangements

Proposals in the May 2015 BCMR Consultation

A22.59 In the May 2015 BCMR Consultation we considered the arrangements that should apply when new infrastructure is required, e.g. to relieve congestion, to clear blockages, repair damage and to extend the network to locations that are not currently served by BT's access network.

A22.60 We proposed that where new infrastructure is required for dark fibre, the corresponding charging arrangements should be the same as those which apply to BT's wholesale leased lines.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.61 Only [✂] commented about our proposals concerning the arrangements for new infrastructure. [✂] said that it was unclear whether BT would be required to install more duct or dark fibre in cases where there is no spare capacity.[474]

Our assessment of stakeholders' responses

A22.62 As we discuss in more detail below, we consider the arrangements for dark fibre provisioning where network congestion is encountered should reflect those for wholesale leased lines.

Our decision

A22.63 For wholesale leased lines, BT's current practice is to provide service to any location upon request, including locations that are not currently served by its network. In cases where new infrastructure is required to fulfil an order for a leased line, BT levies Excess Construction Charges (ECCs) for any extension to its access network that is specific to an individual customer, such as the final leg of its duct and fibre network that serves an individual premise. For fibre-based wholesale Ethernet services this generally equates to fibre between the serving fibre flexibility point (analogous to a distribution point in BT's copper access network) and the customer's premises, and duct that serves an individual customer's premises. New infrastructure in the common parts of BT's network (such as the installation of a new fibre flexibility point) and work to repair blockages and damage are not charged as ECCs even when undertaken to fulfil a customer order. These common infrastructure costs are capitalised and recovered from connection and rental charges over time.

A22.64 In relation to new infrastructure we consider that the same arrangements should apply for both the active and dark fibre remedies in order to:

[474] [✂]

- enable CPs to deliver comparable outcomes to wholesale leased lines and to compete effectively with them;
- ensure that any differences in the arrangements for active and dark fibre remedies are not unduly discriminatory; and
- minimise the risk that differences between the arrangements adopted for wholesale leased lines and the dark fibre remedies might artificially incentivise CPs to use one type of remedy over another.

A22.65 In view of these considerations, our view is that the existing charging arrangements for network extensions in relation to active services would provide the most suitable solution for dark fibre.

A22.66 For the avoidance of doubt, we consider that, where construction of new infrastructure is required which is not specific to an individual customer (for example to increase capacity or to repair broken duct), the arrangements should not differ between active access and dark fibre. Therefore, in this situation, BT would not charge an ECC.

Provisioning processes

Proposals in the May 2015 BCMR Consultation

A22.67 In the May 2015 BCMR Consultation we considered the provisioning processes that would be required for dark fibre. We considered that the provisioning processes for Ethernet leased lines should be suitable for dark fibre with minimal adaptation to remove the process elements associated with the network components not required for dark fibre (i.e. terminal equipment and alarm equipment).

A22.68 We considered that as there are fewer activities to perform there may be some scope for dark fibre to have shorter lead times than wholesale Ethernet services such as EAD. We expected that these differences would be reflected in the SLAs and SLGs for dark fibre.

A22.69 We also noted that there would be differences in the circuit handover arrangements. Our initial view was that these differences would be relatively minor and could be agreed as part of the implementation process.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.70 BT considered that we had played down the complexity of delivering dark fibre. BT considered that our assumption that BT could minimise implementation costs and timescales by adopting existing EAD and EAD LA processes and systems was unfounded. BT considered that delivering dark fibre will require new systems and processes to support provisioning and hand-over.[475]

[475] BT response to May 2015 BCMR Consultation, Part A, page 30.

A22.71 BT explained that the new provisioning processes for dark fibre (with accompanying technical specifications) would need to be agreed with industry. These would need to include:[476]

- a new technical specification for dark fibre (comparable to Suppliers' Information Note (SIN) 349 for Metallic Path Facilities[477]) would need to be developed and agreed;
- specifications for the class of lasers and engineering principles for use on BT's network to conform to BT's health and safety standards;
- new planning requirements and supporting operational processes to capture the end-to-end route distance and to calculate estimates of fibre loss;
- handover to the new fibre standard with loss and distance recorded for repair purposes, with network and systems records updated;
- provisioning in shorter timescales (than the active product) to be agreed with industry; and
- migration processes.

A22.72 BT also said that dark fibre would require a supporting 'cease' product. Unlike other wholesale leased line products, it would not be possible to remotely disable dark fibre using network management systems, and therefore BT would have to physically sever dark fibre connections. The costs would need to be recovered through an appropriate cease charge.[478]

A22.73 Vodafone considered that the ordering process for dark fibre should follow the passive parts of the EAD and stand-alone processes.[479]

Our assessment of stakeholders' responses

A22.74 We acknowledge that BT has identified several additional aspects of the wholesale leased line provisioning processes that would need to be adapted for dark fibre. Nevertheless, we remain of the view that, given the similarities between wholesale leased lines and the dark fibre remedy, the operational processes are likely to be very similar.

A22.75 Based on BT's consultation response and our earlier analysis, we now consider that the main changes that would need to be made to Openreach's systems and processes for dark fibre are likely to be:

- removal of the process elements associated with ordering and installation of terminal equipment and alarm/monitoring equipment and circuits;

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[476] BT response to May 2015 BCMR Consultation, Part A, page 31.
[477] http://www.sinet.bt.com/sinet/SINs/pdf/349v2p5.pdf
[478] BT response to May 2015 BCMR Consultation, Part A, page 32.
[479] Vodafone response to May 2015 BCMR Consultation, Annex 3, page 2.

- modifications to the planning process to ensure that circuits are designed in accordance with the dark fibre technical specification;
- revised circuit commissioning and test procedures, which may include loss measurements; and
- revised process timescales to reflect the differences noted above.

A22.76 We also acknowledge that BT's Reference Offer would need to include a technical specification of the dark fibre product and also to specify permissible laser types and power levels, and other engineering and safety rules.

A22.77 We recognise that it will take time to develop and agree the product specification and provisioning processes and also to make the necessary adaptations to operational systems. In Section 9 we address the implementation timescales for introducing dark fibre, taking into account the points raised by BT about the complexities of developing a dark fibre product.

A22.78 We agree with BT that dark fibre will require a supporting cease product. We have set out our consideration of cease charges and costs in our pricing guidance in Annex 23.

A22.79 Whilst these variations might mean that there is scope to shorten provisioning lead times for dark fibre compared with comparable active services, we consider that such scope is likely to be limited. Therefore, while we consider that the details relating to SLAs and SLGs arrangements for provisioning will need to be agreed between BT and the industry as part of the implementation process, our expectation is that the provisioning service times for dark fibre would be broadly similar to those for active services.

Our decision

A22.80 We consider that the provisioning processes (along with appropriate SLAs and SLGs) should be developed by BT and agreed with industry as part of the implementation process for dark fibre. We therefore do not propose to impose any specific obligations in relation to this.

Repair processes

A22.81 In this sub-section we discuss the practical implications relating to the repair process for dark fibre. The potential benefits/risks relating to fault detection and repair under dark fibre are covered in Annex 18.

Proposals in the May 2015 BCMR Consultation

A22.82 In the May 2015 BCMR Consultation we considered the arrangements for fault reporting and repair for dark fibre.

A22.83 We acknowledged that the fault repair processes for dark fibre would differ significantly from those for wholesale leased lines, because CPs rather than BT would be operating the network equipment that facilitates monitoring and fault diagnosis. We noted, however, that commercial dark fibre services are well established in the UK and in other countries and were confident that workable arrangements could be agreed and implemented.

A22.84 We also acknowledged that the differences in the repair processes would need to be reflected in the SLAs and SLGs for dark fibre fault repair. In particular, longer fault repair lead times would be required as BT would be responsible only for fibre faults which would generally take longer on average to repair than faults which are reported in the operation of BT's active services, which are a mixture of fibre faults, faults with BT's active equipment and faults with the customer's equipment.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.85 BT considered that the introduction of dark fibre would have the largest impact on its repair processes, since BT will lose the 'eyes on' active monitoring capability in operation today. BT considered that Ofcom had underplayed the practical implications of the absence of active monitoring on dark fibre circuits.

A22.86 BT explained that under a dark fibre remedy it would be unable to operate a proactive repair and monitoring service for dark fibre and that, to compensate, industry-wide processes would be required to ensure that quality of service is maintained.[480]

A22.87 BT highlighted the following operational issues relating to fault repairs:[481]

- BT would need to specify the diagnostic test information that CPs would provide to BT from their own triage/diagnostics as it would not be able to carry out remote diagnostics itself;
- BT would need to validate customer faults against stored provision test results history;
- BT would need to build 'job packs' and send details to a fibre control team; and
- all fibre faults to require a 'truck roll', to one or both ends of the circuit.

A22.88 Vodafone suggested that CPs should be responsible for detecting faults and booking out Openreach to repair these.[482]

A22.89 BT agreed with Ofcom that the "*performance achieved by Openreach in the delivery of active and passive services*" would not be identical. BT explained that the current SLA Direction does not apply to dark fibre and a new SLA/SLG framework would need to be identified. BT considered that the most appropriate mechanism is to negotiate the terms with industry against objectively justifiable criteria.[483]

Our assessment of stakeholders' responses

A22.90 We recognise that dark fibre will require different arrangements in relation to the fault reporting and repair processes since CPs, rather than BT, would be operating the network equipment which facilitates monitoring and fault diagnosis. In particular:

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480 BT response to May 2015 BCMR Consultation, Part A, page 32.
481 BT response to May 2015 BCMR Consultation, Part A, page 30.
482 Vodafone response to May 2015 BCMR Consultation, Annex 3, page 3.
483 BT response to May 2015 BCMR Consultation, Part A, page 32.

- CPs will need to take the lead role in fault diagnosis;
- as BT will not have its own remote diagnostic capability, CPs will need to take greater responsibility for the dispatch of BT technicians to repair fibre faults;
- to ensure that BT's field resources are used efficiently, it will be necessary to specify a minimum set of diagnostic tests and associated test results as criteria for dispatch of BT field technicians; and
- CPs will need to provide fault diagnosis information to BT to support its field repair activities.

A22.91 We acknowledge that there may be some practical challenges, and we accept that developing new processes and agreeing them with industry will require effort from BT and other CPs. However, we are confident that workable arrangements can be agreed and implemented. In this respect, we note that commercial dark fibre services are well established in the UK and in other countries.

A22.92 In Annex 18 we consider BT's concerns that poor fault diagnosis could greatly increase the workload of its field teams that deal with fibre fault diagnosis and repair.

A22.93 We acknowledge, given that there will be differences between fault and repair processes for dark fibre relative to active services, these differences would need to be reflected in the SLAs and SLGs for dark fibre fault repair. In particular, longer fault repair lead times would be required as BT would be responsible only for fibre faults which would generally take longer on average to repair than faults for active services, which are a mixture of fibre, active equipment and customer faults. We agree with BT that these SLAs and SLGs should be developed and agreed with industry as part of the implementation process.

A22.94 We set out our views regarding the inclusion of SLAs and SLGs in the Reference Offer in Section 9.

Our decision

A22.95 We consider that the fault repair processes (along with appropriate SLAs and SLGs) should be developed by BT and agreed with industry as part of the implementation process for dark fibre. We therefore do not propose to impose any specific obligations in relation to this.

Service migration processes

Proposals in the May 2015 BCMR Consultation

A22.96 In the May 2015 BCMR Consultation we considered that requirements for migration processes from wholesale leased lines to dark fibre should be agreed by negotiation between CPs and BT as part of the implementation process.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.97 BT proposed that the Reference Offer would include migration options from the current active products to dark fibre. However, BT considered that the Reference Offer would exclude migration options from a single fibre to a dark fibre pair because BT would be unable to guarantee that the fibres would be in the same sheath and therefore could not guarantee the fibre routing.[484]

A22.98 Vodafone considered that CPs should be free to migrate to dark fibre from active services, free of penalty and regardless of the minimum term for the active service.[485]

Our assessment of stakeholders' responses

A22.99 We acknowledge that the practical difficulties cited by BT may complicate migration from single fibre to dual fibre circuits. If these difficulties prove to be insurmountable, this type of migration may need to be effected by the provision of a new dual fibre circuit. We suggest that arrangements for this type of migration are best developed by BT and agreed with industry as part of the implementation process.

A22.100 We do not agree with Vodafone that CPs should be free to migrate to dark fibre from active services without penalty regardless of the minimum term for the active service. In providing an active service, BT will have incurred costs that need to be recovered. Establishing a minimum term allows BT to ensure a set of revenues that contribute to its recovery of costs. Allowing CPs to freely migrate to dark fibre from active services (regardless of the minimum term) could undermine BT's ability to recover those costs.

Our decision

A22.101 Given the uncertainty about the detailed specification of dark fibre and CPs' detailed requirements in relation to migration processes, we consider that requirements for migration processes are best agreed by negotiation between CPs and BT during the implementation process. In view of this we have decided not to impose specific obligations concerning migration of active services to dark fibre.

A22.102 We consider that CPs are likely to focus initially on using regulated dark fibre to provide new circuits rather than to migrate existing ones and therefore migration processes are a somewhat lower priority for the initial service launch.[486] Therefore, we have decided that BT should not be required to have developed a process for migrating active services to dark fibre circuits for the initial service launch. During this initial phase, should a customer require an existing active service to be migrated to a dark fibre circuit the 'cease and re-provide' method could be used.

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[484] BT response to May 2015 BCMR Consultation, Part A, page 32.
[485] Vodafone response to May 2015 BCMR Consultation, Annex 3, page 2.
[486] This is reflected in our analysis of the volume impact to BT's active services as a result of the introduction of dark fibre in Annex 33.

Infrastructure Discovery

Proposals in the May 2015 BCMR Consultation

A22.103 In the May 2015 BCMR Consultation we considered Colt's and UKCTA's suggestion in their responses to the April 2014 CFI, that Openreach should provide an online tool to enable CPs to view Openreach's duct and fibre infrastructure.

A22.104 We noted that Openreach was assessing the feasibility of developing such a tool for use in connection with wholesale Ethernet leased lines and considered that it could also be used for dark fibre. However, we did not propose any specific obligations relating to infrastructure discovery.

Stakeholders' responses to the May 2015 BCMR Consultation

A22.105 Vodafone considered that CPs should be provided with route maps for standalone survey and electronic systems to enable network planning, reusing or adding to the infrastructure discovery capability or other internal network information resources.[487]

Our assessment of stakeholders' responses

A22.106 We consider that the infrastructure information described by Vodafone would be of particular benefit in the 'access network extension' scenario as described in paragraph A22.33 above. Under this scenario, CPs would have the ability to use dark fibre to extend their existing access networks and would therefore require detailed information about the location of BT's duct and fibre infrastructure to plan their own access network extensions.

A22.107 However, as explained in paragraph A22.43 the dark fibre remedy we are imposing will only require BT to provide dark fibre terminating segments in a similar manner to active wholesale leased line services (the 'dark leased line' scenario). CPs' requirements in relation to infrastructure information for the dark fibre remedy are therefore likely to be very similar to those for wholesale leased lines. As Openreach has not historically provided CPs with detailed information about the location of its duct and fibre infrastructure in connection with wholesale leased line provision, we consider that provision of such information is not essential for the dark fibre remedy we are imposing in this review. Consequently, we have decided not to impose a specific requirement for BT to provide infrastructure information.

A22.108 Information about the location of Openreach's duct and fibre infrastructure could, however, be useful for dark fibre provisioning. It could, for example, help CPs estimate lead times and the likelihood of ECCs. In this context we note that since the May 2015 BCMR Consultation, Openreach has launched the infrastructure discovery tool for Ethernet provisioning discussed above. We consider that this tool could also be used with dark fibre.

A22.109 Furthermore, in our DCR Statement, we explained that in relation to our strategic intent of encouraging investment in FTTH through making it easier for CPs to access BT's duct and poles, we would be requiring Openreach to establish an

[487] Vodafone response to May 2015 BCMR Consultation, Annex 3, page 2.

online database, accessible to all of its wholesale customers. This database would provide CPs with information on the location, condition and capacity of the infrastructure that BT deployed.

Our decision

A22.110 We have decided not to impose a specific requirement for BT to provide infrastructure information.

Annex 23

Dark fibre pricing

Introduction

A23.1 In Sections 7 and 9 we have set out our decision to introduce a dark fibre remedy, and that it should be priced on an 'active-minus' basis.[488] We also decided (in Section 9) that rather than specify the value of the minus upfront, we will provide guidance on how we would expect to calculate it at any given time.

A23.2 In light of these conclusions, and reflecting consultation responses, this annex now explains our final guidance. We provide a summary of the guidance itself in Annex 24.

A23.3 In this annex, we discuss:

- the relevant cost standard for assessing the 'minus' used for determining the dark fibre rental and connection charges (we refer to the differential between the active benchmark and dark fibre price as the 'active differential');
- our guidance on calculating the active differential for dark fibre rental and connection services, including an illustrative calculation of this;
- our guidance on rental and connection pricing where asymmetry between dark fibre and the reference EAD product may be warranted (including dual-fibre pricing); and
- our approach to ancillary services associated with the dark fibre product.

A23.4 Taking each of these areas in turn, we first summarise our June 2015 LLCC Consultation proposals, then summarise the views of stakeholders, and set out our resulting conclusions.

Cost standard

Summary of our initial view

A23.5 In the June 2015 LLCC Consultation, we considered a LRIC or LRIC+ approach to assessing the active differential, and proposed to use the former due to the productive and dynamic efficiency incentives it would provide. In particular, given we did not consider it necessary or desirable to set charges to promote dark fibre over other forms of access in the leased line market, we wanted to create incentives for access-seekers to base their choices between dark fibre and active products on the productive and dynamic efficiencies they could achieve with dark fibre. We

[488] In Section 9, we also state that we would expect the reference prices used in the active minus calculation to be the one year price for the corresponding active product, irrespective of the dark fibre contract length/minimum term.

considered that it would be consistent with promoting these efficiencies to set the relative charges to reflect those costs which BT avoids in the long run in providing dark fibre instead of the active product.

A23.6 We also proposed that compliance with the LRIC-based active differential should be assessed based on cost data that is available to BT at the point at which it sets its charges, and so considered that this should be the year to end December, prior to the charge control year (e.g. for the charge control year 2017/18, it would be assessed based on cost data for the year to 31 December 2016).

Responses to the May 2015 BCMR and June 2015 LLCC Consultations

A23.7 In relation to the cost standard, several respondents (PAG[489], Sky[490], Vodafone[491] and GTC[492]) raised concerns about the use of LRIC. In particular, these CPs argued that BT's LRIC may not provide sufficient margin for even efficient operators to compete in the provision of active services (including 1Gbit/s services), which would reduce the benefits of the remedy. Several reasons were given for this:

- The PAG (in a report produced by Frontier Economics ('Frontier'))[493], Sky and Vodafone all argued that rivals are unlikely to benefit from BT's scale and possibly scope economies, meaning BT is likely to have lower unit costs for the provision of active services than even equally efficient competing CPs. While Frontier accepted that the degree of economies of scale and scope may be relatively more limited in the provision of active services, it argued that it is reasonable to expect that both will still be present, and referred to the higher volumes of active equipment purchased by BT, the sharing of operating/maintenance costs between different equipment types, and the sharing of other fixed/common costs between the provision of active and other services by BT as examples. Frontier also argued that this effect is likely to be more pronounced given the proposed pricing approach restricts the scale of CPs since it limits the volume of services which can be viably provided with dark fibre.[494]

- Both PAG and GTC argued that not deducting any contribution to common costs where a CP switches from an active BT product to dark fibre may distort competition. This is because a competitor migrating to dark fibre must make the full contribution to BT's common costs associated with an active service as well as a contribution to its own common costs associated with delivering that active

[489] PAG non-confidential response to the May 2015 BCMR Consultation, paragraph 2.18.
[490] Sky non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultation, paragraph 8.30-8.31.
[491] Vodafone non-confidential response to the June 2015 LLCC Consultation, paragraph 7.8.
[492] GTC non-confidential response to the June 2015 LLCC Consultation, response to Q8.1.
[493] Frontier Economics, *Ofcom's proposals on regulated dark fibre pricing: a report prepared for the Passive Access Group*, page 16-18. Received as part of the PAG non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultations.
[494] Frontier argued that if LRIC ends up being too low to make 1Gbit/s contestable, then less than 10% of the market would be contestable by the end of the charge control. It argued this means there is a real risk that the charge control volume assumptions for active services (which are based on 100% cannibalisation of 1Gbit/s in the final year) may be too low, and so then the charge control for Ethernet services will allow BT to over-recover its costs. We discuss the volume assumptions in Annex 33.

service, but BT does not suffer any reduction in the contribution to its common costs in that scenario. GTC argued that it does not seem appropriate for BT to recover the whole component of the common cost component from the CP, and instead there needs to be a mechanism for allocating these common costs between upstream and downstream components.[495]

- The PAG (in a report produced by Frontier) argued that the fact that CPs already have active equipment in place does not support the use of dark fibre where the margin is not sufficient to cover the LRIC of active equipment as equipment tends to have relatively short asset lives. Further, dark fibre is in any event expected to be used for new demand, where there would be no existing equipment, rather than the substitution of existing services.

A23.8 BT agreed that a LRIC+ approach was not appropriate. In particular, it argued that it would not be proportionate given the risks of incentives to use dark fibre purely because of price arbitrage opportunities. However, it also argued that a LRIC approach does not remove these incentives, referring to aggregation and other arbitrage opportunities for the different EAD 1Gbit/s variants (such as EAD ER) which remain even with a LRIC approach (we discuss these further in Annex 33). BT also stated that Ofcom had not considered stranded assets in proposing a LRIC-based active differential on productive and dynamic efficiency grounds. Therefore BT considered that the approach fails to recognise a number of the opportunity costs which directly impact the opportunity for BT to recover its costs in the future.[496]

A23.9 In relation to compliance, BT stated that DLRIC cost data to end-December may either not have been produced, or if available, would not have been sufficiently audited for use as the basis for setting prices.[497] Therefore, BT stated that the proposal for the active LRIC to use available cost data means in practice it will be based on prior year costs from the RFS (for example, the active LRIC for the year 2016/17 will be based on the financial year to 31 March 2015). It also stated that there would be an issue in practice, as the RFS for the financial year to 31 March 2015 is published on 31 July 2015, and so it would not be possible to notify new prices that use published data from the RFS 2015/16 before 1 September 2015 (with new prices taking effect 28 days later).[498]

A23.10 Vodafone[499] and PAG[500] also argued that there is a risk that the active minus pricing proposal creates a margin squeeze, which we discuss further in Annex 21.

Our decision

A23.11 In line with our general approach to price regulation and our approach to the LLCC specifically (as discussed in Section 5 of Volume II), we consider it appropriate to

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[495] Relatedly, GTC queried whether the common costs for dark fibre were necessarily the same as those incurred in the provision of EAD. It argued that if this was not the case, customers of dark fibre would make a greater contribution to costs than downstream BT/active services.
[496] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 267-273.
[497] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 278.
[498] Annex A of BT's non-confidential response to June 2015 LLCC Consultation, Paragraph 2-3.
[499] Vodafone non-confidential response to the June 2015 LLCC Consultation, Paragraph 7.8.
[500] PAG non-confidential response to the May 2015 BCMR, Paragraph 3.2.

base the active differential on BT's costs. There are two main options for the cost standard to use to calculate the active differential based: LRIC or LRIC+. In order to determine which is appropriate, we have taken into account, amongst other things, the need to promote efficiency (including productive, allocative and dynamic efficiency) and sustainable competition.

A23.12 When making this assessment on the cost standard, we consider that the relevant increment is a material negative increment in the volume of 1Gbit/s EAD or EAD LA active circuits sold due to the sale of dark fibre service, when compared with the likely situation absent the imposition of a dark fibre remedy. To be clear, we do not consider that the relevant increment at this point includes the possibility of active service provision falling to zero, meaning the exiting of the active business. Therefore LRIC in this context measures the 1Gbit/s EAD and EAD LA active service costs that BT is likely to avoid incurring in the long run as a result of providing dark fibre.

A23.13 In addition, while we note that fibre can be used to provide a service of any bandwidth, when considering the appropriate cost standard, we focus on the active differential between the reference active products (1Gbit/s EAD or EAD LA) and dark fibre, given this is the regulated margin. We recognise that based on BT's current active pricing structure, the differential between the resulting dark fibre price and other Ethernet services which are not used as a reference product may differ from the cost standard chosen (which could affect the efficiency considerations below with regards to these products). However, this is a matter of commercial pricing (i.e. we are not setting, or seeking to set, a regulated margin between dark fibre and other non-reference active services). Further, subject to the constraints of the LLCC and the safeguard cap on services above 1Gbit/s, we would expect competition in the provision of active services which is facilitated by dark fibre to drive BT's future margins on other active products (i.e. we would not necessarily expect margins between dark fibre and non-reference products to stay at their current level once dark fibre is available).

Productive efficiency

A23.14 In determining the differential between dark fibre prices and the reference active products, we wish to incentivise the use of dark fibre where it provides benefits relative to active remedies, rather than for arbitrage per se. Taking into account our other objectives of maintaining an opportunity for BT to set a bandwidth gradient, as well as mitigating the impact on rival infrastructure investment, we consider that this is best met by setting the charge relative to BT's EAD 1Gbit/s product (we set out our rationale for the active minus pricing approach (as well as the efficiency implications) more generally in Annex 21). Having done so, we consider that productive efficiency is best achieved by requiring that the differential in charges between the active reference product (1Gbit/s EAD or EAD LA) and dark fibre product reflects those costs that BT avoids in the long run by providing a dark fibre rather than the active product i.e. the LRIC of the 'active' elements. Such a differential allows downstream firms that are at least as efficient as BT to make an efficient choice to purchase the dark fibre input when providing 1Gbit/s services, which account for the majority of the usage we anticipate for dark fibre in this review period.[501]

A23.15 Stakeholders have argued that requiring them to make a full contribution to BT's active-specific common costs under a LRIC approach will cause a distortion given they will need to recover their own common costs associated with active services (see paragraph A23.7). However, we consider that these concerns are misplaced. We do not expect OCPs to use dark fibre to sell a wholesale active product in competition with Openreach. Rather, we consider active circuits and dark fibre are both wholesale products which serve as alternative inputs for the same retail services, i.e. business connectivity services sold to end customers. Setting the charge differential between the active reference product and dark fibre to be equal to the LRIC differential – so that these substitute wholesale products recover the same common costs – should induce an efficient choice of wholesale inputs, and so help to minimise overall resource costs.[502]

A23.16 Although BT has argued that we had not considered stranded assets (which could have implications for productive efficiency), it appears this is a more fundamental concern about the productive efficiency implications for a dark fibre remedy overall (which we discuss further in Annexes 18 and 19), rather than specifically the cost standard to use for the minus. In particular, the risk of stranded assets arises as a result of active circuits switching to dark fibre before the equipment has been fully depreciated.[503] This risk arises irrespective of whether a LRIC or LRIC+ cost standard is used if circuits migrate. However, to the extent that a LRIC+ approach facilitates inefficient migration to dark fibre, we consider that the risks of stranded assets associated with such inefficient use would be higher, and therefore would tend to support the use of a LRIC approach for the active differential.

Allocative efficiency

A23.17 We consider that allocative efficiency considerations are less important than productive and dynamic efficiency considerations when setting the active differential. In forming this view, we note that increasing the active differential, by using LRIC+ rather than LRIC, would result in a lower dark fibre price (an increased differential between the active price and the dark fibre input price). While this might

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[501] We note that it is possible that the implied differential with active services above 1Gbit/s could exceed LRIC (particularly based on current prices). However, we do not consider it proportionate to adjust the dark fibre price to reflect this, as such a charge would render dark fibre uneconomic at 1Gbit/s, and so be contrary to our objective of encouraging widespread take-up of dark fibre. In addition, as set out above, we are only regulating the margin between the reference (1Gbit/s EAD and EAD LA) active services and dark fibre, and we note BT is able to respond to market dynamics in setting the prices of active services above 1Gbit/s relative to dark fibre, as it considers it appropriate.

[502] CPs have raised a related issue about recovery of common costs between upstream and downstream products in relation to the LLCC, which we discuss in Section 5. This view is also consistent with our approach (and rationale behind our approach) for MPF and SMPF+WLR in the 2014 Fixed Access Market Review. See for example paragraph 3.78, *Fixed Access Market Reviews: Statement – Volume 2: LLU and WLR Charge Controls*, 26 June 2014 http://stakeholders.ofcom.org.uk/binaries/telecoms/ga/fixed-access-market-reviews-2014/statement-june-2014/volume2.pdf

[503] We discuss further in Annex 19 why we would not expect there to be a significant risk of fibre stranding.

have benefits in terms of higher dark fibre take up, it would mean that BT would recover less of its common costs from the dark fibre product, and these would need to be recovered elsewhere by BT. This suggests that overall allocative efficiency impacts would be difficult to estimate, and could be positive or negative (depending on services purchased).[504] For these reasons, we have not given allocative efficiency considerations significant weight when forming a view on the best approach to calculating the active differential.

Dynamic efficiency

A23.18 We consider that the introduction of a dark fibre remedy would, in and of itself, tend to promote dynamic efficiency (as discussed in Section 7 of Volume I and Annex 18). However, dynamic efficiency can also be enhanced by increased competition, and as a result, in some cases Ofcom actively seeks to sets access charges in a way to promote entry due to the dynamic benefits this may deliver. This may include considering whether it is appropriate to allow for an increased pricing differential while downstream competitors become established and develop economies of scale. For example, we previously considered it appropriate to promote LLU-based competition, and so adopted a pricing approach in the early years to help achieve this. This involved the price differential between active and passive access products being more than the differences between their respective LRICs. The differential has since been reduced as LLU-based competition has become more established.

A23.19 In the case of the dark fibre remedy, however, we do not consider it necessary or appropriate for us to seek to actively promote entry using dark fibre by increasing the differential between the 1Gbit/s EAD or EAD LA reference active products and dark fibre charges. This is because contrary to the view of the PAG, Sky and Vodafone (see paragraph A23.7), we consider that the use of a dark fibre remedy is unlikely to involve significant economies of scale, beyond those associated with the provision of active services. In particular, as explained in Annex 18, CPs are already supplying their own active elements in many cases, effectively 'bookending' BT's equipment with their own similar equipment. Consequently, there would appear to be more limited additional investment required to use dark fibre over and above active services, even when taking into account the operating and maintenance costs involved (as well as the equipment itself). As such, it is not clear it would be necessary to set a LRIC+ differential to actively assist entry.

A23.20 Further, while we do not dispute that BT enjoys certain economies of scope (as argued by Frontier, in its report for the PAG) at the network level, it is less clear that these translate to significant advantages at the active level such that other CPs will be unable to utilise the dark fibre remedy effectively. Indeed, BT's regulatory accounts seek to ensure an appropriate level of costs is recovered from services in the business connectivity market. In addition, given many CPs already purchase equipment which is capable of running an active service when they purchase an active circuit which they use alongside BT's active equipment, the 'minus' component will in some cases likely be largely a cost saving (rather than needing to

[504] We note that if the net effect was to increase the price of low bandwidth services where customers might be most price sensitive, then this would favour a LRIC approach over LRIC+, because (all else equal) we would expect BT to need to make smaller adjustments to rebalance its active price structure.

compensate for purchasing electronic equipment[505]). Frontier has argued that this is not the case given the relatively short asset lives of equipment and since dark fibre is expected to be used for new demand rather than substitution (see paragraph A23.7). However, our expectation is that given many CPs appear to effectively ‘bookend’ BT’s equipment with their own, they will not necessarily incur significant additional equipment costs for new dark fibre circuits relative to if they had purchased an active circuit. Therefore to the extent this is true, the active differential is not necessarily required in order for the CP to purchase electronic equipment.

A23.21 Therefore we consider that a LRIC-based active differential based on BT’s costs provides sufficient margin for efficient operators to compete in the provision of active 1Gbit/s EAD or EAD LA services using dark fibre, and therefore deliver the dynamic benefits of dark fibre we are seeking to achieve. In light of this, we do not consider it necessary to increase the active differential in order to favour competition based on dark fibre over that based on BT’s active products.[506]

A23.22 In addition, we note that we have adopted an active minus pricing approach partly because we place significant weight on not undermining efficient investment in alternative passive infrastructure and the dynamic benefits it can deliver (as discussed in Annex 21). We consider that a lower dark fibre price due to an increased active differential (based on LRIC+) would at the margin reduce those incentives, which would be contrary to this rationale.

Risk of error for dynamic efficiency

A23.23 We note that if there is any error in the estimation of LRIC (accidental, or as a result of gaming by BT), there could be harm to competition and dynamic efficiency. In particular, setting the differential lower than the LRIC differential would mean even efficient CPs will find it uneconomic to use dark fibre, while setting the differential above LRIC could lead to inefficient entry. If we were particularly concerned about the risk of harm from setting an active differential too low (i.e. below LRIC), it could suggest a LRIC+ approach would be more appropriate.

A23.24 We acknowledge that, at least in theory, calculation errors may result in a differential that is below the ‘true’ LRIC of the active elements. However we do not think this is a major risk in this case. The major active cost components are relatively clearly identified in BT’s regulatory accounts (see discussion below), so the risk of a significant underestimate of the active LRIC appears relatively limited. Moreover, our proposal to provide guidance as to how BT should calculate the differential, rather than specifying the differential upfront, will reduce the risk of forecast error.

A23.25 More fundamentally, our aim is to allow CPs to take advantage of the potential benefits of dark fibre over and above active services (for example, to differentiate their offerings). If there are genuine benefits to consumers from dark fibre, then dark

[505] There may be some additional cost (e.g. longer distance lasers may be required then were previously used in the CP equipment), but we consider these are likely to be relatively limited.
[506] We consider this is consistent with our decision in the June 2014 FAMR Statement, where we chose to set differences between charges for substitute inputs at LRIC. See paragraphs 3.77–3.108 of June 2014 FAMR Statement Volume 2.

fibre may still be adopted to the extent that these benefits exceed any slight underestimation of the LRIC of the active elements. We also note that the dark fibre product is benchmarked for the purposes of pricing to the BT EAD and EAD LA 1Gbit/s services, but the objective is not purely to exactly replicate that product. In practice, a 1Gbit/s active product allows the user to consume up to a maximum of 1Gbit/s of capacity, while a dark fibre may be used to carry considerably more bandwidth than this. Even in cases where dark fibre is used for a 1Gbit/s bandwidth, it provides additional benefits including reduced equipment, greater service differentiation and the ease of future upgrading (as discussed in Annex 18). Therefore it is not clear that the precise calculation of the differential, in terms of potentially undermining the LRIC of the active elements, would be critical to the economics of dark fibre use in most applications.

A23.26 In light of the above, we do not think a LRIC+ differential is needed to avoid the possible risks to dynamic efficiency of underestimating the LRIC differential.

Conclusion on cost standard

A23.27 For the reasons set out above, we consider that both productive and dynamic efficiency point to pricing being set to reflect LRIC differentials. In particular, we do not consider it is necessary or desirable to set charges to promote dark fibre over other forms of access in the leased line market. This means that to promote efficiency, the relative charges of the active benchmark and the dark fibre products should reflect those costs which BT avoids in the long run by providing dark fibre rather than the active product. We therefore conclude that the active differential should be set at LRIC.

Time period for compliance

A23.28 The differential in long-run incremental costs may change over time. Compliance with the condition could in principle be assessed based on either current period costs, or on prior period costs. Compliance on the basis of current period costs would have the benefit of being related to the actual differential at that period in time. However, it would mean that compliance could be subject to some forecast gaming opportunities, and also may mean that BT could inadvertently not comply due to forecast error.

A23.29 There are also some practical issues to consider with assessing compliance based on prior period costs (as noted by BT).

A23.30 To our knowledge, BT only produces LRIC data for its financial year based on the audited FAC RFS. BT’s financial year runs from April to March (meaning a March year-end), with BT’s RFS being published at the end of July and the LRIC data (supplied in the form of unaudited Additional Financial Information (AFI)) in September. In the example of compliance in the Second Relevant Year (1st April 2017 – 31st March 2018), there would be no LRIC data available to December 2016. There would also be no LRIC data available for the Prior Relevant Year (1st May 2016 – 31st March 2017) as BT prepares LRIC data based on its financial year. The LRIC data in respect of the Prior Relevant Financial year (1st April 2016 – 31st March 2017) would not be available until September 2017. Therefore the only information available to BT would be in respect of the financial year 1st April 2015 – 31st March 2016. Part way through the Second Relevant Year (around September 2017) information in respect of the financial year 1st April 2016 – 31st March 2017 would become available.

A23.31 For this reason, we conclude that compliance will be assessed not on December data (as per the LLCC compliance), but based on the latest available prior financial year LRIC data. In particular, compliance will be assessed based on actual cost data for the latest financial year which is available to BT at the point at which it sets its charges. This must be updated when new actual cost data becomes available. For example, compliance for 2018/19 will initially be based on 2016/17 LRIC data, until the 2017/18 LRIC data is submitted to Ofcom (in September 2017), when we would expect BT to update its dark fibre price if necessary to ensure compliance with this new data (in the same way BT would if the price of the active product changes). Given dark fibre will be introduced in October 2017, BT will already have supplied the 2016/17 LRIC data, and so compliance will be assessed on this basis.

Overall conclusion on cost standard

A23.32 In light of the above discussion we conclude that a LRIC approach to calculating the active differential is appropriate, and this should be assessed based on cost data for the latest available financial year.

Guidance on calculating the active differential (i.e. the ‘minus’)

Introduction

A23.33 We set out guidance on how we would anticipate determining the appropriate active differential for the purposes of setting a dark fibre price (for example, if we were to resolve a dispute in relation to the proposed SMP condition). This guidance is intended to provide further clarity to BT on what is required under the SMP condition, and also provide transparency to other CPs about our approach. A summary of the guidance itself (without the underlying rationale) is provided in Annex 24.

A23.34 The guidance is based on the information we currently have available. While any assessment of BT’s compliance with the SMP condition would be based on the prevailing circumstances at the time, and we recognise that we cannot fully predict all eventualities during this review period, given our guidance sets out an approach to the cost components rather than the specific level of costs to be included, we would expect this to already provide a degree of flexibility to reflect many reasonable changes in circumstances which may have a material effect on the active differential.[507] Therefore we would only expect to need to depart from this guidance where circumstances are materially different from those described below.[508] As a result, to the extent BT wanted to depart from this guidance, we would expect it to be able to present a clear, strong and evidence-based justification for doing so in light of the prevailing circumstances.

[507] For example, this will allow changes in the level of the cost components to be reflected in the active differential.
[508] For example, our guidance is based on the existing attribution of costs to components in the RFS. If this attribution changes, our assessment of costs may need to adapt to reflect the new attribution of costs. We would anticipate however, that such changes would be consistent with the principles in this guidance (e.g. to the extent BT changed its cost components in the future, we would expect it to follow a similar approach to the replacement components as we have set out below for the existing components).

A23.35 As set out in Section 9 of Volume I, we consider that dark fibre variants based on 1Gbit/s EAD (with and without Main Link) and EADLA (as well as some of their variants, such as RO2 and Enable), are likely to constitute reasonable requests for access. We consider it appropriate to have different dark fibre prices for each of these dark fibre variants as we consider this will allow CPs to compete more effectively using dark fibre. This is because the different EAD and EAD LA variants which may be relevant for dark fibre (as set out in Section 9 of Volume I) are potentially very different, both technically (in terms of what is provided) and in price and cost terms. For example, the RO2 variant involves two diversely routed (single fibre) circuits, while the standard variants are each a single fibre circuit. Therefore the guidance we set out below would be applicable for determining the dark fibre charges for each of the dark fibre variants provided (so in effect, there will be different dark fibre prices according to which variant is supplied).

A23.36 Each dark fibre price will be determined at any point in time by subtracting the relevant active differential (which, as discussed above will be based on data from the latest available prior financial year) from the prevailing price of the corresponding active product.[509]

A23.37 We have identified three components of the LRIC-based active differential, which will need to be considered in setting dark fibre prices for the 1Gbit/s EAD and EAD LA variants, as well as Main Link:

- the costs avoided by BT when providing dark fibre instead of a corresponding active service ("first component");
- the non-domestic business rates associated with the corresponding active service ("second component"); and
- the costs of any objectively justifiable differences between dark fibre and the corresponding active service ("third component").

A23.38 We now set out our guidance on each of these three components of the active differential, by setting out our proposals in the consultation, a summary of stakeholder responses, and our final guidance. We then provide an illustrative calculation of the active differentials.

A23.39 Given the reference active products are all single-fibre circuits[510], this guidance relates to the pricing for a single-fibre dark fibre circuit (we discuss dual-fibre circuits separately below). In addition, since there are both internal and external volumes of the reference products, we would expect BT to determine the dark fibre price under this guidance based on a volume average across internal and external services.[511]

[509] We would expect the reference prices used in the active minus calculation to be the one year price for the corresponding active product, irrespective of the dark fibre contract length/minimum term (as set out in Section 9 of Volume I).

[510] The RO2 product provides two diversely routed single-fibre circuits.

[511] It will be necessary to use an average as the unit costs of some active services (including 1Gbit/s EAD and EAD LA) are slightly different for internal and external sales, reflecting where BT purchases a different mix of service variants to external CPs. E.g. BT may purchase more or less of different service variants (e.g. resilience options), which are combined under a single service code.

First component – costs avoided by BT when providing dark fibre instead of the active service

Summary of our initial view

A23.40 In the June 2015 LLCC Consultation, we set out detailed guidance on how we would expect to calculate the LRIC-based active differential for the EAD and EAD LA 1Gbit/s benchmark product variants for the active minus pricing approach only. While we recognised that some dark fibre circuits may also require Main Link, we proposed that the same Main Link charge would, in principle, be applicable to both active and dark fibre circuits, since the Main Link charge for an EAD circuit relates only to passive components.

A23.41 Our starting point was the nine cost super-components that are used to supply the active reference products for the dark fibre price (i.e. EAD and EAD LA 1Gbit/s), covering both rentals and connections. We divided these super-components into what we called asset and service components, and considered the extent to which each might contribute to the active LRIC costs for EAD services. Based on this, we proposed guidance on how each super-component might be treated in determining the LRIC-based active differential. The results of this analysis are summarised in Table A23.1 below.

Table A23.1: Summary of proposals from June 2015 LLCC Consultation

Component	Asset/Service	Proposed treatment
Wholesale and LAN extension services fibre	Asset	No contribution to incremental costs of active services: exclude from active differential
Ethernet Main Links	Asset	No contribution to incremental costs of active services: exclude from active differential
Ethernet Electronics	Asset	Contributes to incremental costs of active services: include in active differential based on the LRIC/FAC ratio of this super-component
Access cards (Other services)	Asset	Excluded : not relevant to EAD services
Service Centres (Provision)	Service	No contribution to incremental costs of active services: exclude from active differential
Routeing and Records	Service	No contribution to incremental costs of active services: exclude from active differential
Service Centres (Assurance)	Service	Contributes to incremental costs of active services: allocate share to active differential using share of active fault volumes
Sales Product Management	Service	Contributes to incremental costs of active services: allocate share to active differential using share of active incremental costs relative to EAD cost stack
Revenue Debtors	Service	Contributes to incremental costs of active services: allocate share to active services using share of active incremental costs relative to EAD cost stack

Responses to the May 2015 BCMR and June 2015 LLCC Consultations

A23.42 BT made some comments on how we had proposed to treat some of the individual super-components:

- Ethernet Electronics: BT did not explicitly disagree with the proposed approach, although it noted that Ofcom excludes around [✂]% of the costs of Ethernet Electronics in the charge control to reflect how BT has historically recovered the upfront costs of the electronics. It argued that the active LRIC calculation should also reflect this reduction in the FAC.

- Sales Product Management ("SPM"): BT disagreed with our proposed approach to base the allocation of SPM costs included in the active differential on the share of active incremental costs relative to the EAD cost stack. It stated that there is a near linear relation between the FAC of SPM and the FAC of the rest of the components for each service, which suggests that SPM costs are allocated proportionately to previously allocated costs, rather than in relation to any specific cost driver. Therefore given a dark fibre service would have a lower FAC than the active service (because it would have no electronics), it would have a lower SPM cost allocation. However, BT stated Ofcom's approach to SPM was unclear and could lead to counterintuitive results since: i) it results in different prices for EAD and EAD LA active services based on an assumption they would have different SPM costs, which does not seem reasonable[512]; and ii) there should not be a reduction in SPM costs due to avoided equipment costs as it is not clear that the two largest cost categories in the component ("Plant Support, Core Transmission Equipment" and "Transfer Charges, Plant Support") would be reduced substantially if BT supplied dark fibre instead of an active service. In any event, BT argued that if there is any reduction in costs related to not sourcing equipment it is unlikely to be related to the relationship between the active LRIC and FAC of the other components.

- Revenue Debtors: BT disagreed with our approach to Revenue Debtors for the same reasons as described above in relation to SPM costs, since we proposed the same approach. Further, it argued that the costs of revenue debtors are, in practice, almost entirely related to the price, with a ratio of approximately [✂]%. Therefore BT considered that the guidance should take [✂]% of the active LRIC differential (excluding revenue debtors) to calculate the active LRIC differential of revenue debtors.

- Service Centres Assurance: BT disagreed with our view that fault volumes will decline by as much as we suggested in light of dark fibre (25%).[513] In particular, BT argued that we should reflect in the assumptions that its assurance centres will have to deal with incorrectly reported equipment faults, meaning even if 21% of all faults relate to equipment, it is unclear that this would lead to a 21% reduction in the volume of work for the assurance centre. BT argued this was

[512] The total LRIC:FAC ratio for active EAD LA services is higher than active EAD services (since the former uses less fibre and hence has a lower FAC), but the LRICs are fairly similar. On this basis, the active LRIC of SPM is lower for EAD services than EAD LA services, despite the FAC being higher.
[513] BT stated it was also unclear why the percentage of faults avoided has been increased from the 21-22% indicated by the faults data to 25%.

because although any equipment related faults should be picked up by the dark fibre purchaser, there are likely to be cases where they cannot identify a fault on their equipment and so pass the fault back to Openreach (even though the ultimate fault lies with the dark fibre purchaser). Therefore it argued that further analysis is required on fault identification and understanding what the fault rates will be on Dark Fibre, and how often CPs will fail to identify an equipment fault accurately. In addition, BT argued that the LRIC:FAC ratio of the assurance centre cost category is [✂]%, and so a reduction in fault volumes of 21% would not lead to a 21% reduction in costs, but around an [✂]% reduction in costs. [514]

A23.43 In addition, Frontier (in its report for the PAG) argued that the guidance provides significant scope for interpretation, which could provide BT with considerable flexibility in how it calculates LRIC which it could use to favour a lower margin (and this this lack of predictability over dark fibre prices could reduce take-up and deter investment). It also considered that the guidance lacked transparency, giving the following examples:

- Ofcom assumed that some software costs in wholesale and LAN extension services fibre and Ethernet Main Links (which are two asset categories that are included in the provision of active services but refer mainly to ducts and fibre) are not related to active services;

- The derivation of the AVEs/CVEs by Openreach (which are used by Ofcom to estimate the LRIC of the electronics component) is not transparent, with BT having an incentive to underestimate variable costs.

- Ofcom’s approach to service centre costs (which relate to fault repair costs) appears to be conservative (i.e. likely to under-estimate LRIC), by attributing to the LRIC of active services to the share of fault repair costs that relate to repair of equipment (25%). However 50% of faults are under the heading of ‘fault not found’ or ‘right when tested’, and it is unclear why at least some proportion of costs related to these should not be attributed to the active service.

- It may be worth investigating whether the LRIC estimate for non-domestic rates should be based on BT’s costs or an access seeker’s costs further, if the choice has a material impact on the LRIC estimate – but this may differ by CP (we discuss this further below).

- There is additional flexibility for BT to adjust the dark fibre price to reflect differences in the incremental cost with the corresponding EAD service (and also in relation to repair, provisioning and migration charges, which we discuss further below).[515]

A23.44 Finally, BT argued against the guidance that 'each and every charge' for a Dark Fibre service is reasonably derived from the charge for the corresponding 1Gbit/s

[514] BT’s non-confidential response to June 2015 LLCC Consultation, paragraph 265-266 and Annex A.

[515] Frontier Economics, *Ofcom’s proposals on regulated dark fibre pricing: a report prepared for the Passive Access Group*, page 21-22. Received as part of the PAG non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultations.

EAD service or 1Gbit/s EAD LA service (as defined in the draft SMP condition 5C.1 of Annex 15 of the LLCC Consultation). In particular, it stated that there will be multiple Dark Fibre prices for the same connectivity service (e.g. Extended Reach, Resilient RO1 and EAD Enable variants) as the active LRIC for different active variants may be different, and so it would be required to derive different Dark Fibre prices for exactly the same Dark Fibre non-local access variants. It stated that an alternative that would potentially simplify and improve certainty and stability in the pricing aspects of implementation of the Dark Fibre obligation may be to set the "reference price" as a weighted average of the bundle of variants. The active LRIC could then be based on the same bundle.[516] Relatedly, Virgin stated that it was unclear how the prices for the different EAD 1Gbit/s variants (including EAD, EAD Enable, and EAD SyncE) would be turned into a benchmark for the dark fibre price.[517]

Our decision

A23.45 In line with our LRIC approach to the active differential, we consider that the first component should reflect the long-run incremental costs that are avoided by BT when providing dark fibre instead of the corresponding 1Gbit/s EAD (with or without Main Link) or 1Gbit/s EAD LA service.[518]

A23.46 In this section we provide further guidance on which specific costs we consider fall into this category, and so should be included in the first component of the active differential. In order to do this, we have updated our analysis in the June 2015 LLCC Consultation of the (super) component costs[519] provided in BT's 2013/14 RFS that were used to provide EAD and EAD LA services to now reflect 2014/15 data. This analysis allows us to determine which costs would be avoided when BT provides dark fibre instead of its EAD (both with and without Main Link) and EAD LA 1Gbit/s services. As the RFS reports costs on a FAC basis, we have adjusted these costs to estimate the LRIC that BT would avoid by providing dark fibre services instead of the corresponding EAD or EAD LA 1Gbit/s service.[520]

A23.47 We also note that BT's RFS does not currently separately identify costs for the different variants of EAD; so for example there are no separate cost stacks for RO2, or the Enable variants. Our analysis is therefore based on 'blended' costs for a mix of the different EAD and EAD options and this should be borne in mind when interpreting the indicative calculations that we present later in this section. We would expect though that our guidance could be used to set appropriate prices for all variants (for example, the resilience dark fibre option, should it be introduced).

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[516] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 259-262.
[517] Virgin non-confidential response to the June 2015 LLCC Consultation, response to Q8.1.
[518] As set out above, such costs should to be averaged over the Prior Relevant Financial Year.
[519] In its regulatory accounts BT reports the costs of services by what are called super-components. A super-component is a collection of network components, though many super-components consist of only one network component. BT describes a network component as constituting a discrete part of its network. A network component collects costs from various plant groups. See also BT's 2014 DAM pages 11 and 206.
[520] We have however adopted a different approach to non-domestic rates costs (cumulo costs) which we discuss below.

A23.48 BT has argued that we should use a weighted average active differential (see paragraph A23.44). However, as set out in paragraph A23.35, we consider it appropriate to have different dark fibre prices for each of these dark fibre variants in order to allow CPs to compete more effectively using dark fibre. Further, if we were to adopt an average approach, it would only seem appropriate to reflect the variants which were actually provided, which may well change over time, leading to greater pricing instability. As a result, we consider that using an average would risk distorting the incentives to use dark fibre. Therefore the guidance we set out below would be applicable for determining the dark fibre charges for each of the dark fibre variants provided (so in effect, there will be different dark fibre prices according to which variant is supplied).

A23.49 To conduct this analysis, we requested further information from BT, which included detailed descriptions of the equipment used by EAD, EAD LA and Main Link services and the function within the network, clarification as to where particular cost items were recorded within BT's RFS, and detailed descriptions of EAD and EAD LA provision, repair and cessation processes.[521]

A23.50 The responses received indicated that the Ethernet Main Link costs for an EAD circuit relate only to passive components (i.e. there are no active-specific cost components for Main Link). As such, we consider that these costs are all likely to still be incurred irrespective of whether the Main Link is provided for dark fibre or active services, and so consider the first component of the active differential is unlikely to be relevant for Main Link services.

A23.51 Therefore we focus the guidance below on identifying the first component of the active differential for EAD and EAD LA 1Gbit/s service.

A23.52 To do this, we first identify the relevant super-components for 1Gbit/s EAD and EAD LA services, and identify whether these are asset or service support based. We then consider how to treat each of these for the purposes of calculating the LRIC of the costs which would be avoided when BT provides dark fibre instead of its EAD and EAD LA 1Gbit/s services.

A23.53 There were nine super-components that contributed costs to EAD and EAD LA 1Gbit/s services in 2014/15. We have categorised these into two groups – those that relate to assets and those that relate to other operating costs. This categorisation into asset and operating costs is consistent with the approach we have taken in our 2016 LLCC Model.

- Asset based components. These are mainly associated with equipment and network infrastructure. Capital costs account for a high share (>60%) of overall costs for these components. The remaining costs are operating costs associated with running these assets on an ongoing basis, for example maintenance and property costs.
- Service support components. These cover the other operating costs required to provide EAD services. There are relatively few capital costs. Operating costs excluding depreciation account for over 97% of total costs for these components. These components generally cover front (sales) and back (support) office

[521] BT response to the 10th s135 request, dated 5 February 2015.

activities. For example costs include those for sales and marketing, order processing and fault handling. We have also classified Revenue Receivables as a service support component.[522]

A23.54 Table A23.2 below shows the nine super components that contribute costs to EAD services within BT's 2015 RFS and how we have classified these as being asset based or service support related. It also indicates whether the relevant costs are attributed to rentals, connections, or both.

Table A23.2: Classification of 2014/15 Ethernet super-components[523]

Super-Component	Asset/Service	Rentals	Connections
Ethernet Access Direct Fibre	Asset	X	
Ethernet Main Links	Asset	X	
Ethernet Electronics	Asset	X	
Openreach Systems and Development (Ethernet Specific)	Service	X	X
Service Centres (Provision)	Service		X
Routeing and Records	Service		X
Service Centres (Assurance)	Service	X	
Sales Product Management	Service	X	X
Revenue Receivables	Service	X	X

Source: BT's 2015 RFS and Ofcom. An 'X' indicates that the cost super-component contributes to the cost of either rental or connection charges.

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[522] Revenue Receivables are part of the working capital for a service. They are an estimate of the amounts owed to BT, both internal and external. They are based on the average trading terms of BT Groups' external trades. See also BT's 2015 AMD p. 267. Revenue Receivables were called Revenue Debtors in the 2014 RFS. We have therefore classified this cost as a service support component as it is not directly linked to the costs of assets.

[523] These super-components differ from those set out in the June 2015 LLCC Consultation which were based on 2013/14 data. 'Access Cards (other services)' and 'Wholesale and LAN extension services fibre' super-components were included in 2013/14 – the former has been removed for 2014/15 and the latter has been divided into 'Ethernet Access Direct Fibre' and 'Openreach Systems and Development (Ethernet Specific)' super-components in 2014/15.

A23.55 In light of these classifications, we now consider how we would expect to treat each of these super-components for the purposes of calculating the first component of the active differential. The guidance and indicative calculations contained in this section reflect the structure of the costs as reported in 2014/15. We note that this already reflects changes since 2013/14 (and the data assessed in the June 2015 LLCC Consultation), and there may be further changes to this list of components in the future (which may not be limited just to changes to components or super-components). Therefore our analysis gives guidance as to our approach to these super-components, and we would expect the principles set out to be used in the event of future changes to components or super-components (although we recognise the guidance may need to be adapted in the event of significant changes in circumstances).

Asset based super-components

A23.56 We have analysed the costs attributed to each of the three asset based components to see whether these costs are likely to be avoided, and so should be included in the first component of the active differential. For two of the super-components, Ethernet Access Direct Fibre and Ethernet Main Links, we found no evidence of inclusion of any active-specific costs. The main costs within each of these super-components are duct and fibre required to provide Ethernet services. The costs also contain an attribution of some software assets that are required to support services using these assets.[524] We therefore consider that the costs of these super-components are not likely to be relevant to the calculation of LRIC-based active differential.

A23.57 The Ethernet electronics super-component relates to costs associated with operating and maintaining active equipment, including the capital costs of that equipment, and so relate to the ‘active’ element of EAD services. We have therefore examined what proportion of the costs of this component is likely to be appropriate to include within the first component of the active differential.

A23.58 The Ethernet electronics super-component includes the cost of the electronic equipment installed as part of EAD services. This equipment is variable on a per customer basis and so we would expect it to be avoided when BT provides dark fibre instead of its EAD and EAD LA 1Gbit/s services. However, not all of the costs within this super-component will be part of the active differential. This super-component also contains attributions of costs for activities and assets that are shared with other services and would not be saved by BT in the long run. Examples of these include some general management costs, supplies and logistics costs, and finance and billing costs. We would however expect most of the active equipment capital and depreciation costs to be included within the first component of the LRIC-based active differential.

A23.59 We consider that the share of costs within the Ethernet Electronics super-component that should be included in the active differential should be estimated by the LRIC to FAC ratio for this component using LRIC and FAC data from BT’s LRIC model. This is consistent with the approach we have adopted in our modelling for

[524] Ofcom analysis of Additional Financial Information Schedules AFI3 provided by BT as part of its regular financial reporting.

this charge control to estimate how costs vary with volumes. We have used LRIC to FAC ratios as the basis for our CVEs and AVEs.[525] While we recognise Frontier's arguments that the derivation of AVEs/CVEs is not transparent (see paragraph A23.43), we note that we have scrutinised the outputs and made adjustments where we consider it appropriate, and we note that the LRIC to FAC ratios have been relatively stable over time (so we would expect BT to explain any significant changes in the ratios it sought to use in calculating the active differential). Therefore on this basis we believe the LRIC to FAC ratio provides a reasonable estimate of the proportion of these costs that would be avoided in the long run.

A23.60 As summarised above (see paragraph A23.42), BT has argued we should reflect the exclusion of past Ethernet Electronics costs in the active differential. However, we do not consider this relevant for the purposes of determining the appropriate dark fibre price. Any adjustment that would need to be made to costs would be minimal and probably zero by the time that dark fibre is available in mid-2017/18.[526] Therefore we do not consider an adjustment to be necessary.

A23.61 We consider therefore that a share of Ethernet Electronic costs should be included in the first component of the LRIC-based active differential, and that the share should reflect the ratio of LRIC to FAC costs as reported within BT's LRIC model.

Service support super-components

A23.62 There are six super-components that contribute costs to EAD services which we have categorised as being 'service support'. These generally cover back office provisioning and cessation activities, back office maintenance processes and sales and marketing costs, including bad debt costs. We now analyse each of the super-components in turn.

Openreach Systems and Development (Ethernet Specific)

A23.63 Prior to 2014/15 the costs for this super-component were included within the Wholesale and LAN Extension Services Fibre (WALESF) super-component. The WALESF super-component was predominantly made up of duct and fibre costs required to provide Ethernet services. In the June 2015 Consultation, we considered the costs for the WALESF super-component were not relevant to calculating the LRIC-based active differential.

A23.64 This new super-component predominantly covers software costs (approximately [✂]% of the component costs and more than [✂]% of MCE relate to software). We asked BT to provide details behind the software attributed to this component.[527] This suggests that whilst most of the costs were associated with provision of fibre services this super-component also received an attribution of software assets that were common across other products, including non-leased line products. It was unclear whether the software attributed to fibre services related solely to passive assets or included elements that related to the active elements of these services.

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[525] See the discussion of AVEs and CVEs in Annex 32.
[526] The exclusion of costs is £[✂] in the Base Year model and will fall to zero by the end of this control period. See discussion in Annex 27.
[527] BT response to 27th LLCC s135 request dated 30 November 2015, question F1.

The attribution of some of these software costs are subject to our proposals for base year adjustments. These proposals will affect attributions in future years.

A23.65 The costs for this component are attributed across Ethernet services on a per circuit basis: BT considered this allocation appropriate because "*in this way customers pay the same contribution to Ethernet systems development for each different service taken up*"[528]. We take this to mean that bandwidth and hence the costs of active services are not a key driver of these costs, and so would not expect them to be avoided, but we have not been able to verify this at this stage.

A23.66 If BT is able to show that the costs of this super-component are not associated with active services, then they should not be included in the calculation of the first component of the LRIC-based active differential. If BT is not able to show this, then it should include an element of these costs within the LRIC-base active differential. This will be based on the LRIC to FAC ratio for this component multiplied by the proportion of costs that relate to active services. In the indicative numbers that we have presented below we do not include any contribution to the LRIC-base active differential from the costs of this super-component.

Service Centres (Provision) and Routeing and Records

A23.67 Service Centres (Provision) super-component covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints related to provision processes.[529] The Routeing and Records super-component covers the costs associated with the physical verification and initial recording of routings within the network.[530] We consider that the costs for these super-components are not relevant for calculating the first component of the LRIC-based active differential for the reasons set our below.

A23.68 BT provided us with details of the tasks within the provision processes for EAD and EAD LA, and where the associated costs are recorded within the RFS. This showed that:[531]

- many of the activities associated with the provision of active equipment appear to be separately identified and attributed within BT's RFS to the Ethernet Electronics component that we have discussed above;

- similarly many of the activities associated with the network build and provision of fibre also appear to be separately identified and attributed to the Ethernet Access Direct Fibre component within BT's RFS;

- activities mapped to the Routeing and Records component appear to be related to recording network details: there was no clearly identifiable activity that related solely to recording active equipment. The incremental costs of any such activity

[528] BT response to 27th LLCC s135 request dated 30 November 2015, question F1.
[529] See for example the description of the DTNIK base on p. 58, BT's 2014 DAM.
[530] See for example the description of the PDTRAR base on p. 99, BT's 2014 DAM.
[531] BT response to the 10th s135 request, dated 5 February 2015.

are likely to be small and routing and records costs are in any case a small element of connection costs;[532]

- the costs of most of the remaining activities appear to have been attributed to 'Service Centres (Provision)'. Our analysis of these remaining activities against the process maps suggested that either they were associated with building the network and thus related to provision of fibre or they would need to be undertaken regardless of whether an active or dark fibre service was being provided. It therefore appeared that there are few, if any, costs of activities attributed to Service Centre (Provision) that would be saved were a dark fibre service to be provided instead of an active one. We therefore would not expect these costs to be included in the active differential; and

- BT also provided us with details of the tasks within the cessation processes for EAD and EAD LA, and where the associated costs are recorded within the RFS. As in the case of provisioning, our analysis of the information provided showed that active incremental costs associated with cessation processes appear to be captured in the components identified that directly related to active electronics. In particular, 'recovery of equipment' costs are already allocated to active super-components. The cessation related admin costs are captured within 'Service Centres (Provision)' while the task of updating records is included in the 'Routeing and Records' component. As in the case of provisioning, it seems reasonable to treat these costs as largely related to the provision/cessation of fibre, and so are unlikely to be avoided.

Service Centres (Assurance)

A23.69 The Service Centres (Assurance) super-component covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints relating to fault reporting and repairs. We consider that it is appropriate for a proportion of these costs to be included in the first component of the LRIC-based active differential, as it is likely that some of these costs will be avoided when BT provides dark fibre.

A23.70 BT provided details of fault reporting and fault resolution processes for EAD and EAD LA services and where the associated costs were recorded within BT's RFS.[533] As in the case of the previous cost categories discussed above, this showed that a number of the tasks associated with maintenance and fault repair were directly attributed to the relevant active or passive asset based super-components already identified: Ethernet Electronics or Ethernet Access Direct fibre.

A23.71 There were however more general activities, such as initial fault reporting and diagnosis, resolution design and closure and fault clearance and closure which were attributed to the Service Centre (Assurance) super-component. The costs of these activities are not split between faults related to active equipment as opposed to passive (dark fibre) infrastructure. However, it seems likely that if BT were only to provide a dark fibre service it would have to handle fewer fault reports because it

[532] See for example the costs by component on BT's Revised 2015 RFS, p78.
[533] BT response to the 10th LLCC s135 request dated 5 February 2015 and 27th LLCC s135 request dated 30 November 2015.

would not have to deal with faults associated with active equipment failures and because CPs would operate the network equipment that would therefore enable them to take a bigger role in fault diagnosis.[534]

A23.72 We therefore consider that there is likely to be a reduction in these costs if a dark fibre rather than an active service is provided. We consider that it is likely to be appropriate to estimate the incremental active costs of Service Centres (Assurance) from an analysis of fault volumes. In the June 2015 LLCC Consultation we analysed data provided by BT which showed the number of faults for EAD and EAD LA circuits in 2013/14 broken down by fault type. Based on this analysis, we assumed that fault volumes would reduce by 25%, but we noted that a large proportion of faults – approximately 50% – were marked as “fault not found” or “right when tested”.

A23.73 We have updated this analysis using 2014/15 fault data from BT.[535] This showed that in both 2013/14 and 2014/15 20-25% of faults were equipment related, but that approximately 50% were again marked as “fault not found” or “right when tested”. Total “right when tested”, “fault not found” and equipment faults were relatively stable at 70-75% of all fault reports for both EAD and EAD LA Services over the two years.

A23.74 In providing guidance for the active differential, we are interested in the reduction of faults if BT were only to provide a dark fibre service, as we consider this provides a reasonable proxy for estimating the first component of the active differential in light of the information we have available. As a starting point, we remain of the view that equipment related faults will not occur with dark fibre, and so the costs associated with these should be included in the first component. However, we agree with Frontier (see paragraph A23.43) that our previous assessment was conservative and likely to understate the reduction in fault volumes, given some of the volume of faults categorised as ”fault not found” or ”right when tested” are not likely to be reported to Openreach with a dark fibre service. This could be because, for example, some of these faults are equipment related which will now be in the direct control of the CP, or because for dark fibre services CPs will have network equipment attached to the circuit that will allow them to undertake the initial fault diagnosis themselves, and so avoid reporting such faults to Openreach for diagnosis.

A23.75 Therefore, as well as the reduction in active-specific faults, we would also expect there to be a significant reduction in the proportion of “right when tested” and “fault not found” faults for dark fibre services (although we note this may not happen immediately and it is unlikely they will reduce to zero). We recognise that CPs might still pass some faults to Openreach for diagnosis that are ultimately cleared as “right when tested” (as argued by BT) which may limit the reduction in fault volumes. However, we consider that CPs will have an incentive to minimise the incidence of such cases in order to clear faults as quickly and as cost effectively as possible. This is because firstly, BT will not have remote diagnostic capabilities with dark fibre services and will therefore have to dispatch technician(s) to perform a diagnostic test (at one or both ends of the circuit); and secondly, because BT would be likely to

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[534] TRCs will also be relevant for dark fibre – see Section 8 of Volume II.
[535] BT response to the 27th LLCC s135 request dated 30 November 2015, question C1.

levy TRCs in cases where fault reports result in a "right when tested" finding. We therefore do not agree with BT (see paragraph A23.42) that we have overstated the likely reduction in fault rates, and actually consider a share of "right when tested" and "fault not found" faults should also be included in estimating the reduction in active-specific faults.

A23.76 However, we acknowledge that the precise reduction is difficult to assess with accuracy in the long run, particularly prior to the introduction of the remedy. In light of this uncertainty, for the purposes of this guidance, we consider that it is likely to be appropriate for BT to determine the amount of this cost component included in the active differential by taking account of reductions in fault volumes. In the indicative calculations that we present at the end of this section we have assumed that "right when tested" and "fault not found" faults will be about a fifth for dark fibre services of what they are on active circuits, which we consider may be reasonable given the increased CP diagnosis described above. This, combined with the equipment related faults (of approximately 20-25%), means prices could be set assuming that fault volumes per circuit would reduce by approximately 60-65% (we have assumed the mid-point of 62.5%) compared to those on EAD and EAD LA services. We consider this provides a reasonable basis for a base case, and so would expect BT to provide evidence to support any variations from this. That evidence should include actual relative fault volumes per circuit for dark fibre and EAD services and where the back-office costs associated with processing faults are recovered.

A23.77 BT also argued that the reduction in fault volumes will lead to a reduction in variable costs only (see paragraph A23.42). We agree that this is likely to be the case, and so consider that the share of costs within the Service Centres (Assurance) super-component that fall within the first component of the LRIC-based active differential should be estimated by the LRIC to FAC ratio for this component using LRIC and FAC data from BT's LRIC model. We believe this ratio provides a reasonable estimate of the proportion of these costs that would be avoided in the long run. As described above, we consider this is consistent with the approach we have adopted in our modelling for this charge control to estimate how costs vary with volumes.

A23.78 Therefore, we consider that a share of Service Centres (Assurance) costs should be included in the first component of the LRIC-based active differential, based on the reductions in fault volumes for dark fibre relative to actives applied to the LRIC to FAC ratio for this component. As an illustrative base case, we have used 62.5% of the ratio of LRIC to FAC costs as reported within BT's LRIC model. However, given the uncertainty around the impact of dark fibre on fault volumes (particularly in the absence of industry agreement on fault monitoring processes for dark fibre), we recognise this figure may change, although we would expect BT to explain deviations from our base case assumption.

'Sales Product Management'

A23.79 The Sales Product Management (SPM) super-component covers the costs of staff who work in the SPM division of Openreach.[536] We consider that it is appropriate for

[536] See for example the description of the Except base BP on p. 44, BT's 2015 AMD.

a proportion of these costs to be included in the LRIC-based active differential, as it is likely that some of these costs will be avoided when BT provides dark fibre.

A23.80 The analysis we did in the June 2015 LLCC Consultation suggested that SPM costs are not included within the activities discussed above covering installation, maintenance and cessation processes. SPM costs as recorded are not split between active and passive network components. However it is very likely that some product management costs are associated with active elements of services; for example, activities associated with the choice of equipment and equipment manufacturer, specifying active functionality to be supplied, managing product change requests and so on. Similarly some sales costs are likely to be incremental to the sale of active services.

A23.81 BT has argued that the major component costs are in the Plant Support cost category and therefore not related to equipment (see paragraph A23.42), so it did not consider there should be a reduction in SPM costs due to avoided equipment costs. However, our analysis[537] suggests that the majority (approximately [✂]%) of costs were in General Management and Overheads (with [✂]% in Planning and Development and [✂]% in Computing/Software), and we would expect some product management as part of this to be associated with the development of active services. Therefore we remain of the view that some of these costs are likely to be avoided.

A23.82 We consider that the share of the SPM costs attributable to the LRIC-based active differential should be estimated based on the proportion of the overall EAD cost stack which relates to the first component. SPM costs account for a relatively small element of the cost stack of EAD and EAD LA services (less than 1% of rental costs and approximately 1.5% of connection costs). We therefore consider that a share of SPM costs should be allocated to the active layer based on the first component of the active differential (excluding the SPM super-component) as a proportion of the overall 1Gbit/s EAD or EAD LA cost stack. This should then be multiplied by the LRIC to FAC ratio for this component (using LRIC and FAC data from BT's LRIC model), in order to determine the share of SPM costs which should be included in the LRIC-based active differential. We note BT's comments that it would expect the active LRICs for this component to be similar for EAD and EAD LA (see paragraph A23.42), and consider the outputs of this approach are broadly consistent with this expectation.

Revenue Receivables

A23.83 The Revenue Receivables super-component covers part of the working capital for a service. Revenue Receivables are "an approximation of the amounts owed to BT, both internal (i.e. for Openreach representing receivables that would be generated if trades between BT's lines of business were undertaken to a third party and at arm's length) and external. They are based upon the average trading terms of BT Group's

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[537] Using data within Additional Financial Information schedule AFI 3 that BT supplies to Ofcom.

external trades".[538] They are attributed "directly in proportion to the revenues of each revenue-generating service".[539]

A23.84 As with SPM costs, costs associated with 'Revenue Receivables' do not appear to have been included within the activities already discussed above. Within BT's regulatory financial system we have confirmed they are attributed to services: they are not split between active and passive network components.

A23.85 In the June 2015 LLCC Consultation we said we would expect these costs to be largely driven by revenues and so would expect some of these to be avoided in the event dark fibre is provided instead of the active service. We proposed that the share of the Revenue Receivable costs attributable to the LRIC-based active differential should be estimated based on the proportion of the overall EAD cost stack which relates to the active LRIC (i.e. in the same way as the SPM super-component).

A23.86 BT has argued that we should instead estimate the active differential using the ratio of Revenue Receivables to prices that apply to all services. In 2013/14 BT said this was [✂]% (see paragraph A23.42). We agree this approach is likely to be more appropriate and more consistent with BT's attribution of the costs of this super-component.

A23.87 Therefore we consider that the Revenue Receivable costs to be included in the LRIC-based active differential should be estimated based on the first component of the active differential (excluding the Revenue Receivable super-component) as a proportion of the overall 1Gbit/s EAD or EAD LA cost stack, multiplied by the ratio of revenue receivable costs to revenues for EAD and EAD LA 1Gbit/s rental services. This approach to the active differential will also ensure that the dark fibre price makes the same contribution to this super-component as our reference products.

Summary of proposed approach to costs in calculating the first component of the active differential

A23.88 Table A23.3 below provides a summary of the proposals detailed above.

Table A23.3: Summary of guidance

Component	Contribution to Incremental Costs of Active Services?	Treatment
Ethernet Access Direct Fibre	No	
Ethernet Main Links	No	

[538] BT's 2015 AMD, page 267.
[539] BT's 2015 AMD, page 267.

Ethernet Electronics	Yes	Based on the LRIC/FAC ratio of this super-component.
Openreach Systems and Development (Ethernet specific)	?	If BT is able to show that the costs of this super-component are not associated with active services, then they should not be included. If BT is not able to show this, then it should include an element of these costs based on the LRIC to FAC ratio for this component multiplied by the proportion of costs that relate to active services.
Service Centres (Provision)	No	
Routeing and Records	No	
Service Centres (Assurance)	Yes	Based on reduction in fault volumes per circuit for the provision of dark fibre services instead of the reference Ethernet services, applied to the LRIC to FAC ratio for this super-component.
Sales Product Management	Yes	Based on the total first component of the active differential (excluding the SPM costs) as a proportion of the overall 1Gbit/s EAD or EAD LA cost stack, multiplied by the LRIC to FAC ratio for this component.
Revenue Receivables	Yes	Based on the total first component of the active differential (excluding the Revenue Receivables costs) as a proportion of the overall 1Gbit/s EAD or EAD LA cost stack, multiplied by the ratio of revenue receivable costs to revenues for EAD and EAD LA 1Gbit/s rental services.

Second component – non-domestic business rates

Summary of our initial view

A23.89 We considered that an attribution of BT's non-domestic rates bill should also be included in the calculation of the LRIC-based active differential. That was because under current rating law and precedent the person who lights the fibre is considered to be in rateable occupation of the circuits. Therefore if BT were to provide a dark fibre service and another CP were then to light that fibre by placing its equipment on each end, it would be the CP who would be responsible for the non–domestic rates on that circuit and not BT. We considered there were several disadvantages in basing this reduction on an access seeker's costs. Based on the information we had available, we proposed that the amount of non-domestic rates to be included in the active differential would be based on the attribution of BT's Cumulo rating costs to EAD 1Gbit/s services.

Responses to the May 2015 BCMR and June 2015 LLCC Consultations

A23.90 In relation to the proposed approach to non-domestic business rates, BT argued that there is only a cumulo effect on the non-domestic rates attributed to fibre within the WES fibre super-component in the AI market. It said that:

> *"the total cumulo allocated to the WES fibre super-component in the AI market was around £[✂] (based on the new 2014/15 allocation methodology). This is around [✂]% of the total WES fibre that relates to AI services. Around [✂]% of capital of the WES fibre super-component related to fibre (the rest is mostly duct). We therefore take [✂]% of costs out of the WES fibre super-component".*

A23.91 It noted however that this calculation was based on high level data, and this allocation may be revised in light of additional information being supplied. Lastly BT noted that "there is likely to be a small effect on Main Link because there will be less "lit" fibre in the Main Link, but this effect is likely to be less than £[✂] per km".[540]

A23.92 We received relatively limited comments from some other stakeholders on our proposed approach to non-domestic rates, though none made any direct objections to our proposal to use BT's allocation. While [✂[541]] it argued, along with the PAG (which includes Colt, Three, TalkTalk, Sky, and Vodafone)[542], UKCTA[543], Hyperoptic[544], and Six Degrees Group[545], that the broader approach to non-domestic rates by the VOA could affect (and undermine) take-up of the dark fibre remedy (particularly at 1Gbit/s). [✂], the PAG, Hyperoptic and Six Degrees Group referred to what they perceived as differing approaches to the assessment of non-domestic rates between BT and other CPs by the VOA. They argued the shift in liability for these rates from BT to the CP purchasing dark fibre could limit the ability of CPs to use dark fibre, and distort competition: Hyperoptic argued this was particularly the case for smaller CPs. Six Degrees said it could make the utilisation of dark fibre assets impracticable. Hyperoptic and the PAG suggested that an alternative approach would be for BT to continue to pay the 'Fibre Tax' as if it had lit the fibre (thus ensuring no change to the effective taxation of Ultrafast broadband products), as is currently the case for LLU. Six Degrees Group suggested that Ofcom liaise with the VOA to ensure that the shift in liability does not increase the tax burden which would then be passed on to end-users.

Our decision

A23.93 We consider that an appropriate attribution of BT's non-domestic rates bill should also be included in the LRIC-based active differential. This is based on the fact that, in relation to dark fibre, the rating authorities have determined that "*as a general rule of thumb, the person who lights the fibre is considered to be in rateable occupation*".[546] Under this precedent, if BT sells an active circuit to a CP, BT is

[540] Annex A of BT's non-confidential response to the June 2015 LLCC Consultation, paragraph 22-26.
[541] [✂]
[542] Letters from the PAG received 4 February 2016 and 24 February 2016.
[543] UKCTA non-confidential response to the May 2015 BCMR, June 2015 LLCC and Review of BT's cost attribution methodologies consultations, paragraph 2.9.
[544] Hyperoptic non-confidential response to the May 2015 BCMR Consultation, p12-13 (response to Q7.3, 7.4, 9.1 and 9.2).
[545] Six Degrees non-confidential response to the May 2015 BCMR Consultation, p8.
[546] Section 871, Valuation Office Agency (VOA), *VOA Rating Manual*, *Volume 5*, *http://manuals.voa.gov.uk/corporate/Publications/Manuals/RatingManual/RatingManualVolume5/sect871/toc.html#TopOfPage* (VOA Rating Manual).

liable for the associated rates, whereas if BT sells a dark fibre circuit then the purchasing CP is liable for the rates. We first provide some background on non-domestic rates and explain why we consider non-domestic rates are incremental costs for active services before setting out our final view.

Background on non-domestic rates and BT's cumulo rates costs

A23.94 Business rates are a form of tax payable on non-domestic properties. BT pays non-domestic rates on its office buildings but also on its rateable network assets. Under rating law and precedent the rates on BT's rateable network assets are assessed together. The assessment of BT's rateable network assets is therefore called a 'cumulo' assessment. In what follows we refer to the costs of BT's non-domestic rates on its rateable network assets as being BT's cumulo rates costs.

A23.95 BT's rateable network assets are defined by the Central Rating List Regulations.[547] The rateable assets within BT's cumulo assessment include most 'dark fibre' assets including: duct and manholes, copper and fibre, poles and cabinets as well as exchange buildings. Active network equipment such as routers, modems, and other pieces of electronic equipment are not rateable assets.

A23.96 In broad terms a ratepayer's non-domestic rate costs are the result of multiplying a rateable value (RV) by a centrally set rate in the pound[548] that is the same for all ratepayers.[549] RVs are assessed by the rating authorities and reassessed at regular intervals. The next reassessment of RVs in England, Wales and Scotland will come into force from 1 April 2017.

A23.97 In previous charge controls, including previous leased line charge controls, we have allowed BT to recover the appropriate share of BT's cumulo rates costs within its regulated active prices; we consider non-domestic rates are legitimate business costs.

A23.98 BT allocates its cumulo rates costs using a methodology called "*profit weight net replacement costs*" (PWNRCs).[550] We directed BT to change the way it attributed its cumulo costs following the 2014 Fixed Access market review. This change related mainly to the way BT allocated rebates that it had received.[551] The 2014/15 base data within the LLCC model is consistent with this direction as should BT's allocation of its cumulo rates within future regulatory financial statements.

[547] See for example: The Central Rating List (England) Regulations 2005 (SI 2005/551), as amended by The Central Rating List (Amendment) (England) Regulations 2006 (SI 2006/495) and The Central Rating List (Amendment) (England) Regulations 2008 (SI 2008/429) and the Central Rating Lists (Wales) Regulations 2005 (SI 2005/422). We understand that similar definitions also apply in Scotland and Northern Ireland.
[548] The rate in the pound is effectively a percentage. So for a Rateable Value of £100 and a rate in the pound of 50p in a particular year, the rating liability would be £50 (£100 x 50p/100p).
[549] For an introduction to how rates liabilities are calculated see: http://www.voa.gov.uk/corporate/Publications/businessRatesAnIntro.html
[550] For more details on BT's current allocation of its cumulo rates costs see the description of the CUMNORM and CUMRBTE bases on pages 53-55, BT's 2014 DAM.
[551] See for example paragraphs 4.63 to 4.67, March 2015 Directions Statement.

The non-domestic rates on fibre and duct are incremental costs of active services

A23.99 As noted above, in relation to dark fibre, the rating authorities have determined that "*as a general rule of thumb, the person who lights the fibre is considered to be in rateable occupation*". We noted in the June 2015 LLCC Consultation that we consider that this has two implications in particular:

- it is the act of lighting a circuit and therefore providing an active service that causes the non-domestic rating liability to be incurred. This would suggest that non-domestic rates should be considered part of the incremental costs of active services; and

- if BT were to provide a dark fibre service and another CP were then to light that fibre by placing its equipment on each end, then it would be the CP who would be in rateable occupation of the dark fibre and thus responsible for the non-domestic rates and not BT.

A23.100 We received no stakeholder comments that disagreed with our view that non-domestic rates on fibre and duct are incremental costs of active services. We have therefore decided to include guidance on the appropriate amount of non-domestic costs that should be included in the active differential.

Final approach to non-domestic rates

A23.101 In June we noted that the appropriate amount of non-domestic rating costs to be included in the active differential could in principle be based either on the likely cost to an access seeker or the likely cost to BT. We said that currently the RV on a particular fibre paid by CPs other than BT is determined by the rating authorities, and we understand that a number of factors are taken into account, including the number of fibres that are lit, the route length of the fibre and the total fibre route kilometres of the network to which the fibre is connected.[552] This may result in different RVs and hence non-domestic rate costs applying to different fibres and also to different operators.

A23.102 We noted that basing the amount included in the active differential on the likely cost to an access seeker would have the advantage of, all else equal, not distorting the access-seeker's choice between the active and dark fibre products. However we believed this advantage was outweighed by several significant disadvantages notably that:

- this approach is contrary to our general principle of setting charges (and indeed basing the active differential) on BT's costs, and not those of the access seeker (see discussion above);

- it risked setting a price for the dark fibre product below BT's cost of supply, which may not give BT the opportunity to recover its efficiently incurred costs; and

- there were practical considerations that would mean this approach was unlikely to produce a stable and predictable access price given the variation in costs to

[552] Appendix 1.1 and 1.2, Section 871, *VOA Rating Manual*.

different access seekers. That was compounded by further uncertainties: the Valuation Office Agency's (VOA) dark fibre RVs for its 2010 list were still under appeal and RVs would also change when the new rating list came into force with effect from 1 April 2017.

A23.103 We therefore considered that the disadvantages of basing the attribution on an access seeker's costs were significant. We did not consider this method to be appropriate, and instead considered that the rates cost should be based on the cumulo rates costs to BT.

A23.104 We then noted that there were some practical difficulties with basing the costs on BT's cumulo rates if this were to require BT to estimate the long-run incremental impact on its cumulo rates costs of those leased line circuits that switch to dark fibre. This would be unlikely to be feasible as such a degree of disaggregation had proved difficult in the past. BT's rates bill is based on a cumulo assessment: its rateable assets are assessed together. As noted in the 2013 FAMR charge control consultation, the VOA "*confirmed that the calculations were generally done at an aggregate level and did not consider a disaggregation of the existing valuation model by product is possible*".[553] The VOA's comments applied to the valuation model developed to support BT's RV for the 2010 rating list and a new model is likely to be developed for the 2017 rating list.[554] However we did not consider it reasonable to assume that it would be practical to estimate rigorously the long-run incremental impact on BT's cumulo rates costs attributed to those leased lines circuits that switch to dark fibre.

A23.105 We therefore proposed that the appropriate amount of non-domestic costs that should be included in the active differential should be based on the attribution of BT's cumulo rating costs to active services within BT's regulatory accounts, specifically the attribution to EAD and EAD LA 1Gbit/s services.

A23.106 Stakeholders other than BT did not comment on our proposed approach. However, some commented on the rating system and suggested that the VOA should review the RVs it sets for fibre circuits (see summary above in paragraph A23.92 above).

A23.107 We have reviewed the concerns raised by stakeholders. Our concern is that any differences in the non-domestic rates payable by different CPs in using the same regulated dark fibre circuit from Openreach could frustrate the design of the dark fibre remedy we have decided to introduce. We have discussed our concerns with the VOA, the Department of Communities and Local Government (DCLG), and with the Department of Culture, Media and Sport (DCMS) and explained the potential effects on future competition based on use of regulated dark fibre.

A23.108 Although the setting of non-domestic rates is a matter for Government, and not for Ofcom, we have nevertheless asked Government to consider ways to ensure that current rules for levying non-domestic rates do not frustrate our design of regulated dark fibre access. Our recommendation is that the rating rules be amended so that BT would pay the rates for the dark fibre circuits which it provides to other CPs

[553] Paragraph A14.27 onwards, Annex 14, July 2013 FAMR CC Consultation.
[554] It may also be that BT makes an appeal on its rateable value to reflect the take-up of dark fibre services. Any subsequent changes to BT's RV might then provide relevant evidence.

under Ofcom's regulations. We intend to have further discussions with Government on this issue with a view to resolving it in good time before the launch of BT's dark fibre product in October 2017.

A23.109 However, in the event that CPs remain responsible for the non-domestic rates when using regulated dark fibre, we consider that it is appropriate to maintain the proposal in the June 2015 Consultation whereby we would expect to use BT's allocations in the active differential. This is because responsibility for paying rates will transfer to the CP renting the dark fibre service, and so we do not consider that CPs should contribute to BT's rates bill on these services. For all the reasons set out above, we consider using BT's allocations to be more appropriate at this stage than basing the costs on those of an access seeker or trying to estimate the long-run incremental impact on BT's cumulo rates costs attributed to those leased lines circuits that switch to dark fibre.

A23.110 We have considered BT's argument that the amount included in the active differential should only be based on fibre assets and not include rates on associated rateable assets such as duct. A dark fibre service includes not just the occupation of fibre but also the duct – indeed a contribution to BT's duct costs are effectively included within our active minus pricing approach. When CPs have their own network, they will also pay rates on duct as well as the fibre assets, and purchasers of existing commercial dark fibre services will also pay the relevant costs of the duct. We therefore consider it appropriate that the active differential should include the non-domestic rates that are paid on all rateable assets required to provide dark fibre services.

A23.111 However, we consider that in light of BT's response, the second component may be relevant for determining the active differential for Main Link charges. Although these services are effectively entirely "passive" (as discussed above), their costs appear to include some contributions to BT's cumulo rates costs. CPs renting dark fibre services from BT that require Main Links will therefore become liable for the rates on the related fibre and associated rateable network assets. We therefore believe that BT will also need to publish dark fibre prices for the corresponding Main Link services which removes an element for non-domestic rates.

A23.112 Therefore in light of the discussion above and stakeholders' comments, our approach to non-domestic business rates (and the second component of the active differential) is as follows:

- in the event that access seeking CPs are liable for business rates when using dark fibre, the non-domestic rates deducted from the dark fibre charge should be based on the average attribution of BT's cumulo rating costs to the corresponding active service based on an average across internal and external volumes; or

- in the event that there is a change in the ratings rules as described above (such that BT paid the rates for dark fibre circuits it provided to CPs), we would no longer expect cumulo to be relevant for determining the dark fibre price.

A23.113 Based on current allocations, we would expect this to apply when determining the dark fibre prices for EAD and EAD LA 1Gbit/s services, as well as Main Link.

Third component – objectively justifiable differences between the dark fibre RO and the benchmark EAD services

Summary of our initial view

A23.114 In the June 2015 LLCC Consultation, we allowed for the potential that BT's dark fibre product(s) may differ from their reference active products in some respects. We therefore proposed that the dark fibre price should reflect the long run incremental costs of any objectively justifiable differences between that dark fibre product and the corresponding active service.

Responses to the May 2015 BCMR and June 2015 LLCC Consultations

A23.115 BT stated that it is important that Openreach can be in a position to reflect the full extent of the costs that it will incur because of dark fibre, both fixed and incremental and that would underpin how the dark fibre reference offer differs from the benchmark EAD services. BT provided the following examples of costs that may be incurred by Openreach:

- Increased volumes of engineering visits to test and diagnose reported faults within stretching target resolution timescales, due to CPs not identifying equipment faults before referring the fault to Openreach. Consequently, Openreach will need to have a larger workforce of testers for provision and migration that can perform the OTDR[555] tests, and they will need to be equipped with additional handheld test equipment. This will result in further costs in training;
- Fixed costs incurred for the development and upgrades of the dark fibre product;
- Further line test tools to enable efficient processing of fault reports received; and
- Deployment of a patch panel as a clear point of demarcation between the Openreach Dark Fibre product and the CP domain to support efficient operations.

A23.116 BT stated that these fixed and incremental costs would only be understood on full completion of the design of the remedy, and after a period of piloting. While it acknowledged that Ofcom had made some provisions in paragraphs 8.72-8.74 of the June 2015 LLCC Consultation for the differences that may arise between dark fibre and EAD services, it did not believe these to be fully reflected in the draft SMP condition 5C of the legal instrument.[556]

Our decision

A23.117 While we expect the dark fibre remedy to replicate the existing arrangements in relation to the relevant reference Ethernet product to the extent possible, as discussed in Section 9 of Volume I and Annex 22 we recognise there may be necessary and legitimate differences between active and dark fibre products, which

[555] Optical time-domain reflectometer, which is an instrument used for testing.
[556] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 274-277.

may have direct implications for the dark fibre price. In particular, differences in processes, systems or in the physical nature of the dark fibre infrastructure used to support the product may mean there are services/features associated with dark fibre which are not relevant for the corresponding active service, and as such are likely to result in dark fibre-specific incremental costs being incurred. These costs will also need to be recovered, and as such, they may have legitimate impacts on the final dark fibre rental and/or connection charges.

A23.118 To be clear, these costs differ from the development and implementation costs necessary for introducing a new dark fibre remedy, as these are already taken into account in the LLCC (as discussed in Annex 33). Therefore to the extent relevant and appropriate, many of the potential costs identified by BT (summarised in paragraph A23.115), are already captured in the charge control adjustment (e.g. the costs of developing the dark fibre product). Therefore we focus here on dark fibre specific costs which are not captured there, and in particular the per-circuit and/or recurring types of cost differences between dark fibre and the reference active products, such as the patch panel example provided by BT.

A23.119 Although some elements of the dark fibre design are to be negotiated (and so are currently unknown), we have at this stage identified two main areas where there may be such legitimate differences between the access provided using dark fibre and the corresponding reference active product:

- **Essential services/features associated with the provision of a dark fibre remedy** – these are those which are necessary in order for dark fibre to be a useable product, but which are different to (or irrelevant for) active circuits. For example, dark fibre may require different handover arrangements to an active circuit, as discussed in Annex 22; and
- **Provision of a dual fibre circuit** – the main (EAD and EAD LA) reference products used to price dark fibre are single-fibre circuits[557] and while the majority of active services can be provided using a single-fibre circuit, there may be some services which require a dual-fibre circuit.

A23.120 Therefore we now set out our expected approach for essential services/features when determining the active differential, in order to provide guidance on the approach to rental and connections for dark fibre. We do not consider that the latter is relevant for determining the active differential, and so consider it separately further below.

A23.121 As discussed in Annex 22, we consider that the design of the specific dark fibre remedy is best agreed by negotiation between CPs and BT as part of the implementation process. Where differences between the active and dark fibre products arise as a result of these negotiations and these are objectively justifiable as necessary for the dark fibre remedy to be effective, then we would expect these to be identified and specified in the RO. Such differences are likely to result in dark fibre-specific per circuit costs being incurred which also need to be recovered. For example, a different handover arrangement for dark fibre may require an additional piece of equipment (such as, for example, a patch panel).

[557] The resilience option (RO2) involves the provision of two diversely routed single-fibre circuits.

A23.122 At this stage the exact terms of these requirements are unclear but to the extent that these are necessary for the dark fibre product to be useable, we consider that BT should adjust the relevant dark fibre price to take them into account. In particular, we consider that to the extent there are any objectively justifiable differences between the dark fibre service and the corresponding reference Ethernet service, the dark fibre rental and/or connection charge should be adjusted to reflect the relevant long-run incremental costs of these differences. This approach is consistent with our overall LRIC approach to the active differential described above, and would therefore allow CPs to offer competing leased line services based on dark fibre. We would therefore expect differences in incremental cost arising from any such differences between the products to be reflected in the active differential (and therefore BT’s rental and connection charges). We note however that given our dark fibre remedy design, we would expect such differences to be minimal.

A23.123 We would expect this position to hold for most elements of the dark fibre product which do not already have a separate explicit charge (we discuss ancillary services which have separate charges below). For example, there is currently no separate cease charge for the reference active products, but rather these costs are recovered as part of the rental and connection charges (as discussed in paragraph A23.68). The active-specific cessation costs are reflected in our active differential and so would not feature in the dark fibre price, while there are some fibre-specific cease costs already included in the dark fibre price (i.e. those related to the ‘Service Centres (provision)’ and ‘Routeing and Records’ components). However, we recognise BT’s argument as discussed in Annex 22 that it may need to physically sever the fibre in the event of a dark fibre cease which it would not need to do for active services (which are disabled remotely by the network management systems). As such, BT may incur additional direct dark fibre specific cease costs, and we consider to the extent this was the case, it is likely to be reasonable for BT to recover these costs on a long-run incremental cost basis.

A23.124 In order to aid transparency for compliance purposes, we consider it may be more reasonable and appropriate for BT to recover the relevant long run incremental costs as a separate per-circuit cease charge, as and when a dark fibre circuit is terminated. However, to the extent BT preferred to recover these costs as part of the dark fibre rental or connection price (i.e. by adjusting the level to reflect the relevant long-run incremental costs), we would expect BT to separate these costs out to aid compliance.

A23.125 We note that if BT were to introduce differences between the dark fibre and active products without an objective justification this may have implications in relation to its obligation not to unduly discriminate between its active and dark fibre product offers.

A23.126 Therefore to the extent that the third component of the active differential is necessary and appropriate, we consider it should reflect the long run incremental costs of the objectively justifiable difference(s).

Indicative calculation of the active differential

A23.127 We have prepared an indicative calculation of the active differential for BT's EAD and EAD LA 1Gbit/s service, as well as Main Link, based on the guidance above.[558] However, given the uncertainty around the specific dark fibre remedy design, these estimates are based on the first and second component only[559], and do not make any attempt to quantify the third component (to the extent it is required).

A23.128 These calculations are indicative only; it is likely that they will change as actual future cost data replaces forecasts, and their implications for the dark fibre price may also change slightly as the dark fibre product is fully design (through industry negotiations.[560] In addition, the costs used to estimate these illustrative examples are a blend of several variants (for example, the EAD estimate reflects average costs across resilience options, extended reach variants etc.). Therefore it is possible that the active differential applicable when dark fibre is introduced will be different (and vary across the different dark fibre variants) to the level indicated below. Nonetheless, the illustrative analysis below provides an indication of the active differential that may be expected when dark fibre is commercially available.

A23.129 Our calculation is summarised in Table A23.4. The full details of this calculation for EAD 1Gbit/s and EAD LA 1Gbit/s are set out in Annex 33. In relation to our Main Link calculation, we have estimated a unit cumulo cost per fibre km by dividing the estimated cumulo costs allocated to Ethernet Main Link[561] in 2018/19[562] by the volumes. All calculations are based on non-WECLA data, and for the purposes of this indicative calculation we have used external costs only (for the reasons set out in Annex 33). This analysis suggests that the Local Access variant of the Dark Fibre product could have a rental charge approximately £710.01 lower than the EAD LA 1Gbit/s equivalent in 2018/19 (subject to the difference across variants), and that the non-Local Access variant could have a rental charge of approximately £735.60 lower (assuming no differences between the active reference product and the dark fibre remedy).

[558] As noted above, this calculation does not include any of the Openreach Systems and Development super-component costs.
[559] It uses an estimate of BT's current allocation of cumulo costs for the purposes of the second component.
[560] For example, there may be some dark fibre specific costs which need to be included in the active differential, as we discuss further below.
[561] Ethernet Main Link Rentals External Non WECLA (SD115).
[562] These costs are estimated on the basis that Cumulo costs were [✂]% of Ethernet Main Link non-pay costs in 2014/15. We have then applied this to the forecast 18/19 Ethernet Main Link non-pay costs to estimate the Cumulo costs allocated to Main Link in 2018/19.

Table A23.4: Indicative calculation of 2018/19 active differential

Active product	Active differential
EAD 1Gbit/s rental	£735.60 per circuit
EAD LA 1Gbit/s rental	£710.01 per circuit
EAD 1Gbit/s connection	£0.06 per circuit
EAD LA 1Gbit/s connection	£0.05 per circuit
EAD Main Link rental	£[✂] per fibre km

Source: Ofcom

A23.130 Some stakeholders have argued that the guidance provided above may give BT considerable flexibility and may not provide sufficient certainty on the dark fibre price level. However, for the reasons set out in Section 9 of Volume I, we consider guidance to be appropriate, and have sought to provide as much detail as we can at this stage (given the dark fibre remedy does not exist yet) to restrict BT's flexibility and provide information to other stakeholders. Further, we have imposed cost accounting obligations to support this remedy, which are vital to help reduce the risk that BT is able to game the remedy (as discussed in Section 17 of Volume I). Therefore we consider this guidance and the indicative calculation provides sufficient certainty (to both BT and access-seeking CPs) for this review period.

A23.131 These estimates assume there are no differences between the active reference product and the dark fibre remedy (beyond those associated with the provision of the active equipment). However, this may not be the case in reality, and so we now discuss the potential differences between the two, and the impact we would expect such differences to have on the dark fibre price.

Dual fibre pricing and additional pricing asymmetry

Summary of our initial view

A23.132 In recognition that our reference active products were single-fibre circuits, and our proposal for BT to also offer a dual-fibre dark fibre circuit, we considered two potential options for the price of the latter: price the second fibre at incremental cost or at double the single-fibre circuit price (adjusted for any incremental cost savings associated with supplying multiple fibres). On balance, we proposed the second option, on the basis that it would still allow dark fibre to be commercially viable for the same active circuits as the first option but also addressed the concerns that the second option risks leading to an inefficient use of fibre[563] and greater arbitrage (as CPs may use the two fibres to provide different active circuits).

[563] That is, two fibres may be ordered even though only one is required to deliver the service, given would expect the incremental cost to BT of the second fibre is likely to be low.

Responses to the May 2015 BCMR and June 2015 LLCC Consultations

A23.133 In relation to the potential differences between dark fibre and the reference active products, the majority of stakeholders commented on our proposals for the price of a dual-fibre dark fibre circuit. However, BT also raised some examples of potential differences it may want to introduce.

Dual-fibre circuits

A23.134 TalkTalk[564], PAG[565], Vodafone[566] and UKB Networks[567] disagreed with our proposed approach.

A23.135 In its report for PAG, Frontier argued that the proposed approach could further reduce the potential addressable market for a dark fibre product, as the margin between BT's active products for services which require dual-fibre and the corresponding costs of dark fibre would not be sufficient for a competing provider to competitively offer the service using dark fibre.

A23.136 More specifically, TalkTalk, UKB Networks and Vodafone all argued that CPs would be placed at a material disadvantage relative to Openreach since the underlying cost to Openreach of using two strands of fibre (instead of one) will be low and not equivalent to double the single-fibre circuit price (which will be the price faced by other CPs). Therefore, Openreach will face a different trade-off to other CPs, who will either have to invest in single fibre working (which has higher costs) or incur the large additional cost for a dual fibre dark fibre circuit, even though the incremental cost (to Openreach) of an additional fibre on the same route is low. As a result, there will not be a level playing field and competition will be distorted/will not be on the merits.[568]

A23.137 In relation to the arguments against adopting an incremental cost approach to the second fibre, TalkTalk considered that arbitrage concerns are misplaced since it is highly unlikely a CP would use a dual-fibre circuit over the exact same route (since for instance if they required additional capacity they would use WDM over a single fibre), and BT could contractually prohibit such usage. It also argued that the inefficient (over) consumption concern (i.e. that CPs will request dual-fibre even if service could be provided with a single-circuit) can be avoided by allowing a premium for the two strand option reflecting the additional incremental cost (although TalkTalk acknowledged that the additional cost is trivial).[569]

A23.138 Relatedly, Frontier (in its report for PAG) argued that it is unlikely that CPs would incur the incremental cost (however small) for an additional fibre unless it provided a benefit to the end user which exceeded this cost. In this case, it argued that

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[564] TalkTalk non-confidential response to May 2015 BCMR and June 2015 LLCC Consultations.
[565] Frontier Economics, *Ofcom's proposals on regulated dark fibre pricing: a report prepared for the Passive Access Group*, page 22-23. Received as part of the PAG non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultations.
[566] Vodafone non-confidential response to the June 2015 LLCC Consultation, paragraph 7.12.
[567] UKB Networks non-confidential response to the June 2015 LLCC Consultation, page 5.
[568] Vodafone also argued that it is debatable whether BT's single fibre working is the most efficient deployment for active services, since lower fibre costs are traded for higher equipment costs.
[569] TalkTalk response to May 2015 BCMR and June 2015 LLCC Consultations, page 53.

provision of a second fibre would increase allocative efficiency and as the contribution to common costs would be the same whether the CP used a single or two fibres, BT's recovery of fixed and common costs would not be affected by the choice. It also considered that the cost recovery from dark fibre could better reflect the contribution made by the equivalent Openreach active services, ensuring competitive neutrality.[570]

A23.139 Vodafone argued that a middle ground which does not favour either BT or a CP is required, which would see the provision of the second fibre (where required) offered at a far lower cost than double EAD.[571]

A23.140 Conversely, BT noted the following in relation to our proposal for setting the price of a dual-fibre circuit close to that of two single fibres:

- it would reduce the extent to which CPs might seek to use multiple fibres for different active circuits, which for each of those active circuits Ofcom's charge control calculations assume that the CP would have paid for in full.

- current market prices for comparable Dark Fibre services (whether on-net or off-net) present a much higher price than a single "EAD 1Gbit/s minus" per fibre, and reflect the fact that Dark Fibre is typically used as a substitute for very high bandwidth services. This further promotes the notion that services requiring two fibres should be priced very near that of two distinct fibres.

- whilst WDM based systems that carry multiple wavelengths have tended to use a fibre pair, there are existing and emerging technologies where vendors are offering single fibre working WDM optics which utilise single fibre working. While this may compromise the total number of wavelengths that are able to be transmitted by a CP, Openreach's view is that CPs will consider the cost/benefits of single fibre work WDM optics over using the traditional fibre pair for transmission purposes.[572]

A23.141 We note with regard to the last point that CityFibre stated it expected demand for BT's dark fibre products to be predominantly for single fibre. This is because it considered the number of connectivity applications that require the use of dual fibre is very limited (since modern optical electronics can deliver very high bandwidth transmission over a single fibre for limited (3 to 7% of total equipment value) price premiums over dual fibre optics. It also noted that WDM systems that prefer dual fibre delivery are normally used in long-haul networks that Ofcom recognise as being largely competitive, and argued that WDM is unlikely to be utilised to any large extent in local access networks.[573]

A23.142 Finally, BT stated that in selling a fibre pair as opposed to a single fibre, it would expect that some costs may be avoided in relation to sales and product

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[570], Frontier Economics. *Ofcom's proposals on regulated dark fibre pricing: a report prepared for the Passive Access Group* Received as part of the PAG non-confidential response to the May 2015 BCMR and June 2015 LLCC Consultations, page 22 – 23.
[571] Vodafone response to May 2015 BCMR Consultation, page 41.
[572] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 280-284.
[573] CityFibre non-confidential response to the June 2015 LLCC Consultation, Section 7.3.

management, service centres – assurance, and revenue debtors. It estimated a reduction of less than £100 on the LRIC differential for the second fibre (based on 2013/14 RFS). Overall, it considered that this would result in the price for two fibres being close to double that of a single fibre.[574]

Additional pricing asymmetry

A23.143 BT argued that it would like some additional asymmetry between active and dark fibre pricing (in particular creating new product variants including on-net and off-net variants of Dark Fibre whilst maintaining the existing EAD and EAD LA product variants for active products), to help mitigate some of the risks associated with inefficient take-up of dark fibre solely based on price arbitrage. This is because it considered such an approach would make Dark Fibre more reflective of the costs to serve and mitigate the risks of under-recovery due to aggregation of subsequent demand using dark fibre. It also argued that maintaining the existing EAD pricing structure could help maintain the advantages of averaged product type pricing and certainty for the business connectivity market. In particular, it proposed two forms of asymmetrical pricing between active and passive to reflect the differences in the nature of the services, which it considered could mitigate some of the risks:

- Removal of ECC exemption for Dark Fibre – maintaining the ECC exemption for dark fibre would be counterproductive if Openreach decided it was appropriate to reflect de-averaged costs and prices. As Dark Fibre inherently presents additional risk that the fibre strand will not be further reused (because a customer only needs a single Dark Fibre for a given route as further upgrades are made on the electronics), BT would want to consider whether the exemption should remain in place for active products only.

- Special forms of volume discount – to compensate for the risks of aggregation of Dark Fibre, one form of volume discount that could be attractive to both CPs and Openreach would be a discount offered when a CP purchases more than one circuit for the same route going from a postcode A to a postcode B. In other words, CPs could pay less than twice the charges when they procure two active circuits from Openreach on the same route. It would also make those active circuits more commercially viable compared to Dark Fibre, and would reduce the risk of fibre and electronic stranded assets, on the existing circuit base. It also argued that it would enable the CP to realise economies, while removing some of the inefficient incentives for migrations to Dark Fibre (e.g. risk of inefficient use of fibre and existing electronics).[575]

Our decision

A23.144 The main (EAD and EAD LA) reference products used to price dark fibre are single-fibre circuits[576] and while the majority of active services can be provided using a single-fibre circuit, there may be some services which require a dual-fibre circuit.

[574] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 281.
[575] BT's non-confidential response to the June 2015 LLCC Consultation, paragraph 163-7.
[576] The resilience option (RO2) involves the provision of two diversely routed single-fibre circuits.

A23.145 We now discuss our expected approach for the pricing of dual fibre circuits. We then discuss BT's specific proposals for additional differences between dark fibre and the reference active products (summarised above).

Dual-fibre circuits

A23.146 As discussed in Section 9 of Volume I, depending on the exact design of the service to be provided, leased lines may require one or two fibres, and so BT will be required to include the option for dark fibre with one or two fibres as per CPs' requirements. This will help ensure that CPs can obtain dark fibre circuits in configurations that are comparable to the current range of active services offered by Openreach.[577]

A23.147 However, the reference products used for pricing dark fibre are single-fibre circuits, and so we need to consider how we might expect a dual-fibre dark fibre circuit to be priced. In relation to this, we are mindful of the need to:

- Provide efficient long term signals to CPs purchasing dark fibre. It is technically feasible to provide some WDM services over either dual-fibre or single fibre, but single-fibre equipment is more expensive than dual-fibre equipment (as noted by several stakeholders, see paragraph A23.136 onwards). Therefore we would want to seek to ensure that the relativity between the two regulated prices (i.e. single- and dual-fibre) reflects the 'true' costs associated with the additional fibre, in order to not distort this decision between providing the WDM service using single- or dual-fibre dark fibre.

- Ensure a dual-fibre circuit can be used to commercially provide an active service where there are benefits of providing it in this way.

A23.148 We have considered two broad approaches to pricing a dual-fibre dark fibre circuit:

- Price the second fibre at incremental cost – under this approach the dual-fibre circuit would be priced so it makes the same contribution to fixed and common costs as a single-fibre circuit, with the only difference in price reflecting any incremental costs BT incurred in providing a pair of fibres rather than a single fibre; or

- Price the second fibre on the same basis as a single-fibre circuit – under this approach, the price of a single-fibre circuit would be doubled for the provision of a dual-fibre circuit, but then adjusted for any incremental cost savings to BT associated with supplying multiple fibres.[578]

A23.149 We recognise that the first option has potential efficiency advantages, since it will ensure active services requiring a dual-fibre circuit can be supplied at a price that only reflects the incremental costs involved in the supply of the second fibre. This should reduce the distortions between single and dual fibre circuits, and therefore

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[577] May 2015 BCMR Consultation, paragraph 9.7.

[578] For example, for provisioning, we would expect the incremental cost of installing two fibres simultaneously to be similar to that of a single fibre, rather than twice the amount charged for a single-fibre circuit installation.

allow CPs to make more efficient trade-offs between single- and dual-fibre provision in their purchase decisions.

A23.150 However, there is no dual fibre EAD 1Gbit/s service to use as a reference product for an incremental cost approach[579], and we are concerned that the existing measures of the incremental cost of providing an additional fibre on a per circuit basis may not be appropriate. In particular, we are concerned that the existing measures may not be reflect the ‘true’ long term incremental costs associated with the additional fibre. This is because BT currently allocates many of its costs on a per circuit rather than per fibre basis, meaning that even where a dual fibre circuit exists (e.g. OSA), its cost stack may not provide an accurate reflection of the incremental costs associated with the additional fibre.

A23.151 For example, while not a measure of incremental costs per se, our concerns that BT’s current allocation of costs is not an accurate reflection of the incremental costs associated with an additional fibre, can be observed with a comparison of the cost components of an OSA (dual fibre) circuit relative to an EAD 1Gbit/s circuit (single fibre). In particular, the cost component ‘Ethernet Access Direct Fibre’[580] features in the cost stack for both circuit types, and is predominantly made up of duct and fibre costs (as discussed above, see paragraph A23.56). However, this component was £[✂] for external OSA rentals (non-WECLA) in 2014/15, compared to £[✂] for external 1Gbit/s EAD rentals (non-WECLA). Given the former is a dual-fibre circuit and the latter is single fibre, we consider this emphasises the risk that the existing allocation of costs in relation to fibre and duct do not reflect true incremental cost differences between the two services.

A23.152 Therefore it seems unlikely that the true incremental cost of an additional fibre would be as low as indicated by this illustrative comparison of costs allocated to single and dual fibre circuits. Furthermore, given the scale of fibre costs, we consider it is important that we do not adopt an incremental cost approach which would tend to underestimate them.

A23.153 This is of particular importance since, for BT’s active circuits, the decision on whether to use one or two fibres is BT’s own choice, depending on (for example) the length of the circuit and nature of the service provided. Therefore it is reasonable to assume BT will use two fibres only where it is technically necessary and/or more efficient to do so (given its overall network utilisation and fibre requirements). In contrast, dark fibre would make it the access seeking CP’s choice on whether to purchase a single- or dual-fibre circuit, and so in order to ensure efficient choices in this trade-off, the price signals provided are very important. This is true not just in absolute terms, but also because an increase in demand for dual-fibre circuits may mean BT needs to undertake additional capital expenditure to increase the availability of fibre to meet this demand, which would ultimately affect the costs of the network.[581]

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[579] The nearest equivalent services are the resilience options, but these are two diversely routed single-fibre circuits, which makes them less relevant for a dual-fibre single circuit.
[580] Component CW609.
[581] This is also another reason why (depending on how it is measured) existing measures of the incremental cost of an additional fibre on a per circuit basis may not be a true reflection of the (longer

A23.154 As a result, we are concerned that the implied incremental costs based on the current (active-only) regime could lead to inefficient demand for dual-fibre circuits, with negative implications for efficient network utilisation.[582] This is because if faced with a lower premium for the additional fibre which does not reflect the true incremental costs, it would distort CP purchase decisions, with access seeking CPs purchasing dual-fibre circuit (rather than single-fibre circuit) even though this was not the efficient choice. Not only would this be an inefficient use of existing resources, but to the extent BT needed to increase capital expenditure in fibre to meet this demand, it would also represent inefficient investment.[583] Further, it is likely to increase the scale and scope of price arbitrage opportunities (for very high bandwidth circuits) as well as density based arbitrage, since CPs could use the two fibres to provide different active circuits on the same route as opposed to using them for the same circuit[584]. We consider this would be contrary to our overall aims for dark fibre where we are seeking to provide incentives for CPs to use it where it provides additional benefits rather than as a cost reduction mechanism per se (i.e. the purpose of dark fibre is not to create arbitrage opportunities).

A23.155 While we recognise stakeholder arguments that CPs will only incur the additional costs (however small) where the benefits outweigh this (see paragraph A23.137 and A23.138), we still consider the risk of inefficient over consumption of dual-fibre to be high given that current measures of incremental cost based on the current (active-only) regime are likely to be lower than the “true” cost of an additional fibre.

A23.156 Therefore we remain of the view that an incremental cost approach based on current allocations is likely to raise significant risks of inefficient use of fibre and may incentivise arbitrage-based use of dark fibre, which would not be a desirable outcome. Therefore we do not consider an incremental cost approach based on current allocations to be appropriate for this review period, particularly as in deciding the price for dual fibre circuits, we take into consideration other factors such as the benefits of preserving an opportunity for BT to set a bandwidth gradient for common cost recovery and investment incentives. We also note that changing the cost allocations or estimating the true incremental costs for this review period, would be highly complex and require significant engineering of data which we consider would not be proportionate at this introductory stage.

A23.157 Pricing the second fibre on the same basis as a single-fibre circuit (less any incremental cost savings to BT associated with supplying multiple fibres) would significantly reduce the risk of inefficient fibre usage and arbitrage-driven demand (as noted by BT, see paragraph A23.140). However, it is important that this approach still provides scope for the use of a dual-fibre circuit where there are

term) costs incurred, given the potential scope for additional fibre demand. As such, it may not provide efficient long term signals to dark fibre purchasing CPs.

[582] For example, CPs could adopt a dual-fibre WDM system when a single-fibre option would have been more efficient if they had faced the true cost of the additional fibre (this is a particular risk given a greater number of services are now able to be supplied on a single fibre, as argued by CityFibre (see paragraph A23.141)). Such a distortion could result in an inefficiently fibre-rich network topology.

[583] We also note that the LLCC is based on current (and forecast) usage, based on BT’s own expected utilisation or single- and dual-fibre circuits. If demand for dual-fibre circuits changed significantly, there is a real risk it could not be appropriately adjusted for in the LLCC model.

[584] Although we note they can aggregate onto a single-fibre circuit where technically feasible and desirable to.

benefits of doing so, so as not to undermine the benefits of the dark fibre remedy. We consider the commercial viability of this pricing approach relative to the current active product set further in Annex 33. Our analysis indicates that under this pricing approach dual-fibre dark fibre would be viable for WDM circuits (when applied to the access segment). Therefore we do not consider that this approach would reduce the addressable market for dark fibre, as argued by PAG (see paragraph A23.135).

A23.158 Notwithstanding this, we only consider it appropriate for this dual-fibre pricing approach to apply to the access segment (i.e. the EAD/EAD LA-related dark fibre charge), rather than to any MainLink charge as well. This is because we consider that doubling the MainLink charge would result in too high a price and could restrict the use of a dual-fibre dark fibre circuit (and the benefits that would derive from this). Rather, we consider that pricing a dual fibre circuit at up to twice the price of a single-fibre circuit (less any incremental cost savings) for the access segment but maintaining a single MainLink charge would provide a sufficient premium for the additional fibre to reduce the risk of inefficient fibre use and/or significant price arbitrage, while still providing scope for the commercial use dual-fibre to provide an active circuit where it provides additional benefits (we discuss the viability of a dual-fibre dark fibre circuit for OSA in Annex 33).[585] We consider this to be consistent with our overall aims for the dark fibre remedy.

A23.159 We are providing this guidance as a maximum rather than an absolute (i.e. BT should price at no more than double the single fibre circuit price for a dual fibre circuit, but can charge less than this), as we recognise that there may be some benefits from additional pricing flexibility, in line with our general approach to price controls (i.e. where we set price ceilings).

A23.160 While we recognise that this approach makes a dual-fibre service more expensive to supply than the incremental cost approach and potentially results in a different cost profile to BT's current dual fibre active circuit (OSA) (as argued by stakeholders, see paragraph A23.136), we consider that it is appropriate given:

- the risks associated with the incremental cost approach, as set out above;
- our overall aims for dark fibre where we are seeking to provide incentives for CPs to use it where it provides additional benefits rather than as a cost reduction mechanism per se (i.e. the purpose of dark fibre is not to create arbitrage opportunities).
- It provides the opportunity for CPs to compete across the suite of active services by making a trade-off between single-and dual-fibre provisions, since more circuits are able to be supplied with a single fibre and a dual-fibre circuit remains commercially viable compared to the current active product set under this approach. As such, it will not undermine the use of the dark fibre remedy where there are benefits; and
- Where BT seeks to provide a new product using dark fibre, it will face the same price trade-off between single- and dual-fibre circuits as the other CPs.

[585] We also note that this approach is not inconsistent with BT's pricing for MainLink for its own dual-fibre (active) circuit, as BT charges a single MainLink charge for OSA circuits.

Additional pricing asymmetry

A23.161 As summarised above, BT has argued that some additional pricing asymmetry between dark fibre and the reference active products may be desirable to help mitigate some of the arbitrage incentives (see paragraph A23.143). In particular, it refers to the aggregation risks which it considers some pricing asymmetry may help mitigate. Before we consider this further, we first note that to the extent aggregation occurs, this is likely to be reflected in BT's costs through the regulatory accounts (as costs reflect utilised circuits rather than all fibres), and can also be reflected through the relevant charge controls (as discussed in Annexes 19 and 33).

A23.162 Our starting point in both price and non-price design features of dark fibre is the active services currently provided. As discussed further in Section 9 of Volume I and Annex 21, this is because we consider this approach will help reduce the potential regulatory arbitrage opportunities of regulating different levels of the value chain during this transitional period to dark fibre. While we recognise this may not fully mitigate all the risks, as discussed in Annex 33 it is not clear that dark fibre significantly increases the aggregation risk relative to the active regime. Therefore we do not consider that pricing asymmetry is necessary to address the aggregation risks as argued by BT. Nonetheless, we do recognise that there may be legitimate differences between the active and dark fibre product as discussed above, and so we would not necessarily have concerns with asymmetric pricing where the differences are objectively justifiable.

A23.163 Therefore in line with our overall approach, we would (broadly speaking) expect the dark fibre price to mirror that of the active reference product, unless there are objectively justifiable differences (in which case we would expect charges to reflect the incremental costs associated with such differences).

A23.164 We now address the two specific examples proposed by BT:

- Removal of ECC exemption for dark fibre: as described above, the rationale for aligning dark fibre prices with those of the reference active products is to reduce the risk of inefficient signals and distorted purchase decisions. While BT claims the asymmetry from the removal of the ECC from dark fibre may reduce the risks associated with aggregation, we consider there is a significant risk it may result in its own additional distortions of incentives. For example, it could lead CPs to buy an active circuit where additional infrastructure build is required (in order to take advantage of the ECC exemption), but subsequently migrate it to dark fibre (subject to the cost of doing so). Further, although the exemption threshold is based on an average of costs incurred, the ECCs actually incurred for any active circuit cover the full cost of the passive infrastructure deployed (i.e. BT's cost recovery is not dependent upon additional active circuits being provided using that infrastructure). Therefore it is not clear why a customer that only needs a single dark fibre for a given route (and can aggregate additional services using this) should lead to additional concerns relative to the active services. We consider that the ECC regime should be the same for actives and dark fibre, and so to the extent the exemption regime remains for active products, it should also be in place for dark fibre. We discuss ECCs further in Section 8, Volume II.

- Volume discounts for active circuits which are between the same postcodes: Our aim is to provide efficient signals for CPs deciding between dark fibre and active circuits, and this applies whether they are purchasing one circuit on a particular route or multiple. As such, we would not want BT to distort these incentives through the use of targeted active discounts to make multiple active circuits on the same route more commercially viable relative to dark fibre, as this may undermine the use of dark fibre (even where it is efficient). We consider that such discounts would be unlikely to be objectively justifiable. However, if discounts were introduced in a way which did not distort the signals between buying multiple active circuits or aggregating multiple circuits on a (single- or dual-fibre) dark fibre circuit, this could be desirable. For example, an additional active circuit on the same route would appear akin to a dual-fibre dark fibre circuit, in terms of physical infrastructure provided. As discussed above, we would not expect BT to set the price for dual-fibre dark fibre circuits at more than double the single-fibre circuit price (for the access segment, less any incremental cost savings), which is (broadly speaking) equivalent to paying for two active circuits. Therefore if BT sought to provide a discount on a second active circuit on the same route to reflect the economics of the additional circuit being provided, we would expect this to also be reflected in the dual-fibre dark fibre pricing approach so as not to create significant distortions.

Ancillary services

Summary of our initial view

A23.165 We recognised that dark fibre would require specific processes/ancillary services, and expected BT to specify arrangements for these processes in its Reference Offer. We proposed that any charges for these services should be based on the long-run incremental costs of any objectively justifiable differences between the active and passive product. That is, to the extent that there is a corresponding charge for the reference active product, we would expect that the corresponding charge for the dark fibre equivalent would be based on that charge, minus any long-run incremental costs avoided by not providing the active service.

Responses to the May 2015 BCMR and June 2015 LLCC Consultations

A23.166 BT did not agree with the guidance that 'each and every charge' for a Dark Fibre service should be reasonably derived from the charge for the corresponding active service for ancillary services (as defined in the draft SMP condition 5C.1 of Annex 15 of the June 2015 LLCC Consultation), since there are no reference products for potential Dark Fibre prices specifically in relation to such products (for example migration products) that may be defined in future. Therefore it considered that essentially imposing an “each and every charge” obligation which is referenced to a service which may not currently exist is disproportionate.[586]

A23.167 More specifically, BT stated that:

- Provisioning, repair and migration charges – this will need to be further defined in the reference offer, but the long run incremental costs of any objectively justifiable differences associated with migrations need to be fully inclusive of all

[586] BT’s non-confidential response to June 2015 LLCC Consultation, paragraph 259-261.

consequences to BT of the migration (e.g. the existing kit recovery or disposal, the cost of stranded assets, and the opportunity cost[587]).[588]

- Excess Construction Costs (ECCs) – BT disagreed with the application of the same ECC exemption to dark fibre as occurs for active circuits. We consider its specific concerns in Section 8 of Volume II.[589]

Our decision

A23.168 As discussed in Section 9 of Volume I, the network access obligation includes any ancillary services as may be reasonably necessary for a third party to use the services, and this includes for dark fibre. Ancillary services are payments that Openreach levies from customers for other services used in the provision of core services, and have traditionally been comprised of services such as ECCs, TRCs, accommodation and migration.

A23.169 In line with our general pricing approach for dark fibre, our starting position for the price for these services when incurred for dark fibre would be the equivalent service provided for the corresponding reference EAD or EAD LA 1Gbit/s active service. Where relevant and appropriate, we would expect the price for the dark fibre equivalent to reflect the long run incremental costs avoided by not providing the service for an active circuit. Therefore, to the extent that there is a corresponding charge for the reference EAD or EAD LA 1Gbit/s active service, we would expect that the corresponding charge for the dark fibre equivalent would be based on that charge, minus any long run incremental costs avoided by not providing the active service

A23.170 However, as discussed in Annex 22, we consider that some of the details of the design of the dark fibre remedy will need to be agreed by negotiation between CPs and BT as part of the implementation process, and so there is currently uncertainty around the final product design and requirements. Therefore to the extent that additional ancillary services are reasonably necessary for a third party to use the dark fibre services but for which there is no corresponding charge for the reference EAD or EAD LA 1Gbit/s active service, we would expect it to be priced on a fair and reasonable basis as per the general network access obligation, which requires BT to provide network access on fair and reasonable terms, conditions and charges (as discussed in Section 9 of Volume I).

A23.171 We discuss below some specific examples which we consider are likely to be relevant for dark fibre.

New infrastructure and ECCs

A23.172 We set out our rationale and final position for new infrastructure provisioning, including ECCs, in Section 8 of Volume II. In summary, we consider that the

[587] BT suggested the fact that CPs will never buy an additional circuit on a given route once migrated to dark fibre as an example of an opportunity cost which should be reflected in migration costs.
[588] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 285-286.
[589] BT's non-confidential response to June 2015 LLCC Consultation, paragraph 287-291.

existing charging arrangements for (active) network extensions would provide the most suitable solution for the dark fibre service. In particular:

- where construction of new infrastructure is required which is not specific to an individual customer, for example to increase capacity or to repair broken duct, we consider that the arrangements should not differ between active and dark fibre access and so there should be no additional charge.

- where construction of new infrastructure is specific to an individual customer (i.e. customer specific ECCs), we consider that the same ECCs should also apply to both active and dark fibre services. In particular, we consider the ECC arrangements for dark fibre should mirror those of active services (so, for example, where BT provides an exemption from a specified value of ECCs for active circuits, the same value for dark fibre should be used, and the balancing charge should also be the same).

TRCs and accommodation

A23.173 As set out in Section 8 of Volume II, we consider that for TRCs and accommodation costs, the controls applied to active services and access arrangements for accommodation services should also apply for the dark fibre service (although to the extent that negotiations around the dark fibre product design reveal any objectively justifiable differences between accommodation services for active products and dark fibre, we would expect these to be reflected in the charges on the basis of long run incremental cost differences).

Migrations

A23.174 As discussed in Annex 22, the need for a specific migration product within this review period is for industry negotiation. However, in line with the general principles described above, we would expect that to the extent that any dark fibre migration product reflected the existing EAD or EAD LA 1Gbit/s product, it would be priced based on the active charge, adjusted to reflect the long run incremental costs of any objectively justifiable differences associated with migrating to dark fibre products rather than to active products. For example, we acknowledge that migration activities related to dark fibre services may differ from those involved with the provision of active services (e.g. they may involve the removal of equipment from an existing fibre without the need to install new equipment).

A23.175 However, although BT has argued that the cost should reflect stranded assets (see paragraph A23.167), we do not consider it appropriate for this to be reflected in any migration charge for an active service to dark fibre given stranded assets are already reflected in the LLCC (see Annex 33 for more detail).

Annex 24

Guidance on assessment of BT's pricing of Dark Fibre Access

Introduction

A24.1 This Annex sets out guidance on how we would assess whether BT is complying with SMP condition 10C. The guidance should therefore be read alongside SMP condition 10C and Annex 23.

A24.2 This guidance reflects the approach we would expect to take based on the information available to us at this time. However, any assessment of BT's compliance with the SMP condition would be based on the prevailing circumstances at the time, and it may therefore be appropriate to depart from this guidance. We would expect to do so only where circumstances are materially different from those described in this guidance, and would anticipate that any such changes would be consistent with the principles in this guidance.

A24.3 Defined terms used in this guidance are the same as those used in SMP condition 10C unless otherwise stated.

Structure of this guidance

A24.4 In SMP condition 10C.1, we impose a basis of charges condition requiring BT to ensure that each and every charge for Dark Fibre Access is reasonably derived from the charges for the corresponding 1Gbit/s EAD Service or 1Gbit/s EAD LA Service or Main Link Service (including variants, where relevant) at any point in time[590], adjusted to reflect the difference in costs. In, particular each and every charge offered or payable for Dark Fibre Access should be reasonably derived from the charge for the corresponding 1Gbit/s EAD Service or 1Gbit/s EAD LA Service or Ethernet Main Link Service, adjusted to:

- subtract the long-run incremental costs that are avoided by BT when providing that Dark Fibre Access instead of the corresponding 1Gbit/s EAD or 1Gbit/s EAD LA service, such costs to be averaged over the Prior Relevant Financial Year ("First adjustment");

- if applicable, subtract the average of the Cumulo costs attributed to the corresponding 1Gbit/s EAD Service or 1Gbit/s EAD LA Service or Main Link Service in each Prior Relevant Financial Year ("Second adjustment"); and

- reflect the long-run incremental costs of any objectively justifiable differences (except any differences in circuit length) between that Dark Fibre Access and the corresponding 1Gbit/s EAD Service or 1Gbit/s EAD LA Service or Main Link

[590] We would expect the reference prices to be the one year Ethernet product price, irrespective of Dark Fibre Access contract length/minimum term (as discussed in Section 9).

Service, such costs to be averaged over the Prior Relevant Financial Year ("Third adjustment").

A24.5 This guidance sets out how we would anticipate calculating each of these three adjustments (which we refer to below in aggregate as the 'active differential') for the purposes of SMP condition 10C. In particular, we provide guidance in relation to:

- which costs we would expect to BT to avoid in the long-run by providing Dark Fibre Access instead of the corresponding EAD and EAD LA 1Gbit/s services;
- the approach to non-domestic business rate costs to be included in the active differential for each of the EAD and EAD LA 1Gbit/s services, as well as Ethernet Main Link; and
- differences between the dark fibre Reference Offer (RO) and the benchmark active services.

A24.6 We then provide guidance in relation to the pricing for dual-fibre dark fibre circuits (SMP condition C10.2), and relevant ancillary services (SMP condition C10.4).

Calculation of the active differential for SMP condition C10.1

First adjustment – the long-run incremental costs avoided by BT

A24.7 As set out in Condition 10C.1, BT is required to set the active differential to include costs which would be avoided when BT provides a single-fibre Dark Fibre Access circuit instead of the corresponding active service. More specifically, this should reflect the long-run incremental costs avoided by BT when providing the Dark Fibre Access instead of the corresponding 1Gbit/s EAD or 1Gbit/s EAD LA service (SMP condition 10C.(i)). We would expect BT to determine these costs based on a volume weighted average across internal and external services.

A24.8 This sub-section now sets out our guidance on which specific costs we consider will be avoided by BT when provides a Dark Fibre Access instead of the corresponding 1Gbit/s EAD service or 1Gbit/s EAD LA service for the purposes of dark fibre rental and connection charges. We recognise this approach may not be directly relevant for other dark fibre services (for example, these super-components may not be applicable for ancillary services).[591] However, we would expect similar principles to apply.

A24.9 Based on BT's RFS for 2014/15, we have identified nine cost super-components[592] that are used to provide EAD and EAD LA services, which are relevant to rentals

[591] We also note there are currently no active-specific incremental costs in Ethernet Main Link services, and so would not currently expect this first adjustment to be relevant for determining the relevant dark fibre price for Main Link.

[592] In its regulatory accounts BT reports the costs of services by what are called super-components. A super-component is a collection of network components, though many super-components consist of only one network component. BT describes a network component as constituting a discrete part of its network. A network component collects costs from various plant groups. See also BT's 2014 DAM pages 11 and 206.

and/or connections. For the purpose of this guidance, we have categorised these super-components into two groups: asset-based components (mainly associated with equipment and network infrastructure) and service support components (relating to other operating costs required to provide EAD services).

A24.10 Table A24.1 below shows the nine super-components and whether they are classified as asset-based components or service support components. It also indicates whether the relevant costs are attributed to rentals, connection charges, or both, and therefore which active differential (rental or connection) that we would expect them to be included. The names of the super-components are taken directly from BT's RFS for 2014/15.

Table A24.1: Classification of Ethernet super-components

Super-Component	Asset-based/Service-based	Rentals	Connections
Ethernet Access Direct Fibre	Asset	✓	
Ethernet Main Links	Asset	✓	
Ethernet Electronics	Asset	✓	
Openreach Systems and Development (Ethernet Specific)	Service	✓	✓
Service Centres (Provision)	Service		✓
Routeing and Records	Service		✓
Service Centres (Assurance)	Service	✓	
Sales Product Management	Service	✓	✓
Revenue Receivables	Service	✓	✓

Source: BT's 2015 RFS and Ofcom. A '✓' indicates that the cost super-component contributes to the cost of either rental or connection charges.

Asset-based super-components

A24.11 Ethernet Access Direct Fibre and Ethernet Main Links mainly cover the costs of duct and fibre required to provide Ethernet services, as well as an attribution of some software assets that are required to support services using these assets. We do not consider that these costs are likely to be incremental to active services, and we would therefore not expect these costs to be included in the active differential.

A24.12 Ethernet Electronics covers costs associated with operating and maintaining active equipment, including the capital costs of that equipment. These costs do not appear to be associated with the passive infrastructure elements, and are therefore incremental to the active services. However, we would not expect all of the costs of the Ethernet Electronics super-component to be included in the active differential, as some of the costs relate to systems used for multiple active services (i.e. not just the reference products). We would therefore expect an attribution of these costs to be included in the active differential, based on the proportion of costs that would not be incurred if BT provided Dark Fibre Access instead of the corresponding EAD 1Gbit/s or 1Gbit/s EAD LA services. This proportion of cost should be calculated by the LRIC to FAC ratio for this component using LRIC and FAC data from BT's LRIC model.

Service support super-components

A24.13 The Openreach Systems and Development (Ethernet Specific) super-component predominantly covers software costs. If BT is able to show that the costs of this super-component are not associated with active services, then we would not expect them to be included in the calculation of the first component of the LRIC-based active differential. If BT is not able to show this, then it should include an element of these costs within the LRIC-base active differential. This will be based on the LRIC to FAC ratio for this component multiplied by the proportion of costs that relate to active services.

A24.14 The Service Centres (Provision) super-component covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints related to provisioning processes. We do not consider that these costs are incremental to active services, and we would therefore not expect these costs to be included in the active differential.

A24.15 The Routeing and Records super-component covers the costs associated with the physical verification and initial recording of routings within the network. We do not consider that these costs are incremental to active services, and we would therefore not expect these costs to be included in the active differential.

A24.16 The Service Centres (Assurance) super-component covers the costs of staff working in Openreach customer contact centres who deal with enquiries and complaints relating to fault reporting and repairs. We consider that a proportion of these costs are incremental to active services and so should be included in the active differential. The relevant proportion should be calculated on the basis of the reduction of fault volumes per circuit for the provision of dark fibre instead of the reference Ethernet services, multiplied by the LRIC to FAC ratio for this component using LRIC and FAC data from BT's LRIC model. This should include the reduction in 'right when tested' and 'fault not found' faults, as well as equipment-related faults. Our starting assumption is that there will be a 62.5% reduction in faults, and we would expect BT to be able to demonstrate (if required) how any variations from this level is consistent with the guidance we have set out.

A24.17 The Sales Product Management super-component covers the costs of staff who work in the Sales Product Management division of Openreach. We consider that a share of these costs should be included in the active differential, and the proportion should be based on the total first component of the active differential (excluding the SPM costs) as a proportion of the overall 1Gbit/s EAD or EAD LA cost stack, multiplied by the LRIC to FAC ratio for this component using LRIC and FAC data from BT's LRIC model.

A24.18 The Revenue Receivables super-component covers part of the working capital for a service. Revenue Receivables costs are an estimate of the amounts owed to BT (both internal and external) for each service based on BT's standard payment terms. For Revenue Receivables, we consider that a share of these costs should be included in the active differential. This amount should be calculated based on the total first component of the active differential (excluding Revenue Receivables costs) as a proportion of the overall 1Gbit/s EAD or EAD LA cost stack, multiplied by the ratio of revenue receivable costs to revenues for EAD and EAD LA 1Gbit/s rental services.

Second adjustment - Non-domestic business rates

A24.19 We consider that if access-seeking CPs are liable for business rates when using dark fibre, an appropriate attribution of BT's non-domestic rates bill should be reflected in the active differential of the corresponding EAD 1Gbit/s, EAD LA 1Gbit/s or Ethernet Main Link Service. This should be based on the average attribution of BT's cumulo rating costs to the corresponding active Service (SMP condition 10C.1(ii)), based on an average across internal and external services.

A24.20 However, if the rating rules are amended during this review period such that BT would pay the rates for the dark fibre circuits which it provides to other CPs under Ofcom's regulations, this second adjustment would not be required.

Third adjustment – Objectively justifiable differences between dark fibre and the benchmark active services

A24.21 While we expect Dark Fibre Access to replicate the existing arrangements in relation to the relevant reference Ethernet product to the extent possible, we recognise there may be necessary and legitimate differences between active and DFA remedy products. For example, there may be services/features associated with DFA remedy which are not relevant for the corresponding active service (e.g. DFA may require different handover arrangements), but are necessary for dark fibre to be useable. SMP condition 2.2 allows for the potential that BT's Dark Fibre Access may differ from EAD services in some respects.

A24.22 Such differences may have implications for the price of Dark Fibre Access. At this stage the exact terms of requirements are unclear, but we consider that BT should adjust the Dark Fibre Access price to take objectively justifiable differences into account. In particular, we recognise that there may be other objectively justifiable differences between Dark Fibre Access and the corresponding 1Gbit/s EAD, 1Gbit/s EAD LA or MainLink Service, and in such a scenario, the Dark Fibre Access price should reflect the long run incremental costs of any such objectively justifiable differences (SMP condition 10C.1(iii)).[593]

Dual-fibre dark fibre circuits

A24.23 The EAD 1Gbit/s, EAD LA 1Gbit/s and Ethernet Main Link services are all single fibre services. However, where BT provides a dual-fibre dark fibre circuit it will be

[593] The only exception to this approach is where a dual-fibre dark fibre circuit is provided. We set out guidance on pricing for this scenario further below.

permitted to charge no more than twice the relevant single-fibre circuit charge (as determined under SMP condition 10C.1) less any incremental cost savings to BT associated with supplying multiple fibres (this is set out in SMP condition 10C.2). We would expect the latter to be calculated on a long run incremental cost basis.

A24.24 To be clear, this relates to the corresponding 1Gbit/s EAD and 1Gbit/s EAD LA Services only; the charge for a dual-fibre Main Link Service will be as derived under SMP condition 10C.1 only.[594]

A24.25 To the extent that BT provides more than two fibres in a circuit, we would expect the charge to be no higher than the relevant single-fibre circuit charge multiplied by the number of optical fibres included in that Dark Fibre Access, less any incremental cost savings of providing network access to more than one optical fibres at the same time.

Ancillary services

A24.26 This includes such services as ECCs, TRCs, Accommodation and migration activities. We expect BT to specify arrangements for these processes in its reference offer.

A24.27 We would expect the charge for each of these services provided for Dark Fibre Access to be determined as per SMP condition 10C.3. Therefore, in line with our overall pricing approach, each ancillary service should be priced to reflect the charge for the equivalent service provided for the corresponding 1Gbit/s EAD, 1Gbit/s EAD LA or Main Link Service, but this can be adjusted to reflect the long run incremental costs avoided by not providing the service for an active circuit and/or the long run incremental costs of any objectively justifiable differences where necessary and appropriate.

A24.28 The application of this guidance to different ancillary services may vary. For example, we consider there is unlikely to be a material difference between the costs incurred for dark fibre ECCs and regulated TRCs relative to their active equivalents, and so would expect BT should set the same charges for Dark Fibre Access as for active products. In comparison, while we would not expect there to be a difference between the accommodation services required by CPs who purchase active products compared to Dark Fibre Access, we do recognise that there is a degree of uncertainty about what would be required. Therefore to the extent that negotiations around the Dark Fibre Access design reveal any objectively justifiable differences between accommodation services for active products and dark fibre, we would expect these to be reflected in the charges on the basis of long run incremental cost differences.[595]

A24.29 To the extent that additional ancillary services are reasonably necessary for a third party to use the Dark Fibre Access but for which there is no corresponding charge for the reference EAD or EAD LA 1Gbit/s active service, we would expect such services to be priced on a fair and reasonable basis as per the general network access obligation, which requires BT to provide network access on fair and reasonable terms, conditions and charges.

[594] The rationale for this is set out in Annex 23.
[595] Each of these examples is discussed further in Section 8 of Volume 2.

Annex 25

Glossary

21st Century Network (21CN)	BT's next generation network upgrade.
2007/8 Review	Ofcom's review of retail and wholesale leased lines markets, concluded in 2008
2013 Review	Ofcom's review of the retail and wholesale leased lines markets, concluded in 2013
2013 LLCC	The current leased line charge controls.
2013 LLCC Model	The model published in conjunction with the March 2013 BCMR Statement.
2015 LLCC Base Year Model	The base year model used for the preparation of the June 2015 LLCC Consultation.
2015 LLCC Model	The model published in conjunction with the June 2015 LLCC Consultation.
2016 LLCC	The charge controls that we propose to implement in the 2016 BCMR Statement for the leased line markets effective from 1 May 2016 until 31 March 2019
2016 BCMR Statement	The statement that will be published implementing charge controls for the leased line markets effective from 1 May 2016 until 31 March 2019.
Accumulated (HCA) depreciation	Totality of deductions made to the original purchase price of a tangible fixed asset to reflect its cumulative consumption since acquisition.
Accumulated (CCA) depreciation	Totality of deductions made to the gross replacement cost of a tangible fixed asset to reflect its cumulative consumption since acquisition.

Alternative Interface (AI)	Leased line services typically using an Ethernet interface.
Alternative interface symmetric broadband origination (AISBO)	Leased line terminating segment typically using an Ethernet interface.
Anchor pricing	An approach that sets the upper bound for charges of existing services by reference to the cost of providing those services using existing technology. This ensures that the introduction of new technology which is intended to provide a greater range of services does not inappropriately lead to an increase in the cost of the existing services.
Asset Volume Elasticity (AVE)	The percentage increase in capital costs required for a 1% increase in volume.
Asymmetric Digital Subscriber Line (ADSL)	A variant of DSL that supports higher bandwidth on downlink transmissions, i.e. from the exchange to the end user than from the end user to the exchange.
Asynchronous Transfer Mode (ATM)	A network technology that uses asynchronous time division multiplexing techniques and which supports data transmissions at up to 622Mbit/s.
Backhaul	Connections between access nodes and core nodes.
Backhaul Ethernet Services (BES)	A BT wholesale Ethernet service providing high bandwidth inter-exchange connectivity.
Bandwidth	In digital telecommunications systems, the rate measured in bits per second (bit/s), at which information can be transferred.
Base-station Controller (BSC)	An element of a mobile telephone network that controls a number of Radio Base Stations.
Bearer	A transmission link that carries one or more multiplexed smaller-capacity connections.

Bulk Transport Link (BTL)	A BT wholesale Ethernet interconnection product providing high bandwidth, point-to-point connections between an Openreach Handover Point (OHP) to a Communications Provider's site.
Business Connectivity Market Review (BCMR)	The consultation of this market review, published on 15 May 2015.
Call for Input (the CFI)	The document issued by Ofcom at the start of this review seeking initial stakeholder input.
Capital expenditure (capex)	The firm's level of investment in fixed assets over the course of the financial year.
Central Business District (CBD)	These are central business districts of urban centres in Birmingham, Bristol, Glasgow, Leeds and Manchester, as defined in the May 2015 BCMR Consultation.
Central and East London Area (CELA)	The geographic market covering central and east London as defined by Ofcom in the 2007/8 Review.
Central London Area (CLA)	A proposed geographic market in central London set out in the May 2015 BCMR Consultation.
Co-location	The provision of space and associated facilities at a BT exchange for CP equipment.
Contemporary Interface (CI)	A set of modern technologies used for delivery of leased line services (e.g. Ethernet or wavelength-division multiplexing).
Contemporary interface symmetric broadband origination (CISBO)	A service defined in the May 2015 BCMR Consultation consisting of wholesale leased line services using CI technologies.
Communications Provider (CP)	An organisation that provides electronic communications services.

Compound Annual Growth Rate (CAGR)	The year-on-year smoothed annualised growth rate of an investment. It can be calculated as follows: CAGR = $\left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\text{number of years}}\right)}-1$
Consumer price index (CPI)	The consumer price index (CPI) is a measure of inflation. It measures changes in the price level of consumer goods and services purchased by households. The most significant item excluded in the CPI, but included in the RPI, is mortgage interest rate payments.
Contractor ECCs	Construction activities that Openreach provides through an external contractor.
Cost Volume Elasticity (CVE)	The percentage increase in operating costs for a 1% increase in volume.
Cost Volume Relationship (CVR)	The relationship of how cost and volumes move in relation to one another.
Core Transmission Costing System (CTCS)	A BT core network costing system which models the volumes and network usage associated with the transmission across the BT Core network.
Cumulative OCM depreciation (Cum OCM dep)	The sum of the individual in-year OCM depreciation over the asset life up to the year being forecast, adjusted to reflect any changes in asset values over time.
Current Cost Accounting (CCA)	An accounting convention, where assets are valued and depreciated according to their current replacement cost whilst maintaining the operating or financial capital of the business entity.
Customer Premises Equipment (CPE)	Sometimes referred to as customer apparatus or consumer equipment, being equipment on consumers' premises which is not part of the public telecommunications network and which is directly or indirectly attached to it.

Customer Sited Handover (CSH)	An interconnection between BT and another communications provider where the BT handover circuit terminates at the communications provider's premises.
Data Over Cable Service Interface Specification (DOCSIS)	A telecommunications standard that enables cable TV networks to support broadband internet access services.
Detailed Attribution Methods 2014 (DAM)	BT Group, *Detailed Attribution Methods 2014*, 15 August 2014, http://www.btplc.com/Thegroup/RegulatoryandPublicaffairs/Financialstatements/2014/DAM2014.pdf
Digital Private Circuit Network (DPCN)	A BT network that is used to provide very low bandwidth TI leased lines services (services at bandwidths below 2Mbit/s)
Digital Subscriber Line (DSL)	A family of technologies generically referred to as DSL or xDSL that enable the transmission of broadband signals over ordinary copper telephone lines. ADSL (Asymmetric Digital Subscriber Line), HDSL (High bit rate Digital Subscriber Line) and VDSL (Very high data rate Digital Subscriber Line) are all variants of xDSL.
Direct ECCs	Construction activities that Openreach provides through its own staff.
Distributed long run incremental cost (DLRIC)	The LRIC of the individual service with a share of costs which are common to other services over BT's core network.
Disposals (Disp)	The assets that the firm disposes of (e.g. an asset that becomes fully depreciated or an asset that the firm sells) over the course of the financial year.
Distributed stand alone cost (DSAC)	An accounting approach estimated by adding to the DLRIC a proportionate share of the inter-increment common costs. Rather than all common costs shared by a service being allocated to the service under consideration, the common costs are instead allocated amongst all the services that share the network increment.

Equi-proportional Mark-Up (EPMU)	The application of the same percentage mark-up to the incremental costs of two or more services.
Equivalence of Input (EOI)	A remedy designed to prevent a vertically-integrated company from discriminating between its competitors and its own business in providing upstream inputs. This requires BT to provide the same wholesale products to all CPs including BT's own downstream division on the same timescales, terms and conditions (including price and service levels) by means of the same systems and processes, and includes the provision to all CPs (including BT) of the same commercial information about such products, services, systems and processes.
Ethernet	A packet-based technology originally developed for and still widely used in Local Area Networks. Ethernet networking protocols are defined in IEEE 802.3 and published by the Institute of Electrical and Electronic Engineers. Developments of this technology known as Metro Ethernet or Carrier Ethernet are now being used in communications providers' networks to provide leased line and backhaul services.
Ethernet Access Direct (EAD)	A BT wholesale Ethernet product offered by Openreach providing high bandwidth, point-to-point connections.
Ethernet Backhaul Direct (EBD)	A BT wholesale Ethernet backhaul product providing high bandwidth, inter-exchange connectivity between designated BT exchanges.
Ethernet in the First Mile (EFM)	A network technology for the delivery of Ethernet services over access networks. Although the technology also encompasses fibre access networks, in common usage, EFM refers to the provision of Ethernet services over copper access networks.
Excess Construction Charges (ECCs)	A charge levied by BT where additional construction of duct and fibre or copper is required to provide service to a customer premise.

ECC Direction	Ofcom, *Excess Construction Charges for Openreach Ethernet Access Direct, Directions affecting the operation of the Leased Lines Charge Control, Statement*, 16 May 2014, http://stakeholders.ofcom.org.uk/binaries/consultations/excess-construction-charges/statement/excess-construction-charges-statement.pdf (May 2014 ECC Direction).
Fibre Channel	Standardised storage area network protocol operating at bandwidths between 1Gbit/s and 16Gbit/s
Fibre-to–the-Cabinet (FTTC)	An access network structure in which the optical fibre extends from the exchange to the street cabinet. The street cabinet is usually located only a few hundred metres from the subscriber's premises. The remaining part of the access network from the cabinet to the customer is usually copper wire but could use another technology, such as wireless.
Fibre-to-the-Premises (FTTP)	An access network structure in which the optical fibre network runs from the local exchange to the end user's house or business premise. The optical fibre may be point-to-point – there is one dedicated fibre connection for each home – or may use a shared infrastructure such as a GPON. Sometimes also referred to as Fibre To The Home (FTTH).
FICON	IBM specific SAN protocol based on Fibre Channel operating at bandwidths of 1, 2, 4 or 8Gbit/s
Financial Capital Maintenance (FCM)	An alternative approach to CCA in which an allowance is made within the capital costs for the holding gains or losses associated with changes over the year in the value of the assets held by the firm. In contrast to OCM, the FCM approach seeks to maintain the financial capital of the firm, and hence the firm's ability to continue financing its functions.
Frame Relay	A packet-based network technology, typically used to interconnect Local Area Networks.
Fully allocated cost (FAC)	An accounting approach under which all the costs of the firm are distributed between its various services. The fully allocated cost of a product may therefore include some common costs that are not directly attributable to the service.

Gbit/s	Gigabits per second (1 Gigabit = 1,000,000,000 bits) A measure of bandwidth in a digital system.
General Building Cost Index (GBCI)	A national index that measures the costs of construction work including materials and labour.
Gigabit Passive Optical Network (GPON)	A shared fibre network architecture that can be used for NGA.
Gross Replacement Cost (GRC)	The Current Cost Accounting (CCA) equivalent of Gross Book Value, i.e. the cost of BT replacing its assets with new ones now.
Holding gains and losses (HGL)	The change in the value of the underlying assets used by the company over the course of the financial year
HCA (historical cost accounting) depreciation	The measure of the cost in terms of its original purchase price of the economic benefits of tangible fixed assets that have been consumed during a period. Consumption includes the wearing out, using up or other reduction in the useful economic life of a tangible fixed asset whether arising from use, effluxion of time or obsolescence through either changes in technology or demand for the goods and services produced by the asset.
Hull Area	The area defined as the 'Licensed Area' in the licence granted on 30 November 1987 by the Secretary of State under section 7 of the Telecommunications Act 1984 to Kingston upon Hull City Council and Kingston Communications (Hull) plc.
In Building Handover (IBH)	An interconnection between BT and another communications providers' network where the handover takes place at collocation space rented by a CP in a BT local exchange.
In Span Handover (ISH)	An interconnection between BT and another communications provider where the BT handover circuit terminates at a point between BT's premises and the communications provider's premises.
Inflation	The general change in prices across the economy.

Input price changes (IPC)	Changes in the prices of the underlying inputs to costs. This includes changes to assets prices and changes to operating costs.
Internet Protocol (IP)	A network technology used in packet-switched networks to route packets across network nodes.
Internet Service Provider (ISP)	An organisation that provides internet access services
ISDN	A digital telephone service that supports telephone and switched data services.
ISDN30	A digital multiline telephone service conforming to the ISDN Primary Rate Access standard as defined by the ITU.
Jitter	A measure of the variation of delay in transmission over a transmission path.
June 2015 LLCC Consultation	The consultation on charge controls for leased lines services published as part of this market review in June 2015.
June 2015 Cost Attribution Review	The consultation that will be published shortly and is relevant to the proposals within the June 2015 LLCC Consultation.
July 2009 LLCC Statement	The statement published in 2009 implementing charge controls in wholesale leased lines markets.
kbit/s	Kilobits per second (1 kilobit = 1,000 bits) A measure of bandwidth in a digital system.
Latency	A measure of delay in transmission over a transmission path.
Leased line	A permanently connected communications link between two premises dedicated to the customers' exclusive use.
Local Area Network (LAN)	A network typically linking a number of computers together within a business premise, enabling intercommunication between users and access to email, internet and intranet applications.

Local loop	The access network connection between the customer's premises and the local serving exchange, usually comprised of two copper wires twisted together.
Local Loop Unbundling (LLU)	A process by which a dominant provider's local loops are physically disconnected from its network and connected to competing provider's networks. This enables operators other than the incumbent to use the local loop to provide services directly to customers.
Local Loop Unbundling (LLU) backhaul circuit	A circuit provided by BT that enables the connection of a communications provider's DSLAM to a communications provider's point of connection with BT's SDH network.
Local Serving Exchange (LSE)	A building at which local loops are terminated and which also houses telecommunications network and switching equipment.
London Periphery	A proposed geographic market set out in the May 2015 BCMR Consultation and adjacent to the CLA.
Long Run Incremental Cost (LRIC)	The cost caused by the provision of a defined increment of output given that costs can, if necessary, be varied and that some level of output is already produced.
Main Distribution Frame (MDF)	A wiring flexibility frame where copper local loops are terminated.
March 2013 BCMR Statement	The statement published in 2013 implementing charge controls in wholesale leased lines markets.
May 2015 BCMR Consultation	The consultation published in May 2015 setting out our provisional analysis of the leased lines market and identifies segments of the market in which we propose that a provider has SMP.
Mbit/s	Megabits per second (1 Megabit = 1 million bits). A measure of bandwidth in a digital system.
MDF Site	A BT operational building containing an MDF. Also referred to as a Local Serving Exchange

Mean capital employed (MCE)	The mean value of the assets that contribute to a company's ability to generate revenues. BT's definition of Mean Capital Employed is total assets less current liabilities, excluding corporate taxes and dividends payable, and provisions other than those for deferred taxation. The mean is computed from the start and end values for the period, except in the case of short-term investments and borrowings, where daily averages are used in their place.
Mobile switching Centre (MSC)	A component of a mobile telephone network that switches voice calls between mobile users
Modern equivalent asset (MEA)	The approach to set charges by basing costs and asset values on what is believed to be the most efficient available technology that performs the same function as the current technology.
Multi Protocol Label Switching (MPLS)	A packet-based network technology that uses label switching techniques in order to prioritise the routing of packets between network nodes. MPLS is commonly deployed in VPN and NGN core applications.
Multi Service Access Node (MSAN)	A network access device associated with an IP-based networks that provides network interfaces for telephony, broadband and other services. MSANs are typically installed in a telephone exchange or a roadside cabinet.
Multiple Interface (MI) leased lines	Leased line services with bandwidths greater than 1Gbits/s and leased lines services of any bandwidth delivered using WDM equipment at the customer's premises.
Multiple Interface Symmetric Broadband Origination (MISBO)	Leased line terminating segments supporting high bandwidth services –either an Ethernet interface with bandwidths greater than 1Gbit/s or services of any bandwidth/interface delivered using WDM equipment at the customer's premises.
Net current assets (NCA)	A measure of the amount of capital being used in day-to-day activities by the company. It is equal to the current assets less current liabilities.

Net replacement cost (NRC)	Gross replacement cost less accumulated depreciation based on gross replacement cost. An alternative is Depreciated replacement cost (of tangible fixed assets other than property:- The cost of replacing an existing tangible fixed asset with an identical or substantially similar new asset having a similar production or service capacity, from which appropriate deductions are made to reflect the value attributable to the remaining portion of the total useful economic life of the asset and the residual value at the end of the asset's useful economic life.
Next generation access (NGA)	A new or upgraded access network capable of supporting much high capacity broadband services than traditional copper access networks. Generally an access network that employs optical fibre cable in whole or in part.
Next Generation Network (NGN)	An IP based multi-service network capable of providing voice telephony, broadband and other services.
November 2014 BCMR Passives Consultation	The November 2014 consultation forming part of the BCMR.
Openreach Handover Point (OHP)	Nodes in BT's network at which certain Openreach backhaul services are terminated.
Openreach Network Backhaul Services (ONBS)	A BT wholesale Ethernet backhaul service providing high bandwidth inter-exchange connectivity.
Operating capability maintenance (OCM)	A CCA convention, where the depreciation charge to the profit and loss account relates to the current replacement cost of the firm's assets, taking account of specific and general price inflation. As the name suggests, the OCM approach seeks to maintain the operating capability of the firm.
OCM depreciation (OCM dep)	The reduction in value (as measured by the GRC) of the assets over the course of the financial year associated with the reduction in the asset's remaining life.

Operating expenditure	Costs reflected in the profit and loss account excluding depreciation financing costs such as interest charges.
Optical Spectrum Access (OSA)	A BT wholesale WDM service.
Optical Spectrum Extended Access (OSEA)	A BT wholesale WDM services supporting longer circuits than OSA.
Other Communications Providers (OCPs)	A communications provider other than BT.
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.
Passive Infrastructure Access (PIA)	A remedy requiring BT to provide CPs with access to its passive access network infrastructure (i.e. ducts and poles).
Passive Optical Network (PON)	A point to multipoint fibre-optic network architecture that uses passive optical splitters
Plesiochronous Digital Hierarchy (PDH)	An older digital transmission technology that uses Time Division Multiplexing. Although PDH systems are is still in widespread use, they are being replaced by SDH and increasingly Ethernet services.
Point of Handover (POH)	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 node in a CPs network (such as an exchange or other operational building), generally one used to serve customers in a particular locality.

Points 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.
Previously Allocated Costs (PAC)	BT's cost attribution system (see section 5 of the June 2015 Cost Attribution Review) allocates costs to the different levels of their cost exhaustion system. When we propose that these costs should be allocated based on all previously allocated total costs we mean that the costs in each division, market, service, and component (i.e. the different levels of the cost exhaustion system) should be allocated based on the previously allocated total costs at that level of the cost exhaustion system divided by the total of all previously allocated total costs within BT as shown in the following formula $\boldsymbol{x = \textbf{OUC costs X}\left[\frac{\textbf{Previously allocated total costs at level x}}{\textbf{Total previously allocated total costs within BT}}\right]}$, where x = allocation of the OUC's costs at a specific level of BT's cost exhaustion system.
Public Switched Telephone Network (PSTN)	A telecommunications network that uses circuit switched technology to provide voice telephony services.
Quality of service (QoS)	An assessment or measure of how well a delivered service such as provision and repair conforms to the customer's expectations.
Radio Base Station (RBS) backhaul circuit	A circuit provided by BT that connects a mobile communications provider's base-station to a mobile communications provider's mobile switching centre.
RAV model	This model calculates the forecast asset values, depreciation and holding gains for Access Copper and Duct. The model also applies a regulatory adjustment (RAV adjustment) previously applied by Ofcom.
Regulatory asset value (RAV)	The value ascribed by Ofcom to an asset or capital employed in the relevant licensed business.

Regulatory financial statements (RFS)	The financial statements that BT is required by Ofcom to prepare, have audited and publish available at: http://www.btplc.com/thegroup/RegulatoryandPublicaffairs/Financialstatements/index.htm
Rest of the UK (RoUK)	A proposed geographic market set out in the May 2015 BCMR Consultation, consisting of an area outside the CLA, the LP and the Hull Area.
Retail price index (RPI)	A measure of inflation published monthly by the Office for National Statistics. It measures the change in the cost of a basket of retail goods and services.
Return on capital employed (ROCE)	The ratio of accounting profit to capital employed. The measure of capital employed can be either Historic Cost Accounting (HCA) or Current Cost Accounting (CCA).
Revised agreement for Access Network Facilities (RANF)	The Reference Offers which set out revised terms and conditions on which Openreach will provide local loop unbundling services: https://www.openreach.co.uk/orpg/home/products/llu/contracts/contracts.do
Sales Product Management (SPM)	A network cost component.
Service Level Agreement (SLA)	A contract between a network service provider and a customer that specifies, usually in measurable terms, what services the network service provider will furnish.
Service Level Guarantee (SLG)	A contractual agreement specifying the compensation payable if the service provider fails to deliver the agreed service performance.
Significant market power (SMP)	The significant market power test is set out in European Directives. It is used by National Regulatory Authorities (NRAs), such as Ofcom, to identify those CPs which must meet additional obligations under the relevant Directives.

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.
Stand Alone Cost (SAC)	An accounting approach under which the total cost incurred in providing a product is allocated to that product.
Statement of Requirement (SoR)	A BT process for submission and processing of requests for product/service enhancements.
Storage Area Network (SAN)	A network dedicated to data storage. SAN protocols include additional checking of transmitted data integrity and can be distance limited.
Sub-basket	A sub-basket refers to a control on a group of two or more charges.
Sub-cap	A sub-cap refers to a control on a single charge.
Supplementary depreciation	The additional depreciation charge to convert an HCA depreciation charge into a CCA depreciation charge.
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 DSL variant that allows broadband signals to be transmitted at the same rate from end user to exchange as from exchange to end user.
Synchronous Digital Hierarchy (SDH)	A digital transmission standard that is widely used in communications networks and for leased lines.
Tender Price Index (TPI)	A national index that measures tenders prices charged for construction work.
The Act	The Communications Act 2003.

The November 2014 BCMR Passives Consultation	The November 2014 consultation forming part of this market review.
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.
Time Division Multiplexing (TDM)	A method of combining multiple data streams for transmission over a shared channel by means of time-sharing. The multiplexor shares the channel by repeatedly allowing each data stream in turn to transmit data for a short period. PDH and SDH are examples of systems that employ TDM.
Time-limited discount	A temporary reduction in the charge for a service. After a certain period of time, the relevant charge is set back to its original level (before the change was implemented).
Total cost of ownership (TCO)	The total price of a service, including all incurred charges, over a specified period.
Traditional Interface (TI) Leased Lines	Leased lines services with an ITU G.703 Interface.
Traditional interface symmetric broadband origination (TISBO)	Leased line terminating segment with an ITU G.703 interface.
Virtual Private Network (VPN)	A technology allowing users to make inter-site connections over a public telecommunications network that is software partitioned to emulate the service offered by a physically distinct private network.
Voice over IP (VoIP)	A generic term used to describe telephony services provided over IP networks.

Wavelength Division Multiplex (WDM)	An optical frequency division multiplexing transmission technology that enables multiple high capacity circuits, to share an optical fibre pair by modulating each on a different optical wavelength.
Weighted average cost of capital (WACC)	The rate that a company is expected to pay on average to all its security holders to finance its assets.
Western, Eastern, Central and East London Area (WECLA)	The geographic market defined by Ofcom in the March 2013 BCMR Statement.
Wholesale Broadband Access (WBA) Market	The wholesale market for fixed broadband services.
Wholesale end-to-end service (WEES)	A BT wholesale Ethernet product that can be used to provide a point-to-point connection between two customer's sites.
Wholesale Extension Service (WES)	A BT wholesale Ethernet product that can be used to link a customer premise to a node in a communications network.
Wholesale Line Rental (WLR)	A remedy that requires BT to rent telephone lines to CPs on a wholesale basis.
Wholesale Local Access (WLA) Market	The wholesale market for fixed telecommunications infrastructure, specifically the physical connection between end users' premises and a local exchange.
Wide Area Network (WAN)	A geographically dispersed telecommunications network, typically a corporate network linking multiple sites at different locations.